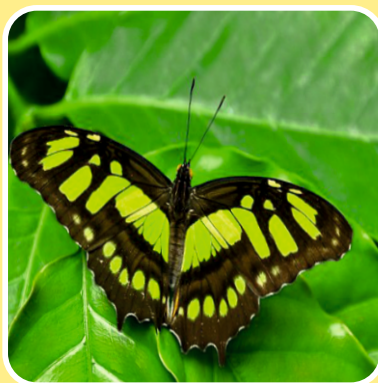


3rd International Conference
Global Initiatives in Agricultural, Forestry and Applied Sciences
(Theme: Food Security, Environmental Safety and Sustainable Development)

Souvenir Cum Abstracts/ Proceedings Book



Volume 2



Editors :

■ Dr. Wajid Hasan	■ Dr. C. P. Singh	■ Dr. A.K. Srivastava	■ Dr. U. S. Rawat
■ Dr. Sanjay Swami	■ Dr. Moinuddin	■ Dr. Arvind Kumar	■ Dr. Jameel Akhtar
■ Dr. Md.Minnatullah	■ Mr. Kota Chakrapani	■ Dr. Hrikesh Singh	■ Dr. Huma Naz



October 17-18, 2021

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Global Initiative in Agricultural, Forestry and Applied Sciences
(Food Security, Environmental Safety and Sustainable Development)

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“Quest for Excellence”



SHRI GURU RAM RAI UNIVERSITY
(Established under Shri Guru Ram Rai University
Act. No. 03 of 2017)

Message

I am happy to learn that the 3rd International Conference on Global Initiatives in Agricultural, Forestry and Applied Sciences (GIAFAS-2021) with the theme of Food Security, Environmental Safety and Sustainable Development is being organized by the Agricultural and Environmental Technology Development Society (AETDS), U. S. Nagar, U.K., India at Shri Guru Ram Rai University, Dehradun w.e.f. October 17-18, 2021. The conference will take an in-depth look at many issues about the obstacles and opportunities induced by the changing Global climatic scenario. This conference is a step towards achieving our vision in becoming a world-class academic and research institution in order to produce human capital with excellent state of mind.

Dehradun is a beautiful city and one of the most notable academic and research destinations of India where learning is promoted in the best possible way and carries the label of “School Capital of India”, thus it is known also as India’s education hub. Shri Guru Ram Rai School of Agricultural sciences, Dehradun is a prime centre of teaching and learning for those candidates who want to frame their career in mega agriculture sector of the world. The School focuses on synergizing multi-disciplinary education and strengthening problem specific research relevant to the state which helps building innovative set-up.

I am confident that this occasion will be able to provide a platform towards strengthening our relationships in knowledge sharing while at the same time provide the necessary thrust in joint research collaborations and product commercialization within the research society. I hope that this conference will be a foundation for the growth of new ideas towards a better tomorrow. I would like to thank AETDS, US Nagar, U.K., India for choosing SGRR University as venue of this conference and wish a grand success of this conference.

Shri Mahant Devendra Dass

Chancellor

Shri Guru Ram Rai University



Ref: AETDS/ SO/201

Date: 15.10.2021

Dr. C.P. Singh

President



MESSAGE

It's a matter of great pleasure that the Agricultural & Environmental Technology Development Society (AETDS), U.S. Nagar, UK, India organizing **3rd International Conference on "Global Initiative in Agricultural, Forestry and Applied Sciences for Food Security, Environmental Safety and Sustainable Development (GIAFAS-2021)"**, with the collaboration with Shri Guru Ram Rai University, Dehradun, Uttarakhand, India; Department of Agronomy, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh; Soil and Water Research Institute (SWRI), Karaj, Iran; Department of Soil Science, Faculty of Agro-Based Industry, UMK, Malaysia; College of Horticulture and Gardening, Yangtze University, P.R. China and Corteva agriscience at Shri Guru Ram Rai University, Dehradun, Uttarakhand, India on October 17-18, 2021.

In this context, emphasis will be on novel tools and technologies in the field of Agricultural and Allied Science, Medical Science, Social Sciences, Biological, and Physical Sciences. This conference will bring together the global scientific community, policymakers, administrators, industry representatives, and other stakeholders to exchange and share their experiences, new ideas. It will be an opportunity of sharing our expertise and experience with renowned speakers from all over the world. It will also be a platform to strengthen the friendship and collaboration among the scientists, academia, and the institutes. The various subthemes of the conference will offer many opportunities to delegate to learn new things and apply the same in their respective workplace.

I want the conference associate eminent accomplishment in achieving its goal towards food security, environmental safety and property development therefore enlightening international innovative in agricultural, biological science and applied sciences.

(Prof. C. P. Singh)

Conference Director & President AETDS

Former Prof. GBPUAT, Pantnagar

डॉ. प्रदीप कुमार बिसेन
कुलपति

Dr. Pradeep Kumar Bisen
Vice Chancellor



जवाहरलाल नेहरू कृषि विश्वविद्यालय
कृषि नगर, आधारताल, जबलपुर ४८२ ००४ (म.प्र.)
Jawaharlal Nehru Krishi Vishwa Vidyalaya
Krishi Nagar, Adhartal, Jabalpur 482 004 (M.P.)

Message

I am happy to know that Agricultural & Environmental Technology Development Society is organizing a 3rd International Conference on "Global Initiatives in Agricultural, Forestry and Applied Sciences" during October 17 -18, 2021 at Shri Guru Ram Rai University, Dehradun, Uttarakhand, India.

Agriculture is an important component of rural livelihoods. Agriculture scientists play a pivotal role in all agricultural technologies from planting-to-harvesting-to-post-harvest. Tremendous challenges are being put forth by biotic and abiotic stresses before the agricultural scientists to meet the ever-growing demands of food and nutritional security with a climate change scenario. Food Security, Environmental Safety and Sustainable Development are posing a major threat to agricultural crops in several parts of the country. Development of sustainable food security, management strategies offers one of the best options to enhance the crop production and protection, as land water and other natural resources are depleting.

I am confident that interactions among scientists during the conference will provide useful recommendations.

I congratulate Dr. Wajid Hasan, Secretary, AETDS, Society and Prof. C. P Singh, Conference Director and President AETDS, Society, U.S. Nagar, U.K. for taking initiation and leadership.

I extend my heartiest greetings to participants and wish the event the grand success.

(P.K. Bisen)



Professor Dr. Md. Shahidur Rashid Bhuiyan,
Vice-Chancellor, Sher-e-Bangla Agricultural
University, Dhaka-1207

&
Patron: GIAFAS-2021, E-Mail: vc@sau.edu.bd
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Message from Patron

It gives me immense pleasure to know that Agricultural & Environmental Technology Development Society (AETDS), U.S. Nagar, UK, India is going to organize the 3rd International Conference ‘*Global Initiatives in Agricultural, Forestry and Applied Sciences (GIAFAS-2021)*’ in collaboration with Department of Agronomy, Sher-e-Bangla Agricultural University, Dhaka-1207 along with other reputed organizations around the world. The theme for this year conference “*Food Security, Environmental Safety and Sustainable Development*” is of global priority today.

The COVID-19 pandemic is still on-going. During the last couple of years, the world has experienced and realized how whimsical the nature could be at times and how badly the consequences could affect the entire mankind for food, treatment and shelters. As we know this world is still the one and only liveable habitat for human, other animals and plants which is facing tremendous environmental pressures in recent years due to regular advent of natural disasters. Limited agricultural resources and continuous population increase in developing countries ultimately leading to an environmental imbalance thus aggravating the food security issues in coming decades. In addition, under the present pandemic circumstance, farmers and their farming have become more challenging and vulnerable to ensure food and nutritional security. However, to comply with the SDGs’2030 we need to nurture our environmental resources in a sustainable way giving emphasis on sourcing renewable energies. Thus, there is a great need for institutional efforts and peoples’ participation to address issues related to food security, environmental safety, sustainable development and preserving natural resources in general. To do so, the linkages between agricultural and applied sciences are essential. Collective efforts should be made by relevant institutions through ensuring participations of people from all walks.

I am sure that this dual mode (offline and virtual) International Conference will focus on the various scientific tracks covering major areas of research on agriculture, biological and applied sciences and would become a platform for bringing together administrators, business bodies, policy makers and the members of global scientific community including scientists, researchers and distinguished professors to find out the key problems, challenges and pragmatic solutions which will help in in-depth understanding of the global food security and environmental safety issues in a long-lasting way. I do believe that the outcomes of this International Conference will help policy makers to formulate plans and take immediate actions appropriate for ensuring food and nutrition security and agricultural sustainability in the deprived regions of the world.

I would like to appreciate the organizing institutes of this conference and thank the people whose dedicated efforts and creative plans will make the conference successful. Finally, I wish a grand success of the 3rd International Conference going to held at Shri Guru Ram Rai University, Dehradun, U.K., India during 17th to 18th October 2021.

Dated: 10-10-2021



Date : 11.10.21

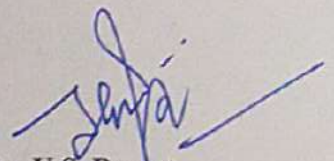
Message

With immense pleasure and pride, I heartily congratulate the Department of Agriculture of the University for organizing a two-day International Conference *w.e.f.* 17th -18th October, 2021 in collaboration with other organization of national and international repute on Global Initiatives in Agricultural, Forestry and Applied Sciences (GIAFAS-2021) with the premise of Food Security, Environmental Safety and Sustainable Development supported by the Agricultural and Environmental Technology Development Society (AETDS), U. S. Nagar, U.K., India.

In view of the changing Global climate, the theme of the conference chosen by the organizers is need of the hour and highly appreciable. Participants from several institutions around the world meet here to share their research work. The discussions during the conference through the expert-talks and dialogic-exchanges on the challenges of Food Security, Environmental Safety and Sustainable Development under changing climatic conditions are documented as proceeding of the conference. The conference proceeding shall help the policy-makers to shape the policies in the interest of common people and other stakeholders that eventually positively shape our nation and make the citizens future-ready. This conference will also inspire the entire team of the University to persistently undertake such ventures which work for knowledge- enhancement of the society at large.

I am optimistic that this International Conference organized by the Department of Agriculture, Shri Guru Ram Rai University, Dehradun in association with other national and international organization and supported by AETDS, U. S. Nagar, U.K., India will further strengthen and promote collaboration in the Commerce fraternity.

My best wishes for the success of the conference.


Dr. U.S. Rawat
Vice Chancellor

Amar P. Garg

M.Sc., Ph.D., LL.B., F.B.S., F.P.S.I., F.S.M.P., M.N.A.Sc., F.N.R.S., CAS Fellow (U.K.), DAAD Fellow (Germany)
Distinguished Professor, Dean Research, Director Biotechnology
Sectional President Environmental Science, 108th Indian Science Congress (2020-22)
Former Professor & Head, C.C.S. University, Meerut, Former PVC, JNU, Jaipur, Former Vice Chancellor SIET, Meerut
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I am delighted to know that one of the most prominent society of Agricultural education popularly known as AETDS based in Uttarakhand, **India** is organizing *3rd International Conference on “Global Initiative in Agricultural, Forestry and Applied Sciences For Food Security, Environmental Safety and Sustainable Development (GIAFAS-2021)”* at Shri Guru Ram Rai University, Dehradun in collaboration with Sher-e-Bangla Agricultural University, Dhaka, Bangladesh; Soil and Water Research Institute (SWRI), Karaj, Iran; UMK, Malaysia; Yangtze University, P.R. China and Corteva Agriscience, on October 17-18, 2021.

The organizers have very rightly selected the most relevant topic in view of the focus of world economy on agriculture which is the foundation growth and development of any country. The conference will provide an excellent opportunity for active interaction with great International Professors, prominent agriculturalists, food security experts, environmentalists and authorities working in various fields of Life Sciences to discuss various issues related to Agriculture, Forestry, Environment and Allied Sciences. I am confident that the participants will take fullest advantage of this international conference in dual mode and will enjoy the excellent weather of Dehradun.

I wish all success to the organizers.

Dated: 06-10-2021

(Prof. Amar P. Garg)
Dean, Research & Development



Professor Dr. Mirza Hasanuzzaman, Department of
Agronomy, Sher-e-Bangla Agricultural University,
Dhaka-1207

&
Associate Director: GIAFAS-2021
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Cell: + 8801716587711

Message from Associate Director

I would like to take the opportunity to express my profound joy on the event of the 3rd International Conference ‘*Global Initiatives in Agricultural, Forestry and Applied Sciences* (GIAFAS-2021) jointly organized by the Agricultural & Environmental Technology Development Society (AETDS), U.S. Nagar, UK, India and other widely known organizations at Shri Guru Ram Rai University, Dehradun, U.K., India during 17th and 18th October 2021.

The United Nations sustainable development goals include eradication of hunger from the world by 2030. But the world currently is in need of surplus production of food in order to meet the food demand especially in developing nations where hunger is still one of the major issues. Food security and environmental safety are both key policy goals in the contemporary global arena, but there is no necessary congruity between them. Conflicts and contradictions always pave their ways when actors (global, national or local) seek to achieve both security in food supply and delivery, and sustainability in the use of the natural resources needed to produce food. However, making a hunger free world is a gigantic task that involves many other issues like environmental protection, nutritional safety, reduce deforestation and urbanization that also need to be addressed with prior concern. Therefore, at this juncture, the initiative taken up by the collaborating institutions under the theme ‘*Food Security, Environmental Safety and Sustainable Development*’ for this year conference is of global preference today.

Projected world population by 2050 will reach 10 billion. To feed 10 billion mouths, we need to get the trade-offs right between sustainability, food security, food safety, and make better use of food already produced. Hence, feeding 10 billion people in a sustainable way will probably require disruptive changes of the food supply chains during the next 20 years. Moreover, the reduction of food losses and food waste could be a part of the solution. Equally, the introduction of new socio-technologies in rural areas, for instance for renewable energy generation, driven by environmental interests, may help to undermine the social sustainability of such areas in ways which threaten continued food production.

I hope the deliberations and sharing of the core ideas, experiences, creative imaginations, innovations and formulas of different expertise under different sub-themes will be a milestone for the solutions of ongoing challenging issues of food and environmental security of the world. Indeed, I believe that, such kind of scholarly gatherings could play a vital role in making the world a better place and also make ready to tackle any difficult situations in the near future.

As an Associate Director of the Organizing Committee, I am grateful to the researchers and academicians of national and international level and others who have offered their collaboration by submitting constructive papers and abstracts for this conference.

Finally, I wish the conference an eminent accomplishment in achieving its goal towards food security, environmental safety and sustainable development thus enlightening global innovative in agricultural, forestry and applied sciences.

Dated: 05-10-2021

(Mirza Hasanuzzaman)



**Dr. Sanjay-Swami, Professor (SSAC)
& Organizing Convener: GIAFAS-2021**
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MESSAGE

It is indeed a matter of great pride for me in organizing the 3rd International Conference on *Global Initiatives in Agricultural, Forestry and Applied Sciences for Food Security, Environmental Safety and Sustainable Development* (GIAFAS-2021) organized by the Agricultural & Environmental Technology Development Society (AETDS), U.S. Nagar, UK, India and many other reputed organizations at Shri Guru Ram Rai University, Dehradun, U.K., India during 17th to 18th October 2021 in hybrid mode.

Friends, while agriculture can feed the world's population, it is responsible for deforestation globally. Commercial agriculture accounts for about 40 per cent of deforestation in the tropics and sub-tropics, local subsistence agriculture for 33 per cent, infrastructure for 10 per cent, urban expansion for 10 per cent and mining for 7 per cent. Combating climate change and ensuring food security are both extremely important. When we compare the numbers, deforestation or converting forests into agricultural lands contributes more than 10 per cent of greenhouse gas emissions annually, but it only expands the world's agricultural land by around one-tenth of a per cent a year. This means that protecting and restoring forests is critical for stopping climate change, but the big gains in improving food security will happen elsewhere.

The 2030 agenda for sustainable development, as well as the Paris agreement on climate change recognizes that we can no longer look at food security and the management of natural resources separately. There are clear linkages and synergies between agricultural production and sustainable forest management. If the sustainability of the agriculture and forests can be assured, food security, environmental safety and sustainable development would go in long-term perpetuity.

I am confident that this International Conference will deliberate on the issues of food security, environmental safety and sustainable development to ensure triple win through innovative approaches of agricultural, forestry and applied sciences.

I wish the International Conference a grand success.

Dated: 17-10-2021

(Sanjay Swami)



Ref:AETDS/SO/403

Date: 16.10.2021



From the Desk of Chief Organizing Secretary

It is a matter of great privilege for me to organize the **3rd International Conference on “Global Initiative in Agricultural, Forestry and Applied Sciences for Food Security, Environmental Safety and Sustainable Development (GIAFAS-2021)”**. Jointly Organized by the Agricultural & Environmental Technology Development Society (AETDS), U.S. Nagar, Uttarakhand, India; Shri Guru Ram Rai University, Dehradun, Uttarakhand, India; Department of Agronomy, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh; Soil and Water Research Institute (SWRI), Karaj, Iran; Department of Soil Science, Faculty of Agro-Based Industry, UMK, Malaysia; College of Horticulture and Gardening, Yangtze University, P.R. China and Corteva agriscience at Shri Guru Ram Rai University, Dehradun, Uttarakhand, India on October 17-18, 2021.

On behalf of the organizing committee, I warmly welcome all participants, delegates, researchers, scientists, students from different institutions, colleges, and universities from India and abroad.

GIAFAS-2021 has been designed to focus on various scientific tracks covering major areas of research on agriculture, biological, and applied sciences. In this context, emphasis pointed on novel tools and technologies in the field of Agricultural and Allied Science, Medical Science, Social Sciences, and Biological Sciences. This conference will bring together the global scientific community, policymakers, administrators, industry representatives, and other stakeholders to exchange and share their experiences, new ideas. The conference is aimed to provide a common platform to scientists, researchers, academicians, professionals, social workers, policymakers as well as farmers and expertise corporate to exchange their new ideas and recent research findings with colleagues, which will boost their knowledge and experience. In this global event scientists across the world are participating.

The organizing committee has been very active and arrangements are well underway to ensure that **3rd International Conference on “Global Initiative in Agricultural, Forestry and Applied Sciences for Food Security, Environmental Safety and Sustainable Development (GIAFAS-2021)”** is a resounding success. I appeal to the research community to extend their continued support and cooperation to the future activities of AETDS.

I look forward to welcoming you all and pray almighty to bless us for making GIAFAS-2021 a grand success.

(Dr. Wajid Hasan)

Chief Organizing Secretary, GIAFAS-2021

Secretary, AETDS, Society

Email: gifas2021@gmail.com, Mob. 7004942581



Shri Guru Ram Rai University

(Estd. By Govt. of Uttarakhand, vide Shri Guru Ram Rai University Act No. 03 of 2017 Act No. 03 of July 2017)

Dr. Moinuddin

Associate Professor (Agronomy)

School of Agricultural Sciences

Shri Guru Ram Rai University (Quest for Excellence)

Pathri Bagh, Dehradun, Uttarakhand-248001, India



I am gratified to Almighty God, the most gracious and most merciful, for His blessings in giving us this precious opportunity to organize this memorable event. The 3rd International Conference on Global Initiatives in Agricultural, Forestry and Applied Sciences (GIAFAS-2021) with the theme: Food Security, Environmental Safety and Sustainable Development is a wonderful experience of my career. It gives me a great pleasure to welcome you all at 3rd International Conference on Global Initiatives in Agricultural, Forestry and Applied Sciences (GIAFAS-2021) to be held *w.e.f.* 17th -18th October, 2021. Due to the challenging times COVID-19 for last two years, the conference is being organized in a hybrid mode of both off- as well as on-line. The scientific sessions of the conference have been carefully planned that will cover a wide spectrum of topics along with orations, guest lectures, key note addresses, etc. which will cover latest innovations, research and current topics. We propose making this a high tech conference with innovations in registration, entries and audiovisuals.

I would like to thank each of you for attending GIAFAS-2021 and bringing your expertise to this awesome gathering. You, as researcher, have the vision, the knowledge, the resources and the experience to help us pave our way into the future technical activities. Throughout this conference, I request you to stay engaged, keep us proactive and help us bringing out more such events in future. My personal admiration and gratitude goes out to all of you.

I, on behalf of the SGRR University, Dehradun, AETDS, U. S. Nagar and other organizing associates welcome you all for your active and large participation in this conference to make it a grand success.

Dr. Moinuddin
Organizing Secretary

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Anjum Ahmad, Kiran Tigga, J. K.Chauhan, M. Dubey, N.Verma, D. Pandey

**Management of Chilli Thrips (*Scirtothrips dorsalis* Hood)- An Eco-friendly Approach
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ABSTARCT

Chilli, *Capsicum annum* L. is one of the important cash crops grown in almost all parts of the country and widely grown in the tropics and subtropics as well as under glass houses in temperate regions. It belongs to the family solanaceae and said to have originated in the Latin American region. Columbus carried chilli seeds to Spain in 1493. It is commonly used as condiments. The pungency in chilli is due to a substance “capsaicin” (Kumar *et al.*, 2005). Nutritionally, it is rich source of Vitamin A, C, and E. It is an essential ingredient of India curry, which is characterized by tempting colour and titillating pungency. Both as green and dry, chilli is used as paste and powder as whole or in broken/split form. Chilli is a fascinating spice with two important commercial qualities. Some varieties are famous for red colour because of the pigment capsanthin and other known for biting pungency attributed by capsaicin. India is the only country earns significant foreign exchange from export of chilli, oleoresin of low, medium or high pungency, and chilli powder.

India is the world’s largest producer of chilli and the crop is grown all over the country, occupies an area of 775 thousand ha with a production of 1492 thousand tonnes and productivity of 1.6 metric tonnes/ha of chilli in 2014 -15. India contributes about 36% to the total world production. The leading state in chilli production is Andhra Pradesh with a total production of 6,38,298 tons from 195471 ha, followed by Karnataka, West Bengal and Madhya Pradesh. The area under Madhya Pradesh is high whereas, production and productivity is less significant. In Madhya Pradesh, chilli occupies an area of 54.41 thousand hectare with a production of 93.57 thousand metric tonnes and productivity is 1.71 metric tonnes/ha (Anonymous, 2014). The major producing districts in Madhya Pradesh are Khargone, Dhar, Khandwa, Indore, and Betul. Although there are number of factors responsible for depressing the yield of chilli but incidence of various insect pests is one of major bottlenecks of production (Anonymous, 2005).

In India, nearly 25 insects have been recorded attacking chilli leaves and fruits. The attack by a multitude of insect pests and mites at different crop stages is of utmost concern. One of the practical means of increasing chilli production is to minimize losses caused by major sucking pests. Most important among are green peach aphid (*Myzus persicae* Sulzer, *Aphis gossypii* Glover), thrips (*Scirtothrips dorsalis* Hood), yellow mite (*Polyphagotarsonemus latus* Banks), white fly (*Bemisia tabaci* Gannadius) and leafhopper (*Amrascabi guttulabiguttula* Ishida) (Berke and Sheih, 2000). Besides, a number of viruses are transmitted by aphids, whiteflies etc. (Gundannavaret *al.* 2007). Thrips, *Scirtothrips dorsalis* Hood (Thripidae: Thysanoptera) is considered as most destructive pest leading to 30 to 50 per cent yield loss under severe infestation (Bhedeet *al.* 2008).

Thrips alone is reported to be a major pest of chilli in south India and in M.P. (Patel and Khatri, 1982) and Gujarat (Patel *et al.*, 1983) causing 25-50 per cent loss of yield whereas; Narvaria (2003) reported 60 to 74 per cent loss in yield. Economic yield loss due to these pests may be 11-75% quantitatively and 60-80% qualitatively in the event of serious infestation (Ghoshet *al.* 2009). The yield loss due to chilli thrips and mites is estimated to be to the tune of 50-90 per cent (Ahmed *et al.* 1987; Kandasamyet *al.* 1990).

Identification and Plant Monitoring

The small size (< 2 mm) of *S. dorsalis* life stages and rapid movement make it difficult to detect this insect in fresh vegetation. The very tiny eggs are inserted into soft plant tissues, and the egg stage may last one week. These characteristics increase the chance of transportation of *S. dorsalis* through international trade of fresh plant materials. *Scirtothrips dorsalis* life stages occur on all the above-ground plant parts of its hosts, and cause scarring damage due to feeding or the transmission of pathogens (Chang *et al.* 1995, Seal *et al.* 2006 b). Generally, chilli thrips are pale colored and the lengths of their first and second instar larvae and the pupae are 0.37-0.39, 0.68-0.71 and 0.78-0.80 mm, respectively. Adults are about 1.2 mm long with dark wings and dark spots forming incomplete stripes which appear dorsally on the abdomen (Seal *et al.* 2009a).

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Plants with the symptoms described above should be examined closely for the presence of thrips. Samples of thrips from leaves or buds of symptomatic plants may need to be collected and sent to a laboratory for species determination. Place the sample into a Ziploc bag to prevent thrips escape, add a dry piece of paper-towel or napkin to avoid excessive moisture, and seal the bag. Label the bag with collection information including locality (city or town and county), date, species of host plant, and your name and contact information. Samples should be sent via express mail (next-day delivery) to assure good sample quality. If necessary, contact your county extension agent for assistance in submitting your sample

Life Cycle.

The life cycle stages of *S. dorsalis* include egg, first and second instar larvae, prepupa, pupa and adult. Gravid females insert the eggs inside plant tissues above the soil surface. The eggs are microscopic (0.075 mm long and 0.070 mm wide), kidney-shaped and creamy white in color (Seal *et al.* 2009a). Nymphs are tiny, slender, fragile and yellowish straw in colour. Adults has heavily fringed wings and grey in colour. Life cycle is short and completed in 15 to 20 days as many as 25 overlapping generations per year. Reproduction is both by sexual and partheno-generic. Females insert their eggs inside plant tissue on or near leaf veins, terminal plant parts and floral structures. Eggs hatch in 6–8 days under optimal conditions, but may take longer at lower temperatures. Immature thrips pass through two larval stages (1st and 2nd instars). The first instar lasts for 2-4 days and the second instar is completed in 3-6 days. During this time larvae actively feed on tender young plant growth, consuming enough food to complete development to the adult stage. Fully-grown larvae molt into a non-feeding, prepupal stage, which may last up to 24 hours, and then pupate on protected plant parts, leaf litter or in the soil near the base of the plant.

The two larval stages are completed in eight to ten days and the pupal stage lasts for 2.6-3.3 days. The life span of chilli thrips is influenced by the host plant species. For example, at 28°C it takes 11.0 days for a first instar larva to progress to the adult stage on pepper plants and 13.3 days on squash plants. The chilli thrips adult's life span lasts 15.8 days on eggplant, but only 13.6 days on tomato plants (Seal *et al.* 2009a).

Distribution

Scientists believe that *S. dorsalis* originated either in Southeast Asia or in the Indian subcontinent, but it is now widely distributed. It is abundant on sacred lotus in Thailand (Mound and Palmer 1981), and on chilli peppers in India (Ramakrishna Ayyar 1932, Ramakrishna Ayyar and Subbiah 1935), where it is also a serious pest of peanuts (Amin 1979, 1980). In Japan, *S. dorsalis* is a pest of tea and citrus (Kodomari 1978). *Scirtothrips dorsalis* has been reported from South Africa and the Ivory Coast, and plant quarantine interceptions suggest that this pest is widely distributed across West Africa and is present in East Africa (Kenya).

Description.

Adult Description: Chilli Thrips (*Scirtothrips dorsalis*) are approximately 1 mm in length, and pale yellow in color. Adults have dark wings and dark bands across their abdomen. Although other flower thrips are also a pale yellow color, chilli thrips are approximately half their size. Adults are so small that they must be mounted on a slide and viewed under a microscope for accurate identification.

Larva Description: Very small, typical-looking insect larvae. Very difficult to identify.

Host Plant: *Scirtothrips dorsalis* is a polyphagous species with more than 100 recorded hosts from about 40 different families.

Description of Feeding Damage

Infestations by chilli thrips are usually first detected in the landscape by the distinctive damage caused to the host plants. Nymphs and adults suck the sap from tender leaves and growing shoots. Sometimes the buds and flowers are also attacked. Feeding causes leaf, bud, and fruit bronzing (tissues turn bronze in color). The infested tissue turns the colour to silvery to brown or black. The infested leaves start curling and crumbling, ultimately shed whereas buds

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become brittle and drop down. Infested plants become stunted or dwarfed and leaves may detach from the stem at the petioles in some plant species. Feeding may also cause buds to become brittle and drop. Young leaves, buds and fruits are preferred, although all above ground parts of their host plants may be attacked. Severe infestation results in deformation, distortion, defoliation, stunting and dwarfing. It causes 25 to 50% yield loss. *Scirtothrips dorsalis* has not been reported feeding on mature host tissues. According to Sanap and Nawale (1987), adult and nymphs of *S. dorsalis* suck the cell sap of leaves, causing rolling of the leaf upward and leaf size reduction. For example, a heavy infestation of *S. dorsalis* in pepper plants changes the appearance of the plant to what is called "chilli leaf curl." Appearance of discolored or disfigured plant parts suggests the presence of *S. dorsalis*.

A severe infestation of chilli thrips makes the tender leaves and buds brittle, resulting in complete defoliation and total crop loss. Infested fruits develop corky tissues (Seal *et al.* 2006b). Sometimes *S. dorsalis* infested plants superficially appear like broad mite infested plant. On many hosts, after a heavy infestation chilli thrips also start feeding on the upper surface of leaves.

Host Rang and Favourable Condition

Scirtothrips dorsalis is found in almost all chilligrowing areas. It is a polyphagous pest. Besides chilli, it also infests brinjal, cotton, groundnut, castor, bottlegourd, guava, tea and grapevine. It is more common on un-irrigated chilli crop than irrigated one.

Disease Transmission

Scirtothrips dorsalis also possesses strong viruliferous behavior for seven recorded viruses. This species transmits chilli leaf curl (CLC) virus, and peanut necrosis virus (PBNV) (Mound and Palmer 1981, Ananthakrishnan 1993). In 2003, Rao *et al.* found chilli thrips as vectors of tobacco streak virus (TSV) in groundnut crops in India. Recently, in Thailand its role as a vector of three tospoviruses (i.e., melon yellow spot virus (MYSV), watermelon silver mottle virus (WsmoV), and capsicum chlorosis virus (CaCV)) in field crops was confirmed (Chiemsoibatet *et al.* 2008).

Cultural management

Grow resistant varieties like Pusajwala, Phule jyoti, G5, K2, X 235. Inter crop with a green manure crop *Sesbania grandiflora* (agathi) to provide shade which regulate the thrips population. Do not grow chilli after sorghum – more susceptible to thrips. Do not follow chilli and onion mixed crop as both the crops are attacked by thrips. Sprinkle water over the seedlings to check the multiplication of thrips carbofuran 3G @ 200g/ 40 m² area in the nursery.

Biological management

Various biological control agents, including minute pirate bugs, *Orius* spp. (Hemiptera: Anthocoridae) and entomopathogenic nematodes, *Thripinema* spp. (Tylenchida: Allantonematidae), have been reported to effectively control field populations of the chilli thrips. Adults of *Orius insidiosus* feed on all the life stages of thrips. Because *Orius insidiosus* also feeds on aphids, mites, moth eggs and pollen, its population does not decline strongly even if thrips populations are drastically reduced. *Thripinema* species are entomogenous nematodes which parasitize female thrips and make them incapable of laying eggs, leading to the reduction of thrips populations. In addition, they also reduce food consumption of these thrips, resulting in limited feeding damage. Arthurs *et al.* (2009) evaluated two phytoseiid mites, *Neoseiulus cucumeris* and *Amblyseius wirskii*, as potential biological control agents of the chilli thrips and reported that *Amblyseius wirskii* can be a promising tool in managing chilli thrips on pepper. Other predators of chilli thrips which are being investigated, but on which adequate practical studies to assess their potential as significant natural enemies of thrips have not been done, include: Apply neem cake to the beds @ 100 kg/acre in two split doses at the time of planting and 30 days after transplanting

Chemical management

Senguttuvan (1999) evaluated neem extracts and indigenous plant extracts against *S. dorsalis* in chilli viz., ahook, neemgold and neem oil 3 per cent significantly reduced the thrips population by 29, 29 and 28 per cent respectively than no treatment. Mallapur and Lingappa (2005) evaluated the effect of indigenous materials against thrips infesting chilli and found that GCK (Garlic Chilli Kerosene extract) @ 0.5 per cent + nimbecidine @ 2.5 ml/l water gave the lowest mean leaf curl index due to thrips during at Annigeri (Dharwad). According to Sujay *et al.* (2009) eco-friendly modules consisting of application of PGR - NAA (Triacntanol) @ 1.25 ppm, PGPR (*P. fluorescens*) @ 5 g/l at 15 DAT and installation of yellow sticky traps @ 12 traps/ha followed by PGR - NAA (Planofix) @ 10 ppm + neem

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oil 30 ml/l at 30 and 45 DAT effectively reduced *S. dorsalis* population. Barot and Patel (2012) studied the bioefficacy of different oils against thrips, *Scirtothrips dorsalis* Hood in chilli. They revealed that neem oil 0.5 per cent, mahuda oil 1 per cent, mineral oil 0.2 per cent, pongamia oil 1 per cent and eucalyptus oil 1 per cent found most effective against thrips. Mari *et al.* (2013) studied on integrated insect pest management in organic farming system in chilli crop and they evaluated different botanical among them neem powder 3 kg/acre found effective against thrips, whitefly and mite. Seed treatment with imidacloprid 70% WS @ 400-600 g/100 kg seed. Apply fipronil 5% SC @ 320-400 ml in 200 l of water/acre or lambda-cyhalothrin 4.9% CS @ 200 ml in 200 l of water/acre or lambda-cyhalothrin 5% EC @ 120 ml in 160-240 l of water/acre or spinosad 45% SC @ 64 ml in 200 l of water/acre or thiacloprid 21.7% SC @ 90-120 ml in 200 l of water/acre or acetamiprid 20% SP @ 20-40 g in 200-240 l of water/acre or emamectin benzoate 5% SG @ 80 g in 200 l of water/acre or carbaryl 50% WP @ 800 g in 200-400 l of water/acre or carbofuran 3% CG @ 13320 g/acre or ethion 50% EC @ 600-800 ml in 200-400 l of water/acre or fenprothrin 30% EC @ 100-136 ml in 300-400 l of water/acre or methomyl 40% SP @ 300-450 ml in 200-400 l of water/acre or oxydemeton-methyl 25% EC @ 400 ml in 200-400 l of water/acre or phorate 10% CG @ 4000 g/acre or phosalone 35% EC @ 800 ml in 200-400 l of water/acre or indoxacarb 14.5% + acetamiprid 7.7% W/W SC @ 160-200 ml in 200 l of water/acre (Recommended department of Agriculture and Cooperation Ministry of Agriculture, Government of India, AESA Based IPM Package No.24)

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Impact of COVID-19 Pandemic on Global Food Security and Nutrition

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ABSTRACT

The world has witnessed the worst lockdown of 2020-2021 on account of COVID-19 pandemic that led to shut down of almost all business operations, industrial productions, developmental activities, educational institutions, halting the movements of people outside of their homes that resulted the people without work. The objective of lock down was to “flatten the curve” of disease progression. Laid-off workers, particularly daily wage workers who were largely seasonal migrants, struggled to find employment even after the lockdown eases. Coronavirus-related layoffs disproportionately severely hit the service workers mainly in low-paying jobs as restaurants, malls, cafes, shops shut, infrastructure, industrial units, private organizations which led to reduction in their earnings that directly affected their food requirements. For informal sector workers and rural poor, missing even a day’s earnings can make it difficult them to buy even basic food items, and joblessness extension for over twenty months ruined their economy. India also witnessed large-scale reverse migration, with desperate migrants leaving cities amid lockdown and walking hundreds of miles toward their home villages, the prospect of economic devastation and a growing population of rural poor.

The Zero Hunger Challenge was launched by United Nations Secretary-General Ban Ki-moon in 2012 and set a target to end global hunger and malnutrition by 2030. It is unlikely to meet on account of multiple reasons including recent COVID-19 pandemic, however, even before the COVID-19 pandemic, we were already not on track to meet this commitment. Now, the pandemic has made it significantly much more challenging. World hunger increased by 1.5% in 2020 under the shadow of the COVID-19 pandemic it is estimated that during COVID-19 pandemic between 720 and 811 million people in the world faced hunger in 2020, *i.e.* around 118 million more people faced hunger in 2020 than in 2019. More than half of the world’s undernourished people are found in Asia (418 million) and about one-third in Africa (282 million). Compared with 2019, about 46 million more people in Africa, 57 million more in Asia, and about 14 million more in Latin America and the Caribbean were affected by COVID-19 pandemic for hunger in 2020. It is expected that if all things remain constant, around 660 million people may still face hunger in 2030, in part due to long lasting effects of the pandemic on global food security – 30 million more people than in a scenario in which the pandemic had not occurred. Global prevalence of moderate or severe food insecurity suggest that nearly one in three people in the world (2.37 billion) did not have access to adequate food in 2020 – an increase of almost 320 million people in just one year.

Close to 12% of the global population was severely food insecure in 2020, representing 928 million people – 148 million more than in 2019, the women accounted for 10 percent higher than men in 2020 as compared to 6 percent in 2019. Globally, malnutrition remains a challenge as the high costs of healthy diets coupled with persistent high levels of income inequality put healthy diets out of reach for around 3 billion people in the world, especially the poor. It increased in 2020 due to the COVID-19 pandemic. Most children with malnutrition live in Africa and Asia. An estimated 29.9% of women aged 15 to 49 years in 2019 around the world were affected by anaemia due to malnutrition, and the data gathered from post COVID-19 era, revealed that now more than 30 % of women in Africa and Asia are affected by anaemia, compared with only 14.6 percent of women in Northern America and Europe. The COVID-19 pandemic has impacted the prevalence of multiple forms of malnutrition, and could have long lasting effects beyond 2020, as we are already observing in 2021. These will be compounded through the intergenerational effects of malnutrition and the resulting impacts on productivity. Increasing cost of a healthy diet are associated with higher levels of food insecurity, especially among lower-middle-income countries. In 2020, almost all low- and middle-income countries were affected by pandemic-induced economic downturns, and the increase in their number of undernourished was more than five times greater than the highest increase in undernourishment in the last two decades. These countries were also affected by climate-related disasters, conflict, and/or a combination, the largest increase in undernourishment was seen in Africa, followed by Asia while adult obesity is increasing sharply in all regions of the world leading to several diseases.

The six transformation pathways identified are identified that are needed for greater resilience to specifically address the negative impacts of the major drivers behind the recent rise in hunger and slowing progress to reduce malnutrition. These include-integrating humanitarian; development and peace building policies in conflict-affected areas; scaling up climate resilience across food systems; strengthening resilience of the most vulnerable to economic adversity; intervening along the food supply chains to lower the cost of nutritious foods; tackling poverty and structural inequalities, ensuring interventions are pro-poor and inclusive; and strengthening food environments and changing consumer behavior to promote dietary patterns with positive impacts on human health and the environment.

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The year 2020 has brought an immense challenge for the world, with a warning of unwelcome events likely to come in near future, if the world does not commit to more resolute actions to change course, to protect environment and biodiversity in the biosphere. Exceptional efforts are required to address and overcome the effects of the pandemic as part of accelerating progress as the present projections confirm that hunger will not be eradicated by 2030 unless bold actions are taken to accelerate progress, especially actions to address inequality in access to food, to stop wastage of food, to reduce post-harvest losses, to improve food transport chain, to encourage food processing with bio-preservatives, to effectively manage global agricultural market, to encourage high nutritive varieties, protected cultivation, strategies to fight with climate change, to motivate the population for alternate and to focus on production hydroponics, protected cultivation and microbial foods.

Marketing Analysis of Bangalore Red Rose Onion in Chikkaballapura District of Karnataka

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ABSTRACT

Purpose: The present study was conducted to examine the costs and returns in production, price spread in different marketing channels of Bangalore red rose onion.

Methods: The study was conducted by using a random sample of sixty cultivators and twenty market intermediaries from Chikkaballapura and Chennai export markets. The primary data was collected by personal interview method with help of pretested and structured schedule during 2019-20 crop season.

Results: The major findings of the study revealed that About 78.40 per cent of the farmers sold through Channel-I (Producer → Village level trader → Commission agent → Exporter → Foreign importer → Consumers), about 15.00 per cent in channel-II (Producer → Contract trader → Exporter → Foreign importer → Consumers) and about 6.60 per cent in channel-III (Producer → Trader in APMC → Exporter → Foreign importer → Consumers). The price spread was higher in Channel-I (Rs. 9,600) compared to Channel-II (Rs. 8,800) and channel-III (Rs. 9,150) due to a greater number of intermediaries.

Conclusion: With a marketing efficiency index of 3.15, channel-II was the most efficient channel followed by channel-III (2.78) and channel-I (2.59) according to Shepherd’s method.

Key words: Price spread, Marketing channels, marketing efficiency, chikkaballapura

Effect of Itrifal Muqawwi-e-Dimagh (a polyherbal drug) on the transgenic *Drosophila* model of Parkinson’s Disease

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ABSTRACT

Purpose: Parkinson’s Disease (PD) is characterized by the loss of dopaminergic neurons in the substantia nigra pars compacta of the mid brain which leads to the depletion of dopamine levels. The depletion of dopamine leads to the motor dysfunction characterized by tremors, rigidity, bradykinesia and postural instability. In this context, the effect of unani herbal formulation Itrifal Muqawwi-e-Dimagh (IMD) was studied on the transgenic *Drosophila melanogaster* expressing human alpha synuclein in the neurons of flies. IMD is recommended for enhancing mental power and to treat mental illness in the Unani system of medicine. IMD was prepared as per the standard procedures and was subjected to various physico-chemical tests.

Methods: The equivalents of recommended dose for human were established for 20g of fly food i.e. 0.0014, 0.0028, 0.0042 and 0.0056g per 20g of diet. The PD flies were allowed to feed on it for 24 days before performing the assays.

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Results: The PD flies exposed to IMD showed increase in the life span and improvement in the activity. A significant dose dependent delay in the loss of climbing ability was observed in PD flies exposed to various doses of IMD. The exposure of PD flies to IMD showed a significant reduction in the oxidative stress and increase in the anti-oxidant enzymes compared to unexposed PD flies. The PD flies exposed to various doses of IMD showed a significant dose dependent increase in the activity of tyrosine hydroxylase as evident by immunohistochemistry.

Conclusion: It is concluded that IMD is potent in reducing the PD symptoms being mimicked in the transgenic *Drosophila*.

Evaluation of orchid species from Mahabaleshwar plateau of western ghat

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ABSTRACT

Purpose: Western ghat region is well recognized biodiversity hot spot. Several orchid species exist in this region. The Orchidaceae family is diverse and widespread with colourful blooms that are often fragrant. It is also one of the largest family of the flowering plants. Orchid species in Mahabaleshwar plateau includes high altitude epiphytes as well as terrestrial (ground) orchids. The purpose of this study was to evaluate the vegetative and floral attributes of the orchid species from the Mahabaleshwar plateau of the western ghat.

Methods: An orchid germplasm collection at Regional Wheat Rust Research Station, Mahabaleshwar was evaluated during the year 2019-20. Observations regarding vegetative and floral characters were recorded.

Results: Among the evaluated species *Epidendrum radicans* recorded maximum plant height (64 cm), maximum number of leaves (12) and highest spike length (52 cm). More inter-nodal length was recorded in the species *Dendrobium crepidatum* (4.3 cm). The species *Eulophia herbacea*, *Spathoglottis plicata* and *Oberonia recurva* do not have internodes. The species *Oberonia recurva* recorded maximum number of flowers (38) per spike.

Conclusions: Orchids species in Mahabaleshwar plateau of the western ghats have diversity in their habitat adaptation along with vegetative and floral characters. It is necessary to conserve this orchid biodiversity. These orchids can play a vital role in uplifting the floriculture, herbal, pharmaceutical and tourism industry of the western ghat.

Key words: Orchids, Western ghat, Biodiversity

Genetic transformation of *Citrus reticulata* cv. Khasi mandarin

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ABSTRACT

Purpose: Khasi mandarin is the most popular citrus cultivar in North-East, India. They are declining at a very high rate due to its vulnerability to different pathogen and insect/ pest. CTV (Citrus tristeza virus), Citrus canker (CCK), Citrus variegated chlorosis (CVC) and Huanglongbing (HLB) results in significant reduction. Limitation for improvement *via* conventional breeding is associated with nucellar polyembryony, high level of heterozygosity and a long juvenile period. Genetic transformation as a tool for citrus improvement is gaining in popularity. In the present study, *in vitro* regeneration and *Agrobacterium* mediated genetic transformation protocol was optimized for *C. reticulata*

Method: Different explants like epicotyl, hypocotyl, nodal and internodal segments obtained from six-week-old *in vitro* grown zygotic seedling was used for transformation. Explants were transformed with *Agrobacterium* strain LBA4404, harboring plasmid pBI121-AtSUC-GUS containing *nptII* as a selectable marker and *gus* as a reporter gene. Transgenic detection was done through GUS histochemical assay.

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Result: Hypocotyl was found to be the best explants. MS medium supplemented with BAP (2mg/L), NAA (0.5mg/L), 2, 4-D (1mg/L), MES (0.5g/L), sucrose (30g/L) and acetosyringone (100µM) was found to be best medium for co-cultivation. Modified MS medium containing BAP (4mg/L), MES (0.5g/L), sucrose (30g/L), phytigel (4g/L), kanamycin (50mg/L) and timentin (150mg/L) showed highest regeneration efficiency (18%). Modified MS medium containing BAP (4mg/L), GA3 (0.5mg/L), MES (0.5g/L), sucrose (30g/L), phytigel (4g/L), kanamycin (50mg/L) and timentin (150mg/L) showed highest multiple shoot induction. GUS expression in the phloem tissue was observed in the transgenic shoot and leaves.

Conclusion: Transformation efficiency of 0.6% was obtained through this protocol.

Key words: *Agrobacterium strain* LBA4404, CTV, GUS assay, Khasi mandarin

Study on diversity of *Trichoderma* from the rhizospheric soil of solanaceous crops in Assam

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ABSTRACT

Purpose: *Trichoderma* is the most explored bio-control agent in today’s agricultural industries manufacturing biopesticides. Several species under the genus *Trichoderma* of Ascomycetes group are identified as efficient inhibitors of soil borne fungal and bacterial plant pathogens. The present study was conducted to study the morphological and molecular diversity of *Trichoderma* from the rhizospheric soils of solanaceous crops in Assam.

Methods: Rhizospheric soil samples of tomato, brinjal, chilli and potato were collected from organic cultivation sites in various districts of Assam viz., Jorhat, Majuli, Nalbari, Barpeta, Kharupetia, and Nagaon. Serial dilution followed by pour pate method was done to calculate the colony forming units of *Trichoderma*. Morphological identification was carried out by studying the conidia shape, colony colour, mycelia growth rate. Additionally, molecular phylogenetic analysis was performed to analyse diversity of the isolated strains using maximum likelihood method via MEGAX software.

Results: The presence of *Trichoderma* was found in the rhizospheric soils of tomato, brinjal and chilli whereas no *Trichoderma* colonies isolated from rhizosphere of potato. Phylogenetic analyses of 47 other *Trichoderma* species from various geographical regions of India and isolated strains from the current study revealed that the latter clustered separately depicting diverging evolutionary significance. Five strains were subsequently submitted to NCBI.

Conclusions: The current work focuses on understanding species diversity of *Trichoderma* isolated from various geographical locations of Assam. Experimental techniques coupled with *in silico* analysis shows that the isolated strains are unique and diverse from the previously identified *Trichoderma* species in the country, especially from the North-eastern region. The study further aims at establishing the biocontrol potential of these isolated strains and subsequent evaluation of novel biopesticide formulations. Also, a molecular analysis to generate DNA barcode of the identified strains will assist in taxonomic identification of future novel strains.

Keywords: Biocontrol agent, *Trichoderma*, solanaceous crops.

Allantoin mediated regulation of miRNAs for short term salinity stress tolerance in *Oryza sativa* L. cv. IR-29

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ABSTRACT

Purpose: Rice is the most widely consumed cereals of the world, especially in Asia. The growth of rice which is commonly a glycophytic plant species is severely limited under salinity. Allantoin is a nitrogenous compound derived

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from purine catabolism that contributes to nitrogen recycling in plants. In rice, accumulation of allantoin in response to salinity stress has been reported. But the role of allantoin under salinity stress is not elucidated till now. Recently, miRNAs have emerged as major regulatory molecules which have been shown to regulate gene expression during salinity stress condition. To understand the effect of exogenous application of allantoin on miRNAs mediated short-term tolerance of salt sensitive rice genotype IR-29, the relative expression of 10 salinity responsive miRNAs were investigated under salinity stress.

Methods: Salt-sensitive rice genotype IR-29 was used as experimental material. After 14th day of plant growth, treatments of salt (100 mM) along with allantoin (0.01 mM) were given to the IR-29 seedlings either alone or in combination. Subsequently, after 5th day of treatment, IR-29 root samples were collected and stored in -80 °C for RNA isolation. The salt responsive miRNAs in rice were selected from previously studied research papers. Expression analyses of miRNAs through qRT-PCR were done.

Results: The result demonstrates that several miRNA changed their expression pattern in presence of allantoin under salinity. For an example, miRNAs like Osa-miRNA393a, Osa-miRNA414, Osa-miRNA530 and Osa-miR818a were down-regulated under salinity stress condition whereas all these four miRNAs were up-regulated under salinity along with allantoin treated condition indicating that this differential expression under allantoin may play important role for salinity tolerance of IR-29.

Conclusions: Relative expression analyses of salt responsive miRNAs showed that some of these miRNAs were up-regulated when exogenous allantoin was applied along with NaCl that indicates the role of allantoin in providing short-term salt tolerance to salt sensitive rice genotype IR-29 through the interaction with miRNAs.

Key words: Allantoin, IR-29, MicroRNA, Rice, Salinity stress, Stem-loop PCR

tRNA induced non-coding RNA Prediction Methodology (tiRPreM) for model and non-model organism

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ABSTRACT

Purpose: The tRNA-induced non-coding RNA fragments or tRNA-derived RNA fragments (tRFs) is a novel class of small regulatory RNAs processed from mature tRNA or tRNA precursor. These tRFs found to be involved in RNA silencing, translational repression and epigenetic regulation. These tRFs are not just the degraded fragments of tRNAs but are found precisely generated with the evidences suggesting the differences between their generation and biogenesis of miRNAs along with the presence of tRFs in the organisms having no reported miRNAs. But the strategies for identification of these tRFs, especially in plants, are either varying or not well defined and hence we have attempted to standardize it.

Methods: Addressing existing variations, we are proposing a standard methodology (tRNA induced non-coding RNA Prediction Methodology or tiRPreM) to identify any existing class of tRFs whether in model or non-model organism taking all existing consensus definitions. With tiRPreM, we recommended to perform the prediction using organism specific reference genome with the presence in all the replicates, normalized read count support and perfect match search. We have analyzed real sRNA data set from control and salt-treated samples of wild rice, *O. coarctata* to identify salt-related tRFs with tiRPreM.

Results: A total 1152 tRFs were predicted from sRNA data sets of non-model organism, *O. coarctata*. The i-tRF class comprises of 50% of total predicted tRFs followed 35.5% as 5'-tRFs, 14.1% as 3'-tRFs and 0.35% as tRF-1s.

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Guanine (G) is the most common 5' nucleotide or starting base of 5' tRFs with 77.50% frequency. All these results follows the same patterns as reported earlier in other organisms. The same has been demonstrated with a small subset of recently published chickpea data to find significant number (907) of tRFs from data left after miRNA prediction .

Conclusions: The tRF prediction in non-model organism can have revolutionary impact as these non-coding RNAs can act as important genetic engineering targets for disease control or to obtain stress tolerant transgenic plants either through loss or gain of function of target genes.

Key words: tRFs, small-RNA, non-coding RNAs, methodology, non-model organism

Haplotype network of 94 diverse deep-water rice of Assam using eQTLs regulating transcript for internode elongation under deep water stress

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ABSTRACT

Purpose: Flooding, an abiotic stress, distresses the growth of most plants by restricting the exchange of gases such as oxygen and carbonic dioxide and lowering the light intensity; this reduces yield all over the world. Deep water rice under flooding conditions uses escape strategy where the internodes of rice plants beneath water rapidly elongate as the water level rises. Our aim here is to analyse haplotype network among 94 deep water rice accessions using eQTLs for deep water and anaerobic germination related traits.

Methods: In this study, haplotype network of 18 expression quantitative trait loci (eQTL) related to internode elongation and one anaerobic germination tolerance related gene have been investigated among 94 deep water rice landraces. We generated SNP haplotypes for the selected genes using TASSEL 3.2.1. Network software 4 was used for construction of haplotype network for each gene for the analysis of genealogical relationship among the haplotypes. Haplotype diversity was computed with the DnaSP software version 5.105.

Results: Our investigation showed a maximum of 16 haplotypes for the eQTL named as *SET protein 39* with 42 SNP sites and lowest number of 3 haplotypes for 5 different eQTLs. Maximum haplotype diversity in *SET protein 39* (*Os10g36250*) gene was found to be 0.8094 and lowest in *Annexin repeat, conserved site domain containing protein* (*Os03g17634*) i.e., 0.0423 indicating that our genotypes are genetically much more diverse in nature.

Conclusions: Our haplotype analysis nicely indicated how all these 94 genotypes interconnected to each other at genomic level in regulation of rapid internode elongation under deep water stress. In addition to providing a greater understanding of variations in rice, this information could lead us to select candidate regions associated with important traits. Upon phenotypic analysis of deep water stress related traits and other economically important traits, we can identify specific superior/desired haplotypes.

Key words: Deep water rice, eQTL hotspot, genotyping, haplotype diversity, Single nucleotide polymorphism (SNP).

Constraints in adoption of recommended soybean production technology

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ABSTRACT

Purpose: Soybean is known as the “golden bean”, “miracle crop” etc, because of its several uses. It is an excellent source of protein and oil. It contains about 43 per cent of good quality protein (43%), carbohydrates (21%), minerals (5%), moisture (8%), fat (20%), fiber (4%) and reasonable amounts of vitamins. Besides utilization of soybean as

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vegetable, it is also used in oil industry where it occupies first place in the world oil production. Madhya Pradesh has the lead among the soybean producing states in India. The prices of soybean in the Indian market are highly volatile because they depend on the prices of the international market. As reference markets, the markets at Indore and Mumbai are looked upon. In Sehore district maximum area covered under soybean crop in kharif season and the soybean growers also want to adopt the recommended production technology but they have faced many constraints in cultivation of soybean crop as well as adoption of recommended technology. So It is mandatory to study the constraints in adoption of recommended production technology. Keeping this in view the present study was conducted in the Sehore district of Madhya Pradesh in the year 2018-19.

Methods: 10 villages from Sehore block was selected purposely for the study, 12 farmers from each village, total 120 farmers were selected randomly. Statistical tools like mean, median, standard deviation, and rank order were used for analyzing and interpretation of the data.

Result: The findings of the study was that constraints faced by the farmers were lack of technical knowledge (78.33%) followed by difficult to follow IPM/ IDM (72.5%), lack of high yielding varieties of seed (69.17%), lack of capital (65%), high cost of critical inputs (61.67%), lack of storage facilities (50.83%), unavailability of seed treatment chemicals and culture (49.17%),lack of irrigation facility (46.67%), non-availability of advanced agricultural information (45%),lack of proper training (43.33%) and lack of transport facilities (40%).

Conclusion: So it was concluded that lack of technical knowledge, difficult to follow IPM/ IDM and lack of high yielding varieties of seed etc. were the major problems of soybean growers in adoption of recommended soybean production technology respectively.

Key word: Soybean, Constraints, Adoption, Recommended soybean production technology)

Effectiveness of herbicide to control weeds in direct-seeded rice under different agro-ecosystems

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ABSTRACT

Purpose: Rice (*Oryza sativa* L.) is the world’s most important staple food crop and primary source of food for more than half of the world’s population. Direct-seeded rice (DSR) is a feasible alternative to transplanted rice to mitigate methane emission, besides saving water, labour and energy. But the productivity of the DSR is often reported to be lower, mainly due to infestation of weeds which may cause yield losses of 50–91%. Therefore, the application of several herbicides in combination or sequence can be more useful.

Methods: A field experiment was conducted during *Kharif* season 2019 at Research Farm, College of Agriculture, JNKVV, Jabalpur (M.P.). Sowing of rice cultivar *MTU 1010* was done on 12 July 2019 in split plot design with three replications comprising rainfed and irrigated agro-ecosystems as main plot treatment and eight subplot treatments including bispyribac sodium 10% SC @ 25 g *a.i./ha*, fenoxaprop-p-ethyl 6.7% EC @ 60 g *a.i./ha*, fenoxaprop-p-ethyl 6.7% EC + penoxsulam 24% SC @ (60 + 26.7) g *a.i./ha*, cyhalofop 10% EC + penoxsulam 24% SC @ (135 + 26.7) g *a.i./ha*, bispyribac sodium 10% SC + (metsulfuron methyl 10% WP + chlorimuron ethyl 10% WP) @ (25+4) g *a.i./ha*, triafamone 20% WG + ethoxysulfuron 10% WG @ (40+20) g *a.i./ha* as post-emergence herbicides, hand weeding twice at 20 and 40 DAS and weedy check.

Results: The results showed that among all kinds of monocot as well as dicot weeds *Echinochloa colona* was the most dominant with a mean relative density of (30% and 28.6%) followed by *Alternanthera sessilis* (26% and 25%), *Cyperus rotundus* (18.9% and 18%) and *Cynodon dactylon* (18.4% and 17.9%) under rainfed and irrigated agro-ecosystems. The maximum weed control efficiency under both rainfed and irrigated rice was observed in plots receiving hand weeding (97% and 97.4%) which was closely followed by bispyribac sodium @ 25 g *a.i./ha* (89.5% and 89.6%) and fenoxaprop-p-ethyl + penoxsulam @ (60 + 26.7) g *a.i./ha* (88.3% and 88.2%). Growth parameters of rice (*viz.* plant population, plant height, number of tillers/m²) as well as yield attributes (*viz.* number of panicles/m², panicle length, number of grains/panicle, grain yield and straw yield) were higher in plots receiving bispyribac sodium 10% SC @ 25 g *a.i./ha* at 20 DAS except for hand weeding twice which registered the maximum values of these parameters.

Conclusions: Based on the above findings it may be concluded that application of bispyribac sodium at the rate of 25 g *a.i./ha* was most effective for suppressing weed growth with maximum grain yield and net return from direct-seeded rice.

Key words: Bispyribac sodium, Direct-seeded rice, Weeds

Impact of processing methods on lipid oxidation of normal and high oleic peanut genotypes Hemalatha S¹., Dileepa K C¹. And Kavera Biradar²

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ABSTRACT

Purpose: Peanut (*Arachis hypogaea*) is one of the most important oilseed crop in India. Groundnuts have good amount of proteins (25-28%) and lipids (50-55%). Due to their high oil content, they are susceptible to developing rancidity and off-flavors through lipid oxidation. Recently, several attempts have been made to produce new cultivars with improved physio-chemical properties (Jonnala *et al.*, 2005). Normal groundnuts have 40-50 per cent oleic acid and 30-40 per cent of linoleic acid, whereas peanuts with high oleic to linoleic acid ratio (O/L) have been released for better oil stability and nutritional quality. Dh-245 is one of the prominent high oleic genotypes developed by UAS, Dharwad through mutation breeding. In this study the high oleic peanut genotype (HOP), Dh-245 and normal peanut genotype (NP), GPBD-4 were compared for oxidative stability upon storage and effect of processing methods on quality deterioration.

Methods: The high oleic peanut genotype (HOP), Dh-245 and normal peanut genotype (NP), GPBD-4 were procured and shells were removed using manual groundnut decorticator. The initial parameters i.e. Moisture content (MC), Fat content (FC), Ash content were determined using the Association of Official Analytical Chemists guidelines (Anon., 2005). The weight of 100 representative kernels from each accession was recorded as test weight in grams. The peanut kernels were subjected to skin colour assessment in Premier Color scan Spectrophotometer Model No. SS5100A. The kernels of both the genotypes were subjected to different processing treatments like roasting, deep fat frying, boiling and soaking. The time and temperature combinations were selected based on sensory evaluation i.e. Roasting: 120-130° C for 10 min; Deep fat frying: 160 °C for 1 min; Boiling: 100 ° C for 30 min; Soaking: 10 hrs at room temperature and control without any treatment. Changes in the fatty acid profile by HPLC, free fatty acid and per oxide value were studied using AOAC protocols (Anon, 1993).

Results: The moisture, fat and ash content of raw peanuts were found to be 4.0, 45 and 3.1 g/100g in Dh-245 and 3.7, 44.3 and 2.3 g/100g in GPBD-4. The 100 kernel weight was 33.50 g (Dh-245) and 41.00 g (GPBD-4). The fatty acid profile of Dh-245 was observed to be, palmitic acid (8.58%), oleic acid (58.10%) and linoleic acid (21.54%) of the total fatty acid profile. Where as in the GPBD-4, palmitic acid (9.86%), oleic acid (49.73%) and linoleic acid (28.54%) of the total fatty acid profile.

The roasted peanuts had higher peroxide value and free fatty acids followed by fried peanuts and boiled peanuts. The values of soaked peanuts was almost near to the control. GPBD-4 had highest PV (5.70 meq O₂/kg) and FFA (0.75%) in roasted peanuts compared to Dh-245 (PV-3.63 meq O₂/kg and FFA- 0.63%). Exposure of fats and oils to elevated temperatures results in a series of reactions including thermolysis, oxidation, polymerization and auto-oxidation. Volatiles such as aldehydes, ketones, hydrocarbons, alcohols and esters are produced from decomposition of hydroperoxides. Many non-volatile polar compounds, triacylglycerol dimmers and polymers are produced by radical reaction (Kim *et al.* 1999).

The oleic: linoleic ratio and per cent saturation increased in all the treatments with highest value in roasted peanuts followed by fried peanuts, boiled peanuts and soaked peanuts respectively. In case of unsaturated : saturated ratio, roasted peanuts had the lowest value. So it is clear that the processing treatments affect the fatty acid profile and the effect was more pronounced in case of roasting treatment with 120-130° C for 10 min followed by frying (160°C for 2 min), boiling (100°C for 20 min). Soaking treatment had less effect on the alteration of fatty acid profile of peanuts in both the varieties. In both the varieties similar trend was observed and the range of O/L ratio was 2.70 to 3.04 in Dh-245 variety which was high compared to O/L ratio of GPBD-4 variety i.e. 1.74 to 1.95. The highest O/L ratios

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are associated with longer shelf life and the Dh245 variety was predicted to have longer shelf life compared to GPBD-4.

Conclusion: This study revealed that the high oleic peanut variety Dh-245 had good oxidative stability than conventional GPBD-4 variety after different thermal processing treatments. The processing treatments have their effects on oxidation of peanut kernels and it depends on temperature and duration of treatments. High temperature results in faster degradation. So from commercial point of view high oleic peanut oil can be used for fried products such as potato chips, french fries etc. to increase their shelf life and to improve oxidative quality.

Effect of Religious motifs on stress management

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ABSTRACT

Purpose: Stress is a condition or feeling experienced when a person perceives that demands exceed the personal and social resources the individual is able to mobilize. Stress is a condition of mental pressure for particular individual facing problems from environmental and social well-being which leads to so many diseases. Stress can be positive or negative: stress is good when the situation offers an opportunity to a person to gain something. It acts as a motivator for peak performance. Stress is negative when a person faces social, physical, organizational and emotional problems. Psychological stress refers to the emotional and physiological reactions experienced when an individual confronts a situation in which the demands go beyond their coping resources. Young age is the critical period because at this time youth faces lots of changes in his/her life. Thus, they should enhance their stress management abilities so as to live a healthy life after entering the society. Therefore, understanding the sources of stress among them and how they can cope with the stress is very important.

Psychologists attempt to understand the role of mental functions in individual and social behaviour, while also exploring the physiological and biological processes that underlie cognitive functions and behaviours. Psychology is the science of behaviour and mind, embracing all aspects of conscious and unconscious experience as well as thought. It is an academic discipline and a social science which seeks to understand individuals and groups by establishing general principles and researching specific cases. Colour has long been used to create feelings of coziness or spaciousness. However, how people are affected by different colour stimuli varies from person to person. Colour influences perceptions that are not obvious, such as the taste of food. There are four psychological primary colours – red/ pink, blue, yellow and green. They relate respectively to the body, the mind, the emotions and the essential balance between these three. Thus, relating the colour, design and chanting to the psychology of an individual, it was planned to design and develop stress relief bed linens with the objective to know the effect of bed linen on stress management after using by the individuals with stress.

Pink indicates being a tint of red, pink also affects us physically, but it soothes, rather than stimulates. (Interestingly, red is the only colour that has an entirely separate name for its tints. Tints of blue, green, yellow, etc. are simply called light blue, light green etc.) Pink is a powerful colour, psychologically. It represents the feminine principle, and survival of the species; it is nurturing and physically soothing. Too much pink is physically draining and can be somewhat emasculating. Blue is the colour of the mind and is essentially soothing; it affects us mentally, rather than the physical reaction we have to red. Strong blues will stimulate clear thought and lighter, soft blues will calm the mind and aid concentration.

Methods: Ethnic / religious motifs considered as stress relief and sense controller motifs viz., lotus motif of white, pink / red and blue colour, Peepal tree leaf with climbers motif of green colour were selected, designed and simulated in Arahne weave software. Punch cards of the simulated motifs were developed and were used for weaving of these motifs on bed linens on handloom with jacquard mechanism. Stress relief bed linens were woven with 2/20s cotton yarn on an electronic jacquard handloom by chanting while weaving.

The ADSS scale developed by Pallavi Bhatnagar, Megha Singh, Manoj Pandey, Sandhya and Amitabh and published from National Psychological Corporation, Agra was distributed to fifteen each Teaching, non teaching and House

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wife groups in order to test or interpret the cut off points in case of anxiety, depression and stress levels among 90 respondents, 30 each randomly selected from teaching staffs, non teaching staffs and housewives.

According to the ADSS Scale the obtained data were analysed on the basis of their cut-off points. Among all the three groups, ten respondents from each group with highest scores in stress, anxiety and depression were listed and the developed bed linen was distributed among them. After one month, Post test was carried out by distributing the Anxiety, depression and stress Scale and the effect of designed bed linens on stress relief was assessed The data were analysed using frequencies, percentages, and t-tests.

Results: Majority (60%) of the respondents without ADSS scale said bed linen is very good with regards to its psychological feel followed by 56.67 per cent of respondents with ADSS scale said the effect of bed linen was excellent after use, this may be due to the use of religious motif, colour combination, cotton yarns and chanting that will psychologically give good and soft feel. To know the total comparison of ADSS scale before and after using bed linen paired t-test was applied to find out whether the bed linen affected the stress level of user or not. It was found that, after using the stress relief bed linen the stress level of the respondents was reduced and at certain point the stress level totally vanished and however t value was significant at 5% and highly significant at 1%. This may be due to the spiritual feeling of the respondents towards the use of bed linens with religious motifs, colour combination, cotton yarns and chanting that will psychologically give positive effects and reduce stress.

Conclusion: The best way to reduce stress quickly and reliably is by using the senses—what you see, hear, smell, taste, and touch—or through movement. These ambitious and religious motifs with colour were having significant role in controlling human psychology. Unnecessary stress and tension can be maintained by the help of these symbolic motifs. Hence, these bed linens were very helpful in reducing stress and anxiety, and also helpful in reducing other health conditions like blood pressure problem, tension, cramps and pain.

Antibacterial activity of skin mucus entangled bacteria of *Labeo calbasu*

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ABSTARCT

Purpose: Massive production of fish in intensive aquaculture system may expose fish to various stressful conditions like poor water quality, improper feed and overcrowding which in turn have the potential to induce infections by opportunistic pathogens causing high mortalities and to prevent these infections, antibiotics have been administered indiscriminately leading to the emergence of antibiotic resistance as well as tissue accumulation. So, there is an immediate call for an alternative source which can replace antibiotics to prevent pathogenic diseases in fishes. Fish skin mucus has been considered the first line of defence against pathogens. Numerous studies have illustrated the role of fish skin mucus as an antibacterial agent against various human and fish pathogens i.e. *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Staphylococcus aureus*, *Bacillus cereus* and *Aeromonas hydrophila* but few studies have been done so far concerning the importance of skin mucus entangled antimicrobial bacteria.

Objective: The objective of the present study was to isolate antimicrobial bacteria from skin mucus of *Labeo calbasu* and to test their inhibitory potential against common fish pathogen *A. hydrophila*.

Methodology-: Spread plate technique was used to isolate bacteria from fish skin mucus. Centrifuged skin mucus of *L. calbasu* was spread on nutrient agar plates and plates were incubated at 37°C for 24 to 36 hr. After that, morphologically different bacterial colonies of fish skin mucus were picked up from agar plates and repeatedly streaked on different agar plates till the pure culture of bacteria was obtained. Then the bacteria were grown in nutrient broth media at 37°C for 24 hr. The inhibitory potential of isolated bacteria was tested by agar well diffusion assay against *A. hydrophila*.

Results: Thirteen bacterial strains (LC1 - LC13) were isolated from the fish skin mucus and their inhibitory potential has been tested against common fish pathogen *A. hydrophila* by agar well diffusion assay. Three bacterial strains (LC1, LC7 and LC13) out of thirteen showed a clear zone of inhibition (mm) against *A. hydrophila* depicting the antagonistic activity.

Conclusion: The results of present study indicated that the host specific or autochthonous antimicrobial bacteria entangled in fish skin mucus inhibited the growth of *A. hydrophila* due to their antibacterial properties. Thus it can be

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concluded that if these bacterial strains are added to the holding water of fish, they can promote fish health by successfully eliminating the pathogenic bacteria, eventually leading to reduced mortality due to opportunistic pathogens. Moreover, replacement of antibiotics with these antimicrobial bacteria for disease prevention and treatment can solve the worldwide problem of antibiotic resistance.

Preliminary studies on the abiotic and bacteriological parameters of sewage water in kurukshetra

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ABSTRACT

Purpose: Sewage wastewater mainly comprises of domestic, industrial and agricultural effluents which contain organic and inorganic waste in dissolved or suspended form and varied number of microorganisms. Before discharging this wastewater into rivers or using it for agricultural purposes it must be decontaminated. Sewage water itself contain autochthonous bacteria that possess biodegrading potential. These bacteria can be isolated and cultured individually and then can be used in bioremediation processes. Before isolating these autochthonous bacteria there is need to conduct preliminary studies on the physiochemical and bacteriological characteristics of sewage water

Objective: The main objective of the present study was to analyse sewage water collected from two different sewage treatment plant located in Kurukshetra city and its physiochemical parameters and bacteriological analysis was done.

Methodology: Various physiochemical parameters such as BOD, COD, DO, free CO₂, chloride, calcium, magnesium, hardness, pH, ammonia, nitrate and phosphate level etc. were determined by standard methods given by APHA. Heavy metal content was determined by Inductively coupled plasma mass spectrophotometer (ICP-MS). Presence of coliform bacteria was determined by most probable number (MPN) method which include presumptive, confirmatory and completed test. Bacterial count of the wastewater was done by serial dilution and spread plate method.

Results: It was observed that temperature was higher than surface water because of various biochemical reactions. pH was found to be slightly alkaline. Sample also shows high turbidity because of suspended solid. DO was very less as compared to surface water which indicates pollution level. BOD values were ranged from 100-200mg/l and COD values were ranged from 50-250mg/l. Heavy metals such as Al, B, Cd, Cr, Cu, Fe were ranged near 6.30, 61.2, 15.2, 4.9, 5.4 ppb respectively. MPN index shows coliform number more than 2400/100ml.

Conclusion: Most of the values were higher than the values prescribed by CPCB. Both of the samples of wastewater show the presence of extensive number of coliform bacteria through MPN test. Different colonies in variable sizes and colour were observed on agar plates which show high bacteria count in wastewater sample. Thus there must be some autochthonous bacteria those possess biodegrading potential.

Keywords: sewage wastewater, biodegradation, autochthonous, coliform

Banana pseudo stem sap: An eco auxiliary for textile finishing

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ABSTRACT

Purpose: Banana (*Musa paradisiaca*) is one of the most important gigantic and oldest cultivated fruit crops grown almost everywhere in India. Banana is the second largest produced fruit contributing about 16 per cent of the world's total fruit production (FAO, 2009). Abundantly available banana pseudo stem has been traditionally used for fibre extraction for products diversification and the sap is one of the most important bio agent for various applications has not been utilising properly either by farmers or industrialist. Hence the present study is designed with the objective, extraction and characterization of banana pseudo stem sap of local varieties and application of optimised sap on cotton fabric.

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Methods: The banana pseudo stem sap of Grand Nain and Ney Poovan varieties were characterized for total phenolic content (TPC), fourier transform infrared spectroscopy (FTIR), antioxidant assay and bioassay test. Based on characterization Ney Poovan variety was selected for finishing of cotton fabric. The finished cotton fabric was assessed for physical properties *viz.*, cloth count, cloth thickness, cloth weight, cloth stiffness and cloth crease recovery and functional properties *viz.*, cloth tensile strength, elongation, cloth drapeability, antimicrobial, UV property and the finished cotton fabric is characterised by FTIR.

Results: Results revealed that, the total phenolic content and antioxidant activity exhibited greater in Ney Poovan pseudo stem sap than Grand Nain pseudo stem sap. The FTIR spectrum of banana pseudo stem sap (Grand Nain) exhibited presence of C-Br stretching attributed to presence of bromine compound and Ney Poovan pseudo stem sap exhibited presence of N-O stretching and S=O stretching specifies the presence of nitro and sulfoxide compound. The optimised BPS treated cotton fabrics became significantly thicker, heavier, softer, pliable and good drape than control fabric. The cloth tensile strength and elongation were found to be significantly greater in BPS treated cotton fabric. The BPS treated cotton fabric exhibited increased ultra violet protection factor with decreased UVA and UVB resulting into good to excellent protection category and also exhibited good antimicrobial properties than control fabric. The FTIR of BPS treated cotton fabrics exhibited additional medium peaks at varied wavelengths resulting into formation of intermolecular bonding between fibre and BPS compounds which yields UPF properties.

Conclusions: BPS treated fabrics can be suitable for summer apparels, health care and home textiles. The processed sap can be used as eco auxiliaries for functional finishing of textiles and optimum utilization of biowaste provides an immense help to the farmers and entrepreneurs to creates employment opportunity among the banana growers and doubling the farmer’s income.

Key words: Banana pseudo stem, total phenolic content, antioxidant activity, Fourier transform infrared spectroscopy (FTIR), physical property, antimicrobial assay and ultra violet protection factor.

Screening, production and optimization of lignocellolytic enzymes from microbial sources Sakshi Goyal*, Kajal Kumari, Sushil Nagar

ABSTRACT

Purpose: Worldwide, wide range of chemicals and synthetic polymers are manufactured on large-scale using fossil resources. However, our fossil resources are limited in nature, thus search for alternative and viable sources that can replace fossil fuels and still provide valuable end products is needed. One of the identified sources is lignocellulosic biomass, which is currently the most abundant bio-renewable biomass on earth, and it contains cellulose, which is the most extensively available organic polymer. Lignocellulosic biomass is readily available as a waste material with cost effectiveness. For these reasons, it is being considered as a genuine candidate for raw materials used to produce biofuels, commodity chemicals, and polymers that will provide significant economic value and also environment friendly. Biomass which comes from lignocellulose comprises lignin and polysaccharides such as cellulose, hemicellulose, pectin, ash, minerals, and salts. Lignocellolytic enzymes are biocatalysts involved in the breakdown of lignin and cellulosic materials into their components for further hydrolysis into useful products.

Methods: For the preliminary or the qualitative screening of the isolates, zone of hydrolysis was analyzed with Remazol brilliant blue (RBB) for laccase whereas Congo red was used for cellulase and xylanase. The enzymes were produced using submerged fermentation technology using basal media for laccase and cellulase with respective substrate guaiacol and carboxy methyl cellulose (CMC) as a main ingredient. The laccase activity was assayed at 37°C by using Guaiacol as a substrate whereas cellulase and xylanase activity was determined at 55°C using CMC and xylan as a substrate. Different parameters such as inoculum size, age, pH and incubation period were optimized using one variable at a time approach.

Results: The qualitative screening was done on the basis of zone of hydrolysis. Total 6 potential isolates were selected on the basis of zone of hydrolysis 2 for each of laccase, cellulase and xylanase. The following strains; LS-1 and LA-2 for laccase, CL-3 and CL-4 for cellulase and XHS-22 and XHS-32 for xylanase have been selected for optimization of enzyme productions. The effect of age on inoculum was studied by inoculating with 1 % inoculum of 6 to 42 h old culture of selected strains and found maximum activity for LS-1, LA-2, CL-3 XHS-22 at 18h and for CL-4 and XHS-

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32 at 24 h old inoculum. The effect of age on inoculum was studied by inoculating with 1 % inoculum of 6 to 42 h old culture of selected strains and found maximum activity for LS-1, LA-2, CL-3 XHS-22 at 18h and for CL-4 and XHS-32 at 24 h old inoculum. Enzyme production was highest when 1% of inoculums were used for LA-2, CL-3, CL-4, XHS-22 and 1.5% of inoculums for LA-1 and XHS-32. The effect of varying pH from 3 to 11 was also studied on production of Laccase, xylanase and cellulase. The effect of incubation period from 12 to 84 hours was studied on production of Laccase, xylanase and cellulase. The laccase (LS-1 and LA-2) and cellulase (CL-3 and CL-4) production was maximum after 72 h of incubation whereas, xylanase (XHS-22 and XHS-32) activity was found maximum after 48 h of incubation.

Conclusions: The following strains; LS-1 and LA-2 for laccase CL-3 and CL-4 for cellulase and XHS-22 and XHS-32 for xylanase had been screened and selected for optimization of enzyme productions. The highest enzyme activity was 6.6 (LS-1) and 7.8 U/mL (LA-2) for laccase, 6.9 (CL-3) and 7.5 U/mL (CL-4) for cellulase and 188.2 (XHS-22) and 176.4 IU/mL (XHS-32) was obtained for xylanase production, till up to the optimization work. The completed optimization of the fermentation leads to a substantial increase in the production of lignocellulolytic enzymes.

Key words: Laccase, Cellulase, Xylanase, Lignocellulolytic, Enzymes, Fermentation

Mining of putative biosynthetic gene clusters (BGCs) in halotolerant *Exiguobacterium profundum* PHM 11

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ABSTRACT

Purpose: Halotolerant bacteria produce a wide range of bioactive compounds with important applications in agriculture for abiotic stress amelioration and plant growth promotion. In this study we aim to mine the secondary metabolite biosynthetic gene clusters (BGCs) of recently identified halotolerant *Exiguobacterium profundum* PHM11.

Methods: The number and types of secondary metabolite BGCs in these sequences were identified by antiSMASH version 5.1.2 and the integrated ClusterFinder algorithm, an hidden Markov model based probabilistic algorithm was used to detect biosynthetic gene clusters (BGCs) like regions in genomes. Domain functions and genetic similarities with known BGCs in these gene clusters were further predicted and annotated using Protein-Protein BLAST and *Pfam* analyses.

Results: A total seventeen regions of BGCs were identified and having 514 genes which represent one-sixth of the genome belonging mainly to desmotamide, pseudaminic acid, dipeptide aldehydes and terpene biosynthetic pathways. Most of the BGCs (15) correspond to saccharide type, one BGC corresponds to each fatty acid and terpene biosynthesis. Region 1.2, 1.5, 1.6, 1.7, 1.9 and 1.14 belongs to most similar known clusters of desmotamide, capsular polysaccharides, O-antigen, emulsan, pseudaminic acid and dipeptide aldehydes, respectively. These all BGCs comprised approximately one sixth of the genome. The region 1.6 is the largest one with ~63 Kb having more than 157 genes which belongs to the o-antigen and polysaccharides production while region 1.1 is the smallest BGC with ~19 Kb nucleotides only having 19 genes in the cluster. The region 1.3, 1.9 and 1.14 represent the presence of the clusters of gene for the biosynthesis of desotamides, dipeptide aldehydes, polyketide and non-ribosomal peptide synthesis (NRPS).

Conclusions: We have exploited the antiSMASH to investigate the secondary metabolites pathways which identified the presence of the NPS, polyketide, dipeptide aldehydes, AMP and carotenoid biosynthesis. The AMPs might be providing superior competitiveness in the environment and make *E. profundum* PHM11 as a suitable candidate for plant growth promotion under salt stress.

Keywords: antiSMASH, *Exiguobacterium profundum*, biosynthetic gene clusters and polyketide.

Ecological Assessment of Land Use Patterns in Rajasthan: Beginning of 21st Century

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ABSTRACT

Purpose: The land is a key source of economic activity for individuals and societies. It is more inelastic in terms of supply. The utilisation of land is complex and a constantly changing process. The policy discussions and development planning must be based on a clear understanding of these dynamic processes. In this context, we intend to investigate (i) the temporal changes in different land-use classes; as well as (ii) the growth and dynamics of shifts between different land-use classes.

Methods: The present study was conducted in the state of Rajasthan, which was chosen on purpose. Based on time series data from 2000-01 to 2017-18, this study was conducted. The Land Use Dynamics Model, compound annual growth rate, and instability index were used to investigate the dynamics of land use.

Results: Over time, the percentage share of forest, land used for non-agricultural purposes, land under miscellaneous tree crops and groves, and net sown area grew, while the percentage share of barren and unculturable land, permanent grazing land, culturable wasteland, and fallow lands decreased. The forest, land under miscellaneous tree crops and groves, and net sown area showed significant and positive growth. However, barren and unculturable land, permanent pasture, culturable wasteland, old fallow land, and current fallow land experienced negative and significant growth. The land was shifted from the agricultural and ecological sectors to non-agricultural sector.

Conclusions: The massive land shifts occurred from the agricultural and ecological sectors to non-agricultural sector, which cause a concern for policymakers in the future. This cause can be addressed by using land for non-agricultural purposes vertically rather than horizontally to meet the growing need for urbanisation and industrialisation. The shifting trend in land from the ecological and agricultural sectors must be checked by formulating better land policies.

Key words: Growth, instability, ecological, non-agricultural, agricultural, net sown area.

Design and development of ohmic heating setup for food processing

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ABSTARCT

Purpose: Ohmic heating also known as joule heating, direct heating or resistance heating. It's an advanced, alternative and new innovative thermal heat treatment method in food processing. It is a technology where an alternating electric current pass through food conducting materials. The electric energy supplied to release within the food in the form of heat. Heat is generated very fast, owing to the electrical current within the food material. Therefore, ohmic heating reduces the time required for heating as compared to conventional heating.

Methods: The ohmic heating setup mainly comprised a heating chamber, power source, type of electrodes and distance between electrodes, auto cut-off temperature controller, volt-amp meter, control panel and stand. The circular shaped ohmic heating geometry was selected due to reduced in heating loss and convenient in operation taking into considerations. The distance between electrodes and optimization of time taken for reaching the desired temperature were considered as performance parameters.

Result.: Stainless steel material was selected for electrodes; 18 cm distance was optimized through all experiments and kept for designed purpose. The volume and capacity of ohmic heating chamber were calculated as 453 cm³ and 4.5 kg/hr respectively. The highest heat conversion efficiency was found to be 63.28 % for the developed ohmic heating setup

Conclusions: The designed laboratory scale ohmic heating setup showed an excellent performance during experiments. The ohmic heating is fast rising technology in the food processing sector. It permits for the best quality production in the food development sector.

Keywords: Ohmic heating, electrodes, heating rate, food processing

Weed management in yellow sarson under conservation agriculture based direct seeded rice - yellow sarson - greengram cropping system

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ABSTRACT

Purpose: Conservation agriculture (CA) is a viable alternate which is suitable for today's limited natural resources and changing climate. That's why it is becoming a common approach in rainfed areas for water and soil conservation. In CA, problem of weeds can be controlled by both manual weeding and/or by the use of herbicide. However, labour is becoming expensive and is rarely available at the critical time of weeding. To control weeds, herbicides are being extensively used in CA, but there is not a single herbicide that can be applied for several types of weeds present in agricultural fields. Hence, technique of integrated weed management is highly desirable to enhance sustainability of CA. Integrated approaches must be considered and optimized to have proper weed control in conservation agriculture. Keeping this in view, the present experiment was conducted to study the effect of tillage and weed management practices on weed growth and productivity of yellow sarson under conservation agriculture based DSR-yellow sarson-greengram cropping system.

Methods: A long term experiment on weed management in a conservation agriculture based direct seeded rice (DSR)-yellow sarson- greengram cropping system was initiated in 2015. The present experiment was conducted as 5th year cropping cycle during 2019-20 at Agriculture Farm, Visva-Bharati, Sriniketan, West Bengal. The experiment was laid out in a strip plot design with three replications. Four tillage practices comprising of conventional tillage (CT) (DSR) — CT (yellow sarson) — CT (greengram), CT (DSR) — zero tillage (ZT) (yellow sarson) — ZT (greengram), ZT (DSR) — ZT (yellow sarson) — ZT (greengram), ZT + residue (R) (DSR) — ZT + R (yellow sarson) — ZT + R (greengram) were allocated to the horizontal strip and three weed management practices, *viz.* recommended herbicides (RH) (pendimethalin at 1.0 kg/ha followed by bispyribac-sodium at 25 g/ha in direct-seeded rice, pendimethalin at 0.75 kg/ha each in yellow sarson and greengram), Recommended herbicides + hand weeding (HW) at 35 days after sowing (DAS), Unweeded control were assigned to the vertical strip.

Results: Results revealed that conservation tillage (i.e.zero tillage + residue) along with recommended herbicide (RH) (pendimethalin at 0.75 kg/ha)+ one hand weeding (HW) recorded the lowest values of total weed density and dry weight at 45 DAS. Conservation tillage (Zero tillage + residue) along with recommended herbicide (RH) (pendimethalin at 0.75 kg/ha) + one hand weeding (HW) also registered the highest value of seed yield of 1687 kg/ha in 2019-20. Conservation tillage *i.e* zero tillage along with residue retention resulted in 76.76% increase in yield of yellow sarson as compared to conventional tillage. It was also observed that seed yield of yellow sarson under unweeded control with conservation tillage was significantly higher than conventional tillage with recommended herbicide.

Conclusions: Thus, after 5th cycle of cropping it may be concluded that, conservation tillage with recommended herbicides alone in yellow sarson may be advocated for effective weed management, higher productivity of yellow sarson in conservation agriculture based direct seeded rice - yellow sarson - greengram cropping system in lateritic belt of West Bengal.

Key words: Yellow sarson, residue, conservation agriculture, weed management and pendimethalin

Cost-Effective Investigation of Milk Production of different dairy animals in Gujarat, India

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ABSTRACT

Purpose: Milk production is an integral part of farming system in India. Most of the milk producers in India are small and marginal, mainly consisting of 1-2 animals, due to which it is characterized by low input-low output system. The 20th Livestock census-2019 of India has placed total livestock population at 536.76 million, out of which, 26.9 million livestock population was in the state of Gujarat. Therefore, the present study was undertaken in the state of Gujarat which is the leading milk producer in the country with cooperative dairy sector well established, but growth in dairy is not uniform in all regions of the state. Keeping the above conditions in mind, it is essential to study the cost-effective investigation of milk production of cattle and buffalo milch animals sector in Gujarat.

Methods: Present study conducted to assessment the cost- benefit analysis of Milk Production by the milk producers were selected from four regions of the Gujarat state, i.e. North , South, West and East Gujarat and 120 Milk Producer Selected from selected region during 2017-18. The cost and returns analysis was carried out different variable like feed & fodder, veterinary labour charges and milk production.

Results: Out of 120 selected sample, around 55 per cent animals were milch animals, the highest share was of cross breed (78.6%), followed by buffaloes (58.6%) and cows (52.5 %).The species wise total cost of maintenance of a milch animal of cattle’s and buffalo was estimated to be Rs. 194.4 and 203.5 per animal per day but per litter buffalo milk of cost was lower than the cattle animals. The similar finding observed Meena *et.al.*,(2012), Sharma and Kalamkar, (2020). On an average, net return of about Rs. 45/- per buffalo animal per day was realized by the selected households as compared to Rs. 27.41 to 35.34/- per local and cross breed animal per day realized by the selected households. The net return realized by the buffalo category was higher by 60 per cent at overall level. The highest net return by selected households was recorded in case of buffaloes, followed by crossbred cows and lowest was in case of local cows due to most of have good buffalo breed Murrah and Bhadawari which have good quality of fat content. The similar results revealed by Gill and Singh (1986), Vashist and Katiha (1988), Shah *et.al.*(1996), Sharma and Kalamkar (2020). Low margins in case of local cattle and cross breed this is may be due to low milk productivity from milch cattle animals with low genetic potential, poor health, and feeding and husbandry practices low price offered by private agent/agency.

Conclusions: The net returns realised by the buffalo milch animals was higher than other dairy cattle’s. Livestock sector occupies a pivotal position in the Indian economy and its contribution to the agricultural sector is the highest, the plan investments made so far do not appear proportionate with its contribution and future potential for growth and development. This suggests that public investment in the livestock sector should be enhanced to help the smallholder livestock producer, which deprives their larger share of income from the livestock sector. The livestock services like artificial insemination/natural service, vaccination, de-worming, etc are time-sensitive and government institutions are not able to deliver in time due to financial as well as bureaucratic constraints. Therefore, there is a need to re-orient the government policy for delivery of livestock services and involve major stakeholder.

Key words: Buffalo, Cattle, Cost, Dairy, Milk, and Return,

Direct and residual effect of integrated nutrient management on pulse based intensive cropping system

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ABSTRACT

Purpose: Groundnut is a widely cultivated crop in north western zone of Tamil Nadu. Inclusion of pulses and millet in cropping system as intercrop or sequential crop by doing intensification provides nutritional security. For harnessing higher crop yield, adequate and balanced nutrition is a prerequisite. By assessing suitable crop productivity, profitability and soil fertility status a sustainable cropping system with efficient nutrient management technique was identified.

Methods: Field experiments were conducted during 2017-18 and 2018-19 on intensive groundnut based cropping system at farmer’s field of Dharmapuri located in Tamil Nadu. The experiment was set up in a randomized block design with four replication. During Kharif season, groundnut was intercropped with redgram which was followed by sorghum during rabi season and blackgram was sown during summer season. Recommended dose of fertilizers at different doses 100, 50 and 75 % was applied in all the season. Organic sources which include FYM at 12.5 t/ha and vermicompost at varying rate of 2.5, 5, 7.5 t/ha were applied to first season crop alone.

Results: In groundnut intercropped with redgram, growth, yield attributes, yield and total nutrient uptake were higher in vermicompost at 5 t/ha along with 100 per cent NPK fertilizer. Total nutrient uptake were also higher under this treatment. This might be due to better performance of growth attributes which led to maintain higher yield. This results were in conformity with the findings of Badole *et al.* (2003) is that integrated nutrient supply system significantly improved the nutrient uptake of groundnut compared to control.

With respect to sorghum, growth, yield attributes, yield and total nutrient uptake were higher with the application of 100 per cent NPK fertilizer when compared to 75 and 50 per cent NPK fertilizer. As sorghum is highly exhaustive crop and it requires more nutrients for proper growth and development. Reduction in fertilizer dose leads to have lesser yield. This was in concordance with the findings of Mishra *et al.* (2010) whereas sorghum recorded taller plants with RDF, which were on par with INM through FYM. There was a significant improvement in plant height with increasing levels of RDF and in the interactions. It might be due to the availability of nutrients at early crop growth stages and elongation of internodes of the sorghum stem.

Incase of blackgram, growth, yield attributes, yield and total nutrient uptake were higher with application of 100 per cent NPK fertilizer when compared to 75 and 50 per cent NPK fertilizer. Higher yield and yield attributes gained under the application of 100 per cent NPK fertilizer treatments. This might be due to crop requirement which might have been met out by nutrient provided to the soil and also favourable soil environment and nourishment for better plant growth which resulted in better vegetative growth in terms of plant height and total dry matter. Singh and Pareek (2003) reported that application of recommended dose of fertilizer significantly increased the plant height, branches per plant, number of nodules per plant and nodule weight/plant of mungbean over control.

Conclusions: An integrated supply of farm yard manure along with 100 per cent RDF leads to minimized use of chemical fertilizers to a greater extent without affecting the crop yield and conserved soil fertility status for succeeding crop.

Keywords: Nutrient management, Cropping system, pulse and groundnut.

Tree Diversity, Distribution and Biomass Carbon Stock Potential of a Riparian forest along Upper Narmada region of Madhya Pradesh.

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ABSTRACT

Purpose: Riparian areas are known as the three-dimensional ecotones and it is the transition zone between the terrestrial and aquatic ecosystems. A considerable amount of carbon dioxide is stored in natural ecosystems, especially forests, wetlands and peat lands which act as a vital buffer regulating the atmospheric level of carbon dioxides. The purpose of this paper was to study the phytosociology and carbon sequestration potential of riparian forest in Narmada river.

Methods: A riparian buffer of 100 m has been created on both sides of the Narmada River using GIS software and the riparian forests are divided into three classes according to the crown density of the forest i.e., very dense forest (VDF), moderately dense forest (MDF) and open forest (OF). Depending on the length of the forest at every 300 m a quadrat of 0.1 ha were laid out at each selected forest site for phytosociological analysis and to estimate the carbon stock in biomass.

Results: A total of 35 tree species belonging to 23 families were recorded from the three different classes of Riparian forest along the Narmada River. The species richness was highest at the MDF (29) followed by VDF (23) and OF (17). The total carbon stock is the sum of tree carbon stock and carbon stock in soil which is equal to 112.791 t/ha, 74.107 t/ha and 42.953 t/ha in DF MDF and OF respectively.

Conclusion: Our present study shows that Riparian forests along Narmada river have the greater potential for sequestering high amount of carbon from the atmosphere which will acts as an important source of climate change mitigation. Therefore, Riparian forest can play an important role in mitigating and adaptation of climate change.

Key words: Riparian forests, riparian buffer, species richness, carbon stock, IVI, very dense forest (VDF), moderately dense forest (MDF), open forest (OF) etc.

Dairy Value Chains in India: A brief review

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ABSTRACT

The share of livestock in Indian agricultural sector GDP growth has been increasing faster than the crop sector due to rising demand for livestock products propelled by income and population growth. Since livestock products are more perishable, efficient value chains, which require immediate transportation from farm to consumption centers, storage or processing units is of prime importance. The livestock value chain includes the full range of activities to bring a product (e.g. live animal, meat, milk, egg, day old chick, feed, medicine, leather, fiber, manure) to final consumers passing through the different phases of production, processing and delivery. Therefore, Value chain analysis serves as guide to understand the markets, their relationships, the participation of different actors, and the critical constraints that limit the growth of livestock production and consequently the competitiveness of farmers. The present study is an attempt to analyze the type and structure of dairy value chains based on the literature available.

The Indian Dairy Sector

Dairy development has assumed significant importance in the rural economy of India due to its immense potential for supplementing income and employment generation for the rural people. India accounts for 56 per cent of world's buffalo population (9.8 crore buffaloes) and 14 per cent of total cattle population (18.5 crore cattle) (GoI, 2006; Gupta, 2007). India ranks first in the world in milk production, which has risen from 17 million tonnes (Mt) in 1950-51 to about

198.4 million tonnes by 2019-20 (Economic Survey, 2020). Whereas world’s milk production is increasing at the rate of 1-1.5 per cent per annum, in India, it is increasing at the rate of 5 per cent. Consequently, the per capita availability of milk has also increased from 124 grams/day in 1950-51 to 394 grams/day in 2018-19 (DHAD&F, 2020).

Typical Dairy Value Chain in India:

Dairy value chain map of India suggests that about 40 per cent of the produced milk is retained for home consumption, while 60 per cent is of which 36 percent through informal chains and 24 percent through formal chains managed by cooperatives, the private sector, and government organizations, is disposed off to various agencies (Gupta, 2007, World Bank 2010). Informal and semi-formal chains are generally short and primarily serve local markets, while formal chains are longer and link producers with local and distant consumers. Most common value chain through which milk flows is from producers through processing and value addition to consumers (Singh, 2012).

It is broadly estimated that over 50 percent of milk production is consumed as fluid milk, about 25-percent is converted into butter or ghee (clarified melted butter), 10 percent into milk powder, seven percent into paneer (cottage cheese) and other cheeses. The rest goes to other dairy based products such as dahi (yogurt), sweet meals, and ice cream (Gandhi and Zhou, 2008). Mohapatra 2020, observed that the overall utilization of milk in the form of liquid milk and other milk products was 27.44 and 72.56 per cent of the average milk consumption by the farmer household, respectively in Haryana. Halwais utilized highest proportion i.e. 38.40 per cent of milk in paneer preparation, followed by ghee (21.60%).

Formal Versus Informal Dairy Value Chains in India

Kabir and Talukder (1999) examined the financial performance of small-scale dairy farms and observed significant increase in production of milk as well as in labor employment. **Babu and Verma, 2010 revealed that co-operative dairy plant in Tamil Nadu was more efficient in the manufacturing of toned milk, standardized milk, full cream milk and ghee, whereas the private dairy plant had an edge in manufacturing of butter and skimmed milk powder.** Bardhan *et al.*, 2012 informed that the farmers’ participation in formal milk marketing sector influenced their income significantly. Pica-Ciamarra, 2005 argued that the delivery of livestock products through informal markets tends to serve poor consumers, creating an even tighter focus on the poor and with potential multiplier effects for pro-poor development interventions. Kumar *et al.*, 2010 observed traditional milk marketing seemed to offer good opportunities for the small and resource-poor milk producers and traders and if the traditional milk sector is addressed in a constructive manner it will allow the informal players to improve their performance including quality control and integration with the emerging modern milk supply chains.

Furthermore, Shrivastava *et al.* 2010 demonstrated that the farmers could get better returns on developing value chain through a self-help group in the Seoni district of Madhya Pradesh. Singh, 2010 estimated the technical efficiency of dairy farming of members of a co-operative and non-members in Haryana. The mean technical efficiency level of dairy co-operative farmers were found considerably higher (79%) than of non-member dairy farmers (66%). Singh *et al.* 2010, argued different capacity building programmes like trainings, demonstrations, awareness generation, exposure visits, farmer scientists’ interactions on various aspects of livestock value chains would reinforce its fate.

Conclusions

Processing and market linkages are pre-requisites for value creation and addition. Above analysis shows that the integrated supply chain for liquid milk and other dairy products in cooperatives had certainly provided support and augmented the income of its members and also have added efficiency in the process. Small and resource poor farmers can only be protected from the market shocks, when they work collectively may be through SHGs or FPOs. Further to expand the market reach through exports, overall quality and safety standards in value chains need to be maintained. Hence, systematic capacity building trainings and awareness programme at regular intervals will strengthen the performance of dairy value chains.

To Assess the Efficiency of Seed Minikits of Pulses Program in Rajasthan

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ABSTRACT

Purpose: Pulses are an important commodity group of crops that provide high quality protein complementing cereal proteins for pre-dominantly substantial vegetarian population of the country (GOI, 2019). The production of pulses in India has been caught in the vicious cycle of low and uncertain yields, low per hectare returns resulting in farmers' least preference to grow pulses on irrigated and fertile parcel of land (farmers preferred to grow pulses on marginal lands with no use of production inputs), thereby leading to unstable and low yields (Joshi and Saxena, 2002; Lingareddy, 2015). Seed Mini-kits are meant for introduction and popularization of latest released /pre released varieties /hybrids not older than 10 years among the farmers free of cost. As the programme is under progress for last three to four years, it is required to see the various aspects of implementation of this programme. How efficiently the distribution of seeds is taking place? We need to check whether the scheme is relevant and useful from the view point of farmers. Therefore, keeping the importance in mind, the present study was undertaken to examine the need, application, pertinence and efficiency in distribution of seed minikits.

Methodology: The primary data were collected from the state of Rajasthan. For the selection of sample two districts were selected, one irrigated (Bundi) and one dryland (Nagar) based on highest seed minikits distributed during the reference period of 2017-18 and 2018-19 were selected. From selected district, a sample of 145 seed minikit beneficiary farmers and 80 control group pulse growing farmers were selected using random sampling method. Lentil seed minikits beneficiaries were selected from Bundi district and Mung beneficiaries were selected from Nagar district. The first section gathered information on household characteristics and other demographics, while the second section collected cost and return data associated with Seed Minikit of pulses production during the 2018/2019 cropping year. The cost and returns analysis was carried out by use of different variable like land preparation, seed, fertilizer & manure, irrigation, pesticides, harvesting, labour, main product and by-product.

Results: At overall level, about 49 per cent households were from other backward classes group followed by about 38 per cent from SC, about 10 percent from ST and rest were from open category. Majority of households have agriculture as a main occupation while agriculture labour and allied was subsidiary occupation. Around one third of the total household respondents were educated mostly up to the SSC level. This indicates the lower education status of the respondents in Rajasthan in general, women in particular. The per quintal cost of production of kharif crops (mung) was estimated lower in case of beneficiary farmers (Rs. 3382 per quintal) than non-beneficiary farmers while opposite picture was estimated in case of rabi crops (lentil). Thus, on an average, selected farmers have realised the net return of Rs. 9000-10000 per acre in cultivation of pulse crops. All sample household opined that seed distribution programme is advantageous and noted the yield and quality difference in same. However, all of them were also opined that seed distributed was insufficient and at least seed should cover 0.32 ha (0.79 acre) area compared to 0.2 ha (0.49 acre) under present scheme.

Conclusion and policy Recommendation: The cost of cultivation per acre of beneficiary households was estimated to be lower than the non-beneficiary households, must be because of lower cost of seed to some extent (due to partial share of seed minikit). While net returns per acre was reported higher in beneficiary group in cultivation of green

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gram only. Higher seed share in cost of cultivation was reported by non- beneficiary households than its counterpart. All sample household opined that seed distribution programme is advantageous and noted the yield and quality difference in same. The major problems faced by farmers in availing the seed minikit were less supply of seed minikit was the major problem faced by the selected farmers. The policy implications emerged out of the study is as follows (1)The government should ensure timely availability of adequate quantity of quality seed by taking into account the actual requirement of seed in particular area.(2) Bottom-up approach should be used in implementation of the scheme. (3)Demonstration should be given before distributing the Seed minikit (4) State Agriculture Universities should try to develop the seed varieties suitable to local conditions.

Keyword: Dryland, Irrigated, Pulses, Seed Minikits, Productivity

Eco – dyeing cotton with herbal dye extract

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Purpose; Worldwide, growing consciousness about organic value of eco-friendly products has generated renewed interest of consumers towards use of textiles dyed with eco-friendly natural dyes. The use of natural products such as natural dyes for antimicrobial finishing of textiles materials has been widely reported. Many natural dyes obtained from various plants are known to have antimicrobial activities. Keeping these facts in view the present research was conducted to standardize a protocol for dyeing of cotton yarn with *tulasi* leaves dye extract and to know the effect of various mordants on the colour parameters of *tulasi* dyed cotton yarns.

Methods: Myrobolan was used as natural mordant for pre-treatment of cotton yarn. Metallic salts such as potash alum, copper sulphate, aluminium sulphate, lead acetate, ferrous sulphate, stannous chloride and zinc chloride were used for pre-mordanting. 1% myrobolan, 1% mordant concentration and 2% dye concentration was optimized for dyeing cotton yarn with *tulasi* dye extract and analysed for colorfastness properties and colour strengths (K/S) of the dyed yarn were evaluated.

Results: Significant difference in the colour strength values of the dyed samples was observed with the ferrous sulphate (251.84) as compared to the other mordants. Lightfastness of the samples mordanted with stannous chloride and Aluminium acetate was moderate. Perspiration fastness of PA and CS mordanted samples was good to both acidic and alkaline medium. However, FS mordant showed good fastness to alkaline perspiration and ZC, SC and LA mordants showed good fastness to acidic perspiration. It is possible to obtain diversified shades varying from yellowish green to green shades using potash alum, copper sulphate, potassium dichromate, ferrous sulphate with *tulsi* dye extract.

Conclusion: The rapid growth in technical textiles and their end-uses has generated many opportunities for the application of such innovative eco-friendly finishes on textiles. Naturopathy, ayurveda, yogic science, herbal treatments, eco products are now popular for maintaining good health. Eco-friendly biodegradable sources for textile finishing are the need of the present day that not only upkeeps health of an individual but also saves the environment.

Keywords: Cotton, Colourfastness, Dyeing, Environment, Mordants, *Tulasi*,

Impact of processing methods on lipid oxidation of normal and high oleic peanut genotypes Hemalatha S¹., Dileepa K C¹. And Kavera Biradar²

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ABSTARCT

Purpose: Peanut (*Arachis hypogaea*) is one of the most important oilseed crop in India. Groundnuts have good amount of proteins (25-28%) and lipids (50-55%). Due to their high oil content, they are susceptible to developing rancidity and off-flavors through lipid oxidation. Recently, several attempts have been made to produce new cultivars with improved physio-chemical properties (Jonjala *et al.*, 2005). Normal groundnuts have 40-50 per cent oleic acid and 30-40 per cent of linoleic acid, whereas peanuts with high oleic to linoleic acid ratio (O/L) have been released for better oil stability and nutritional quality. Dh-245 is one of the prominent high oleic genotypes developed by UAS, Dharwad through mutation breeding. In this study the high oleic peanut genotype (HOP), Dh-245 and normal peanut genotype (NP), GPBD-4 were compared for oxidative stability upon storage and effect of processing methods on quality deterioration.

Materials and Methods: The high oleic peanut genotype (HOP), Dh-245 and normal peanut genotype (NP), GPBD-4 were procured and shells were removed using manual groundnut decorticator. The initial parameters i.e. Moisture content (MC), Fat content (FC), Ash content were determined using the Association of Official Analytical Chemists guidelines (Anon., 2005). The weight of 100 representative kernels from each accession was recorded as test weight in grams. The peanut kernels were subjected to skin colour assessment in Premier Color scan Spectrophotometer Model No. SS5100A. The kernels of both the genotypes were subjected to different processing treatments like roasting, deep fat frying, boiling and soaking. The time and temperature combinations were selected based on sensory evaluation i.e. Roasting: 120-130° C for 10 min; Deep fat frying: 160 °C for 1 min; Boiling: 100 ° C for 30 min; Soaking: 10 hrs at room temperature and control without any treatment. Changes in the fatty acid profile by HPLC, free fatty acid and per oxide value were studied using AOAC protocols (Anon, 1993).

Results and discussion ; The moisture, fat and ash content of raw peanuts were found to be 4.0, 45 and 3.1 g/100g in Dh-245 and 3.7, 44.3 and 2.3 g/100g in GPBD-4. The 100 kernel weight was 33.50 g (Dh-245) and 41.00 g (GPBD-4). The fatty acid profile of Dh-245 was observed to be, palmitic acid (8.58%), oleic acid (58.10%) and linoleic acid (21.54%) of the total fatty acid profile. Where as in the GPBD-4, palmitic acid (9.86%), oleic acid (49.73%) and linoleic acid (28.54%) of the total fatty acid profile.

The roasted peanuts had higher peroxide value and free fatty acids followed by fried peanuts and boiled peanuts. The values of soaked peanuts was almost near to the control. GPBD-4 had highest PV (5.70 meq O₂/kg) and FFA (0.75%) in roasted peanuts compared to Dh-245 (PV-3.63 meq O₂/kg and FFA- 0.63%). Exposure of fats and oils to elevated temperatures results in a series of reactions including thermolysis, oxidation, polymerization and auto-oxidation. Volatiles such as aldehydes, ketones, hydrocarbons, alcohols and esters are produced from decomposition of hydroperoxides. Many non-volatile polar compounds, triacylglycerol dimmers and polymers are produced by radical reaction (Kim *et al.* 1999).

The oleic: linoleic ratio and per cent saturation increased in all the treatments with highest value in roasted peanuts followed by fried peanuts, boiled peanuts and soaked peanuts respectively. In case of unsaturated : saturated ratio, roasted peanuts had the lowest value. So it is clear that the processing treatments affect the fatty acid profile and the effect was more pronounced in case of roasting treatment with 120-130° C for 10 min followed by frying (160°C for 2 min), boiling (100°C for 20 min). Soaking treatment had less effect on the alteration of fatty acid profile of peanuts in both the varieties. In both the varieties similar trend was observed and the range of O/L ratio was 2.70 to 3.04 in Dh-245 variety which was high compared to O/L ratio of GPBD-4 variety i.e. 1.74 to 1.95. The highest O/L ratios are associated with longer shelf life and the Dh245 variety was predicted to have longer shelf life compared to GPBD-4.

Conclusion: This study revealed that the high oleic peanut variety Dh-245 had good oxidative stability than conventional GPBD-4 variety after different thermal processing treatments. The processing treatments have their effects on oxidation of peanut kernels and it depends on temperature and duration of treatments. High temperature results in faster degradation. So from commercial point of view high oleic peanut oil can be used for fried products such as potato chips, french fries etc. to increase their shelf life and to improve oxidative quality.

Effect of foliar application of micronutrients on yield and quality traits of cherry tomato (*Solanum lycopersicum* var. *cerasiforme*) under protected condition

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ABSTRACT

Purpose: The small round tomato having a varied size from a thumb tip to a golf ball is known as a cherry tomato. Cherry tomatoes belongs to the family Solanaceae having $2n=24$ chromosome number and are the direct ancestors of modern tomatoes and a wild cultivar in the Andean regions of South America. While tomato production is high in the Indian plains, it is decreased to a greater extent due to higher summer and early Kharif temperatures, which require exploration for advanced safe cultivation such as polyhouse cultivation and shade net. Micronutrients are critical in the development of high-quality cherry tomatoes and increasing the production. Some micronutrients, such as zinc, boron and copper can boost tomato production and quality. Keeping a sufficient amount of nutrients in the soil or by foliar spray can improve tomato quality and yield potential. Foliar application of micronutrients shows better efficiency than soil application as the latter method takes more time. Higher fruit setting by foliar supplementation of secondary and micro nutrients can be obtained which may attribute the supply of nutrients at critical stage such as flowering and fruit set. Therefore, this research was conducted to find out the effect of Copper, Boron, Zinc, Magnesium and Ferrous as foliar application on the yield and quality traits of cherry tomato.

Methods: The experiment was conducted at Vegetable Research Farm and Laboratory of Department of Horticulture, Khalsa College, Amritsar. The cultivar Punjab Red Cherry comprised the plant material for investigation. The study was conducted in Spring-summer season, 2021. The experiment was laid out in Randomized Block Design consisting of seven treatments T₁ (100 ppm CuSO₄), T₂ (100 ppm Borax), T₃ (100 ppm ZnSO₄), T₄ (100 ppm MgSO₄), T₅ (100 ppm FeSO₄), T₆ (Mixture of all micronutrients @ 100 ppm each) and T₇ (Control) each with three replications. The data were recorded on various yield and quality parameters namely minimum days to harvest, maximum number of fruits per cluster, number of fruits per plant, average fruit weight, yield (kg) per plant, total yield (q/ha), ascorbic acid (mg/100 g), TSS (°Brix), Juice content (%) and acidity content (%). The mean data was statistically analyzed according to ANOVA techniques of Panse and Sukhatme, 1985.

Results: The result of the experiment stated that the treatment having combination of all micronutrients at the rate of 100 ppm each outperformed the other treatments in terms of yield and quality of the cherry tomato and gave the minimum days to harvest, maximum number of fruits per cluster, greater number of fruits per plant, highest average fruit weight, optimum fruit yield per plant and fruit yield per hectare. Similarly, in quality traits, ascorbic acid (mg/100 g), TSS (°Brix), juice content (%) and acidity content (%) were observed to be highest in mixture of all the micronutrients of 100 ppm dose.

Conclusion : The combined application of 100 ppm Copper sulphate, 100 ppm Borax, 100 ppm Zinc sulphate, 100 ppm Magnesium sulphate and 100 ppm Ferrous sulphate proved to be most effective in increasing the production of cherry tomato. Foliar application of mixture of all the micronutrients increased the yield characters of cherry tomato. This increase in output is also a contribution of foliar spray of micronutrients, as direct application to the leaves helped in easy absorption through the leaves, which meet the cherry tomato plant's ideal nutritional needs. Moreover, better quality fruits were produced from the plots which were treated with mixture of all the micronutrients. Therefore from the present investigation, the foliar application of combined mixture of micronutrients was witnessed to be the best approach for obtaining maximum yield and remarkable quality traits of cherry tomato under protected condition.

Green Dyes from Teak leaves – Initiatives towards Environmental Sustainability

Jyoti V.Vastrad

ABSTRACT

Purpose : Conservation of ecology is of utmost importance while thinking of eco-friendly end uses. Textile dyeing and colouration is one of the emerging fields that have an additional advantage of antimicrobial activity along with UV protection. For successful commercial use of natural dyes, the appropriate and standardized dyeing techniques need to be adopted without sacrificing required quality of dyed textile materials. The present research was carried out to characterize teak leaves dye extract, optimization of dyeing process, analysis of colourfastness properties and colour strength of dyed cotton fabric.

Method: Teak leaves were collected from the forest of Yallapur Taluk for dyeing process. Grey cotton 2/60 yarn and chemicals were procured from local market. Dried teak leaves were powdered in a laboratory blender, packed and refrigerated. Cotton yarn was desized and pre treated with 2 percent myrobolan, pomegranate and tamarind powders respectively and mordanted with Aluminium Acetate, Lead Acetate, Ferrous Sulphate, Copper sulphate, Stannous Chloride and dyeing was carried out and the colorfastness properties, dye absorbance (%) and colour strengths (K/S) of the dyed yarn were evaluated.

Results: Quantitative analysis of dried teak leaves dye extract exhibited Total Phenolic Content (52.50mg/g) and Total Flavonoid content (124.12mg/g) was found to be higher in 50% ethyl alcohol. The light fastness of the dyed samples pre-treated with 2 per cent myrobolan, pomegranate and tamarind showed better fastness (5) on mordanting with ferrous sulphate and stannous chloride and very good fastness (4/5) with other mordants. Irrespective of pre-treatments and mordants, the colour fastness to washing, rubbing and perspiration of teak dyed samples ranged between moderate to better ratings.

Conclusion: There is a need to commercialize natural dye not only to protect the ancient and traditional folklore but also to save and protect the ecology.

Keywords: Cotton, Colourfastness, Extract, Mordant, Teak, Treatment, Yarn

***In silico* comparison of genome of aquatic and fish pathogenic *Flavobacterium* spp.**

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ABSTRACT

Purpose: The genus *Flavobacterium* is a pigmented, Gram -ve bacteria consisting about 130 species reported from aquatic and terrestrial habitats. Many of the species are reported as fish pathogen including *F. psychrophilum*, *F. columnare*, and *F. branchiophilum*, which can cause severe fish diseases called "cold water disease" (CWD) in freshwater aquaculture with a global distribution. In this study we aim to compare the genome of 6 *Flavobacterium* sp isolated from different habitat.

Methods: A comparison of the genome of six pathogenic *Flavobacterium* species viz: *F. indicum* GPTSA100-9, *Flavobacterium* (*F. album* HYN0059, *F. branchiophilum* FL-15, *F. columnare* Pf1, *F. crassostreae* LPB0076, and *F. psychrophilum* FPG3) from different geo-locations was done using publically available genome data. The genome statistics and annotation were performed by using IMG/M server (<https://img.jgi.doe.gov/cgi-bin/m/main.cgi>). The possible genomic similarities and distances were predicted using EDGAR and GGD calculator.

Results: Among these six genome, the genome size varied from 2.71 Mb to 3.98 Mb. *F. psychrophilum* FPG3 has the smallest genome (2.71 Mb) followed by *F. indicum* GPTSA100-9 (2.99 Mb). The functional annotation and phylogenetic studies based on orthology revealed that 51-60% genes are orthologous whereas, the paralogs ranged between 5 to 15% of the total genes. The DDH, AAI, ANI and POCP results indicate that these species are distinct and different, further on the basis of Pan and Core Genome analysis, 41% genes were recorded to contribute to core

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genome of *Flavobacterium*. Analysis of the core genome showed that the number of shared genes decreased with the addition of each new genome. The average gene content in six genomes are 2934 whereas, the core genome was estimated to contain 1210 genes, which is corresponding to the 41 % of the genome and might remain relatively constant.

Conclusion: In conclusion, the comparative analysis exhibited that *Flavobacterium indicum* GPTSA100-9 is closely related to *F. branchiophilum* FL-15 on the basis of genome genome distance (GGD) and DDH and also the genome wise phylogeny also proof that they both are quite closer to each other. Thus, provides a convincing insight for the comparative genome information. **Keywords:** *Flavobacterium*, comparative genomics, DDH, GGD, Core Genome

Genetic variability studies in parthenocarpic cucumber

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ABSTRACT

Purpose: Cucumber is an important member of family Cucurbitaceae having chromosome number $2n = 14$. It is thermophilic and frost sensitive crop thriving best at temperature above 20°C. It is grown primarily in open environment and experiencing various problems viz., incidence of red pumpkin beetle and poor quality and bitter fruits. This makes imperative to establish cucumber under protected environment to protect the crop from harsh weather conditions in Punjab. Cucumber grown in protected structures is gynodioecious and seedless having high variability which is the basic material for any crop improvement programme. Knowledge about existence of genetic variability is the useful tool to carry out effective selection for improving yield. Correlation studies help for deciding which trait contribute towards yield positively or negatively. Heritability along with genetic advance help in determining the direction and magnitude of selection. Therefore, this study was carried out to estimate genetic variability, heritability, correlation and genetic advance as percent of mean of hybrids in relation to yield and yield associated traits and its selection in cucumber with the objective to find associations among different horticultural traits. The estimate of these parameters in controlled condition like protected structures is useful in formulating suitable selection strategy for higher yield in cucumber. The present investigation is taken to evaluate available cucumber hybrids for assessing genetic variability, heritability, correlation and genetic advance present in various growth and yield related traits.

Methods: The present study was conducted at research farm of Department of Vegetable Science, Khalsa College Amritsar. Ten parthenocarpic cucumber hybrids were raised in Randomized Block Design and replicated thrice. Observations were recorded for traits namely days to anthesis of first female flower, nodal position of first female flower, number of female flowers per node, days taken to first fruit harvest, fruit length, fruit girth, fruit weight, number of fruits per plant, marketable yield per plant, harvest duration, internodal length, vine length and total soluble solids. The coefficients of variation were determined as per Burton (1952). The heritability in broad sense and expected genetic advance expressed as percent of mean were calculated by using the formula given by Johnson *et al* (1955). The correlation coefficient among all possible trait association at phenotypic and genotypic level were given by Al-Jibouri *et al* (1958). Path coefficient analysis as suggested by Wright (1921) Dewey and Lu (1959).

Results: The results showed that PCV and GCV estimates were high to moderate for vine length and number of female flowers per node indicating presence of variability ensuring ample scope for improvement through selection. High heritability along with high genetic advance was recorded for internodal length, vine length, number of female flowers per node and total soluble solids indicated the importance of additive gene action for inheritance of these traits. Genotypic correlation was higher than phenotypic correlation indicating highly heritable nature of these characters. The path coefficient analysis revealed that the number of fruits per plant, fruit weight, days taken to first fruit harvest and nodal position of first female flower had direct positive phenotypic and genotypic effect on the yield.

Conclusion: In conclusion, the overall stable phenotypic performance of cucumber hybrids is a good indicator of optimum selection criteria for improvement in parthenocarpic & gynodioecious cucumber breeding in India. Therefore, direct selection on the basis of number of fruits per plant and fruit weight will be rewarding for crop improvement in parthenocarpic cucumber.

Key words: correlation coefficient, GCV, heritability, path analysis, PCV.

Effect of biochar application along with municipal solid waste on heavy metal availability and dry matter yield of spinach

M. Vassanda Coumar, R.S. Parihar, A.K. Dwivedi, J. K. Saha and A.K. Patra

ABSTRACT

Purpose: Biochar are known to have a highly porous structure, contain various functional groups which tends to have strong sorption affinity for organic compounds and also play an important role in controlling organic pollutants in the environment. The formation of surface functional groups and adsorption sites on biochar could influence its CEC and consequently the capacity of biochar amended soils to form complexes with metal ions. More recently, it was demonstrated that biochar was effective at reducing concentrations of Cd and Zn in soil pore water, reducing phytotoxicity to *Lolium perenne* L. However, there is clearly a paucity of data on impact of biochar on heavy metal mobility in soil and its uptake in crop plant. Keeping this in view, the study is conceived and conducted with the following objectives

Methods: Municipal solid waste compost was first mixed thoroughly with biochar at 2%, 5% and 10% level and then applied to the each pot of 5 kg soil according to the experimental design. Potted soils mixed with soil amendments was allowed to equilibrate for one week in moist condition prior to sowing of seeds. The recommended dose of N (75 kg N ha⁻¹), phosphorus (40 kg P₂O₅ ha⁻¹) and potash (40 kg K₂O ha⁻¹) were supplied in the form of urea and potassium chloride respectively. The entire dose of potash, phosphorus and half dose of N was applied basally while rest of N was top-dressed 20 days after sowing. Spinach crop was grown for 60 days and plants were harvested at two different stages, 1st leaf cutting at 30 days after sowing (DAS) and 2nd cutting at 60 DAS. During 2nd cutting, roots were also separately collected from the soil. Oven dry (at 65°C to constant weight) weights of shoots and roots were recorded.

Results: Application of municipal solid waste compost (MSWC) increased the dry matter yield of spinach leaf at both the harvest stage and root increased over control and found to be statistically significant only at the 2nd harvest stage. Further it was evident from the data that application of biochar at different rate (2%, 5% and 10% of MSWC) increased the dry matter yield of spinach leaf and root. The highest dry matter yield in both first and second harvest was recorded in the treatment where biochar was applied at 10% level along with MSWC. It was observed that considerable variation in nutrient content of spinach leaf was observed between the treatments. In the first harvest stage, leaf N content varied from 2.55% to 3.40%, P content from 0.20% to 0.42%, K content from 2.47% to 4.49% and S content from 0.66% to 1.09%, respectively. The nutrient concentration of spinach leaf at second harvest varied from 2.26% to 3.60% for N, 0.23% to 0.39% for P, 2.95% to 4.19% for K and 0.65% to 0.96% for S, respectively. There was slight increase in nutrient contents of leaf after application of MSWC but the significant difference was observed only for P and K in the 1st harvest stage and for P and S in the 2nd harvest stage over control. In general, even though application of biochar along with MSWC increased the nutrient contents of leaf over the application of MSWC alone, significant differences were observed only at highest biochar level (10%). The highest leaf nutrient concentration for N, P, K and S was 3.4%, 0.42%, 4.49% and 1.09% at first harvest and 3.6%, 0.39%, 4.19% and 0.96% at second harvest, respectively when biochar was applied at 10% level along with MSWC@ 5g kg⁻¹. With the application of municipal solid waste compost (MSWC), heavy metal content (Cu, Cd, Pb, Cr and Ni) in spinach leaf and root was increased over control. Irrespective of the biochar level (2%, 5% and 10%), the heavy metal content in spinach leaf and root was decreased over the application of MSWC alone. With increasing rate of biochar addition, the heavy metal content at both the harvest stage of spinach leaf and root was also reduced and found to be lowest in the treatment where MSWC was applied along with biochar at 10% level.

Conclusions: Municipal solid waste compost (MSWC) increased soil nutrient status with simultaneously increasing the heavy metal mobility in soil and its uptake by spinach. Biochar application along with MSWC substantially reduced heavy metal mobility and its uptake by spinach.

Key words: Municipal solid waste compost (MSWC), Biochar, Spinach

Evaluation of pre reported strains for xylooligosaccharides production and their optimization for efficient xylanase production using different agro-residues

Kajal Kumari*, Sakshi Goyal, Sushil Nagar

ABSTRACT

Purpose: Xylooligosaccharides (XOS) are the mixtures of oligosaccharides containing β -1, 4 linked xylose residues produced from xylan rich lignocellulosic materials (LCM) by various methods such as autohydrolysis, chemical treatment, and enzymatic hydrolysis. The number of xylose residue in XOS vary from 2 -10 such as xylobiose, xylotriose, xylotetrose, xylopentose and so on. Xylanase (endo- β -1, 4 xylanase) is the enzyme that catalyzes the hydrolysis of xylan by cleaving the glycosidic bond in order to produce value added products such as xylooligosaccharides. Xylanase have been reported from various bacteria, fungi, actinomycetes and yeast. Agricultural waste (sugarcane bagasse, corn stalks, corn cob, green coconut husk, cereal straw etc.), plant biomass and materials from crops, which are rich in cellulose, hemicelluloses and lignin that can be used for a number of applications like fuel production, energy production, paper industry and using them as fermentable sugars for growing probiotics bacteria. Prebiotics such as XOS can serve as the fuel for probiotics, nourish them and encourage them to function more efficiently. We aim to identify and characterize, efficient xylanase producing strains from selected strains of microorganisms for XOS production over different agricultural wastes.

Methods: Different microbial strains (*A. terreus*, *A. foetidus*, *B. halodurans*, *Cellulosimicrobium spp.*) were procured from microbial type culture collection (MTCC) and *B. pumilus* SV85S, *B. pumilus* SV205 were obtained from the working lab. The obtained lyophilized cultures were revived on broth medium and further seed cultures were prepared. Xylanase production was screened on the production media according to particular strain through submerged fermentation (SmF) using different agricultural wastes (wheat bran, rice bran, coconut husk, sugarcane bagasse, corn cob, rice husk) and xylanase activity was assayed according to dinitrosalicylic acid method (DNSA). Xylanase production optimization was done for various production media parameters such as inoculum age (6 to 42 h), inoculum size (1-5 %), incubation time (12 to 96 h) etc. The fermentation media was filtered through muslin cloth and the crude xylanase extracted through centrifugation at 10000 rpm for 20 min. at 4 °C. The crude xylanase characterized for optimum pH and optimum temperature.

Results: Revival of the bacterial cultures for 24 h was done in nutrient broth while fungal cultures revived up to 5 days in potato dextrose broth medium. Seed culture for every strain was prepared up to seven stages after that the purity of the seed cultures were examined on the agar plates (nutrient agar used for bacterial culture while potato dextrose agar preferred for fungal cultures). Further the production media (modified Horikoshi Medium for bacterial culture and Mandels and Sternburg’s basal medium for fungus culture) was inoculated with 1 % of the seed culture and kept for fermentation at 37° C, 150 rpm for 48 h. All the microbial cultures used in the study showed xylanase activity with different extent on the basis of agricultural waste used during fermentation. Screening was done on the basis of xylanase activity assay of all the strains. Further *B. pumilus* SV85S, *B. pumilus* SV205 were selected for their capacity of highest xylanase production by the use of wheat bran as a substrate. Maximum xylanase production was achieved at 4 % inoculum size, 48 h of incubation of 18 h old inoculum for *B. pumilus* SV85S. Similarly *B. pumilus* SV205 showed maximum xylanase activity at 2 % inoculum size, 48 h of incubation of 24 h grown old inoculum. The crude xylanase from both the strains *B. pumilus* SV85S, *B. pumilus* SV205 was characterized and found that the optimum pH and temperature were 6.5pH and 65 °C respectively. The selected strains and agro residue will be further optimized for XOS production.

Conclusions: These xylanase producing microbial strains can be further used for xylooligosaccharides (prebiotic) production, characterization and prebiotic testing thus a value addition to pharma industry. Xylooligosaccharide production represents an addition to the economic value as an increase in food production without increase of the agricultural areas as their production from agro-industrial residues.

Key words: Xylanase, MTCC, Xylooligosaccharides, DNSA, Submerged fermentation

Health risk assessment of heavy metals due to wheat, cabbage, and spinach consumption at cold-arid high-altitude region

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ABSTRACT

Purpose: Soil, water from the trans-Himalayan high-altitude region contains high concentrations of various heavy metals. Vegetables and cereals such as cabbage, spinach, and wheat are most prone to heavy metal accumulation from soil and water which can be toxic for human consumption. It has yet to be studied how consumption of vegetables and cereals with excess heavy metal content can affect human health in high altitude areas. To this end, the objectives of this study are (a) quantify the concentrations of Aluminum (Al), Iron (Fe), Cobalt (Co), Boron (B), Lead (Pb), Arsenic (As), Cadmium (Cd), Selenium (Se), Copper (Cu), and Zinc (Zn) in wheat, cabbage, and spinach, and (b) evaluate the health risk of excess dietary heavy metal consumption in the local adult population using non-carcinogenic and carcinogenic parameters.

Methods: A total of 210 vegetable samples (7 villages x 10 number of samples from each village x 3 variety of plants) were collected and analyzed by Inductively Coupled Plasma - Optical Emission Spectrometry (ICP-OES).

Results: Results found that spinach has a high mineral content than wheat and cabbage. The Estimated Daily Index (EDI) of each metal in each vegetable was less than the limit of permissible value. The hazard index (HI) of wheat, spinach, cabbage, and target hazard quotient (THQ) were less than the threshold level (<1). The carcinogenic risk (CR) value in all the vegetables was less than the maximum threshold level (1×10^{-4}).

Conclusion: These findings suggest that consumption of wheat, spinach, and cabbage does not have any significant effect on human health due to presence of elevated heavy metals at this high altitude region.

Keywords: Carcinogenic risk; Estimated daily index; Hazard index; Inductively Coupled Plasma - Optical Emission Spectrometry; Vegetable

Genomics-assisted introgression of novel combination of *opaque2* and *opaque16* genes and development of lysine and tryptophan rich biofortified maize

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ABSTRACT

Purpose: Globally 2.37 billion people are affected due to malnutrition. Among all nutrients, protein malnutrition causes the highest number of deaths worldwide. Maize endosperm protein possesses low level lysine (0.200%) and tryptophan (0.040%). Though recessive *opaque2* (*o2*)-based quality protein maize (QPM) maize provides higher amount of lysine and tryptophan, it can not meet the human requirement. A novel combination of *o2* and *opaque16* (*o16*) genes further enhance lysine and tryptophan. So far, no maize hybrid with *o2* and *o16* genes has been released for commercial cultivation. Here, we developed elite inbreds by introgressing *o2* and *o16* genes through genomics-assisted breeding. These inbreds have been used to develop biofortified hybrids with higher nutritional quality.

Methods: Marker-assisted backcross breeding strategy was utilized for the introgression of *o2* and *o16* genes into seven elite maize inbreds. These *o2o2/o16o16*-based inbreds were crossed in a half-diallel mating design and resulting 21 experimental hybrids along with the four *o2*-based popular QPM hybrids were evaluated at multiple geographical locations. Lysine and tryptophan concentrations are estimated using UHPLC.

Results: The *o2* gene-specific SSR markers (*umc1066* and *phi057*) and *o16* linked SSR markers (*umc1149* and *umc1141*) were successfully deployed for foreground selection in BC₁F₁, BC₂F₁ and BC₂F₂ populations. Use of >100 SSR markers led to >90% recovery of the recurrent parent genome. The concentration of lysine and tryptophan among

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the *o2o2/o16o16*-based inbreds varied between 0.410-0.560% and 0.090-0.149%, respectively. The promising experimental *o2o2/o16o16*-based hybrids accumulated significantly higher concentration of lysine (>0.500%) and tryptophan (>0.125%) compared to *o2o2*-based commercial checks (lysine: 0.346%, tryptophan: 0.086%). These promising hybrids possessed >7500 kg/ha grain yield. The promising hybrids also possessed desirable agronomic characters.

Conclusions: Combinations of *o2* and *o16* genes significantly enhanced the nutritional content of maize hybrids over *o2*-based QPM hybrids. These newly developed biofortified hybrids with novel combination of *o2* and *o16* provide sustainable and cost-effective solution to alleviate protein malnutrition.

Key words: QPM, *opaque2*, *opaque16*, MAS, combining ability analysis, maize

Knowledge scale to define students ‘knowledge about environment, recycling, plastic, and plastic waste’

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ABSTRACT

Purpose: The environment is becoming a widely debated topic in our everyday lives. All life on Earth is linked with its surroundings, from the tiniest microbes to the greatest creatures. Humans are part of nature, and their survival is dependent on healthy ecosystems. At the same time, human activities harm the health of the environment for current and future generations as a result of pollution, climate change, and disasters. The purpose of study to develop the knowledge scale to define the students "knowledge about the environment, recycling, plastic and plastic waste" and to assess the knowledge level of the students about the environment, recycling, plastic and plastic waste.

Methods: The present study was carried out in Uttarakhand at Udham Singh Nagar district. Purposive and random sampling technique was used and point-biserial correlation coefficient used as a index of item discrimination, and reliability was measured using the split-half method.

Results: The reliability of the test was calculated by the Spearman-Brown formula. The reliability coefficient of the scale was 0.841 found to be highly significant

Conclusions: The developed knowledge test was found to be valid and a reliable tool that could be used for assessing the knowledge level of students about the environment, recycling, plastic and plastic waste. Further, specific findings of this knowledge test revealed that the majority of respondents possessed a moderate level of knowledge about the environment, recycling, plastic and plastic waste.

Key words: Reliability, point-biserial, random sampling

Behaviour assessment of covid recovered patients towards accurate diagnosis and effective treatment

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ABSTRACT

Purpose: COVID-19 has become a global pandemic by infecting people from almost all over the world. The behaviour of the general public will probably have an important bearing on the progression of the coronavirus pandemic and human behaviour can be influenced by people's knowledge and perceptions of the covid 19 pandemic. As the current focus of most of the researches revolves around the diagnosis, and treatment of the disease. The study attempted to develop a scale and measure behaviour assessment of covid recovered patients towards accurate diagnosis and effective treatment.

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Methods: The area selected to conduct the study is the Kurnool district of Andhra Pradesh. A random sampling method was adopted to select the the sample. The different steps that were followed to develop the scale include Item construction, Content Validity, Pre-testing the scale ,Scaling method ,Item analysis and selecting the items, Item Discrimination value,Reliability of scale.

The final developed scale was administered on the random sample of covid recovered patients.The Likert 5 point format was used to indicate the respondent's degree of agreement with a particular item with scores 5,4,3,2 and 1 for Strongly Agree, Agree, Neutral, Disagree and Strongly disagree. Frequency, Percentages, mean and SD were calculated for each statement related to behavior assessment of covid recovered patients.

Results: The reliability of the test was calculated by the Spearman-Brown formula (0.75) which indicate adequate reliability. The reliability coefficient of the scale was 0.841 found to be highly significant. The reliability was found by calculating the Karl Pearson correlation coefficient to know the correlation between two halves of split half method and the correlation value was found(0.68) which is significant.Most of the respondents positively expressed ‘strongly agree’ and ‘agree ‘ towards the symptoms, transmission, diagnosis and treatment of covid 19.

Conclusion: The scale developed to know the behaviour assessment covid recovered patients towards accurate diagnosis and effective treatment was found adequate reliability and validity to conduct and evaluate the study. After administering the scale to covid recovered patients, maximum patients in the study exhibited a high level(97 %) of behaviour assessment towards diagnosis and treatment thus denoting the good knowledge and awareness about the diagnosis and treatment they have undergone.

Key words: Behaviour assessment, Covid recovered patients, diagnosis and treatment

Assessment of attitude of teachers towards online education

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ABSTRACT

Purpose: Online education is electronically supported learning that relies on the Internet for professor, teacher or student interaction and easy distribution of study materials. With online teaching, students can turn anywhere with Internet access and electricity into a classroom. It can include audio, video, text, animations, virtual training environments and live chats with teachers and professors. The objective of the study was to develop the attitude scale to define attitude of teachers towards online education and to assess the attitude of teachers towards online education.

Methods: The present study was carried out in Udham Singh Nagar district of Uttarakhand. Purposive sampling technique was used to select the study area. The reliability of the tool was found by calculating the correlation coefficient of scores respondents by Split-Half method. The discrimination index was calculated for item analysis. The Spearman Brown formula used for calculating are reliability.

Results: The Spearman Brown formula used for calculating reliability of the attitude scale. Reliability of the attitude scale was calculated as 0.959667 which indicates excellent reliability.

Conclusions: It was concluded from the above findings that the developed attitude scale was found to be valid and reliable tool that could be used for assessing the attitude of individuals towards online education.

The data pertaining to extent of attitude of teachers regarding online education revealed that most of the respondents (about 70 percent) were found to have high attitude, whereas 30 percent had moderate attitude towards online education.

Key words: Attitude scale, purposive sampling, discrimination index

Clean Food’ through adoption of ecologically and economically sustainable farming technology with special focus on soil & plant health management.

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ABSTARCT

Purpose: Today it is no longer a debatable issue that since the “green revolution” of the 1960s have been touted as solutions to the global hunger problem— but focusing only on the potentiality of high crop yields have come at the cost of environmental degradation and lowered sustainable food and nutritional security over the long term. Especially in the crop intensified zones, with the rampant use of chemical fertilizer and pesticides soil quality has been eroded to an alarming stage. Loss of soil fertility, erosion of soil, soil toxicity, diminishing water resources, pollution of underground water, salinity of underground water, increased incidence of human and livestock diseases, risk of food toxicity enhances with indiscriminate and disproportionate use of Agro-chemicals (Rahman, 2015). Thus, shifting focus towards ecologically and economically sustainable crop cultivation is the only option left for future crop sustainability. In this background, pesticide free ‘Clean Food production’ with adoption of various good agricultural practices (GAP), mechanical and biological practices amalgamated with innovative organic approach (IRF technology) specially focused towards soil and plant health management have been adopted in some villages of Fathepur Gram Panchayat in the Haringhata Block, Nadia district of West Bengal from 2020. The objectives of the study are crop sustenance, soil rejuvenation, ecological sustenance and most importantly sustained livelihood generation for small and marginal farmers.

Methodology: The Program initiated with soil sampling and soil quality analysis followed by the development of sustainable soil management program along with the on-field preparation of Novcom compost, which can be made only within 21 days. An integrated approach of plant health management was developed side by side towards sustainable crop growth, higher crop production and gradually reducing the pest/ disease infestation. Finally the end products were analyzed with Colorometric Pesticide Assay Test for evaluation of pesticide residue in vegetable produced under this ‘Clean Food’ program.

Results: Analysis of soil samples in the study area clearly indicated soil quality depletion with very low organic carbon (< 0.70 %), very poor biological properties, poor microbial biomass carbon (<200 µg.CO₂.C/gm dry soil) and poor FDAH (< 50 µg/gm dry soil). Comparative evaluation of crop productivity under clean food programme *vis-a-vis* conventional farmers’ field indicated 3.0–13.5% increase in crop yields in the 1st year of program adoption. Analysis of pesticide residue indicated presence of pesticides residue in less than 4% of the vegetable samples, while in the rest the same were below detection limit (< 0.01 ppm). In contrast, out of the samples procured from the local market about 18 % showed pesticide residue in one or more group especially Organochlorine, Organophosphate, Carbamate, Synthetic Pyrethroids and Nicotinoids.

Study of Energy Use efficiency showed that upto 60% higher energy use efficiency can be achieved under clean food program in comparison to conventional farming practice. In terms of green house gas (GHG) emission, switch over to clean food program can reduce upto 0.5 kg CO₂ equivalent per kg produce and significantly contribute in the climate change mitigation initiatives. Soil development index post production indicated 10 to 15 % enhancement in soil quality which was majorly due to the activation of soil biological properties through the application of compost as well as reduction in the use of herbicides and chemical pesticides.

Conclusion: Thus the clean food program can be a practical option for sustainable agriculture towards crop sustainability, environmental preservation and empowerment of the small and marginal farmers.

Aquatic Hyphomycetes from Amritpur: An Unexplored Region of Uttarakhand, India Ruchi Jalal*; Saraswati Bisht; Saima Altaf

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ABSTRACT

Purpose: Aquatic hyphomycetes, the fascinating group of deuteromycetous fungi form an important component of aquatic ecosystem. They help in energy transfer and nutrient cycling through decomposition of submerged plant material. At present, the studies on aquatic hyphomycetes is more confined to the well oxygenated cold water bodies. Thus, the present study aims to explore various streams of Amritpur, an anthropogenically stressed and warm climatic region in foothills of Kumaun Himalaya (600 m) for the diversity of aquatic hyphomycetes.

Methods: In the present study, the selected sites were surveyed seasonally for decomposed plant material, roots of riparian plants and foam samples. The collected samples were processed, incubated and examined under microscope.

Results: In all, 16 species of freshwater hyphomycetes belonging to 10 genera were recorded from the collected samples, viz., *Acaulopage dichotoma*, *A. tetraceros*, *Alatospora acuminata*, *Anguillospora crassa*, *A. longissima*, *A. filliformis*, *Campylospora chaetocladia*, *C. fillicladia*, *C. parvula*, *Cylindrocarpon aquaticum*, *Lunulospora curvula*, *Setosynnema isthmosporem*, *Tetracladium marchalianum*, *Triscelophorus monosporus*, *Triscelophorus acuminatus* and *Weisneriomyces sp.*

Conclusions: The presence of these fungi in anthropogenically stressed area indicates their tolerance towards pollution. Future studies need to focus more on lower altitude water bodies for the diversity of aquatic hyphomycetes.

Key words: Aquatic Hyphomycetes, Diversity, Foothills, Anthropogenic region.

A low-cost storage for horticulture produces for enhancing farmer's income: an overview on evaporative cooling

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ABSTRACT

Purpose: Due to the absence of proper storage techniques in a tropical country like India, the farmers have to sell their produce in the market immediately after the harvest. Refrigerated storage, which is accepted to be the best system for storing fruits and vegetables in fresh form, is energy-intensive and includes enough capital cost. Most of the peasant farmers are not able to afford the cost of purchasing high-tech storage equipment for their harvested crops. Metabolism in fresh horticultural produce continues even after harvest and the deterioration rate increases due to ripening, senescence and unfavourable environmental factors. To overcome the problem of on-farm storage, low cost, energy-efficient, environmentally benign and made from locally available material evaporative cooling chambers have been developed which is an efficient and economical means for reducing the temperature and increasing RH in an enclosure. In this article, an attempt is made to review the basic principle and methods of the evaporative cooling system, factors influencing during storage, storage conditions of perishables, design consideration of different evaporative cooling systems, cost analysis and advantages/disadvantages are reported.

Conclusions: To overcome the problem of on-farm storage, low cost, energy-efficient, environmentally benign and made from locally available material evaporative cooling chambers have been developed which is an efficient and economical means for reducing the temperature and increasing RH in an enclosure.#

Keywords: Evaporative cooling, Horticulture produce, Factors influencing, Storage, Design consideration and Cost analysis

Preliminary studies on the abiotic and bacteriological parameters of sewage water in Kurukshetra

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ABSTRACT

Purpose: Sewage wastewater mainly comprises of domestic, industrial and agricultural effluents which contain organic and inorganic waste in dissolved or suspended form and varied number of microorganisms. Before discharging this wastewater into rivers or using it for agricultural purposes it must be decontaminated. Sewage water itself contain autochthonous bacteria that posses biodegrading potential. These bacteria can be isolated and cultured individually and then can be used in bioremediation processes. Before isolating these autochthonous bacteria there is need to conduct preliminary studies on the physiochemical and bacteriological characteristics of sewage water

Objective: The main objective of the present study was to analyse sewage water collected from two different sewage treatment plant located in Kurukshetra city and its physiochemical parameters and bacteriological analysis was done.

Methodology: Various physiochemical parameters such as BOD, COD, DO, free CO₂, chloride, calcium, magnesium, hardness, pH, ammonia, nitrate and phosphate level etc. were determined by standard methods given by APHA. Heavy metal content was determined by Inductively coupled plasma mass spectrophotometer (ICP-MS). Presence of coliform bacteria was determined by most probable number (MPN) method which include presumptive, confirmatory and completed test. Bacterial count of the wastewater was done by serial dilution and spread plate method.

Results: It was observed that temperature was higher than surface water because of various biochemical reactions. pH was found to be slightly alkaline. Sample also shows high turbidity because of suspended solid. DO was very less as compared to surface water which indicates pollution level. BOD values were ranged from 100-200mg/l and COD values were ranged from 50-250mg/l. Heavy metals such as Al, B, Cd, Cr, Cu, Fe were ranged near 6.30, 61.2, 15.2, 4.9, 5.4 ppb respectively. MPN index shows coliform number more than 2400/100ml.

Conclusion: Most of the values were higher than the values prescribed by CPCB. Both of the samples of wastewater show the presence of extensive number of coliform bacteria through MPN test. Different colonies in variable sizes and colour were observed on agar plates which show high bacteria count in wastewater sample. Thus there must be some autochthonous bacteria those posses biodegrading potential.

Keywords: sewage wastewater, biodegradation, autochthonous, coliform

**Effect of Integrated Nutrient Management on Growth and Yield of Papaya cv. Red Fort
Priyam Chattopadhyay and Goutam Mandal**

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ABSTRAT

Purpose: Papaya (*Carica papaya*) the “wonder fruit of tropics” is a very popular as well as an important fruit crops of the new worlds for its delicious taste, nutritional status and medicinal property as well. In spite of a large area & production still, the “wonder fruit of tropics”, considered as a backyard crop. But in recent times the importance of Papaya as a commercial fruit crop, growing over the years for its nutritional and pharmaceutical values, besides, its quick and continuous yielding habit, generating early income to the growers. Papaya commonly known as the “Heavy feeder crop” for that the nutrition of papaya differs from other fruit crops because of its quick growth, continuous flowering & fruiting habit and high fruit yield. Apart from the macro nutrients, several micronutrients, biofertilizers and their combination also have an influential role on growth and yield of Papaya. Keeping this in view, the present experiment was conducted to study the effect of Integrated Nutrient Management on Growth and Yield of Papaya cv. Red Fort.

Methods: The present experiment was conducted during 2017-18 & 2018-19 at Farmers Field at kalchini, Alipurduar, West Bengal. The experiment comprised of 4 Treatments (Control, RDF of NPK, 50% RDF, 75 % RDF) (Recommended Dose of Fertilizer i.e. RDF- 200:200:250 g/plant/year) with 5 Factors (Control, Biofertilizer+FYM,

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Vermicompost+Biofertilizer, Boron+FYM, Zinc+FYM) and replicated thrice and the data was statistically analyzed in randomized complete block design.

Result: Among the different treatment combinations highest plant height was observed after 270 days of transplanting, (293.930 cm) in RDF of NPK+ Vermicompost+Biofertilizer (T₁F₂) followed by 75% of RDF+ Vermicompost+Biofertilizer (T₃F₂) (287.145 cm) and the lowest result was observed in Control (without any treatment) (201.960 cm). In case of plant grith at 270days, highest result (50.475 cm) was recorded in RDF of NPK+ Vermicompost+Biofertilizer (T₁F₂) followed by 75% of RDF+ Vermicompost+Biofertilizer (T₃F₂) (47.075 cm) and the lowest result was recorded in Control (35.245 cm). Total no of leaves at 270days, was found highest (57.500) in RDF of NPK+ Vermicompost+Biofertilizer (T₁F₂) followed by 75% of RDF+ Vermicompost+Biofertilizer (T₃F₂) (52.500) and the lowest result was observed in Control (31.500). In case of Fruit Set Percentage, higher value (73.292%) was recorded in RDF of NPK+ Vermicompost+Biofertilizer (T₁F₂) followed by 75% of RDF+ Vermicompost+Biofertilizer (T₃F₂) (72.103) and the lowest result was in Control (53.493). Total no. of Fruit, registered highest (38.725) in RDF of NPK+ Vermicompost+Biofertilizer (T₁F₂) followed by 75% of RDF+ Vermicompost+Biofertilizer (T₃F₂) (34.668) and the lowest result was observed in Control (18.777). Fruit yield was also found highest (59.475 kg/Plant) in RDF of NPK+ Vermicompost+Biofertilizer (T₁F₂) followed by 75% of RDF+ Vermicompost+Biofertilizer (T₃F₂) (56.665 kg/Plant) and the lowest result was observed in Control (28.100kg/Plant). In case of Days Taken to flower emergence, least result (78.480) was recorded in RDF of NPK+ Vermicompost+Biofertilizer (T₁F₂) followed by 75% of RDF+ Vermicompost+Biofertilizer (T₃F₂) (82.190) and the highest result (96.435) was observed in Control. In Days Taken to Fruit emergence, least result (121.825) was observed in RDF of NPK+ Vermicompost+Biofertilizer (T₁F₂) followed by 75% of RDF+ Vermicompost+Biofertilizer (T₃F₂) (129.240) and the highest result (176.655) was observed in Control. Fruit weight (1.675 kg) was recorded highest in RDF of NPK+ Vermicompost+Biofertilizer (T₁F₂) followed by 75% of RDF+ Vermicompost+Biofertilizer (T₃F₂) (1.645 kg) and the lowest result (1.170 kg) was found in Control. Fruit length (25.140 kg) was registered highest in RDF of NPK+ Vermicompost+Biofertilizer (T₁F₂) followed by 75% of RDF+ Vermicompost+Biofertilizer (T₃F₂) (24.435 kg) and the lowest result (17.010 kg) was in Control. Higher Fruit grith (15.403 cm) was also recorded in RDF of NPK+ Vermicompost+Biofertilizer (T₁F₂) followed by 75% of RDF+ Vermicompost+Biofertilizer (T₃F₂) (15.217 cm) and the lowest result (12.520 cm) was found in Control. Similar trend was followed in Spad Value after 270 days of transplanting, highest result (44.403mg/g) was recorded in RDF of NPK+ Vermicompost+Biofertilizer (T₁F₂) followed by 75% of RDF+ Vermicompost+Biofertilizer (T₃F₂) (43.253mg/g) and the lowest result (35.595mg/g) was observed in Control.

Conclusion: It can be concluded from the above experiment that the recommended dose of fertilizers along with vermicompost and Bio fertilizers recorded highest result for every parameter which was at per with 75% of RDF along with vermicompost and Bio fertilizers.

Key word: Papaya, Intigrated nutrient management, growth & yield

Aquatic hyphomycetes of crop fields and agricultural canals of Haldwani and surroundings (Kumaun himalaya)

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ABSTRACT

Purpose: Aquatic hyphomycetes are the fungi that mostly occur in dead leaf litter submerged in freshwater streams. These fungi play an important role in natural bio-geochemical cycles by decomposing the organic matter. Generally, these fungi are known to be found in fresh-water running streams. However, they are also known to persist on land and temporary waters. Therefore, the aim of the present study is to explore the hyphomycetous fungi flourishing on crop fields and agricultural canals.

Methods: Collected samples of decomposed plant material from various agricultural canals and crop fields were brought to laboratory and processed, incubated and examined under microscope.

Results: To our knowledge this is the first documented study of aquatic hyphomycetes in crop fields and agricultural canals. Combination of different species from 10 genera were isolated and identified during this study viz.,

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Anguillospora crassa, *Beltarnia rhombica*, *Cylindrocarpon aquaticum*, *Dicranidion sp.*, *Diplocladiella scalaroides*, *Isthmotricladia sp.*, *Latriramulosa uninflata*, *Weisneriomyces sp.*, *Tricladiopsis foliosa*, *Triscelophorus acuminatus* etc. Among the isolated species *Dicranidion sp.*, and *Weisneriomyces sp.* is being reported for the first time from Kumaun Himalaya.

Conclusions: Though the aquatic hyphomycetes are commonly found in relatively cooler, less polluted fresh water bodies but their ample presence in crop fields and agricultural canals indicate that high nutrient availability increases their stress tolerance and diversity.

Key Words: Aquatic Hyphomycetes, Nutrient availability, Stress Tolerance, Crop fields, Irrigation Canals.

Aquatic Hyphomycetes of Machilivan- An Unexplored Foothill Region of Kumaun Himalaya, India

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ABSTRACT

Purpose: Aquatic hyphomycetes are the main decomposers of submerged dead organic matter that play important role in unlocking the energy flow in lotic aquatic ecosystems. These fungi have been extensively reported from Kumaun Himalaya while are yet to be explored from freshwater bodies of the foothill region. Thus, the present study aimed to reveal the aquatic hyphomycetous diversity of Machilivan that constitutes a part of the Nandhaur River, a freshwater body flowing through Kumaun Himalayan foothill that is still unexplored for its mycofloral diversity.

Methods: Leaf litter, water foam, and riparian root samples were collected from the study site and further processed in the laboratory for the incubation, isolation, and identification of aquatic hyphomycetes.

Results: Altogether twelve species belonging to eight genera namely *Anguillospora*, *Acaulopage*, *Flagellospora*, *Lunulospora*, *Setosynema*, *Tetracladium*, *Trescelophorus*, and *Wiesneriomyces* were identified from the present study site. Ten species were isolated from leaf litter samples, four species from water foam samples and six species occurred as endophytes of riparian roots. Out of the twelve species, *Anguillospora crassa* and *Acaulopage dichotoma* were found only in the form of riparian root endophytes.

Conclusions: The study site lies in the foothill of Kumaun Himalaya and comes under the forest range that makes it a rich source of the substrate to support the occurrence of varied forms of aquatic hyphomycetes. The rich diversity of study site suggested that the region faces less anthropogenic stress. Known for their cold water-loving nature, these fungi still exist in warm temperature regions, this shows their affinity towards warm temperature also.

Keywords: Aquatic Hyphomycetes; Lotic Environment; Machilivan; Nandhaur River; Unexplored, Anthropogenic Stress.

Annotated checklist of major finfish species landing in Chetlat island of Lakshadweep (India) and their conservation status

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ABSTRACT

Purpose: India is blessed with a rich diversity of flora and fauna and put among the mega biodiversity countries of the world. Lakshadweep islands are well known for copious fishery resources. The present study primarily focused on systematic representation of IUCN Red Listed marine finfish landings of Chetlat island of Lakshadweep archipelago (India).

Methods: The study was conducted for a period of 6 months from September 2019 to February 2020. Sample collections were conducted twice in a month. A checklist of finfishes along with their scientific name, common name, family and present conservation status were prepared.

Results: A total of 41 species of fishes belonging to 20 families were identified during the entire study. As per IUCN (International Union for Nature Conservation) Red List (2017-3) the identified fishes categorized into nine groups including Extinct (EX), Extinct in the wild (EW), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC), Data Deficient (DD), and Not Evaluated (NE).

Conclusions: Information on conservation status of fishes plays significant role in fisheries science since it form basis for management of marine fishery resources. This study results depicts ideal data on major finfish landings in Chetlat island of Lakshadweep (India), and it may be inevitable in further fisheries based management and conservation strategies.

Key words: Fish diversity, Chetlat, IUCN Red List, Conservation status

Arsenic stress mitigation using *Bacillus mycooides* NR-5 in spinach plant (*Spinacia oleracea* L.)

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Purpose

In last few decades the geogenic activities added a large quantity of arsenic in aquifer system. The prolong intake of Arsenic (As) contaminated water may cause arsenicosis, and serious impact on skin, lung, kidney, and even coronary heart disease. Management of arsenic through physico-chemical methods is efficient but cost effective. On the other hand, microbial removal of arsenic is a sustainable approach. Hence, the goal of present study was to identify arsenic-resistant bacterial strains and to assess their ability to tolerate arsenic ions from polluted soil and water.

Methods

Polluted water samples were collected from Nag river (21°14'N longitude 79°20'E latitude), Maharashtra, and analysed for their physico-chemical properties. Bacterial isolates obtained from samples were tested for Minimum Inhibitory Concentration (MIC) against arsenite and arsenate. Highest As tolerating strain was selected, identified and evaluated for multiple metal and antibiotic tolerance, and plant growth promoting (PGP) attributes. Scanning Electron Microscopy (SEM), Transmission Electron Micrograph (TEM) and Fourier-transform infrared spectroscopy (FTIR) studies were carried out with selected bacterial strains in absence and presence of As (25ppm). Mechanism underlying

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for As tolerance were studied by screening using various metabolising gene primers. Ability of As tolerating strains for the mitigation of As stress in heavy metal hyper accumulating plant, spinach was studied in pot.

Results

A bacterium isolated from Nag River, Madhya Pradesh, India, exhibited high arsenic tolerance (1100 mg L⁻¹) and even multiple metal resistance, identified as *Bacillus mycooides* NR5. The bacterium was also found to possess plant growth-promoting attributes like P solubilization, siderophores, ammonia and nitrate reduction, and antibiotic tolerance as well. SEM results indicated that under As stress the bacterial cells were swollen and large in size that suggests the possibility of intracellular accumulation of heavy metal. It is further confirmed in TEM where NR5 cells showed surface deposition as well as accumulation of arsenic in inner membrane. In addition to this FTIR spectra of control and As treated NR5 also strengthen the observation of surface As biosorption and described that a strong peak at 3379.0 corresponds to amine which indicates the interaction of the metal with cell surface protein. Upon further validation at molecular level, the amplification of arsenic tolerant genes, arsenic reductase (*arsI*, *amt*) in NR5 suggests that in addition to biosorption and accumulation it also possesses ability to transform As(III) to As(V) at extracellular level. *B. mycooides* NR5 ability to alleviating As stress arsenic uptake in spinach was also evaluated and found that arsenic at 50ppm concentration in soil showed inhibitory effect and delayed germination reduce shoot, root length and flowering in comparison to *B. mycooides* NR-5 treated plants showed early germination, 19.71 and 36.84% increase in shoot and root fresh weight, respectively, and enhanced flowering resulting in alleviation in As stress. In addition to this the elevated proline accumulation in As stressed plants was also lowered down in bacterial inoculated plants.

Conclusions

B. mycooides NR5 exhibited high As tolerance. SEM, TEM, and FTIR studies the biosorption revealed as primary mechanism of As tolerance along with the transformation of As (III) to As (V). Modulation of crop plants with NR5 can help in alleviating effect of As stress and reduce the accumulation in plant parts. The finding indicates that *Bacillus mycooides* NR5 equipped with PGP attributes, high As tolerance and antibiotic resistance can be a good choice for As bioremediation in As polluted agricultural soil.

Key words: Arsenic, Heavy Metal, Biosorption, SEM, TEM, FTIR, *Spinacia oleracea*

Effect of Probiotic on Milk Production of Buffalo in Bharatpur District, Rajasthan

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ABSTRACT

Purpose

India stands number one in milk production in the world. However, the total milk production of India is contributed by a huge cattle and buffalo population but productivity of animals is very low in India. Therefore improving the productivity of the animals by using rumen manipulators is an option to enhance animal productivity. Rumen manipulation can be done by the use of many growth stimulants including hormones and antibiotics but potential alternative is feeding of microbials as probiotics. *Saccharomyces cerevisiae* has been considered as the promising probiotic culture for efficient nutrient utilization.

Methods

20 buffaloes from Ajaypura village of Bharatpur district of Rajasthan were selected for this study as an On Farm Trial (OFT). The buffaloes were multiparous (lactation number 2 and 3) and in early to mid lactation. The cows in all the groups received a basal diet comprising of roughages and concentrates separately, 10 Kg green fodder and @ 1Kg/3L of milk production to meet the maintenance and production requirements. The animals were milked twice daily at 6.00 am and 5.00 pm throughout the experimental period. The buffaloes were divided into two groups each containing 10 animals (T1 &T2) based on the similar average milk yield, parity and stage of lactation. T1 acted as control group and no probiotic was fed. T2 group were fed with probiotics Bioboost @ 20 gm/day/buffalo. The experiment was carried out for 60 days. Daily milk yield was recorded in pre-trial period of 25 days and during 60 days of trial period.

Results

The effect of feeding of probiotic, Bioboost @20gm/day, on milk yield is presented in Table I. During pre trial period average milk yield in T1 and T2 group was 7.50 and 7.55 L/day respectively. During trial period milk yield was

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increased from 7.50 to 10.10 L/day in T1 group and from 7.55 to 11.75 L/day in T2 group respectively. The average net return of farmers during trial period was Rs. 7644 and 10639 in T1 and T2 group respectively.

Conclusion

By the findings of our study, it can be concluded that supplementing the feed with probiotic Bioboost® increased the quantity of the milk and improved the digestion of animals and reduced rumen metabolic diseases. It signifies that the productivity of the animal has improved and hence each animal earns more income. Compared to T1 group, T2 group earned Rs. 2995 more profit during trial period. Our result also concludes that, supplementing the feed with probiotic Bioboost @ 20g/day/cow increased the milk yield and improved health of animals.

Key words: Probiotic, rumen, milk, Bioboost, digestion, *Saccharomyces cerevisiae*.

Morpho-molecular characterization of *Pseudoperonospora cubensis* causing downy mildew of cucumber

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ABSTRACT

Purpose:

Downy mildew, a foliar disease caused by the oomycete *Pseudoperonospora cubensis* (Berk. and Curt.) Rostow is one of the most destructive pathogens of cucurbits. The present study was carried out with an objective to characterize the downy mildew pathogen of cucumber using morpho-molecular markers to devise the management strategies.

Methods:

A total of 50 isolates of *P. cubensis* were collected from six states including Delhi, Karnataka, Madhya Pradesh, Punjab, Uttar Pradesh and West Bengal and finally 24 isolates were selected for morphological as well as molecular characterization. Morphological characterization was done based on sporangiophore and sporangial morphology. Molecular characterization was done using gene specific primer GS 1 to identify the genetically different isolates. The sequences generated for primer GS 1 for 24 isolates were aligned using ClustalW alignment tool and further processed in MEGA 6.0 software to identify variant sequences and a neighbour joining tree was constructed to depict groupings and genetic distances among 24 isolates of *P. cubensis*.

Results:

Microscopic observation revealed significant differences in the length of sporangiophores and size of sporangia among isolates. The presence of oospore was also recorded in three isolates i.e., Pc1, Pc14 and Pc16. Phylogenetic analysis revealed that all *P. cubensis* isolates were divided in 10 different clusters. 50 per cent Central Delhi isolates were clustered in cluster I. Cluster V comprised of isolates only from Varanasi. Cluster VIII was the most diverse having *P. cubensis* isolates from four different regions suggesting no association with geographical origin. Pc15 from Central Delhi and Pc6 from Varanasi were found most distantly related in comparison to other *P. cubensis* isolates. MEGA 6.0 program revealed the mean genetic diversity between groups ranging from 0.004±0.002 between Jabalpur and Cooch Bihar to 0.019±0.003 between Central Delhi and Varanasi.

Conclusion:

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Gene specific and primers could reveal no polymorphism among 24 isolates of *P. cubensis*. However, diversity was assessed successfully on sequence level using one gene specific primer (GS 1). Moreover, this sequence-based marker can be suggested for monitoring genetic diversity within *P. cubensis* isolates in further studies.

Key words: Downy mildew, *Pseudoperonospora cubensis*, cucumber, diversity

Integration of organic manures and urea on available nitrogen, its uptake and yield of rice

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ABSTRACT

Purpose

Nitrogen is the nutrient element limiting in most rice-growing soils of India. However, rice crop being the maximum consumer of N fertilizer constituting one third of the total N consumption of the world, greater efficiency in the use of fertilizer is a key factor for increasing rice production. Organic manure has been recorded to enhance the efficiency and reduce the requirement of chemical fertilizers. Conjunctive use of organic manure along with fertilizer has been proved an efficient source of nitrogen. For sustainability in crop production, it is neither chemical fertilizer nor organic manures alone but their integrated use has been observed to be highly beneficial.

Methodology

A field experiment was conducted at the research farm of College of Agriculture, Central Agricultural University, Imphal (24°48'44.50''N latitude and 93°53'29.98''E longitude) during *kharif* season 2015. The soil of the experimental site was clayey in texture having pH 5.4, OC 1.26%, EC 0.22 dSm⁻¹, available N, P and K were 141.27 mg kg⁻¹, 10.52 mg kg⁻¹ and 95.03 mg kg⁻¹, respectively. Rice variety 'CAU-R1' was used as test crop and treatments used were T₁ -soil (control), T₂ -100% RDN through urea, T₃ -100% RDN through FYM, T₄ -100% RDN through vermicompost, T₅ -100% RDN through poultry manure, T₆ -75% RDN through FYM + 25% RDN through urea, T₇ -75% RDN through vermicompost + 25% RDN through urea, T₈ -75% RDN through poultry manure + 25% RDN through urea, T₉ -50% RDN through FYM + 50% RDN through urea, T₁₀ -50% RDN through vermicompost + 50% RDN through urea, T₁₁ -50% RDN through poultry manure + 50% RDN through urea. Soil and plant samples were collected at transplanting, 25, 50, 75, 100 days after transplanting (DAT) and at harvest and analysed for exchangeable NH₄⁺ and soluble NO₃⁻ by Magnesium oxide-Devarda Alloy method and corresponding N uptake was recorded by multiplying the N content with dry matter production. Grain and straw yield were also recorded at harvest. The experiment was laid out in a randomized block design with three replications and unit plot size being 5m × 4m.

Results

Results revealed that the concentration of NH₄⁺-N was higher at early stages and progressively declined with advancement of crop growth whereas NO₃⁻-N content in soil gradually decreased with stages of crop growth. Significantly higher values of NH₄⁺-N and NO₃⁻-N in soil were recorded in singly or combined treated plots over control. Among the different treatments, NH₄⁺-N content in soil was highest in T₁₀ (50% RDN through vermicompost + 50% RDN through urea) at 100 DAT and at harvest. While T₁₀ remained statistically at par with T₁₁ (50% RDN through poultry manure + 50% RDN through urea) at 25, 50 and 75 DAT. Increase in exchangeable NH₄⁺-N at early stages is due to rapid hydrolysis of urea and accelerated mineralization of organic nitrogen sources in the presence of urea because of the stimulating effect of chemical nitrogen on microbes responsible to carry out the process (Singh *et al.*, 2001). The priming effect is mainly the result of the decrease in the C: N ratio and increase in the rate of decomposition of organic residues in the presence of inorganic N. While the decrease in exchangeable NH₄⁺-N with crop growth may be due to increased uptake by crop with its maturity and other losses such as volatilization, nitrification and immobilization. Higher accumulation of NO₃⁻-N in soil under integrated (T₆ to T₁₁) as well as organically treated plots (T₃ to T₅) during the latter part of crop growth was attributed to slow release of nitrogen from these organic manures and less leaching loss of nitrogen from soil under these treatments. However, nitrate-N in the surface soil at different stages showed lower values in spite of the fact that exchangeable ammonium N content in soil

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was relatively high. This might be due to quick loss of N through denitrification and leaching during the flooded condition of soil.

In general, total N uptake reached its peak at 75 DAT for all the treatments. Different treatment combinations of organic manures and urea were statistically superior over control at all the stages studied. The increased uptake in rest of the treatments over control may be attributed to the increased yield of the crop with the application of organic manures and urea. Better performance under these treatments might also be due to favourable soil environment, which encouraged better root proliferation and ensured N uptake. Among the treatment combinations, the highest total N uptake (116 kg ha⁻¹) was obtained from T₁₀ (50% RDN through vermicompost + 50% RDN through urea) at harvest stage. T₁₀ (50% RDN through vermicompost + 50% RDN through urea) was also recorded the highest grain yield (5.55 t ha⁻¹) and straw yield (7.23 t ha⁻¹) which was at par with T₁₁ (50% RDN through poultry manure + 50% RDN through urea) and T₂ (100% RDN through urea).

Conclusion

This suggests that judicious use of organic material can produce rice yield on par with that obtained with inorganic fertilizer. The increased yield due to combined application of organic manures and urea was mainly attributed to overall improvement in soil fertility including N supply (Azam, 1990). Crop yields depend mainly on the availability of NH₄⁺-N in submerged conditions. Application of urea N produced higher yield than organic manures alone might be due to inability of organic N sources to release nutrients at peak requirement of the crop.

Baby corn + pulse intercropping in influencing baby corn yield, equivalent yield and land equivalent ratio

MINU MOHAN, Dr. S.N. KHAJANJI, Dr. N. PANDEY

ABSTRACT

Purpose

Baby corn has a genetic makeup of non starchy nature and it is emerging as a new crop in the new era. Pulse intercropping has been proved to play a beneficial effect on the cereals. There was a need to identify the suitable pulse intercropping system in the Chhattisgarh plains.

Methods

Field experiment carried on intercrops grown along with the cropping of baby corn during *rabi* season 2018-19 and 2019-20. The treatment consisted of T₁ : sole baby corn (45 x 20 cm), T₂ : paired row baby corn (30/60 cm) T₃ : sole fenugreek (30 x 10 cm), T₄ : sole pea (30 x 20 cm), T₅ : sole cowpea (30 x 20 cm) T₆ : paired row baby corn + pea (2:2), T₇ : paired row baby corn + fenugreek (2:2) and T₈ : paired row baby corn + cowpea (2:2).

Results

The results showed that T₆ : paired row baby corn + pea was found to be the most profitable intercropping system which was closely followed by T₈ : paired row baby corn + cowpea and T₇ : paired row baby corn + fenugreek. Also, the highest baby corn equivalent yield, land equivalent ratio (LER) was obtained under the treatment of T₆ : paired row baby corn + pea (2:2) followed by T₈ : paired row baby corn + cowpea and T₇ : paired row baby corn + fenugreek, respectively.

Conclusion

Baby corn intercropped with pea could be proved to be a profitable system in Chhattisgarh Plains to fully exploit the land resources along with the maximum utilization of land under cropping.

Keywords: baby corn, intercropping, pulse, LER, equivalent yield

Orientation of *Sitophilus oryzae* towards coloured lights **Jabanika Hazarika, Pulin Patgiri and Karanika Gogoi**

ABSTRACT

Purpose

The rice weevil, *Sitophilus oryzae* (Coleoptera: Curculionidae) is a primary grain and seed feeder which attacks several crops, including wheat, rice and maize grains. Light emitting diodes (LED) have become one of the primary means to control the insect attack. The LED lights could effectively reduce the dosage of pesticides used and can be utilized in IPM for control of storage pests. The aim of the study is to identify the most effective light spectrum, which attracts maximum insects.

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Methods

An experimental set up with a acrylic mother container and seven square-shaped small containers were used in the multi-choice test. Square-shaped containers were fitted with green, yellow, infrared, blue, ultraviolet, red and white LEDs. Five hundred insects were released in the mother container of multi-choice experimental sets and observations were recorded under three conditions. In the first case, whole grains of rice were kept in the square-shaped containers and no food was provided in the mother container. In second case, food was provided only in the mother container; and in the third case, both the mother container and square-shaped small containers were provided with food. In vitro movement of insects were recorded through counting the number of migrated insects from the mother container to the small containers lit with different coloured LEDs at 1, 3, 6 and 24 hr after release.

Results

The result showed that in multi-choice test, when food was kept only in the small square shaped containers, preference of *S. oryzae* at 1, 3, 6 and 24 hours after release was highest in green (13.13 to 13.80%), while lowest preference was recorded in ultraviolet (6.20 to 6.73%). Data recorded at different time intervals when only the mother container was provided with food showed blue (11.80 to 12.60% and 12.13 to 13.73%) to be the most preferred treatment while the least preferred LED was infrared (7.27 to 8.20%). Highest preference was found in Blue (11.53 to 11.93%) at different time intervals when food was kept both in the mother container and square-shaped containers and *S. oryzae* showed lowest preference towards infrared LEDs (6.93 to 8.07%).

Conclusions

It can be concluded from the findings of the present experiment that for the management of *S. oryzae* in the grain storage, blue, green and red LED traps could be used to attract or storage structures fitted with ultraviolet, white and infrared LEDs could be used to reduce the infestation.

Key words: *Sitophilus oryzae*, light emitting diode, multi-choice test, preference, attraction

Street light influencing the Physiological and Molecular level on Indian Avian fauna especially Passerine bird Black Headed Munia (*Lonchura Malacca*)

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ABSTRACT

Background:

In nature, the daily light period changes across seasons. A critical day length (threshold photoperiod) is referred to as the ‘minimum’ day light period that will induce a photoperiodic response to half-maximum.

Purpose

This study was done in an experiment, to determine that artificial photoperiod (street light) disturbing the life pattern (sleep-wake cycle) and physiology of Indian avian fauna especially passerine birds.

Methodology

Blackheaded munia were exposed to various day lengths (9, 10, 11, 12, 13, 14, 15, 16 h) and with a particular time interval different physiological parameter body mass, body molt, molt primaries and gonadal growth were observed, for blood profiles time to time blood samples were collected.

Results

The body molt, Molt primaries and testicular volume in *L. malacca* were not changed in Short day length SD (9-13 h) photoperiods but in longer the day length LD (14-16 h) photoperiods, significant changes were observed; Thus the critical day length for this avian species is 14 h.

Conclusion

This experiment shows that the *Lonchura malacca* has a habit of Long photoperiodic response *i.e.* 14 h continuous light for critical day length.

Keywords: Critical day length, street light, Threshold photoperiod, SD, LD, Body molt, Molt primaries and Testicular volume.

Multivariate analysis in oat cultivars under dual purpose and seed purpose systems

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ABSTARCT

Purpose

A standard method for extracting relevant information from complex data sets is Principal component analysis (PCA), which is a multivariate approach which is use to measure the diversity in germplasm collections and to assess the relative contributions that various traits make to the total variability in a crop collection.

Methods

The present study was effectuated to analyze diversity via PCA at Experimental Fodder farm, CSK HPKV Palampur. Two experiments were conducted on same genotypes in order to compare the effect of cut which was made 70 DAS *i.e.* to compare the dual purpose and seed yield purpose traits.

Results

A total of 76.82%, 80.29 % variation explained by the first five principal components in dual purpose traits and variation seed yield purpose systems. Among dual purpose traits, in all the principal components, leaf stem ratio resulted in highest positive value followed by tillers per plant, dry matter percent, β -glucan content and dry matter yield. While, among seed yield related traits, in all principal components, seed yield resulted in highest positive value followed by harvest index, crude protein content, tillers per plant and 100 seed weight. Overall leaf stem ratio followed by tillers per plant, dry matter %, β -glucan content and dry matter yield result positive value in higher extent.

Conclusions

These traits observed as maximum contributors towards genetic divergence. Hence, the selection on the basis of these traits would be effective for improvement of fodder yield in oat.

Key words: diversity; hybridization; oat; selection

Towards efficient photosynthesis: genetic transformation of rice

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ABSTRACT

Purpose: To find an efficient solution to improve crop productivity by increasing photosynthesis

we have raised 5 transgenic rice variety (*Oryza sativa* L. cv. IR64) lines that have over expressed marker free SUV3 gene. Reports suggest that increased efficiency of photosynthesis and salinity toleration (up to 200mM NaCl) in the T₁ generation of rice can be obtained by the over expression of CaMV35 promoter driven SUV3 gene. Validation of the stability in the expression and the incorporation of SUV3 gene in transgenic rice is confirmed by molecular criterions like PCR, southern blotting RT-PCR, and western blotting analyses. After considering all parameter while comparing the transgenic lines and the vector control (VC) and wild type (WT) plants under salt stress, it was observed that the transgenic varieties showed higher photosynthetic attributes (23-32%) like elevated photosynthesis rate (PN) due to increase in chlorophyll content, intercellular carbon dioxide and the stomatal conductance along with higher activity (21-37%) of enzymatic antioxidants for example glutathione reductase (GR), ascorbate peroxidase (APX), guaiacol peroxidase (GPX) and superoxide dismutase (SOD). Howbeit uniform results were obtained from the transgenic variety as well as the VC and WT plant when the photochemical efficacy of PSII as estimated from variable to maximum chlorophyll a fluorescence (Fv/Fm) was taken into consideration. Altogether the motif of presented experimentation was development of marker- free SUV3 over expressing transgenic lines for improving the photosynthetic efficiency of the plant as well as conferring tolerance against salinity stress.

Method:

Cloning and transformation of SUV3 gene in IR64 rice

Here, the application of SUV3 gene in tissue culture technology was done. Production of a perfect reporter as well as antibiotic marker free plasmid named pCAMBIA1300-SUV3 was established from the clone of coding regions of the (1.2 kb) SUV3 gene in a reporter gene from pCAMBIA1300 vector. A pCAMBIA1300 vector control (VC) which

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is an emptied vector (i.e. only *SUV3* gene is excluded) was exerted for functional comparison of the gene. The pCAMBIA1300-*SUV3* and pCAMBIA1300 vectors were applied to *Agrobacterium tumefaciens* (LBA4404) for undergoing the transformation method in order to create the transgenic plant under alike lab conditions (Sahoo and Tuteja 2012).

Biochemical analysis of antioxidant activities of marker-free *SUV3* transgenic lines

For the germination of VC, WT and transgenic *SUV3* variety seeds hydroponics technology was used. After about 21 days they were transferred to 200mM NaCl treated hydroponic kept at 25°C with 16h maintained light and 8h dark photoperiod. Utilization of stress conditions and treatments as explained by Tuteja et al. (2013) is also applied in the case study. Biochemical inspection of glutathione reductase (GR), ascorbate peroxidase (APX), lipid peroxidation, hydrogen peroxide, proline, catalase (CAT) along with electrolytic leakage and relative water content (RWC) of the 24 h salt treated plant was done by utilizing the technique as illustrated by Garg et al.(2012).

Measurement of photosynthetic activities and agronomic characteristics of *SUV3* transgenic plants

Infrared gas analyzer (IRGA; LI-COR, <http://www.licor.com>) was used on broaden leaves of metal pot grown 60 days old plants filled with soil placed inside another horizontal pot/tank containing 200mM salt solution for documenting various photosynthesis parameters (in between 10 AM -12PM of a sunny day) like photosynthetic and yield rate, intercell CO₂ concentration and release, transpiration rate and the stomatal conductivity. Agronomic factor like number and height of plants, number of tillers and panicles per plants, number of filled and chaffs grains per panicle, dry weight of plant, its straw and its roots, grain (~100seeds) weight, length of roots and leaf area of 12day saline stressed plant were noted as per previous methods (Tuteja et al. 2013).

Measurements of Chlorophyll a fluorescence

In the greenhouse plants maintained with 25°C, and cool white fluorescent light (75 Imol photons m⁻² s⁻¹) for 16h light and 8h dark photo period were screened for fluorescence measurements like minimal chlorophyll (Chl) *a* fluorescence (F_o), maximal variable Chl fluorescence (F_v), maximal Chl fluorescence (F_m) as well as F_v/F_m ratios (here F_v = F_m – F_o) measured with average of six replicates along with standard errors ±SE. PAM-2100 fluorometer (Walz, Germany) was used for measuring fluorescence of Chlorophyll a (Chl a) from 25 days old leaves plucked (and kept in dark for 20 min before screening) from each VC, WT and transgenic rice seedlings as suggested by Dutta et al. (2009). The Photosystem II (PSII) Optimum quantum efficiency (φPSII, also referred to as Y) theorized from F_v/F_m = (F_m - F_o)/F_m (Schreiber and Armond 1978; Papageorgiou and Govindjee 2010).

Results:

Analysis of MDA, H₂O₂, ion leakage and antioxidant response in marker-free *SUV3* T₁ transgenic plants

Various changes were spotted while comparing the T₁ transgenic (L4, L7, L8, L11 and L13), VC and WT seedlings for ion linkage deviation due to salt affected changes in H₂O₂ content, along with contents of antioxidants (GR, APX, GPX and CAT), proline, relative water (RWC) and MDA (lipid peroxidation product) as reported below. 52% reduction of MDA level as well as 31% reduction level of ion linkage, 23% reduction in H₂O₂ level whereas 19% enhanced level of proline, CAT level enhanced to 70%, APX level to 90-123% high, GPX to 160% high, RWC to 200% high and GR value went upto 150% higher as reported in salt treated (200 mM NaCl) transgenic varieties in comparison to VC and WT plants.

Photosynthetic characteristics and endogenous ion content of marker-free *SUV3* T₁ transgenic plants under salt stress

Observation of photosynthetic attributes of 12 days salt treated (200mM NaCl) transgenic, VC and WT plants were compared and noted down. The photosynthesis rate of *SUV3* transgenic lines showed 33% higher rate than WT plant and 35% higher rate than VC plants when compared. More over the transgenic varieties showed 43-54% higher rate of stomatal conductivity, intercellular CO₂ and its release along with transpiration rate in comparison to VC and WT plants.

Chlorophyll a fluorescence

As the dark attuned samples exposed to high level light it was observed that fluorescence of Chlorophyll *a* raised from low (F_o / O) to high (F_m / P) level Papageorgiou and Govindjee 2011; Stirbet and Govindjee 2012). The transgenic rice, WT and VC showed uniform level of PSII maximal primary photochemical efficiency as evaluated from F_v/F_m value.

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Conclusion:

Abiotic tensity tolerance in plants is a complicated trait that includes multiple biochemical as well as physiological mechanisms. Transgenic plants with rise in productivity along with elevated commercial value should retain relatively stress tolerance property, which is very important for further agricultural advancements. Two helicase enzymes (SUV3 and PDH47) derived from pea has a significant role in salt stress tolerance along with increasing the photosynthetic efficiency of the plant. We have evolved a way to select marker and reporter- free transgenic lines with consideration to prior reports. The *SUV3* transgenic varieties provided elevation in photosynthesis activities like higher transpiration as well as photosynthetic rate and yield, intercellular concentration of carbon dioxide and its release as well as in stomatal conductance in comparison to WT and VC plants. Theories have proven that the photosynthetic rate in plants significantly increases with increase in sugar content of the plant. *SUV3* over-expressing marker-free transgenic varieties showed high sugar concentration than in VC and WT plants delineating elevation in the photosynthetic efficacy in comparison with VC and WT plants thus providing an epitome for the exploration of helicases for enhancing agricultural production with capability to withstand utmost climatic conditions, maintaining biosafety regulations and ensuring the security of food.

Key words: Transgenic rice; photosynthetic efficiency, abiotic stress, SUV3 gene, stress toletance.

A comparative study between Inter-collaboration networks among the institutional actors of Cooch Behar and Jalpaiguri districts of West Bengal

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ABSTRACT

Purpose

Agricultural extension institutions play different roles at village level. There is always a need of inter-collaboration network between different institutions. Information exchange among these organizations is important for technology generation, information dissemination and adoption. So, it is imperative to know the inter collaboration network among the institutional actors which requires proper investigation and analysis. The objective of the study was to find out the comparative study between Inter-collaboration networks among the institutional actors of Cooch Behar and Jalpaiguri districts of West Bengal.

Methods

The data were collected from 84 respondents from 19 different institutions employing a random sampling technique. The data were analysed through UCINET 6 and Netdraw software. Cooch Behar and Jalpaiguri district have 12 and 7 blocks respectively. Present study undertook 3 blocks each from Cooch Behar (Cooch Behar-I, Cooch Behar-II and Mathabhanga-II) and Jalpaiguri (Jalpaiguri sadar, Maynaguri and Dhupguri) randomly for this study.

Results

It was found from the study that *Krishi Vigyan Kendra* (KVK), Comprehensive Area Development Corporation (CADC), Agricultural line department through Assistant Director of Agriculture (ADA), Agrocultural Technology Management Agency (ATMA) and Farmer Producers' Organisations (FPO) play a pivotal role in this network. It was found also from the study that Cooch Behar district had stronger inter-collaboration network among its institution's actors than Jalpaiguri district.

Conclusions

From this analysis it is concluded that the inter-collaboration networks of both the districts are strong through network building among themselves. Although, Cooch Behar district is slight ahead of Jalpaiguri due to the presence of a greater number of institutions, but in respect of quantitative indicators they are more or less similar in status.

Keywords: Inter-collaboration network, Information exchange, Communication network, Institutional actors,

Role of critical environment parameters favoring for infection and development of Alternaria blight disease on Mustard

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ABSTARCT

Purpose

Rapeseed -mustard is a major oilseed crop of India mainly constituted by *Brassica rapa*. (Syn. *B. campestris* L.), *B. napus* L., *B. juncea* (L.) Czern and Coss and *B. carinata* Braun. *Alternaria* blight caused by *Alternaria brassicae* (Berk) Sacc. is an economically important disease of oilseed brassica in many parts of the world which causes very severe losses both in terms of quantity and quality. For efficient, economic and environmental friendly control *Alternaria* blight epidemiological studies must be conducted to gain the knowledge of weather factors in relation to pathogen attack, to predict the occurrence of *Alternaria* blight and can take efficient crop management practices.

Method

An experiment was laid out at experimental farm on ten different dates of sowing starting from **October 04, 11, 18, 25, November 1, 8, 15, 22, 29, December 6** during 2015-16 and 2016-17. The meteorological parameters data on temperature, relative humidity (RH), rainfall and number of sunshine hrs were also recorded separately at weekly interval during crop season in year 2015-16 and 2016-17 from the Meteorological Department of College of Agriculture, Gwalior. After emergence 10 plants from each plot were randomly selected tagged and inoculated with conidial suspension of *Alternaria brassicae*. The result reveals on the basis of correlation and regression analysis.

Result

The correlation studies between individual weather parameters and *Alternaria* blight intensity was reveals that maximum temperature, evaporation and sunshine hrs. showed -0.611**, - 0.608** and -0.609** negative correlation coefficient with the disease intensity. This highly significant and negative correlation indicates that the disease increased with the decrease in maximum temperature, evaporation rate and sunshine hours. On the other hand average maximum relative humidity 0.609**, minimum relative humidity (0.672**) and total rainfall (0.630**) showed correlation coefficient with the disease intensity which clearly indicates that the disease increased with the increase in average max relative humidity, average minimum relative humidity, total rainfall. Further the regression equation ($Y=33.84+1.080X$) between average maximum temperature and PDI reveals that the average maximum temperature should be less than 33.8⁰ C for the initiation of the disease and thereafter with the decrease in 1⁰C the PDI would increase by 1.08 %. The regression equation between relative humidity and PDI ($Y=-46.24 + 0.581X$) indicate that at least 79.6 % average maximum relative humidity is essential for the development of the disease and thereafter with a unit increase in the relative humidity the PDI would increase by 0.581%. Similarly the regression equation with minimum relative humidity ($Y= -7.197+0.316X$) indicate that the average minimum relative humidity should not be less than 22.8% for the initiation of the disease and thereafter it's a unit increase would result and increase in PDI by 0.316% . The regression equation between rainfall and PDI ($Y= 5.628+2.052X$) reveals that the rainfall accelerate the disease progress but it is not essential in the initiation and development of disease. The regression equation between evaporation and PDI ($Y=14.10-3.851X$) clearly indicate that the evaporation should be less than 3.7 mm. The regression equation sunshine and PDI ($Y=19.88-1.866X$) reveals that the average sunshine hours per week should be less than 10.7 hrs. per day and thereafter with one hrs. decrease in sunshine hrs. would increase in PDI by 1.86 %. About 74.18% variation in PDI was explained by all meteorological parameters included in the regression analysis. The step down regression analysis for the same depicted that after reaching the 3rd step of analysis, the variables retained were X1,X2,X3 and X5 significant and negatively influenced maximum temperature on PDI indicated that PDI decreased with unit increase in X1. The meteorological parameters like X2,X3 and X5 has significantly and positively influenced PDI indicating the increase in PDI with unit increase in X2,X3 and X5. The multiple R² 72.15% the inference could be drawn that these four variables X1,X2,X3, and X5, out of seven meteorological variables had explained a substantive amount of total variation explain by all seven variables that means only 2.66% variation in PDI was explained by these four meteorological variables.

Conclusion

Alternaria blight of mustard is negatively and highly significantly influenced by maximum temperature, evaporation and sunshine hrs while, the maximum relative humidity and minimum relative humidity and rainfall showed highly significant and positive correlation with Alternaria blight infection. Further regression equation between maximum relative humidity disease developments. The disease was also negatively influenced by maximum temperature and positively influenced by relative humidity.

Key word: Alternaria blight, Meteorological parameter, correlation, regression and disease incidence

Performance of *Raphanus sativus* crop as influenced by tree spacing and organic manures under *Melia composita* Willd. based agroforestry system

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ABSTRACT

Purpose

Melia composita Willd. (Syn. *M. dubia* Cav.) is a native, fast-growing, multipurpose tree species having short rotation period of 6 to 12 years depending on the object of management. It is a useful timber species as well as a fodder species that has emerged as one of the most appropriate tree species for various agroforestry systems. The industrial and ecological importance of *M. composita* has encouraged farmers to take large scale plantations with multiple intercrops. Introduction of high-yielding varieties and the use of synthetic fertilizers have led to rising farm incomes and fallow periods have shortened however, this kind of short-term benefits have come at the expense of long-term sustainability. This has led to severe soil erosion and accelerated land degradation, leading to declines in crop yields. It is for the reason that we aim to develop a sustainable land use system by selection of a suitable tree-crop combination whilst reducing the application of inorganic fertilizers.

Methods

An agroforestry experiment was carried out to evaluate the effect of tree spacing and organic manures on the performance of *Raphanus sativus* under 12-year-old *Melia composita* Willd. based agroforestry system with three spacing viz., S₁(8m × 5m), S₂(8m × 4m), and S₀ (sole crop) at the experimental farm of College of Forestry, Dr. Y S Parmar University of Horticulture and Forestry, Nauni (Solan), during two consecutive years 2018 and 2019.

Results

The outcomes of the present study revealed that the minimum number of days (6.00) taken to germination initiation, days taken to complete germination (9.48), days taken to marketable maturity (48.19) as well as the maximum number of leaves (13.31) per plant, leaf length (26.08 cm), leaf width (8.39 cm), root length (16.60 cm), root diameter (41.43 mm), and root yield (361.72 q ha⁻¹) were recorded in sole cropping (open field) system while minimum (10.29) number of leaves per plant, leaf length (18.47 cm), leaf width (6.67 cm), root length (14.14 cm), root diameter (33.44 mm), and root yield (275.28 q ha⁻¹) were recorded under closely spaced trees (S₂). The yield reduction under trees ranged from 1% - 23%. Study further pointed out that, among different combinations of organic manures, the application of 50% recommended dose of nutrients through vermicompost + 50% through goat manure along with Jeevamrut two times @ 500 L ha⁻¹ (T₇) was the best combination for the growth and yield of *R. sativus*. The economic analysis of agroforestry system revealed that the maximum net revenue (Rs. 377070 ha⁻¹) were obtained under wider spacing (8m × 5m) of *M. composita* when contrasted with the sole cropping system.

Conclusion

The growth and yield parameters of *R. sativus* increased with the increase in tree spacing. Among three spacing (S₁, S₂, and S₀), the higher yield of *R. sativus* was obtained in open condition as compared to agroforestry system. The yield reduction was more (23%) under S₂ while it was marginal (1%) under wider spacing (S₁). The net returns obtained from the system as a whole were higher under the wider spacing (S₁) of *M. composita* when contrasted with the sole cropping system. It is for the reason that wider spacing (8m × 5m) of *M. composita* is recommended for intercropping of vegetable crops for the development of sustainable land-use system.

Keywords: Agroforestry, Organic manures, *Melia composita*, Net Returns, Radish

Marketing Analysis of Bangalore Red Rose Onion in Chikkaballapura District of Karnataka

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ABSTRACT

Purpose: The present study was conducted to examine the costs and returns in production, price spread in different marketing channels of Bangalore red rose onion.

Methods: The study was conducted by using a random sample of sixty cultivators and twenty market intermediaries from Chikkaballapura and Chennai export markets. The primary data was collected by personal interview method with help of pretested and structured schedule during 2019-20 crop season.

Results: The major findings of the study revealed that About 78.40 per cent of the farmers sold through Channel-I (Producer → Village level trader → Commission agent → Exporter → Foreign importer → Consumers), about 15.00 per cent in channel-II (Producer → Contract trader → Exporter → Foreign importer → Consumers) and about 6.60 per cent in channel-III (Producer → Trader in APMC → Exporter → Foreign importer → Consumers). The price spread was higher in Channel-I (Rs. 9,600) compared to Channel-II (Rs. 8,800) and channel-III (Rs. 9,150) due to a greater number of intermediaries.

Conclusion: With a marketing efficiency index of 3.15, channel-II was the most efficient channel followed by channel-III (2.78) and channel-I (2.59) according to Shepherd's method.

Key words: *Price spread, Marketing channels, marketing efficiency, chikkaballapura*

Development of Web Based Application for Analysis of Strip Plot Design

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ABSTRACT

Purpose: In agricultural field research experiments, in case of two factors when the numbers of treatment combinations to be tested are large, arrangement of these two factors in Randomized Block Design (RBD) is cumbersome causing heterogeneity. In these situations, strip plot design is used. It is a two-factor experiment conducted when more precision is required for interaction effects rather than the main factors effects.

Methods: Here, a web based online module is developed for analysis of strip plot design using scripting language Active Server Pages (ASP) based on server client architecture. The validity of the outputs/results produced by module are tested with the data taken from the book entitled “Statistical Procedures For Agricultural Research” 2nd edition by Gomez, K. A. and Gomez A. A. on grain yield of six varieties of Rice, broadcast seeded and grown with three nitrogen rates in a strip-plot design with three replications. An attempt is made to provide a user friendly interface for entering/pasting the data, enter the total variables, levels of first factor, levels of second factor and number of replications in the text boxes provided in front of each variable for analysis of strip plot design.

Results: The module produces different output tables such as Analysis of Variance table for yield, mean yield table for horizontal factor, vertical factor and their interaction factors. Critical differences table for various mean comparisons at 5% and 1% level of significance and coefficient of variation. In addition, a complete procedure is also provided in the help file to make a user-friendly interface for analysis of the design.

Conclusions: Strip plot design is most commonly used design in agronomical studies. The present module will facilitate the researcher to analysis their data generated through such experiments. The results produced by the module are in agreement with the results produced from the standard statistical packages.

Key words: *Block design, Fixed effect model, Strip plot design*

Efficacy of Insecticides against litchi fruit borer, *Conopomorpha sinensis* (Bradley)

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ABSTRACT

Purpose: Litchi (*Litchi chinensis* Sonn.: Sapindaceae.) is a delicious juicy fruit of excellent quality belongs to family Sapindaceae and recognized as ‘Queen of the fruits’. Insects-pests are one of the major constraints affecting production and productivity of litchi. Litchi trees are reported to be attacked by about 40-50 insect and mite species in nature. Despite the fact that various insects pest infesting litchi in India have been recorded, litchi fruit borer is recorded as major pest of litchi (*Conopomorpha sinensis*). The studies will help in selecting the safer insecticide in development of recommendation for managing the litchi fruit borer, *C. sinensis*.

Methods: The experiment was laid at State Horticulture Nursery, Department of Horticulture, Maralia, Jammu (J&K) during 2018-19, in a randomized block design with six treatments including one untreated control, each replicated four times. Spinosad 45 SC (0.012%), *Bacillus thuringiensis* var. kurstaki (2g/l), dichlorvos 76 EC (0.076%), imidacloprid 17.8 SL (0.006%), emamectin benzoate 5 SG (0.008%) and untreated control were the treatments. One spraying of all the treatments was given at pea stage (second week of April) and second spraying were done after 15 days of first spraying. The observation on fruit damage were taken one day before and 15 days after spray from randomly selected 100 fruits per tree in different treatments.

Results: Data revealed that spinosad proved to be very effective in recording lowest fruit damage of 6.40 %, followed by dichlorvos 76 EC (8.20%) and emamectin benzoate 5 SG (13.80%) , whereas the remaining treatment *Bacillus thuringiensis* var. kurstaki 2g/l (19.40%/) and imidacloprid 17.8 SL (21.60%) were less effective compare to other treatments. However, the highest fruit damage was noticed in control (42.80%).

Conclusion: The study on estimation of impact of insecticides in major insect pests of litchi viz: litchi fruit borer (*Conopomorpha sinensis*) showed that all the insecticides were significantly superior over the untreated control. Spinosad was found to be as more effective against litchi fruit borer with lowest mean fruit damage (6.40 %) and highest reduction in fruit damage (85.04 %) over control.

Keywords: *Insect pests, Litchi fruit borer, Efficacy, Insecticides, Spinosad*

Effect of Replacement of Maize with Graded Levels of Mango Seed Kernel on Growth Performance and Carcass traits of Giriraja birds

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ABSTRACT

Purpose: An experiment was conducted to examine the effect of replacing maize with mango seed kernel powder (MSKP) in the diets of Giriraja birds on growth performance and carcass characteristics.

Methods: Two hundred Giriraja backyard poultry birds were randomly allocated to five treatment groups in which mango seed kernel powder replaced maize at 0, 2.5, 5, 7.5 and 10 per cent level designed as diets T₁, T₂, T₃ and T₄ and T₅ respectively and the birds were fed ad libitum for a period of 56 days and the standard management practices were carried out in deep litter system. The weekly and cumulative body weight gain, feed intake and feed conversion ratio were recorded for a period of 8weeks.

Results: The growth parameters obtained were not significantly ($p < 0.05$) affected by the different dietary levels of mango seed kernel powder. Caracas traits such as Carcass yield, breast muscle, drumstick yield, thigh muscle yield and abdominal fat per cent as per cent of body weight did not show any significant difference among all dietary treatment groups

Conclusions: The findings in this study shows that mango seed kernel powder can replace maize in the diet of Giriraja birds at 10 per cent level in the diet of Giriraja birds without affecting performance and can serve as an alternative feedstuff to maize which is costly.

Keywords: *Body weight gain, Feed consumption, Feed Conversion Ratio Carcass Characteristics*

Endophytes: A microbial boon to plant health

Ankita Saikia and Popy Bora

ABSTRACT

Purpose: Plant being a non-motile eukaryotic organism suffers a lot of extremities either due to biotic factors or abiotic factors. An interaction between plants and microbes are known from time immemorial in different form of relations like mutualism, competition, amensalism, parasitism, commensalism etc, thus effecting the growth of plant throughout their life. A group of microorganisms called endophytes which adapt themselves to survive inside the plant tissues causing negligible irritation to the plant. These microbes help the plant in their growth and development and also plays important defence role against the invading harmful foreign microbes.

Methods: There are more than 200 genera from 16 phyla of bacterial species that have been reported to be associated with endophytes and most of the species belong to the phyla Actinobacteria, Proteobacteria, and Firmicutes found to produce clear inhibition zone against the pathogen in *in vitro* condition.

Results: Endophytes produces large numbers of bioactive metabolites such as alkaloids, flavonoids, phenolic acids, quinones, steroids, saponins, tannins, terpenoids, diosgenin, hypericin, vinblastine etc which served as a excellent sources of drug for treatment of various disease in plants, and also found to be in competition with the pathogenic microbes for life survival needs. The wildly grown plants are the storehouse of diverse endophytic populations, highly associated with phytohormones and essential oils thus giving vigorous growth to the plant and improved fruit quality.

Conclusions: The growing concern for the upliftment of sustainable environment and reducing harmful effect of chemical fertilizer, pesticides and herbicides etc, endophytes found to be the better alternative in meeting demand of plant health, this emerging platform attracting the research community to explore more about the microbial world.

Keywords: Bioactive metabolites, endophytes, phytohormones.

In-Vitro Assessment of Cytoproliferative Potential Of Malabari Goat Lactoferrin Upon Bovine Peripheral Blood Mononuclear Cells

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ABSTRACT

Purpose: The evolution of multidrug resistant pathogens poses a major obstacle in the path of the treatment of infectious diseases affecting human and animal population. Antibiotics which have been the popular choice for countering infections since the last century are being uprooted by newer types of antimicrobial agents like metallic nanoparticles and antimicrobial peptides. Milk, often popularly known as a complete food, has been proven to be a rich source of a number of bioactive peptides. In the search for novel therapeutic and immunomodulatory agents for future, lactoferrin, the multifunctional whey protein projects a wide range of possibilities. Perusal of literature revealed that the immunomodulatory potential of the multifaceted lactoferrin protein and lactoferrin pepsin hydrolysate from Malabari, indigenous goat breed of Kerala, have not been analysed yet. The present study focussed on the isolation and characterization of lactoferrin (gLf) from the colostrum/milk of Malabari goats, followed by the *in vitro* assessment of its cytoproliferative potential on peripheral blood mononuclear cells (PBMCs).

Methodology: Colostrum/ milk samples collected from Malabari goats were processed and treated with ammonium sulphate to remove globulins from the samples. Fractions containing albumin and remaining proteins including lactoferrin after dialysis were loaded on to CM- Sephadex C-50 cation exchanger column and eluted with a step gradient of 0.4, 0.6 and 0.8M NaCl. The presence of gLf in the high OD₂₈₀ value fractions eluted with 0.8M NaCl was confirmed by 12 per cent SDS-PAGE and Western blotting. The immunomodulatory effect of gLf was studied by culturing with bovine peripheral blood mononuclear cells (PBMCs) *in vitro*. A wide range of concentrations of gLf was utilized to assess the cytoproliferative action on bovine PBMCs with or without phytohemagglutinin (PHA) mitogen, via 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyl tetrazolium bromide (MTT) colorimetric assay method.

Results: In the presence and absence of mitogen, higher concentrations of lactoferrin was found to significantly inhibit the proliferation of PBMCs whereas lower concentrations brought about significantly active proliferation of the cells. Maximum cell proliferation with or without mitogen was observed with 1.5 µg/mL of culture. The proliferation responses induced by PHA mitogen was inhibited by gLf at higher concentrations. This is the first report on the cytoproliferative effect of Malabari goat lactoferrin.

Conclusion: Lactoferrin has been found to be one of the most important multi-functional moonlighting proteins in vertebrates. It seems to play a significant role in the very complex immune system not only as an antimicrobial agent but also as a strong immune modulator thereby bringing about a controlled response of the immune cells against the

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invaders. The present study vouches on its ability as an immune modulator by regulating proliferation of PBMCs both in the presence and absence of mitogen.

Effect of *Moringa Oleifera* Leaf Powder Meal in Diets on the Performance of Commercial Laying Hens

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ABSTRACT

Purpose: The present study was undertaken to study the effect of *Moringa oleifera* on commercial Laying Hens Performance and egg quality characteristics.

Methods: Two hundred and sixteen 25 weeks of healthy commercial laying hens with uniform body weight in a complete randomized design with four treatments and 6 replications. Laying hens were randomly divided into four groups: T1: diets without administration of *Moringa oleifera* leaf meal, T2: diets with 2% *Moringa oleifera* leaf meal; T3: diets with *Moringa oleifera* leaf meal 4%; and T4: diets with 6% *Moringa oleifera* leaf meal, respectively. Each treatment consisted of six replications with 9 birds randomly assigned to each treatment.

Results: Present study showed that addition of the *Moringa* leaf meal powder were increased significantly different on egg productions, egg mass, feed efficiency, yolk color, shell thickness, but not the efficiency of feed consumption. The administration of 2-6% *Moringa* leaves powder in diets results in significantly lower yolk cholesterol contents.

Conclusion: It was concluded that supplementation of 4-6% *Moringa* leaves powder in diets, increased egg production, egg mass, feed efficiencies, yolk color, shell thickness,, but decreased yolk cholesterol contents in laying hens.

Key words: *laying hens, Moringa olifera, Egg production, Yolk cholesterol*

Supplementation of *Asparagus racemosus* (Shatavari) on the Growth Performance and Carcass traits in Giriraja birds

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ABSTRACT

Purpose: An experiment was conducted to study the supplementation of *Asparagus racemosus* (Shatavari) on growth performance and carcass characteristics in Giriraja birds.

Methods: A total of 150-day old Giriraja birds were distributed into five treatment groups with three replicates in each group and ten birds in each replicate. Basal diet (T₁) without Shatavari supplementation and the experimental diets were prepared by incorporating Shatavari at 0.25 per cent (T₂), Shatavari at 0.50 per cent (T₃), Shatavari at 1.0 per cent (T₄) and Shatavari at 1.50 per cent (T₅). The birds were fed with ad libidum for a period of 56 days and the standard management practices were carried out.

Results: The growth parameters revealed significantly higher body weight, lower feed intake and better feed efficiency in Shatavari supplemented groups. The carcass characteristics were significantly higher in dressing percentage, breast muscle yield and thigh muscle yield in Shatavari supplemented groups. There was non-significant difference in abdominal fat percent and drumstick yield in treated groups.

Conclusions: Supplementation of *Asparagus racemosus* at 1.0 or 1.50 per cent was beneficial in improving the growth parameters viz body weight, feed intake, feed efficiency and carcass characteristics in Giriraja birds

Keywords: *Body weight gain, feed consumption, feed conversion ratio carcass characteristics, Shatavari*

Effect of supplementation of *Asparagus racemosus* (Shatavari) on Serum Bio Chemical and Immune parameters in Giriraja birds

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ABSTRACT

Purpose: An experiment was conducted to study the supplementation of *Asparagus racemosus* (Shatavari) on serum bio chemical and immune parameters in Giriraja birds.

Methods: A total of 150 day old Giriraja birds were distributed into five treatment groups with three replicates in each group and ten birds in each replicate. Basal diet (T₁) without Shatavari supplementation and the experimental diets were prepared by incorporating Shatavari at 0.25 per cent (T₂), Shatavari at 0.50 per cent (T₃), Shatavari at 1.0 per cent (T₄) and Shatavari at 1.50 per cent (T₅). The birds were fed with ad libidum for a period of 56 days and the standard management practices were carried out.

Results: Serum cholesterol levels and low-density lipoprotein values showed significantly lower whereas high density lipoprotein levels did not differ significantly when compared to control group. There was a significant increase in weight of bursa of fabricius whereas weight of spleen and thymus did not differ significantly. There was a significant improvement on immune titre against Infectious bursal disease whereas the immune titre against new castle disease did not show any significant improvement when compared to control group

Conclusions: Supplementation of *Asparagus racemosus* at 0.5, 1.0 and 1.50 per cent was beneficial in improving the serum bio chemical parameters (serum cholesterol and low density lip protein) and antibody titre against infectious bursal disease in Giriraja birds

Keywords: *Serum cholesterol, infectious bursal disease, Shatavari*

Study on Socio Economic Factors and Production of Bangalore red rose onion in Chikkaballapura district of Karnataka

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ABSTRACT

Purpose: The present study was conducted to document socio-economic factors and to examine the costs and returns in production, price spread in different marketing channels of Bangalore red rose onion.

Methods: The study was conducted by using a random sample of sixty cultivators from all taluks of Chikkaballapura district. The primary data was collected by personal interview method with help of pretested and structured schedule during 2019-20 crop seasons.

Results: The major findings of the study revealed that cost of cultivation per acre and cost of production per tonne of Bangalore red rose onion was Rs. 70,847 and Rs. 4,167.47 respectively. The average yield per acre was 17 tonnes with a gross return of Rs. 2,72,000 per acre and net returns of Rs. 2,01,153. The return per rupee of investment was Rs. 2.83.

Conclusions: Growing of Bangalore rose onion crop is profitable to the farmers

Keywords: *socio-economic factors, Bangalore red rose onion, Chikkaballapura, cost and returns*

Soil Nutrient Status and Mapping Of Korasagu-4 Micro Watershed Of Channagiri Taluk, Davangere District, Karnataka, India

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ABSTRACT

Purpose: The present agricultural systems are exploiting of nutrients through intensive tillage, mono cropping year after year, use of high yielding varieties, imbalanced use of nutrients coupled with limited use of organic manures, less recycling and burning of crop residues, soil erosion, undulated topography and indiscriminate use of irrigation water. Similarly, different soil groups as regards to production and productivity. For understanding the reasons of deficiency of available nutrients in soil correlation of physical and chemical properties with available nutrients was needed also detailed study on nutrient status in soil group in Korasagu-4 micro watershed of Channagiri taluk,

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Davanagere district land not been undertaken so far. Hence, present study was undertaken to study the nutrient status in Korasagu-4 micro watershed of Channagiri Taluk, Davanagere District, Karnataka, India.

Methodology: A Korasagu-4 micro-watershed in Channagiri taluk, Davanagere district was selected as study site, which located between 14° 0' 54.01" N latitude and 76° 4' 10.51" E longitude and 13° 58' 33.80" N and 76° 4' 28.90" E as well altitude 669 MSL with a spatial extent of 980.94 ha. The survey of India toposheet was used to prepare base maps covering Korasagu-4 micro watershed. The cadastral map having parcel boundaries with survey numbers collected from KRSRAC, Bengaluru were used for the study. The survey of India toposheet with 1:50,000 scale was used along with the satellite imaginary for updating the base maps. A surface soil samples from 0-15 cm was collected at 320 x 320 m in grid samples in the study area. A total 96 surface soil samples were collected from the fixed grid points. The processed samples were analysed by adopting standard procedure. Particle size distribution was determined by international pipette method (Piper, 1966). Soil pH and electrical conductivity was determined at 1:2.5 soil water suspensions by Potentiometric and conductometry method (Jackson 1973). Organic carbon was measured by Chromic acid wet digestion method (Walkley and Black 1934). Available N in the soil was determined by alkaline potassium permanganate method as described by Subbiah and Asija (1956). Available phosphorus was extracted by using Olsen's extractant (0.5 M NaHCO₃) for neutral and alkaline soils and Bray's extractant for acid soils was determined by spectrophotometer (Jackson, 1973). The available K was estimated by extracting the soil with 1 N NH₄OAC (pH 7.0) by using flame photometer. The exchangeable calcium and magnesium were determined by versenate titration method (Jackson, 1973). Available sulphur was extracted from soil using 0.15 per cent CaCl₂ solution and determined by turbidometrically (Black, 1965). The micronutrients like Fe, Zn, Mn, Cu and B in the soil were extracted with DTPA extractant by using Atomic Absorption Spectrophotometer (Lindsey and Norvell, 1978). Hot water extractable boron in soil was determined as per the procedure outlined by John *et al.* (1975) by using Azomethane-H reagent. Nutrient maps are prepared by using GIS technique.

Results: The results of the investigation indicated that soils of micro watershed were slightly acidic to strongly alkaline in soil reaction with non-saline in nature. Soil organic carbon content was found to be medium in major area. The available N, P₂O₅, K₂O was found to be low (73.37%), medium (94.65%) and high (58.72%) respectively, in the micro-watershed. In the total area of the micro-watershed 55.89 per cent and 70.17 per cent of sulphur and boron content was found to be medium and zinc was found to be deficient in 84.85 per cent of the area. High level of soil organic carbon status was observed in major area (192 ha). About 533 ha (56.39%) was medium and 177 ha (18.06%) was low in soil organic carbon status. The medium to high organic carbon status in soil attributed to good vegetative growth and consequent addition of organic matter to soil (Patil and Ananth Narayana, 1990). The entire micro watershed area (980.84 ha) was sufficient in DTPA extractable micronutrients like copper, iron and manganese, while the available zinc was sufficient in 96 ha (9.80%), deficient in 832 ha (84.85%) area. The available boron content was ranged from low to medium (0.15-1.43 mg kg⁻¹). The DTPA extractable iron content in micro watershed was sufficient. This might be due to the granite gneiss parent material, which was known to possess higher iron content.

Conclusion: The DTPA extractable micro nutrients like iron, copper and manganese were found to be sufficient in entire micro watershed area. Whereas zinc was found to be sufficient in 96 ha (9.8%) and deficient in 832 ha (84.85%) and boron content was found to be low to medium. The study highlights the importance of mapping the parameters which give the spatial extent rather than the means, which have limited applicability for better soil management and precise management of nutrients.

Sensitivity of A Fresh Water Teleost *Catla Catla* To Some Organophosphate Pesticides Through Bioassay Studies And Fish Behaviour

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ABSTRACT

Purpose: Pesticides are contributing in current agriculture to fulfil the need of raising population. Use of pesticides is not limited to agriculture but they are also used to control over domestic pest, disease insect vectors and home gardening. *Dimethoate* and *malathion* are widely used pesticides in India. The pesticides find their way to aquatic ecosystem by three major routes: 1. Water column; 2. Organic substrates such as aquatic fauna; and 3. Inorganic substrate, e.g. soil. Standing water has higher concentration than running water. *Catla catla*, major south Asian carp of family *cyprinidae* is a fast growing major food fish having high nutritive value. It is generally cultivated in ponds. Objective of the present study is to focus on some factors which deteriorate the habit of this food fish. In this study,

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effects of two organophosphates-*dimethoate* and *malathion* are observed on the fish through bioassay test and fish behaviour.

Material and Method: The test chemicals- *dimethoate* and *malathion*- are soluble in water. Therefore, for bioassay tests, the *dimethoate* and *malathion* were dissolved in water to get required concentration. Dosage mortality studies were conducted at room temperature ranging 13.7°C to 27.5°C ($\pm 2.0^\circ\text{C}$) in a static water condition as described by Dusodroff and Katz (1950) for 48, 72 and 96 hours. The other parameters like pH of the water (7.0 ± 0.2) hardness (72 mg/l), dissolved oxygen (7.0 ± 0.5 mg/l) and CO_2 (4.1 ± 0.2 mg/l) were also measured for the water used for bioassay studies and 1/3, 2/3 and 1/5 sublethal concentrations are used to Acute exposure. Fish behaviour observed when exposed to different concentrations of *dimethoate* and *malathion*

Results: The results of Bioassay tests for *Catla catla* are as follows:

Lc50 for Malathion

48 hours – 0.084 ppm

72 hours – 0.073 ppm

96 hours – 0.047 ppm

Lc50 for Dimethoate

48 hours – 0.0097 ppm

72 hours – 0.085 ppm

96 hours – 0.007 ppm

Fish Behaviour: Exposure to even lowest concentrations of *dimethoate* and *malathion* enables the fish sluggish, alteration in swimming ability, increased in mucus secretion making them more susceptible to pathogens and secondary infections, and vulnerable to diseases. Interpretation of schooling behaviour of fishes was observed and it results the fish to be more susceptible and easily preyed by other fauna present in its habitat. So we can get desired fish production. Pesticides hamper its growth because they reduce their ability to feed. As *Catla catla* is a surface feeder and sustain on phytoplankton only, the exposure of pesticides increase the movement of opercula, rapid jerk movement, and loss of equilibrium, hyper excitability and sinking to bottom thus disturbing feeding of the fish.

Conclusion: During the study it was found that *Catla catla* shows more sensitivity towards *dimethoate* than *malathion*. So it is suggested that while making use of these pesticides in agriculture their concentration should be carefully monitored so that we can save our fish food. There is a need to decrease the application of chemical pesticides and to make use of herbal pesticides in farming which don't have negative impact on the health of fish.

Cardiac fitness status among male paddy cultivators: a study in context of emerging increasing in ambient temperature

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ABSTRACT

Background: Physical work capacity of the human resources getting affected due to adverse thermal working condition predominant in working environment. Keeping this in view the present study has been undertaken to assess cardiac fitness status in terms of indices of physiological strain among male food crop cultivators.

Materials and Methods: Physical and physiological parameter of the study participants was measured. Indices of thermal working environmental condition were calculated. Indices of physiological strain of the study participants also calculated.

Results: Result of the present study indicated that environmental condition adjudged by select popular heat indices is above the suggested threshold value making the task strenuous.

Conclusion: human resources suffering from varying degree of physiological strain.

Keywords: *paddy, heat indices, thermal comfort, task, fitness*

Holistic approach as Carbon Sequestration in sustaining the Soil Health and Environment

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ABSTRACT

Introduction: Carbon sequestration describes long-term storage of CO₂ or other form of carbon to either mitigate or defer global warming and avoid dangerous climate change. Transfer of atmospheric CO₂ into soil as SOM and secondary carbonates through input of biomass-C and the nutrients (N, P, and S) required to transform cellulose and lignin into humus. (Lal 2004a; Lal 2008). Carbon Sequestration is the placement of CO₂ into a depository in such way that it remains safely and not released back to the atmosphere.

Types of Carbon Sequestration: There are two major types of carbon sequestration:

[A] Terrestrial Sequestration: It means using plants to capture CO₂ from the atmosphere and then storing it as carbon in the stems and roots of the plants as well as in the soil.

[B] Geologic Sequestration: Geologic sequestration is putting CO₂ into long term storage in geologic zones deep underground.

Management Techniques

Cover crop: cover crop improves carbon sequestration by enhancing soil structure, and adding organic matter to the soil.

Crop rotation: varying the type of crops grown can increase the level of soil organic matter.

Conservation tillage: generally, reduce soil erosion, improve water use efficiency, and increase carbon concentrations in the top soil. It also reduces the amount of fossil fuel consumed by farm operation.

Benefits of Soil Carbon Sequestration

- Removing CO₂ from the atmosphere is only one significant benefit of enhanced carbon storage in soils.
- Improved soil and water quality.
- Decreased nutrient loss.
- Greater crop production may result from increasing the amount of carbon stored in agricultural soils.
- Increased soil fertility
- Improved biodiversity
- Healthier ecology

Challenges in Soil Carbon Sequestration

- Deforestation
- Residue burning
- Conventional tillage
- Imbalanced use of fertilizer
- Reduced inputs of organic matter.

Conclusion: Soil carbon sequestration is an effective tool to sequester atmosphere CO₂ with better practical application than other approaches. Soil carbon sequestration using innovate soil and crop management practices is needed to augment soil carbon storage.

Keywords: Atmosphere, Carbon Storage, Sequestration, Tillage

Crop Residue Recycling and Its Effect on Soil Quality Improvement

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ABSTRACT

Introduction: Crop residue is defined as the vegetative crop material left on the field after a crop is harvested, pruned or processed. The removal of crop residues leads to low soil fertility and thereby decreased crop production. The straw of most cereal crop contains about 35%, 10% and 80% of the total N, P and K taken up by the crop.

Management of Crop Residue

[1] Residue Burning

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- [2] Baling and removing the straw
- [3] Surface Retention and mulching
- [4] Residue Incorporation

Limitations of Crop Residue Management

- Physical removal of stubble is not cost effective
- Straw burning, though easiest disposal, but leads to environmental pollution and nutrient losses
- Incorporation of crop residues results in:

Immobilization of nutrients

Accumulation of toxic substances

Incorporation of residues involves huge mechanical energy and thus raises cost of production of succeeding crops.

Effect of Crop Residue on Soil Quality

Leaving crop residue on the soil surface improves nutrient cycling and, ultimately, soil quality that will increase and sustain soil productivity. Through conservation practices that include balanced residue management and soil fertility, environmental quality can be substantially enhanced. By retaining crop residue on the soil surface, soil organic carbon (SOC) and nutrient-holding capacity are increased while protecting the soil from wind and water erosion.

Conclusion: Crop residues of common cultivated crops favorably affect soil physical, chemical and biological properties and also affect crop yields. In long-term incorporation of crop residue increased the productivity. Overall, incorporation of crop residues appears to be a better management option. Incorporation should be done at least 10 days and preferably 30 days before the establishment of succeeding crop.

Keywords: *Burning, Nutrient, Residue, Soil Quality*

Enhancement in yield potential of Elephant Foot Yam (Gajendra) in Nalanda District Kumari Vibha Rani, U.N. Umesh, Jyoti Sinha, Brajendu kumar

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ABSTRACT

Purpose: Elephant foot yam is an important tuber crop cultivated in upland area of Nalanda district. Due to low yield potential of local variety and lesser income from it. This demonstration was conducted to enhance the yield and increase the income.

Methods: The tubers of improved variety Cv. Gajendra weighing 500 to 750 gm treated with imisan-6 @2.5gm/liter and streptomycin @0.5gm/liter is sown at spacing of 50*50 cm instead of local variety with small tubers which sown in irregular manner previously. The demonstration was conducted in two villages of Nalanda district.

Results: It was found that 48.41% increase in yield due to introduction of Gajendra variety in Nalanda district. The yield of this cultivar was 376.41 Q/Ha as compared to local variety yield was 253.62 q/ha. The increase in net return was Rs.260210 from Rs. 149550.48 per hectare. The enhancement in B:C ratio was 2.14 from 1.61. This variety was also widely adopted due to its non-acrid, well shaped and devoid of cornels tubers.

Conclusions: The increase in yield, productivity per unit area and enhancement of net profit by cultivation of improved cultivar Gajendra was found much beneficial for farmers cultivating elephant foot yam.

Keywords: *Elephant Foot Yam, Yield, Profit, Improved variety, Gajendra*

Form of soil phosphorus release as influenced by rock phosphate enriched vermicompost and fertilizer

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ABSTRACT

Purpose: In agricultural land, phosphorus (P) unavailability is one of the main factors that reduces crop production and yield. The availability of P using rock phosphate (RP) with vermicompost and the addition of phosphate solubilizing bacteria to increase the available form in soil.

Methods: A 90-day incubation experiment in the laboratory with five treatments was used to assess the rate of dissolution of various forms of Phosphorus (P) sources in alluvial soil. viz., 0 % RDP (Recommended Dose of Phosphorus); 100% of RDF (Recommended Dose of Fertilizer) NPK; VC (Vermicompost) @ 100% of the RDP;

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REVC (Rock phosphate Enriched Vermicompost) @ 100% of the RDP and 50% RDP+REVC @ 50% of the RDP. The phosphorus release pattern was determined for every treatment at 30 days interval.

Results: The integrated treatment of 50:50 combination of EVC and P-fertilizer performed better than the other treatments. In soil, this combination produced more labile P (16.05 mg kg⁻¹), whereas Fe-Al-bound P (53.86 mg kg⁻¹), Ca-bound P (163.06 mg kg⁻¹) and residual-P (169.78 mg kg⁻¹) in 100 % rock phosphate enriched vermicompost. It may be inferred that enriched vermicompost (50%) combined with reduced inorganic P fertilizer treatment (50%) could be highly beneficial in supplementing plant P requirements by boosting P release and availability under naturally P deficient situations.

Conclusion: Application of enriched organic as well as inorganic sources of nutrients may be a way to improving the effectiveness of applied P to an alluvial soil by enabling P release and availability during the crop cycle.

Keywords: *Phosphorus, phosphorus fractionation, rock phosphate enriched vermicompost, transformation*

Weed Management by Soil Solarization

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ABSTRACT

Introduction: Soil Solarization is a non-chemical method in which the soil is heated to lethal temperature by using solar radiation for weed control. It can be an alternative to agricultural chemicals that have significant environmental risk and pose negative impact on the beneficial soil micro-organisms. This non-chemical control procedure has been adopted by farmers in several parts of the world. It offers weed management based on trapping solar radiation by tightly covering the soil usually with transparent polyethylene sheets. This result in a significant increase of 10-15°C above normal temperature of soil, temperature up to the point where most weeds are vulnerable to heat effects.

Weed Management: Weeds are robbers of nutrients, soil moisture and other crop growth factors. This phenomenon needs to be eradicated or control as per the situation. The weed plants, is not controlled effectively can reduce crop yield to the extent of 20-50 per cent or even more. The loss due to weeds in India is around Rs. 2000 crores every year. Proper weed management practices will definitely improve the total productivity of our nation.

Steps for Successful Soil Solarization

1. Plan to solarize a portion of your garden when solar radiation is optimal (June through August).
2. Avoid areas with shadows or north-facing slopes.
3. Root till the soil to incorporate current weeds, crop residues, compost, fertilizers, etc.
4. Remove any sharp sticks, stalks, etc. that could puncture the plastic.
5. Thoroughly moisten the soil (or wait for a good soaking rain).
6. Cover the moist soil with clear, polyethylene plastic sheeting.
7. Bury the edges of the sheeting with soil, landscape timbers, etc. to prevent wind from getting underneath the plastic or hot air from escaping.
8. To achieve the highest Solarization temperatures, cover the first sheet with another sheet of clear, polyethylene sheeting. (The first sheet may be black if the second sheet is clear.)
9. If you use two layers, create an air “gap” between the layers of sheeting with strips of insulation, small blocks of wood, bricks, etc. Avoid materials with sharp edges. Bury the edges of the second sheet.
10. Keep the top surface free of dust and water during the Solarization period.
11. Remove the plastic after 4 to 6 weeks (perhaps sooner if hot, sunny clear days have been common).
12. When planting your field, avoid the outer edge (1-2 ft.) of the solarized area.

Applicability of Soil Solarization: Unlike other method of weed management soil Solarization brings about control of wide variety of pests including soil brone fungi, bacteria, Nematodes and enhance availability of mineral nutrient to crop plants apart from weed control. In addition, many parts of tropical India experience extreme summer, thus this area have a great potential to utilize soil Solarization for weed management.

Conclusion: Soil Solarization is simple, safe, cost-effective and eco-friendly technology for weed control. Unfortunately, in our country most of the farmers are not aware about the application of soil Solarization technology for weed management and safe crop production. Hence there is an urgent need for the popularization of the soil Solarization process among the farmers through the workshops and mass awareness programmes. Thus, Soil Solarization is a safe and effective alternative for weed management other than chemical.

Keywords: *Polythene Sheets, Soil Solarization, Weed Management*

***In vitro* shoot induction and somatic embryogenesis in *Picrorhiza kurroa* Royle ex. Benth using nodal explants**

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ABSTRACT

Purpose: *Picrorhiza kurroa* Royle ex. Benth is an important medicinal plant of Himalayan region. The plant has been affirmed as endangered owing to their over-exploitation. *In vitro* propagation and conservation of the plant is important to meet the requirements of pharmaceutical industries. A protocol for mass multiplication of *P. kurroa* was developed under *in vitro* conditions

Methods: The plant material was collected from natural habitat from the Kishtwar region of J&K. Nodal buds were used as explants and the effect of different growth regulators was studied for *in vitro* shoot induction and formation of somatic embryos.

Results: A three step sterilization consisting of 70% ethanol, 1ppm KMnO₄ and 0.1% HgCl₂ resulted in maximum survival of explants. Highest number of shoots were achieved on MS medium supplemented with 1.0mg/l BAP, 0.5 mg/l Kn and 1.0mg/l GA₃, while MS medium containing 2.5 mg/l IBA resulted in best root induction. Creamy white and friable callus was obtained in MS medium containing 2.0mg/l and 3.0mg/l 2,4-D. *In vitro* shoot and root induction from callus was obtained in MS media supplemented with BAP, NAA and IBA. However, callus on sub-culturing on MS containing 2.5 mg/l 2,4- D resulted in globular shaped somatic embryos. Embryos turned green on MS medium supplemented with 1.0mg/l BAP and 1.0mg/l GA₃ and further differentiated into shoots with one or two plumules was after three weeks of culturing.

Conclusions: The present study opens fresh avenues towards the germplasm conservation and resource management of the overexploited *P. kurroa* plants.

Keywords: *in vitro*, *P. kurroa*, explants, growth regulators

An Efficient Protocol for Genomic DNA Extraction and RAPD Analysis of Papaya (*Carica papaya* L.)

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ABSTRACT

Purpose: Papaya (*Carica papaya* L.) is one of the most important tropical fruit crop grown in India. In Kerala, the crop has gained popularity due to its nutraceutical value. DNA isolation was done from young emerging leaves of papaya using hexa decyl trimethyl ammonium bromide (CTAB) method with slight modification.

Methods: Hybrids selected for the study were Pusa Nanha x Solo, Pusa Dwarf x Coorg Honeydew, Pusa Nanha x Coorg Honeydew and Solo x Coorg Honeydew. DNA yield of different papaya hybrids ranged from 540 µg ml⁻¹ (Solo x Coorg Honeydew) to 840 µg ml⁻¹ (Pusa Nanha x Coorg Honeydew).

Results: The ratio of A₂₆₀/A₂₈₀ ranged from 1.78 (Pusa Dwarf x Coorg Honeydew) to 1.86 (Pusa Nanha x Coorg Honeydew). All the 10 primers yielded amplification products with the DNA of Pusa Nanha x Coorg Honeydew. Primers OPA-03, OPA-04, OPA-12, OPB-04 and OPB-17 gave 40 scorable bands, with an average of 8.0 bands per primer. The highest number of scorable bands (12 bands) was given by the primer OPA-03. The number of bands resolved per amplification was primer dependent and varied from four to twelve.

Conclusions: Results of the trial revealed that the largest cluster in dendrogram was formed by three hybrids - Pusa Nanha x Coorg Honeydew, Pusa Dwarf x Coorg Honeydew and Pusa Nanha x Solo. The second cluster contained only one hybrid - Solo x Coorg Honeydew. The pair wise similarity coefficient values varied from 0.389 to 0.714. The minimum similarity coefficient detected in the present study was 0.389, suggesting a genetic differentiation among the papaya hybrids

Keywords : *Papaya*, DNA, RAPD, Primer, Hybrid, Genetic differentiation

‘Clean Food’ through adoption of ecologically and economically sustainable farming technology with special focus on soil & plant health management

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ABSTRACT

Purpose: Today it is no longer a debatable issue that since the “green revolution” of the 1960s have been touted as solutions to the global hunger problem— but focusing only on the potentiality of high crop yields have come at the cost of environmental degradation and lowered sustainable food and nutritional security over the long term. Especially in the crop intensified zones, with the rampant use of chemical fertilizer and pesticides soil quality has been eroded to an alarming stage. Loss of soil fertility, erosion of soil, soil toxicity, diminishing water resources, pollution of underground water, salinity of underground water, increased incidence of human and livestock diseases, risk of food toxicity enhances with indiscriminate and disproportionate use of Agro-chemicals (Rahman, 2015). Thus, shifting focus towards ecologically and economically sustainable crop cultivation is the only option left for future crop sustainability. In this background, pesticide free ‘Clean Food production’ with adoption of various good agricultural practices (GAP), mechanical and biological practices amalgamated with innovative organic approach (IRF technology) specially focused towards soil and plant health management have been adopted in some villages of Fathepur Gram Panchayat in the Haringhata Block, Nadia district of West Bengal from 2020. The objectives of the study are crop sustenance, soil rejuvenation, ecological sustenance and most importantly sustained livelihood generation for small and marginal farmers.

Methodology: The Program initiated with soil sampling and soil quality analysis followed by the development of sustainable soil management program along with the on-field preparation of Novcom compost, which can be made only within 21 days. An integrated approach of plant health management was developed side by side towards sustainable crop growth, higher crop production and gradually reducing the pest/ disease infestation. Finally the end products were analyzed with Colorometric Pesticide Assay Test for evaluation of pesticide residue in vegetable produced under this ‘Clean Food’ program.

Results: Analysis of soil samples in the study area clearly indicated soil quality depletion with very low organic carbon (< 0.70 %), very poor biological properties, poor microbial biomass carbon (<200 µg.CO₂.C/gm dry soil) and poor FDAH (< 50 µg/gm dry soil). Comparative evaluation of crop productivity under clean food programme *vis-a-vis* conventional farmers’ field indicated 3.0–13.5% increase in crop yields in the 1st year of program adoption. Analysis of pesticide residue indicated presence of pesticides residue in less than 4% of the vegetable samples, while in the rest the same were below detection limit (< 0.01 ppm). In contrast, out of the samples procured from the local market about 18 % showed pesticide residue in one or more group especially Organochlorine, Organophosphate, Carbamate, Synthetic Pyrethroids and Nicotinoids. Study of Energy Use efficiency showed that upto 60% higher energy use efficiency can be achieved under clean food program in comparison to conventional farming practice. In terms of green house gas (GHG) emission, switch over to clean food program can reduce upto 0.5 kg CO₂ equivalent per kg produce and significantly contribute in the climate change mitigation initiatives. Soil development index post production indicated 10 to 15 % enhancement in soil quality which was majorly due to the activation of soil biological properties through the application of compost as well as reduction in the use of herbicides and chemical pesticides.

Conclusion: Thus the clean food program can be a practical option for sustainable agriculture towards crop sustainability, environmental preservation and empowerment of the small and marginal farmers.

Assessment of high Yielding Variety of mustard Under Firozabad District

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ABSTRACT

Purpose: Mustard is a main oil seed crop of media. It is Very oldest crop of the world originally it was the condiment that was known as mustard. Three types of mustard seed are Popularity used as condiments pale Yellow or black mustard. Apart from their use as auspice mustard are widely used as green Vegetable. The Main purpose of this study to increase is under mustard through cluster frontline demonstration at foramens field in district Firozabad.

Method: Considering the particular constrain a Cluster frontline demonstration during Rabi 2017-18 on formers field at four different Locations in the district. Two Mustard Variations namely RH-749 and DRMR IJ-31 (Girriraj) was tested and Composed with Rohini used mostly farmer which was treated as control.

Result: At all four location RH-749 (25.66 qt/ha) DRMR IJ-31 (Girriraj) (24.55 qt/ha) and in cont Rohini Gave (21.30 qt/ha) respectively. The respective variety assessment RH-744 is better in yield land and Yield was increased 20.47 Percent.

Conclusion: The refined technology is more beneficial in term of production and farmers are adopted very fastly in district.

Keywords: Variety, RH-749, DRMR IJ-31 (Girriraj)

Bioremediation: A Solution to Environmental Pollution

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ABSTARCT

Introduction: Bioremediation is the use of microorganisms for the degradation of hazardous chemicals in soil, sediments, water, or other contaminated materials by metabolic process. *Number of microbes including aerobic, anaerobic bacteria and fungi are involved in bioremediation process. According to the Environmental Protection Agency (EPA), “Bioremediation is a water and soil treatment technique using naturally occurring organisms to attack hazardous materials and change them into less toxic substances. Often, highly contaminated sites can become toxin-free using proper bioremediation steps and specialized equipment”.*

Factors Affecting Microbial Bioremediation: Factors that influence the rate and extent of contaminant degradation by microorganisms can be broadly grouped into two classes of factors: (a) biological factors and (b) environmental factors.

- **Host microbial contaminants** that provide fuel and energy to parasitical microbes
- **Parasitical microbes** that feed off their harmful hosts and destroy them
- **Oxygen** in sufficient amounts to support aerobic biodegradation
- **Water**, either in liquid form or in soil moisture content
- **Carbon** is the foundation of microbial life and its energy source
- **Temperature**, not too cold or hot for microbial life to flourish
- **Nutrients** like nitrogen, phosphorous, potassium and sulfur to support microbe growth
- **Acid and alkaline proportions** or pH ratio in the range of 6.5 to 7.5

Types of bioremediations:

In-situ bioremediation: It includes cleaning up of contamination at the site where it occur. *In-situ bioremediation techniques have been effectively used to treat chlorinated solvents, heavy metals, dyes, and hydrocarbons polluted sites.*

Ex-situ bioremediation: It includes cleaning up of contamination out of site. *Ex-situ bioremediation techniques involve digging pollutants from polluted sites and successively transporting them to another site for treatment.*

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Advantages of Bioremediation

- Contaminants usually converted to innocuous products.
- Relative ease of implementation.
- Minimal exposure of onsite workers to the contaminant.
- Long term protection of public health.
- The cheapest of all methods of pollutant removal.
- Uses natural process

Disadvantages of Bioremediation

- May not reduce concentration of contaminants to required levels.
- Requires more time.
- May require more extensive monitoring.
- Not all organic compound are biodegradable.
- Products of biodegradation may sometime toxic then parental form.

Bioremediation Applications: Bioremediation must be considered as appropriate methods that can applied to all states of matter in the environment

- Solids (soils, sediment and sludge)
- Liquids (ground water, surface water and industrial waste water)
- Gases (industrial air emissions)
- Sub-surface environments (saturated and vadose zones).

Conclusion: Bioremediation is an emerging technology which can be simultaneously used with other physical and chemical treatment methods for complete management of diverse group of environmental pollutants. This technology offers an efficient and cost-effective way to treat contaminated groundwater and soil. Thus, *Biodegradation is very fruitful and attractive option to remediating, cleaning, managing and recovering technique for solving polluted environment through microbial activity.*

Keywords: Bacteria, Fungi, Pollution, Treatment

Novel approach for insecticide biodegradation and bacterial wilt bio-management

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ABSTRACT

Purpose: The use of synthetic pesticides have become inevitable for pest and disease management in today world but their extensive use has left diversified hazards on both, environment and human health. At present the most widely used group of pesticides belongs to the organophosphorous (OP) group. Continuous and excessive use of OP contaminated the agroecosystem due to accumulation of their residues. The microbial degradation of residues of OP is considered as an environmentally benign and economically preferred option. The present investigation was carried out to prepare bioformulations of Organophosphate Degrading Bacteria and Plant Growth Promoting Microbes for evaluating their biocontrol potential against *Ralstonia solanacearum*, a soil borne pathogen responsible for wilt disease of brinjal, paving the way to development of a suitable delivery mechanism for pesticide biodegradation and biological management.

Methods: The potential isolates were subjected to compatibility study with PGPMs such as *Pseudomonas fluorescens* (Pf) and *Trichoderma harzianum* (Th). These studies facilitated the development of bioformulation containing PGPMs and OPDBs, finally evaluated for its efficacy against bacterial wilt disease of brinjal and degradation of Organophosphate pesticide.

Results: The potted experiment showed that combination of Pa + Pf + Th displaying lowest percent wilt incidence (PWI) of 5% coupled with significantly highest root biomass (5.35g/plant), shoot biomass (36.39g/plant), root length (27.88 cm/plant), shoot length (81.42 cm/plant), leaf number (83.20/plant), fruit number (5/plant), branches number (8.80/plant) and yield (1.42kg/plant) applied as seed treatment+seedling root dip+ soil application. The bioformulation consisting of Am + Pa + Pf + Th was observed most effective with 85% degradation of OP at 45 days after application followed by bioformulation of Am + Pf + Th with 70% degradation and Pa + Pf + Th with only 60% degradation.

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Conclusion: This study would be instrumental in providing novelty in bioremediation of pesticide contaminated soil as well as biological management of bacterial wilt disease with a single formulation.

Keywords: *Biodegradation, Biomanagement, Organophosphate Degrading Bacteria, PGPM.*

Effect of harvesting on Vase life of carnation (*Dianthus caryophyllus*.) cutflower in second season crop

Ashwini Kasturi and Chandra Shekhar R.

ABSTRACT

Purpose: Carnation is a perennial crop which is used extensively as a cutflower. Generally it is harvested at different heights and nodes without knowing its impact on the second season crop which influences the quality of the flower which enhances the vase life of a cut flower.

Methods: The experiment was conducted in three cultivars at four different heights i.e. 5, 10, 15, 20 cm of harvesting of cut flower. In the second season the cut flowers are tested with holding solution of 8HQ3 300ppm + AgNO₃ 50ppm + 5% sucrose solution.

Results: Flower stalk harvested at lower levels recorded maximum vase life with holding solution i.e. 10 cm height for the ground level. It might be the better quality of the flower stalks produced by lower level of harvesting.

Conclusions: The study indicated that in carnation, harvesting of flower stalk especially at 10 cm height was the optimum level of harvesting to get good quality of flower which leads to more vase life.

Keywords: *Carnation, harvesting, vase life*

Reduction of pollutants in atmosphere

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ABSTRACT

Purpose: To save and guard the lives of humans due to drastic changes taking place in the environment, environmental safety is necessary. Otherwise life will not be safe on earth.

Methods: We will study how to monitor the changes in the environment and how to reduce their impact technically. A state of projection of the environment and vital human interests from possible negative impact of human activities and emergency situations.

It is dependent on the acceptable level of negative impact of natural and anthropogenic factors.

1. Acceptable level of negative impact
2. Ensure a minimum level of anthropogenic impact on the environment
3. Environmental monitoring
4. There are four methods of purification emission from power plants.
 - a. reduction method
 - b. thermal method
 - c. methods of mechanical purification
 - d. sorption method

Three prime areas of environmental safety

1. Occupational safety and health, 2. Environmental control, 3. Chemical safety produced by factories.
Monitoring of environmental impacts, control of environmental impact source, monitoring of environmental risks, monitoring of sustainable development
Importance of environmental safety

Information has been sought from the internet, learned professor, and concerned N.G.O.

Conclusion: Human race has to adopt the above method sincerely to save the life of humanity. It has to see that global warming is reduced and where it is not possible the environmental factors.

Keyword: *Monitoring, global warming, sustainable development*

Escalation of β -fructofuranosidase fabrication by desolated *Bacillus subtilis* adhered to *Musa* (Banana) exocarp

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ABSTRACT

Purpose: Chemical reactions are difficult steps in any process so as the biochemical reactions. Any reaction that would take a longer time period to occur shall cut short by using catalyst (Chemical origin) or biocatalyst (Biological origin such as ‘enzymes’). Most of the industries today depend upon the biocatalyst as they are relatively uneconomical. One such biocatalyst referred here is “Invertase” (β -fructofuranosidase) that is mostly produced by small bio-factories called microbes. Invertase is an enzyme belonging to class of hydrolases that catalyzes hydrolysis of disaccharides such as sucrose mostly, into its constituents that is glucose and fructose into equimolar mixture called as ‘invert sugar’ and trisaccharide such as raffinose optionally. Invertase has plentiful application in industries like food, textile, pharmacy and confectionary. Although the enzymes are boon to an industry but a well optimized biocatalyst for the maximum output is more than a bonus. In the present study statistically optimization of *BsINV* production from *Bacillus subtilis* (Accession number MN263256) was carried out using Response Surface Methodology (RSM). One time variable approach provided a coherent range of physical (Temperature and inoculum size) and nutritional parameters (Carbon and nitrogen). The range so obtained was used to form a Central Composite Design (CCD) which provides a second order polynomial quadratic equation for evaluation of the responses out of thirty experimental runs using RSM. The response highlighted and R^2 value signposted significant fit of model and capricious results that are drawn into three-dimensional contour graphs.

Objectives

1. To isolate β -fructofuranosidase producing bacteria
2. To optimize bacteria for maximum enzyme production

Methodology: All media and reagent used such as agar, sucrose, yeast extract, peptone (Himedia, India), DNSA (SRL, India) were of analytical grade.

Enzyme assay: Invertase activity was measured using standard method given by Miller (1959) in which Dinitrosalicylic acid (DNSA) was used to observe presence of glucose released per minute per milliliter with certain modification. 0.1 μ l of enzyme solution was incubated with 0.9 μ l of substrate (sucrose) in 0.1M acetate buffer for 30 minutes at 28.5°C. Then 3ml DNSA reagent was added to stop the reaction and heated in boiling water for next 15 minutes. Finally, the absorbance was noted in spectrophotometer at 540nm.

Experimental Design and Response Surface Methodology: Optimization of cultural medium is an essential part to gain profit from cultivated microbes. Optimum conditions provide maximum production of the desired component. Bacterial isolate B1 was first optimized by One Variable at a Time (OVAT) approach for maximum and minimum range of production of *BsINV* for nutritional (Carbon source and nitrogen source) and environmental components (temperature, pH and inoculum size) and then it was further subjected to optimization by applying RSM of Central Composite Design (CCD).

Result and Discussion: According to the table 1 Central values of independent variables for *Bacillus Subtilis* were obtained at 25°C, 1mg, 2.50mg and 1.50 per cent for temperature, carbon source (Sucrose), Nitrogen source (Yeast extract) and Inoculum size respectively, where maximum response 502.95 IU was obtained. According to CCD of RSM, C^2 and D^2 are significant model terms. Interactions of other factors were also found equally important for mass production of *BsINV*. The response surface curves (Illustration 1 a-f) were plotted to show variation in growth as a function of concentration of two variables when all the other factors were kept at their ‘O’ (central) levels. These experimental findings are in close agreement with the model predictions.

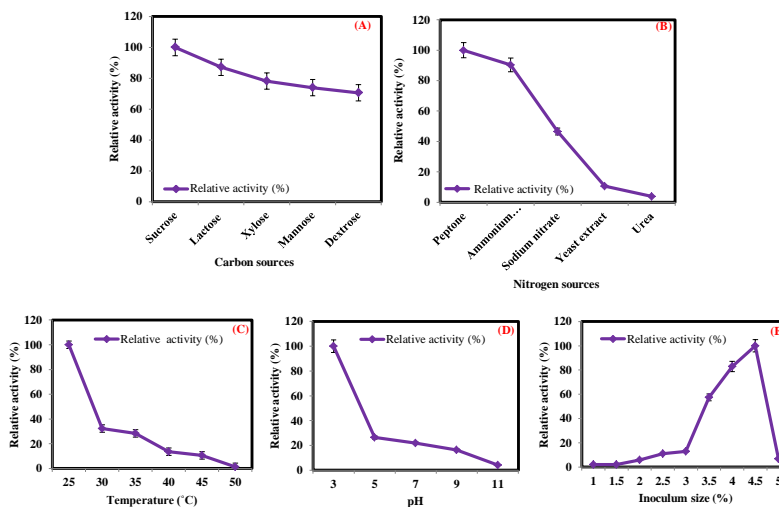


Illustration: Effect of nutritional and environment factor on production of invertase

Conclusion: Agro industrial waste is a potential resource for harvesting a microbial population exhibiting numerous properties as *BsINV* production investigated in the study. *Bacillus subtilis* secretion of *BsINV* takes place under optimal condition which is of low input values proving high output. The *BsINV* activity increased many-folds from being 2.10 IU (lowest) to 502.95 IU (highest) under optimal conditions of 25°C temperature which is normal with respect to industrial view point in the medium containing very low amount of sucrose (1.0g) and peptone (2.5g) inoculated with 1.5 per cent of mother culture.

Study on population dynamic of fruit fly, *Bactrocera* spp. (Tephritidae: Diptera) and species diversity

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ABSTRACT

Purpose: Fruit fly belongs to family Tephritidae found all over the world. Nearly 5000 described spp. of tephritid fruit fly have been categorized in almost 500 genera. Fruit flies are the most important limiting factor due to economic importance and direct damage to the fruit crops. We aim to study and define fruit fly species diversity and population dynamics of fruit flies trapping in pheromone baited traps, economic trap for fruit flies trapping, correlate the Fruit fly population with abiotic factors and species diversity of FruitFlies.

Methods: The Bottle Fruit Fly Traps used in present study and fruit flies trapped in each trap were collected into plastic vials measuring 6.5 x 2.5 cm² separately and brought to the laboratory at weekly interval, starting from 41st SW from 2019 to 22nd SW 2020. Sufficient number of transparent, white mineral water bottles of one litre capacity measuring 276 mm long, 76.4 mm wide at base and 27.4 mm at neck were purchased from market. A total of four entry holes of 22.5 mm² size were made at equal distance just below the curve of the shoulders with the help of a blade. Different treatments were studied viz., Bottle fruit fly baited with Methyl eugenol, Bottle fruit fly baited with Cuelure, McPhail fruit fly trap baited with Methyl eugenol, McPhail fruit fly trap baited with Cuelure, Param fruit fly trap baited with Methyl eugenol and Param fruit fly trap baited with Cuelure.

Results: Population dynamics of fruit flies trapped in ME and CL baited traps was recorded on adult population of fruit fly, *Bactrocera* spp. from 45th standard week (SW) of 2019 to 11th SW of 2020. The population range was 88.9-334.6 FFs/trap/week. The Bottle fruit fly trap baited with cue lure was most effective and economically because it has trapped a total of 5948 adult fruit flies (FFs) and it was 23.58 per cent of totaled trapped flies in both the lures. The

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cost benefit was highest with trapped 10.5 fruit flies after per rupee investment followed by McPhail Fruit fly traps (5.4 FFs/rupee) and Param fruit fly traps (5.0 FFs/rupee) with cue lure. The correlation was recorded as significant between population of *Bactrocera cucurbitae* and maximum & minimum temperature ($^{\circ}\text{C}$) and relative humidity (RH%) but it was non-significant with %, rain fall (mm) and wind velocity (km/hr). Three species of fruit fly viz, *Bactrocera affinis*, *B. dorsalis* and *B. zonata* were trapped in methyl eugenol baited traps and one species viz., *Bactrocera cucurbitae* was trapped in cue lure baited traps.

Conclusions: Among all the species of fruit fly species were attracted in methyl eugenol baited traps, the *Bactrocera affinis* population was lower than the *Bactrocera zonata* population, but it was seen to be higher than the *Bactrocera dorsata* population. Bottle fruit fly trap baited with methyl eugenol was most economic comparison to other traps and trapped 8.4 fruit flies after one rupee investment. Cue lure para-pheromon was most effective with good performance and trapped a total of 17422 fruit flies. *Bactrocera affinis*, *B. dorsalis* and *B. zonata* population trapped in methyl eugenol bait traps was significant with minimum temperature but it was non-significant with maximum temperature, relative humidity, rainfall and wind velocity while it was non-significant with rainfall and wind velocity.

Keywords: diversity, dynamic, *Bactrocera spp*, incidence, population, species, seasonal

Herbicidal Weed Management In Chickpea (*Cicer arietinum*) Through Front Line Demonstration in Farmers Field

R.K. Dwivedi*, M.K. Ahirwar and R.Jharia

JNKVV. Krishi vigyan Kendra Damoh (M.P.)

ABSTRACT

The domestic requirement of pulse had been manifold of a modern living standard which has been fulfilled through the imports that leads to imbalance the Indian economy. To fulfil the domestic demand and to boost the production and productivity of chickpea, the major constraints are still competition from Weeds. Keeping this view in mind, one front line demonstration on herbicidal weed management in chickpea was conducted at farmer's field by krishi vigyan kendra Damoh. Demonstrations were conducted in twenty four farmers field at Jortala and Bandakpur village on chickpea c.v. JG12 during winter season of 2019-20 and 2020-21. Prevailing farmers practices were treated as control for comparison with recommended practice i.e. application of pendimethalin 38.7 cs @ 700ml ai/ha at 0-3 day after sowing (DAS) The result of front line demonstration shows a greater impact on farming community due to significant increase in crop yield greater than farmers practices. The economics and benefit cost ratio of both farmers practice (FP) and recommended practice (RP) were worked out. The Weed intensity and weed biomass were found lower under RP (7/m² and 10.5g/m²) then FP (65/m² and 95.7 g/m²) an average of Rs 36328/ha was recorded under RP while it was Rs 26065 under FP. Benefit cost ratio was 2.54 under RP, while it was 2.34 under FP. By introducing the proven technology i.e. Pre-emergence use of pendimethalin 38.7 cs @ 700 ml ai/ha in chickpea yield potential and net income from chickpea can be enhanced to great extent with increase in the income level of the farming community of the district.

Introduction: Chickpea (*cicer arietinum linn*) is a major rabi pulse crop grown in india. Among the pulses, chickpea, occupies 30% of area with 38% of annual production in india. In Madhya Pradesh, Chickpea occupying about an area of 73.3 lakh ha with the production of 79.7 lakh tonnes and productivity of 1087kg/ha. There are several constraints to achieve desired yield potential of chickpea, but major deterrents to attain higher productivity of chickpea are stiff competition from weeds, multiply nutrient deficiencies, insect pest and incidence of disease. Weeds also interfere with harvest and lower the quality of grains. A healthy stand of chickpea that has a head start on weeds in competitive and will suppress Weed growth. Use of pendimethalin 38.7 cs @ 700 ml ai/ha at 0-3 DAS has been found promising against major weeds (Vyas et al 2003). Herbicidal Weed Management is although effective, cheaper, less time taking and easy in adverse soil and climatic conditions but due to lack of awareness, farmers of the district are not adopting this technology. Hence an effort was made by the KVK Scientist to demonstrate the pendimethaline 38.7 cs @ 700 ml a.i/ha at 0-3 DAS on chickpea during Rabi season of 2019-20 and 2020-21.

Material And Method: The present study is a part of the mandatory programme of krishi vigyan Kendra Damoh (M.P.) . Participatory Rural Appraisal (PRA) group discussion and transect walk were followed to explore the detail information of study the technological intervention. HRD components (Training, kisan

sangosthi/ kisan mela/ Field day etc) were also include to excel the farmers understanding and skill about the demonstrated technology on herbicidal Weed management in chickpea under rainfed conditions. The front line demonstration conduct in twenty four farmers field at jortala and bandakpur village on chickpea c.v JG12 under rainfed condition during winter season of 2019-20 and 2020-21. Chickpea cultivar JG12 was sown between last week of October to first week of November with the rate of 75 kg seed/ha. Chickpea received recommended dose of nutrient (20 kgN, 40 kg P 2O5 and K2O 20 kg per ha) as basal (at the time of sowing) all the above practices adopted on both RP and FP plots. Under RP plots Pendimethalin 38.7 cs @ 700 ml ai /ha at 0-3 DAS used knap sack sprayer in 0.4 ha area, while farmer practice (FP) plots treated as one slight hand weeding (uprooting) when weeds came to flowering stage (Existing Practice). Data on weed intensity and weed dry matter was recorded at 50 DAS with the half of quadrate (0.5m x0.5m) placed at two places per plot and than converted to per square meter. All other steps like site selection, layout of demonstration, farmer participation etc. were followed as suggested by choudhary (1999), visit of the farmers and extension functionaries were organized at demonstration plots to disseminate at large. Yield data was collected from FP and RP other parameters i.e biological yield (q/ha), harvest index (%), gross expenditure (Rs/ha), net returns (Rs/ha) and benefit cost ratio were computed and finally the extension gap, technology gap and technology index were worked out. To estimate the above, following formula (Samui *et al* 2000) have been used.

Technological gap = Potential yield – demo. Yield .

Extension gap = Demo. Yield – farmers yield.

Technology Index = $\frac{\text{Potential yield} - \text{demo yield}}{\text{Potential yield}}$

Results And Discussion

The herbicidal treatment i.e. spray of pendimethalin 38.7 cs @ 700ml ai/ha at 0-3 days after sowing (DAS) was used in RP and weed intensity and weed biomass were calculated at 50 DAS. Under herbicidal treatment (RP) weed intensity and weed biomass were found lower range (7/m² and 10.5 g/m²). while higher under FP treatment (65/m² and 95.7g/m²). Data showed the greater impact of herbicidal treatment (RP) on chickpea while farmers practice (Slight hand weeding) was not sufficient for weed control. An average yield was recorded 15.4 q/ha under RP as compared FP (11.7 q/ha). Among both the treatment harvest index was observed (Table 1) 32.0% and 34.2% in FP and herbicidal treatment (RP). This variation may be due to minimize the crop weed competition in RP. Harvest index(HI) was found higher in herbicidal treatment (RP) where maximum weed control was occurred and minimum HI was associated with FP. This means that sufficient weed control offered the sufficient availability of sunlight, space, plant nutrients, space and water availability which was finally resulted into superior crop harvest. Economics indicators i.e. gross expenditure (Rs/ha), net return (Rs/ha) and benefit cost ratio (B:C ratio) of FLD are presented in Table 3. Average net return from RP were observed to be Rs 36328/ha in comparison to FP 26065 /ha. On an average Rs 10263/ha as additional income is attributed in demonstration plot i.e. application of pendimethalin 38.7 cs @ 700ml a.i./ha at 0-3 DAS., BC of RP and FP was 2.54 and 2.34, found respectively. The average technology gap is 4.4 q/ha reflects farmer’s cooperation in carrying out such demonstration with encouraging results in both year (Table 2). On an average extension gap is 3.6 q/ha (Table 2) which emphasized the need to educate the farmers through various extension means i.e. FLD for adoption to improve production and protection technology to revert the trend of wide extension gap more and more use of latest production technology. Technology index indicates the feasibility of the evolved technology in the farmers fields. The technology index varied from 17.5% to 27% (table 2) which showed the efficacy of good performance of technological interventions. This will accelerate the adoption of demonstrated technical intervention to increase the yield of chickpea.

Conclusion: By introducing the proven technology i.e. pre-emergence use of pendimethaline 38.7 cs @ 700ml ai/ha in chickpea was improved yield potential and net return with increase in the income level of the farming community of the district. Horizontal spread of improved technology i.e. chemical weed management may be achieved by successful implementation of front line demonstration and various extension activity in farmers field for wide dissemination of technology.

Key words: chickpea, Frontline Demonstration, farmers practice, recommended practice.

Table 1: Performance of front line demonstration on chickpea as affected by RP as well as FP (mean of two years)

S.No	Parameters	Treatment	
		RP	FP
1	Grain yield (q/ha)	15.4	11.7
2	Biological yield (q/ha)	42	36.5
3	Harvest Index (%)	34.2	32.0
4	Weed intensity (m ²)	7	65
5	Weed biomass (g/m ²)	10.5	95.7

Table 2: Productivity, Technology gap, Extension gap and Technology index of chickpea as affected by RP as well as FP

Year	Area (ha)	No of Farmers	Grain yield (q/ha)			% increase over FP	Technology gap (q/ha)	Extension gap (q/ha)	Technology Index (%)
			Potential	RP	FP				
2019-20	4.8	12	20	14.6	10.8	35.1	5.4	3.8	27
2020-21	4.8	12	20	16.2	12.7	27.5	3.5	3.5	17.5
Mean	4.8	12	20	15.4	11.7	31.3	4.4	3.5	22.2

Table 3: Economics of front line demonstration of chickpea as affected by recommended practices (RP) as well as farmer’s practices (FP)

Year	Yield q/ha		% increase over FP	Gross Expenditure (Rs/ha)		Gross Return (Rs/ha)		Net Return(Rs/ha)		B:C Ratio	
	RP	FP		RP	FP	RP	FP	RP	FP	RP	FP
2019-20	14.6	10.8	35.1	22413	18715	55280	41040	33067	22325	2.47	2.19
2020-21	16.2	12.7	27.5	24319	19812	63782	49617	39463	29805	2.62	2.50
Mean	15.4	11.7	31.3	23366	19263	59631	45328	36328	26065	2.54	2.34

Organic manure as an alternative to the conventional mineral fertilizers in cultivation of *Digitalis purpurea* L.

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ABSTRACT

Purpose: *Digitalis purpurea* L. commonly known as foxglove or *tilpuspi* is an important medicinal as well as ornamental plant due to the presence of cardiac glycosides in leaves of plant and purple and white coloured flowers which are used as vase plant or for decoration. Flowers and seeds are devoid of glycoside content so they are safe to use for decoration. As far as cultivation of medicinal plant is concern it is important to follow the appropriate cultural practices to get higher yield and quality produce. Medicinal and aromatic plants are valuable natural resources having great potential for the improvement of the economy and health worldwide. Extensive exploitation of these plants from natural sources put great threat to their survivable. Cultivation of medicinal and aromatic plant is the best alternative for the conservation of these plants without affecting their supply for the health care system. From the long time use of chemical fertilizers has leads to the degradation of soil health. From earlier studies it was also reported that extensive use of mineral fertilizers has negative impact on the soil and plant health. The present experiment was conducted aiming to improve the yield and plant growth without leaving any adverse impact on soil and surrounding.

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Methodology: For the current experiment different organic manures were used as individual and in combinations with each other and performance were compared with the recommended dosage of mineral fertilizers and plant with no fertilizer. The different manure used were vermicompost, farm yard manure and litter compost along with the recommended dosage of NPK along with control. The seedlings were raised in nursery and transplanted in treated main field after about a month or they attain the height of 10-15cm. The experiment was layout in randomized block design with twelve treatments and three replications of each treatment. The data was recorded from randomly selected five plants from each replication of the treatment.

Results: Organic manuring significantly affects the growth of the plant. Indicating that source of nutrients also plays an important role in the growth of plant. Vermicompost individually and in combination with mineral fertilizers and other manures shows significant effect on plant growth and yield. The increase in the growth and yield of the plant by applying vermicompost was found significantly higher than that of the plants grown under mineral fertilization. In the experiment, we observed that vermicompost significantly increases the number of leaves and leaf length during both seasons. It also increases the fresh and dry yield during second season of plant growth. Whereas in combination with litter compost it enhances the leaf fresh and dry weight at both season and fresh and dry yield during first season of plant growth. Moreover, it was observed that vermicompost in combination with the farm yard manure increases the leaf area during both seasons. Leaf width was found enhanced by the application of farm yard manure. Replacing a portion of recommended dosage of mineral fertilizer with vermicompost increases leaf width during second season of plant growth. The results obtained shows that the organic manures can be successfully replace the mineral fertilizers without adversely affecting the growth and yield traits. It was also reported that with prolong use of mineral fertilizers there was change in the physical and chemical properties of soil which makes it inadequate for the cultivation of plants whereas organic manure helps in reclamation of degraded soil.

Conclusion: According to the GAPs for medicinal and aromatic plants the use of mineral fertilizers should be minimized and the emphases should be on total organic cultivation. The use of organic manure had improved the growth and yield parameters in digitalis. From the findings of current investigation organic manure are suitable for the replacement of mineral fertilizers. They not only enhance the growth, yield and quality of plants but also show positive effect on soil health without any residual effect unlike mineral fertilizers. The effect of organic manure and mineral fertilizer on the active constituent should be studied for the optimization of nutritional requirement of plant for better quality and yield.

Biodiversity and Wildlife conservation- Valmiki Tiger Reserve

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ABSTRACT

Purpose: Biodiversity is variability among organisms such as plants, animals and unicellular or multicellular organism. According to UN intergovernmental science policy report currently 1 lakh species are at risk of extinct. India is home of nearly 8% of global biodiversity on 2.4% land. India is so rich in wildlife and biodiversity. Wildlife is necessary to maintain the biodiversity. So conservation of wildlife and biodiversity is need of an hour. Biodiversity helps in maintaining the richness and sustainability of ecological system. My work is based on importance of wildlife conservation & biodiversity and success story of Valmiki Tiger Reserve.

Method: Visited Tiger Reserve, wildlife centuries. Highlighting the methods to protect biodiversity and wildlife like (a) protection of natural habitats (b) captive breeding program . (C) by promoting the eco tourism (d) by sharing the benefits derived from protected areas and wildlife with local residents (e) by strong legislative laws.

Conclusion: Industrialization, climate change and anthropological activities are the main reason behind the loss of biodiversity. Due to above mentioned causes, majority of these endangered species are going to be extinct in coming future. So this is need of an hour to conserve the wildlife and biodiversity. There are so many successful stories of wildlife and biodiversity conservations. Valmiki Tiger Reserve and National park is one of the great success stories of wildlife and biodiversity conservation.

Water Saving Transplanting And Irrigation Management Practices In *Rabi* Rice

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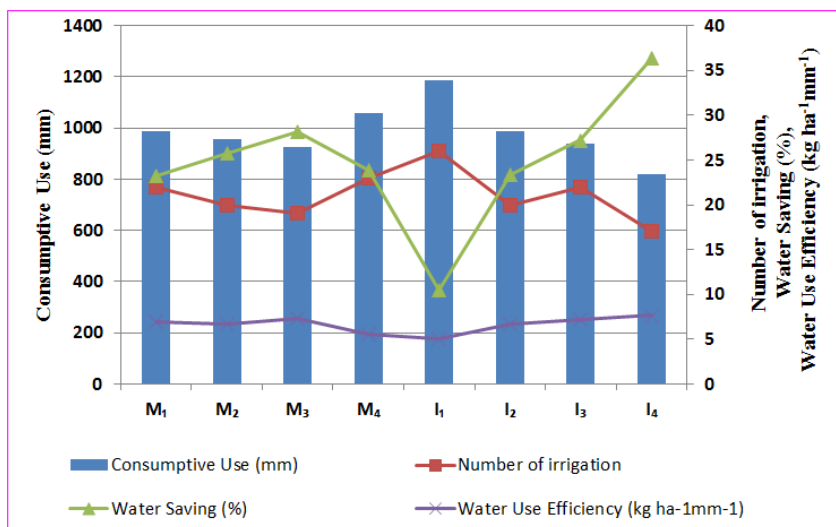
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ABSTRACT

Purpose: More than a half of the world population has rice (*Oryza sativa* L.) as their staple food. Rice seedlings are transplanted into puddled fields and are grown primarily as a wetland crop. In Asia, rice is commonly cultivated by practicing the conventional transplanting method. As mechanical rice transplanting saves labour, ensures timely transplanting and reduces the nursery water requirement, it serves as an alternate and promising option. On the other hand, rice consumes the largest quantity of the total irrigated fresh water resources in Asia and is one of the greatest water demanders among cereal crops. Hence it is necessary to reduce the water supply for rice cultivation without affecting the rice yield. This puts forth a mandatory requirement to invent ways to reduce water use while simultaneously ensuring high yields in rice cultivation (Arif *et al.*, 2012). Alternate Wetting and Drying (AWD) is practiced as a mature water saving technology which demands irrigation when water depth falls to a threshold level below the soil surface observed by using field water tube. In this purview, in order to optimize the irrigation water requirement for machine and manual establishment methods, a field study was undertaken for evaluating the different methods of transplanting and irrigation management practices during *rabi* season of 2016-2017.

Methodology: A Field experiment was conducted during *rabi* season of 2016-2017 at Agricultural College and Research Institute, Coimbatore, Tamil Nadu. The geographical location of the experiment site belongs to the Western Agro Climatic Zone of Tamil Nadu at 11°N latitude, 77 °E longitude and at an altitude of 426.7 m above mean sea level. Its soil texture was clay loam with an alkaline pH (8.10). The test was carried out with the rice variety CO (R) 50 with a duration of 135 days. Strip plot design with three replications was laid out for the experiment. Four different methods of transplanting *viz.*, machine transplanting with 30 cm x 14 cm (M₁), machine transplanting with 30 cm x 18 cm (M₂), SRI transplanting with 25 cm x 25 cm (M₃) and conventional transplanting with 20 cm x 10 cm (M₄), respectively in main plots and four different methods of irrigation management practices in sub plots *viz.*, Farmer practice of continuous submergence of 5 cm throughout the crop period (I₁), Cyclic irrigation management of irrigating the field with 5 cm depth of irrigation one day after disappearance of previously ponded (I₂), SRI irrigation management of irrigation given @ 2.5 cm depth after the formation of hair line cracks in the field upto panicle initiation stage and thereafter the irrigation was given immediately after the disappearance of previously ponded water up to 10 days before harvest (I₃) and field water tube irrigation management of maintenance of 5 cm water level at panicle initiation stage and remaining period irrigation to 5 cm depth after 15 cm depletion of ponded water from ground level (I₄) were followed as treatments. The data were statistically analysed to evaluate the effect of different methods of transplanting and irrigation management practices on water use efficiency (WUE), water productivity and yield using Analysis of Variance (ANOVA) test. The significance of different treatments over each other was calculated with critical difference at 5% level of significance (Gomez and Gomez, 1984). The total consumptive use of water and water use efficiency were calculated as per the standard procedure.

Results and Discussion: The consumptive water use comprises of the amount of water required to meet the demands of evapo-transpiration as well as the metabolic activities of rice and includes the effective rainfall during the growing season. Lower consumptive use of water (925 mm), lesser number of irrigation (19) and higher percentage of water saving (28.1%) was registered in SRI transplanting method whereas higher consumptive use of water (1058 mm) and number of irrigation (23) was observed with conventional transplanting. It is evident that more water of 1185 mm and higher number of 26 irrigations were consumed in the farmers’ practice of irrigation. On the other hand, lesser consumptive use of water (818 mm) at 15 cm drop of water table due to lesser number of irrigations (17) and a higher water saving percentage of 36.4 % was observed under field water tube irrigation. Similar observations were also reported by Ngo *et al.* (2008). The yield can be maintained or increased with reduced quantity of water input which will increase the WUE. A higher WUE of 7.28 kg ha⁻¹ mm⁻¹ was registered by the SRI transplanting method; whereas, lower WUE was found with conventional method of transplanting. On the other hand, increase in WUE was achieved by reducing the consumptive water use under field water tube irrigation at 15 cm drop of water table coupled with the maintenance of yield at an optimum level. Under field water tube irrigation treatment, a higher WUE of 7.63 kg ha⁻¹ mm⁻¹ which was on par with SRI method of irrigation (7.23 kg ha⁻¹ mm⁻¹) was observed. The reasons for increased WUE observed under these treatments can be assigned to optimum need-based irrigation with the help of monitoring device namely the field water tube along with increased grain yield levels. The decreased WUE under farmers’ irrigation practice could be because of higher consumptive use with more frequent irrigations but without corresponding increase in grain yields. This matches the findings of Bouman *et al.* (2007).



Conclusions : Through this experiment, it is evident that lower consumptive use of water with lower number of irrigations, higher percentage of water saving and higher WUE was possible through SRI transplanting method. Moreover, than other combinations of different methods of water management, use of younger seedlings and wider spacing proved to be a better practice. A more satisfactory yield was obtained under wider spacing than under closer spacing even under normal cultivation. Simultaneously, reduced total consumptive use of water with lesser number of irrigations was possible infield water tube with intermittent irrigation besides it increasing the water use efficiency of rice.

Polygenic Variations and Character Association Study Of Tomato (*Solanum Lycopersicon* L.) Genotypes For Yield And Quality Attributes

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ABSTRACT

Purpose: Tomato (*Solanum lycopersicon* L.) is an important member of Solanaceae family. It is the most important warm season fruit vegetable grown throughout the world and is one of the most popular and widely grown vegetable. Tomato is generally consumed as salad, cooked or as processed food. Tomatoes are important source of lycopene (an antioxidant), ascorbic acid, β-carotene and valued for their colour and flavour. Greater the diversity in the material more is the genetic potential and greater are the chances for selection to get desired types. The estimates of different genetic parameters and the association of different characters are important for better understanding of the nature and the magnitude of genetic variability present in the breeding material. India is the richest country for diverse genotypes of tomato. Identification of superior genotypes among the existing germplasm becomes imperative for future breeding programme and for promoting production per unit area. The development of an effective improvement programme in turn depends upon the existence of variability and knowledge of genotypic and phenotypic correlation of yield and quality attributes in the genotypes. Keeping these facts in view, an experiment was conducted with the objective to study the genetic variability and character association study of tomato (*Solanum lycopersicon* L.) genotypes for yield and quality attributes.

Methods: Experiment was conducted in the Vegetable Farm of Bihar Agricultural University in Rabi Season. The experimental material consisted of thirty genotypes of tomatoes which were grown in randomized block design having three replications and study was performed on characters namely plant height, number of primary branches per plant, number of fruits per plant, days to first flowering, days to 50% flowering, days to first harvesting, average fruit weight (g), equatorial diameter (cm), polar diameter (cm), number of picking, yield per plant (kg), fruit yield (q/ha), stigma nature (inserted/exserted), fruit shape, fruit colour, number of locules per fruit, pericarp thickness (cm) and TSS (⁰Brix). The data were statistically analyzed according to the standard methods and procedures for analysis of variance, phenotypic and genotypic coefficient of variation, heritability (in broad sense), genetic advance, phenotypic and genotypic correlation coefficients.

Results: Significant differences amongst the genotypes for all the characters studied in this investigation indicated appreciable scope of improvement in tomato. As far as yield per plant is concerned, the genotypes Hisar

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Lalit, Pusa Ruby, Arka Alok, Pant T-7 and Pusa Rohini were found to be promising. These genotypes also performed well with respect to plant height, number of fruits per plant, fruit weight. Genotypic and phenotypic coefficients of variation were high for average fruit weight, number of fruit per plant, plant height and number of locules per fruit. The results were in consonance with the findings of Bukseth *et al.*, 2012 in tomatoes. The highest estimate of heritability was observed for number of locules per fruit which was closely followed by average fruit weight, pericarp thickness, plant height, TSS, yield per plant, number of fruits per plant, polar diameter, equatorial diameter, number of primary branches per plant, days to first harvesting, days to 50% flowering, number of picking. Days to first flowering had moderate heritability. These characters are therefore, governed by additive gene effects. It can also be concluded that selection on the basis of these characters will be more useful for the improvement of this crop towards attaining higher yield. TSS and days to first harvesting had moderate genetic heritability along with moderate genetic advance, indicating that all these characters are controlled by both additive and non-additive of genes. The data with respect to genetic advance among the different characters under investigation indicated high genetic advance for plant height followed by average fruit weight, number of fruit per plant, whereas days to first harvesting had moderate genetic advance and days to 50% flowering, days to first flowering, number of primary branches per plant, number of locule per fruit, number of picking, yield kg per plant, equatorial diameter, polar diameter, TSS and pericarp thickness showed lower genetic advance. Yield per plant, average fruit weight, number of fruits per plant, and plant height exhibited high heritability coupled with high genetic advance as percent of mean. Correlation coefficient analysis measures the mutual relationship between various plant characters and determines the component characters on which selection can be based for improvement in yield. The data on both genotypic and phenotypic correlation coefficient in the present experiment revealed that fruit yield per plant expressed highly significant and positive correlation with average fruit weight, equatorial diameter and polar diameter. Genotypic correlation coefficient in the present experiment was found to be slightly higher than their corresponding phenotypic correlation coefficient for most of the characters. Similar results were noticed by Bernousi *et al.*, 2011 in tomatoes.

Conclusions: Thus, it may be concluded that for selecting better genotype average fruit weight, number of fruit per plant, number of locules per fruit, polar diameter, plant height, number of fruits per plant, and pericarp thickness can be subjected to selection pressure for effective improvement in this crop. The genotypes Hisar Lalit, Pusa Ruby, Arka Alok, Pant T-7 and PusaRohini were found to be promising with respect to plant height, number of fruits per plant, fruit weight and yield/plant.

Keywords: *Tomato, variability, correlation*

Table -1: Estimates of variability parameters for different traits in tomato genotypes under study.							
Characters	Genotypic variance	Phenotypic variance	Coefficient of variation (%)		Heritability (%)	Genetic advance	Genetic advance as % age of mean
			GCV	PCV			
Days to first flowering	24.77	41.89	9.33	12.13	59.1	7.88	14.78
Days to 50% flowering	25.31	39.00	7.11	8.83	64.9	8.35	11.81
Days to first harvesting	117.89	148.71	7.57	8.50	79.3	19.91	13.89
Plant height(cm)	1183.78	1235.36	30.60	31.26	95.8	69.38	61.71
No. of primary branches/plant	2.23	2.79	22.06	24.69	79.9	2.75	40.62
No. of fruit/plant	173.40	190.20	33.55	35.14	91.2	25.90	66.00
Average fruit wt.(g)	423.96	435.46	48.33	48.98	97.4	41.85	98.24
Equatorial diameter (cm)	0.83	0.97	22.74	24.64	85.2	1.73	43.22
Polar diameter (cm)	0.72	0.84	22.04	23.86	85.3	1.61	41.94
No. of picking	1.4337	2.29	14.84	18.76	62.5	1.95	24.19
No. of locules/fruit	1.5458	1.57	28.01	28.27	98.1	2.53	57.17
Pericarp thickness (mm.)	0.01	0.01	20.85	21.25	96.3	0.17	42.16
TSS(⁰ Brix)	0.41	0.44	15.02	15.68	91.7	1.26	29.64
Yield/pt.(kg)	0.93	1.02	56.41	58.93	91.6	1.90	111.22

Impact of Salicylic acid on Morphological traits of *Valeriana wallichii* DC under Drought stress

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ABSTRACT

Purpose: Medicinal plants are most valuable treasure for the economy and the health sector of the country and *Valeriana wallichii* is one of them. Its multiple uses make it an imperative herb as it is used in pharmaceuticals, cosmetics as well as for perfumery. It was reported that only 20-30% of herbal raw drug is procured from cultivation and rest is still harvested from natural sources. Overexploitation and global climate change is a major constraint for the survivable of natural population. Adverse environmental conditions cause various abiotic stresses among which drought stress is the major stress that limits the growth and development of the plant. Phytohormone like salicylic acid induces stress tolerance to alleviate the effect of drought stress and increase plant productivity and economic yield. Therefore, present study was carried out with the aim to evaluate morphological alterations induced by salicylic acid in *V. wallichii* under drought stress conditions.

Methodology: The experiment was conducted under semi-controlled condition in glasshouse in pots. Rhizomes were used as propagating material. The plants were grown under well-watered and three water deficit conditions (100% FC, 75% FC, 50% FC and 25% FC) and four concentration of salicylic acid (1mM, 0.75mM, 0.50mM and 0.25mM) along with their interactions were evaluated in comparison with their respective controls. The irrigation levels were scheduled by calculating the water holding capacity and field capacity of soil using method given by Black and Evans, 1965. Plant height, leaf length, leaf width, plant spread, shoot, root and rhizome length were measured using meter scale. Fresh and dry shoot weight and fresh and dry root weight were measured using digital weighing balance. Rhizome and leaf thickness was measured by using vernier calipers. Leaf numbers was counted as number and leaf area was measured by digital leaf area meter. The data was observed from 5 plants in each replication of the treatments and mean data was used for further analysis.

Results: Increasing drought stress caused significant reduction in plant height, leaf numbers, leaf length, leaf width, leaf area, plant spread, rhizome thickness, shoot, root and rhizome length, fresh and dry shoot weight and fresh and dry root weight except leaf thickness at both vegetative and flowering stage in leaves as well as in roots. Foliar application of salicylic acid improves morphological and yield attributing traits under water deficit condition. It was noted that at 100% FC, 0.25mM SA concentration found effective during vegetative and flowering stage in leaves as well as in roots. At 75% FC, 0.25mM SA concentration was found effective during flowering stage in leaves as well as in roots while 1mM is useful only during vegetative stage in leaves. At 50% FC, different concentration of SA positively effect in leaves during vegetative stage (*i.e.*, 0.25mM SA concentration), flowering stage (*i.e.*, 0.50mM SA concentration) and in roots (*i.e.*, 1mM SA concentration) found effective. And similarly, at 25% FC, 1mM concentration of SA was found best among all the concentrations during both the stages of leaves *i.e.*, vegetative and flowering stages as well as in roots in comparison to respective control values.

Conclusion: From the experiment it can be concluded that drought significantly reduces the morphological and yield attributing traits. It was also be noted that the deleterious effect of increasing drought stress can be reduced by higher concentration of SA (*i.e.*, 1mM SA) whereas from moderate to well-watered condition lower concentration of SA were found at par with higher concentration. Hence, it is evident that, foliar spray of SA improves all the morphological traits in plants directly or indirectly so that it can be helpful to overcome the hazardous effect of drought stress and improve qualitative and quantitative yield of such a valuable medicinal plant.

Economic Analysis of Cucumber-Based Crop Rotations Under Protected Structures in Haryana, India

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ABSTRACT

Purpose: The present study was conducted in Haryana state to find out the economics of crop rotation in the protected structures. In the study area, four cucumber-based crop rotations were found i.e. cucumber + cucumber (R₁), cucumber + capsicum (R₂), cucumber + tomato (R₃), cucumber + liliium (R₄).

Methods: Sonapat, Karnal, and Hisar districts were purposively selected because of the predominance of protected structures. The cost and returns of cultivation of vegetables crops was worked out by using various cost concepts and income measures

Results: The results obtained in this study indicated that the R₄ cropping rotation (₹4838447) has higher cost of cultivation followed by R₂ (₹1765041), R₃ (₹1760968) and R₁ (₹1574530). Gross returns were higher in case of R₄ cropping rotation (₹6942780) is a higher cost of cultivation followed by R₃ (₹2261224), R₂ (₹2215500) and R₁ (₹2126250). Net returns were highest in R₄ (₹2137185) followed by R₁ (₹511720), R₃ (₹500255) and R₂ rotations (₹450459).

Conclusions: The present study also revealed that maximum respondents were adopting R₁ crop rotation because of the lesser cost of cultivation and higher net returns.

Keywords: *Crop rotations, economics, floral crops, protected cultivation, vegetables*

Characterization of morphological, physio-chemical and fertility properties of pear growing orchards under temperate conditions of Jammu & Kashmir, India

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ABSTRACT

Purpose: The occurrence of diverse soil types necessitates their scientific characterization in order to understand their potential and problems in the production of crops and land resource management. For sustainable pear production, several factors including climate, soil medium and site-characteristics as well as management are critical. Therefore, we aim to characterize and classify the soils of pear orchards as well as evaluate their fertility index in order to determine the soil parameters that affect the yield.

Methodology: During a reconnaissance survey, six typical pedons located in geo-referenced pear orchards from three different physiographic altitudes were undertaken to study the site features as well as morphological characters during in-situ description of the exposed profile. The soil samples collected horizon-wise were analyzed as per the standard procedures. For physico-chemical characterization, both soil and leaf samples collected from the selected pear orchards were analyzed in laboratory as per the prescribed standard procedures.

Result: The soils studied are moderately deep to very deep, light yellowish brown to dark brown, predominantly clay loam and silt loam to loam and occasionally sandy loam in texture. For chemical properties, slightly acidic to slightly alkaline in pH (6.6 to 7.53); normal EC (0.18–0.48 dSm⁻¹) and low to high in OC (0.12 to 1.28%) are recorded. The CEC values are moderate (13.16 to 17.85 Cmol kg⁻¹), dominated by exch. Ca²⁺ (74%) followed by Mg²⁺, K⁺ and Na⁺⁺; with percent base saturation (BS%) of 73.16–7.20% in high followed by mid (65.69–68.70%) and low (61.30–63.32%) altitudes. Soils are high in available N, P, K, Mg, Zn, Cu, Mn & Fe; medium in Ca and S and low in S and B. The spatial variability (CV %) ranges from 2.75 to 30.10% in soil and 2.50 to 26.20% in leaf with significant magnitude among micronutrients along altitude and depth factors. Significant and positive correlation of available nutrients such as N, P, K, Ca, Cu, Mn, Fe, and B with their corresponding leaf nutrients was recorded. Nutrients like N, P, Ca, S, Zn and Fe observed significant and positive relationship with fruit yield. A linear regression model (R²) suggested the combined significant effect of pH and OC (R² = 0.7634 and 0.3069) on the yield performance.

Conclusions: The soils under study are classified as Inceptisols and Entisols in the USDA system of soil classification. Soil properties like texture, structure, OC, pH, and nutrients are influenced by different landscape positions. Relatively lesser amounts of clay in combination with adequate organic matter and better soil fertility attributes demonstrate the zones in good coordination with sustainable production.

Keywords: *characterization, nutrients, pear, physico-chemical properties, relationship*

Characterization of Grain Size 3 (GS3) Locus for Grain Length in Basmati Rice (*Oryza sativa* L.)

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ABSTRACT

Purpose: Characterization of *GS3* locus for grain length in Basmati rice 54 genotypes of basmati rice were undertaken to identify the novel SNPs within the *GS3* gene, region responsible for grain length in Basmati rice.

Method: A total of 54 genotypes of basmati rice (*Oryza sativa* L.) were used in the present investigation. The material consisted of a core set of basmati rice accessions representing landraces, farmer’s varieties, elite cultivars and advanced breeding lines collected from different basmati growing areas of Jammu region of Jammu and Kashmir, India. Besides, checks in the form of Pusa 1121, Basmati 370 and Basmati 564 were included to check variation. PCR amplification was carried out to amplify promoter region of gene *GS3* in 54 core set of basmati genotypes, approximately 500 ng of 54 PCR products of basmati genotypes were cleaned by elution method. For sequencing 50 ng of each of the above cleaned samples were directly used as template for sequencing with both the primers i.e. forward and reverse primers.

Results: Out of 54 basmati genotypes, 29 showed the good quality sequence and among the 29 genotypes, Basmati SJBR39 exhibits a maximum 7 SNPs while Basmati SJBR24 exhibits 5 SNPs with reference to Basmati Pusa1121 which was kept as check for study. A total of 9 SNPs w.r.t. check Pusa1121 [Forward sites {124 (G > C), 221 (G > A), 234 (A > T/G), 427 (T > A), 488 (T > C)} and Reverse sites {138 (A > C), 154 (T > C), 182 (G > A), 251 (T > C)}] were located in the promoter region by predicting the promoter region of the *GS3* gene, thus, providing the basis for the next step of verifying the effect of these SNP sites on transcription factor binding within the basmati *GS3* gene.

Conclusion: The identified novel SNPs within *GS3* gene helps in the development of functional markers for the improvement of grain length in basmati rice through molecular breeding involving marker-assisted selection (MAS). This will help to increase its consumer acceptance and economic value in the national and international market, and will increase the economy of basmati growing states as well of the country.

Keywords: *GS3*, SNPs, PCR, *Oryza sativa* L.

Phytochemical And Antibacterial Studies Of Cordia Africana (Stem Bark Extracts)

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ABSTRACT

Purpose: Concern over rising health challenges regarding antibiotic resistance by different bacterial strains world over, necessitated the need and quest for alternative medicine that can fight these bacterial hence the need to embark on this research with the aim of determining the phytochemical and antibacterial activity of cordia africana a commonly used medicinal plants in Africa.

Methods: The powdered sample was extracted by maceration and subjected to phytochemical screening using standard method. The extracts was tested against four bacterial isolates.

Staphylococcus aureus, *Bacillus subtilis*, *Escherichia coli* and *Pseudomonas Aeruginosa* using Agar well diffusion method. TLC and Column chromatography was carried out in which the fractions obtained was pooled together to sub -fractions (A-F). Isolate A, that appeared to be pure was subjected to both antimicrobial screening and spectroscopic study.

Results: Isolates A shows stronger antibacterial activity with highest zone of inhibition of 22.0mm on *Escherichia coli*. The spectroscopic studies revealed that isolates A consist of three compounds, Isobutyloctadecyl ester, butyl undecyl ester, methyl-12-oxo-9-dodecanoate.

Conclusions : Phytochemical potential of the stem bark of *Cordia africana* has been evaluated in this research and it revealed the presence of phytochemicals such as , Alkaloids, Carbohydrate, Saponins , Flavonoids ,Tannins and Triterphenoids. Result obtained at various concentration of the extracts, indicated that the Ethyl acetate extract possesses the highest antibacterial activities on tested bacterial.

Keywords: *Phytochemicals*, *Cordia africana*, *Bacterial isolates*, *TLC*, *Column chromatography*, *Maceration*.

Knowledge Level Of Tribes And Forest Dwellers On Wild Fruits And Wild Vegetables Rajeshwari N

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ABSTRACT

Purpose: The northern transition zone and hill zone of Karnataka which come under the jurisdiction of University of Agricultural Sciences, Dharwad have ample area of forest which have many fruit and vegetable species. The forest dwellers and tribes collect the fruits and vegetables from the wild and process it by value addition. There are more than 50 wild edible fruit species in western ghats region. These belong to 25 families and 38 genera. These plants meet culinary purposes of the people and traditional home remedial practices. The present research study focuses on the knowledge level of tribes and forest dwellers on wild fruits and wild vegetables in general and availability of wild fruits and vegetables in the adjacent forests as perceived by them.

Methods: The research was conducted in northern transition zone and hill zone of Karnataka state. Two villages each from Dharwad, Sirsi, Siddapur and Khanapur talukas of Dharwad, Uttara Kannada and Belgaum district were selected for the study. The total sample size was forty households. The data collection for the research was done using a semi structured interview schedule and focussed group discussions.

Results: The results revealed that majority of the respondents (59.28%) had medium level of knowledge about fruits and vegetables with 15.81 mean knowledge score. More than quarter of the respondents (22.76%) had low level of knowledge with a mean score of 12.45 and only less percent (17.96%) had high level of knowledge with a mean score of 22.27. The overall mean score was 17.77. Information of important wild fruits found in different talukas. It was expressed by majority of the forest dwellers and tribes of Sirsi and Siddapur that Kokum (*Garcinia indica*), Uppage (*Garcinia gummi-gutta*), Appemidi (*Mangifera indica* L.), Jack fruit (*Artocarpus heterophyllus* Lam.), Amla (*Phyllanthus emblica* L.), Tamarind (*Tamarindus indicus* L.), Karonda (*Carissa caranda*), Jamun (*Syzygium cumini* L.) and Lemon (*Citrus limon*) Indian hogplum (*Spondias mangifera* Wild.) Bael fruit (*Limonia elephantum* L.) Star fruit (*Averrhoa carambola* L.) sampige hannu (*Flacoutia montana*) fruit Nurukulu (*Buchanania lanzan*) was Salle hannu (*Aporussa lindleyana*), halage hannu (*Elaeagnus conferta*) and mullannu (*Ziziphus oenaplia*) were the wild fruits known to them. However, in case of Dharwad and Khanapur talukas majority of the respondents expressed that only few fruits were known to them namely Jack fruit (*Artocarpus heterophyllus* Lam.), Amla (*Phyllanthus emblica* L.), Tamarind (*Tamarindus indicus* L.), Karonda (*Carissa caranda*), Jamun (*Syzygium cumini* L.) and Lemon (*Citrus limon*) Indian hogplum (*Spondias mangifera* Wild.) Bael fruit (*Limonia elephantum* L.). In case of wild vegetables. The major wild vegetables known to forest dwellers and tribes were Madras cucumber (moggekai) *Cucumis maderaspatensis*, Colocasia leaves (kesuvina soppu) *Colocasia esculenta*, Colocasia root (kesuvina gadde) *Colocasia esculenta*, Spine gourd (madhagalu) *Momordica dioica*, Chilli pepper (gokarna menasinakai) *Capsicum frutescens*, chakramuni soppu *Sauropus androgynus*, insulin soppu *Costus igneus*, yalgurga, kardisoppu, ondelaga *Centella asiatica*, ane soppu *Celosia*. The major indigenous value addition done was the fruits were preserved in the form of jams, syrups, juices, butter, powder, pappad.

Conclusion: The world is moving towards natural foods to satiate hunger. Wild fruits and vegetables are collected and consumed from the wild by the forest dwellers and tribes. The communities which reside adjacent to a forest area collect the wild fruits and vegetables and consume them by either processing or raw. Wild fruits and vegetables contribute to food security and nutrition security. Majority of the respondents had medium level of knowledge about wild fruits and vegetables. Hence, farmers can be encouraged to domesticate these fruits and vegetables which are on the edge of extinction.

Evaluation of Insecticides against Leaf Miner of Pea (*Pisum sativum* L.) at farmers fields conditions

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ABSTRACT

Purpose: Pea occupies 459-thousand-hectare area in India and shares 21 per cent production of the world. In Uttar Pradesh, it ranks second in area among vegetable crops after potato and occupies an area of 31.3 thousand hectares. The larvae mine leaves making prominent whitish tunnels resulting in the loss of green matter and also affecting flowering and pod formation. One of the most common insects in field pea is the pea aphid. Pea aphids are small, about 1 inch long and light to dark green. Pea aphids have multiple generations per year and overwinter as eggs in

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alfalfa, clover or vetch. Pea leaves minor have piercing-sucking mouthparts and may vector viral diseases. The main purpose of this study to reduce insect infestation and check the vector population from pea farmer's fields.

Methods: The experiment was conducted in the Year 2019-20 at farmer's field for evaluation of insecticides against leaf minor asses the. Some bio-insecticides and insecticides neem oil @ 4 ml/liter of water and Oxydematon Methyl *a.i.* @ 1.5 ml/lit.

Results: The refined technology, spray Oxydematon Methyl @ 1.5ml/lit reduced the infestation from 27 to 5 per cent and yield was increased by 21 per cent.

Conclusion: The refined technology is more beneficial and technology spreading horizontally and vertically in district Ferozabad. In coming time farmers of pea grower are adopted on large scale in district.

Keywords: *Pea, leaf minor, insecticides*

Situational analysis of social support available to the family caregivers of dependent elderly Parul Kalia and Sarita Saini

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ABSTRACT

Purpose: Family caregivers are the active facilitators in providing care and assistance to the functionally dependent elderly. In the due course of fulfilling caregiving roles and responsibilities along with massive household responsibilities it became very difficult for the family caregivers to take care of their own health and well-being. This unconscious ignorance and awareness may lead them towards deteriorating health conditions which initially are minor but with time could create major health issues in their lives. Therefore,

Methods: The sample for the study comprised 60 family caregivers who were solely responsible for taking care of their dependent elderly. A self-structured personal information sheet was used to gather background information of the respondents. Zarit Burden Interview Scale (Zarit *et al* 1980) was used to investigate the burden of stress upon the caregivers and a Semi-structured Observation-cum-interview Schedule was used to assess the social support available to the respondents. The purposive and snowball sampling technique was used to collect the data. The study adopted the quantitative as well as qualitative research methods approach that concurrently integrated procedures in the collection, analysis and interpretation of the data.

Results: The situational analysis of the available social support to the family caregivers reported minimum availability of social support and indicated dire need to establish full fledge caregiver support services for the middle socio-economic families. As it can be understood that apart from middle economic families, high and low socio-economic have their specific limitations but middle economic families are in between of them. Therefore, requires social support system at least on community level.

Conclusions: The results indicated the essential and benefitting role of the available social support to family caregivers in lessening the impact of burden of stress imposed on them. The facilities available on community level will definitely be readily available and family caregivers can be motivated to provide care to their elderly and can look at the bright side of caregiving.

Keywords: *Caregivers, Caregiver burden, Dependent Elderly, Social Support.*

Natural enemies of *Cinara maghrebica* (Mimeur, 1936) (Hemiptera : Aphididae) on *Pinus halepensis* (Miller, 1768) in Algeria

Leila Bourouba and Malik Laamari

ABSTRACT

Purpose: This study was performed between 2019 and 2020 with the aim of identifying naturel enemies of *Cinara maghrebica* (Mimeur, 1936) in pinaceae (especially *Pinus halepensis* Miller, 1768) forests.

Methods: Specimens were collected from 3 areas in kenchela Regional Forest (Algerian East) with different average between 987-1006 m. Samples of the young branches taken twice a month and put in plastic bags were brought to the laboratory, examined with stereomicroscope.

Results: Nineteen species of predatory insects that blong to the family of Coccinellidae, Chrysopidae, Syrphidae and Braconidae especially parasitoid *Pauesia silana* (Tremblay, 1969).

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Conclusion: The study showed that this parasitoid (*Pauesia silana* Tremblay, 1969) multiplies particularly on *Pinus halepensis*. The presence of abundant natural enemies in this area could explain the low amount damage caused by this aphid.

Keywords: *Pinus halepensis*, *Cinara maghrebica*, natural enemies, Algeria.

Tea Waste Processing For Utilization Of Livestock Feed

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ABSTRACT

Purpose: Tea is a widely cultivated shrub (*Camellia sinensis* of the family Theaceae) native to China, northern India, and south eastern Asia and having glossy green leaves and fragrant white flowers. India is 2nd largest producer of tea and generates 25 thousands tons of tea waste per year. The chief tea producing states are Assam, Himachal Pradesh and West Bengal. Tea may be classified according to its method of manufacture such as black tea, green tea, oolong, white tea. Today the huge demand of milk and meat with increasing population and deficit in feed and fodders then the use of the non-conventional feed resources (NCFR) like TEA WASTE. The animal fodder that allows the transformation of tea waste into animal food by increasing the digestibility and the nutritional value. Green tea extract and tea seed saponin can be used as feed additive with beneficial effects. Tea waste can prove an efficient and economic non conventional feed source to tide over the deficiencies in nutrient availability.

Methods: Waste segregation refers to the separation of wet waste and dry waste, the purpose is to recycle dry waste easily and to use wet waste as compost. Tea waste processing are of two ways i.e. green waste & dry waste tea processing. Green tea extract is prepared from green tea brewed with ethanol then filtered, extract collected by evaporating the solvent. Tea grounds refer to residue left after extraction from leaves by hot water to make tea. Mainly includes tea seed meals (cake, pellet, powder) and tea seed saponin. After extraction of oil from seed the residues are collected and made to tea seed meal. Saponin content of tea seed meal vary between 13.1 and 21.1%. Tea seed saponin are classified as dried and powdered tea seeds were defatted with hexane in a percolator at room temperature. After concentrated under reduced pressure, the percolate was suspended in 70 % methanol.

Results: The animal fodder that allows the transformation of tea waste into animal food by increasing the digestibility and the nutritional value. Green tea extract can be used as feed additive in very small quantity in animal feed. Tea saponin supplementation in the diet improved growth and nutrient utilization in ruminants. The Green tea waste (silage) can be used up to 20% in animal feed without any detrimental effects. Tea seed meals can be added up to 5% in animal diet. Green tea extract and tea seed saponin can be used as feed additive with beneficial effects. Tea waste can prove an efficient and economic non conventional feed source to tide over the deficiencies in nutrient availability.

Conclusions: It is concluded that tea waste and saponin supplementation in the diet improved growth and nutrient utilization in ruminants. So, it is beneficial to growth and development of ruminant livestock.

Keywords: *Tea waste, Green & Dry waste tea processing and Livestock feed*

Effect of Tillage practices and Pendimethalin on Soil Biological Properties and its Dissipation Kinetics in an Acid Inceptisol under Subtropical Region

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ABSTRACT

Purpose: India is the fourth largest oilseed economy in the world. Among the seven edible oilseeds cultivated in India, Indian mustard (*Brassica juncea* L.) ranks second after soybean and contributed 23.94% and 24.65% in country's total oilseed acreage and production, respectively during 2014-15. The crop is mainly cultivated in poor soil under rain fed with poor management practices. There is need for enhancing the productivity of the crop as the productivity in India is quite low compared to many countries. The low productivity of mustard is due to several factors of which moisture stress and weed infestation in the early stages are some of the important factors. Globally, increased emphasis has been put on conservation agriculture in view of sustainable use of resources and as adaptive options to climate change. Tillage practices largely influence the soil physico-chemical and biological properties. Minimum tillage along

with crop residue retention may be an option for conserving soil moisture, enhancing soil organic carbon, higher microbial and enzyme activities which in turn may improve mustard productivity. Weed is one of the major constraints for realizing higher productivity of mustard. Unchecked weed cause 25-45 per cent yield reduction depending on the type of weed flora and their intensity, stage, nature and duration of crop-weed competition. The use of herbicide is gaining popularity among the farmers as it provides economic and efficient weed control. However, environmental impacts of herbicide used are often questioned particularly on soil enzyme activities and dissipation pattern. Pendimethalin [N-(1-ethylpropyl) 3, 4-dimethyl-2, 6-dinitro aniline], a pre-emergence herbicide is commonly used by the farmers for weed control in mustard. It is a non-ionic dinitro aniline herbicide used for the selective control of grassy and broad leaf weeds in a variety of crops. However, limited informations are available on the effect of Pendimethalin on microbial biomass carbon (MBC), soil enzyme activities and its dissipation pattern particularly under minimum tillage. Therefore, the present study was designed to elucidate the effects of Pendimethalin on MBC, soil enzyme activities and microbial biomass carbon in mustard crop under rice – mustard- sesbania sequence, which can provide better understanding of the possible response of soil microorganisms to the herbicide.

Methodology: The present study was carried out in instructional cum research farm, Assam Agricultural University, Jorhat, Assam, India during four consecutive years from 2016-2020. The GPS location of the experimental field was at 26°44'N and 94°12'E and at an altitude of 91.0 m above mean sea level. The site received average total annual rainfall 2124 mm with subtropical climate. The soil textural class of the experimental plot was Aeric Endoaquept with sandy clay loam texture. The soil was acidic with pH 5.41, organic carbon 6.8 g kg⁻¹ and CEC 6.18 cmol(p⁺)/kg with initial MBC, soil β- glucosidase and urease activity were 231.25 μg g⁻¹ soil, 145.22 μg p-nitrophenol g⁻¹ soil h⁻¹ and 210.72 μg NH₄ g⁻¹ soil 2h⁻¹ respectively. The experiment consisted of five treatments as - [T₁- Conventional Tillage (CT) + Transplanted rice (TR) followed by (fb) Mustard (CT), T₂ – CT + TR + Pretilachlor fb Mustard, [Minimum Tillage (MT) + Pendimethalin], T₃ - CT+ DSR (Direct seeded Rice) + Pretilachlor fb mustard (CT + Pendimethalin), T₄- MT + DSR + Pretilachlor fb mustard (MT + Pendimethalin + Residue retention), T₅ - MT+ DSR + Pretilachlor + Residue retention (RT) fb mustard (MT + Pendimethalin + RT), was arranged in a randomized block design replicated thrice. The Indian mustard variety “NRCHB-101” was grown as *rabi* crop. The pre emergence herbicide Pendimethalin was applied at recommended dose (750g ha⁻¹) with spray volume of 450 l ha⁻¹. Observations on MBC and soil enzyme activities were made on the 5th mustard crop during 2020. Estimation of biological properties and Pendimethalin residue in soil was done by collecting treatment wise soil samples (0-15 cm) at 0 (within 4 hours of herbicide application), 3, 7, 15, 30, 45, 60, 75 and 90 DAA (days after application) of Pendimethalin and finally at crop harvest. Each soil samples were divided into two parts. One part of the samples were stored in deep freeze (-32°C) for the study of microbial activities and the other part of the samples were processed and stored in polythene bags for detection of Pendimethalin residue in soil by following standard protocols. MBC, β- glucosidase activity and Urease activity were determined by following standard protocols.

Results: Effect on Soil Biological Properties

The study revealed that Pendimethalin application showed significant influence on soil microbial activities (Fig.A). The microbial activities were significantly higher under MT compared to CT due to higher accumulation of organic C and N in surface soils (Bhaduri *et al.* 2017). MBC, soil β- glucosidase and urease activity showed a transitory declining trend up to 15 DAA, there after increased till 60 DAA. Significantly higher and lower MBC (384.95 μg C g⁻¹ dry soil and 273.36 μg C g⁻¹ dry soil), β- glucosidase activity (123.38 μg p-nitrophenol g⁻¹ dry soil 2hr⁻¹ and 103.46 μg p-nitrophenol g⁻¹ dry soil 2hr⁻¹) and urease activity (244.54 μg NH₄ g soil⁻¹ 2h⁻¹ and 215.58 μg NH₄ g soil⁻¹ 2h⁻¹) was observed at 60 DAA in treatment T₅ (MT + Pendimethalin + residue retention) and T₃(CT + Pendimethalin) respectively. Being biologically active compounds, pendimethalin may adversely affect soil microorganisms and their activity (Latha and Gopal, 2010) during initial application. The recovery of the enzyme activities and microbial biomass carbon towards harvesting might be due to the growth of microbial population and increased adaptation to the existing environment or the increased availability of nutrients after complete degradation of herbicides (Ismail *et al.*, 1998). Application of organic sources was able to provide sufficient nutrition for proliferation for microbes and their activities in terms of soil enzyme activity.

Dissipation of Pendimethalin

Half-life of Pendimethalin (Table 1) varies with the type of tillage practices. Minimum tillage resulted in shorter half lives (12.73 – 17.52 days) compared to the conventional tillage practices (26.43 days). The lowest half-life value was recorded under MT with residue retention. The higher microbial activity under MT with residue retention might have resulted in faster degradation of Pendimethalin. Higher half life period of Pendimethalin under CT is attributed to the bounding of pendimethalin to soil organic matter and reduced loss from soil besides its immobility in soil.

Conclusion: From the study, it can be concluded that MT along with crop residue retention enhances the enzyme

activities and microbial biomass carbon compared CT. There was transitory inhibitory effect on MBC, β -glucosidase and urease activity with Pendimethalin application up to 15 DAA which regained and increased till 60 DAA. The dissipation of Pendimethalin was faster under MT than CT. The Pendimethalin at 750g/ha can safely be used for weed control in Indian mustard for effective control of weeds.

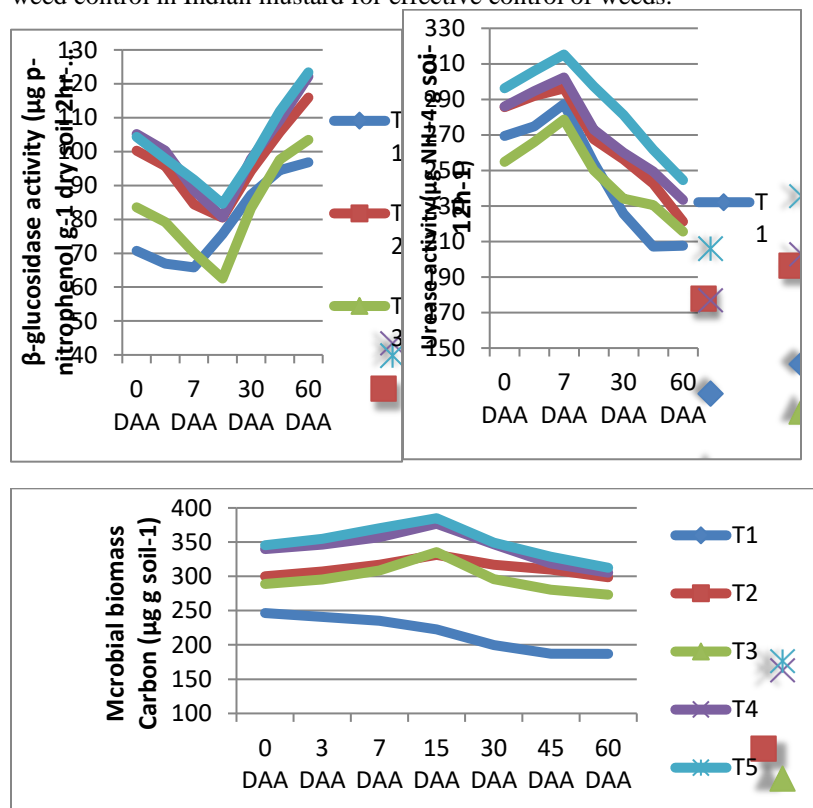


Fig.A: Soil microbial activity in Mustard crop as affected by tillage and pendimethalin

Light and Pheromone traps: Their role in monitoring abundance of *Holotrichia seticollis* Moser (Coleoptera: Scarabaeidae) in North Western, Indian Himalayas Nutan, A. R. N. S. Subbanna, Amit Paschapur, Johnson Stanley, Ila Bisht

Purpose: *Holotrichia seticollis* Moser (Coleoptera: Scarabaeidae) is one of the predominant and notorious white grub species in hill agro-ecosystem of north-western Indian Himalayan region. Both, the grubs (rhizophagous) and adults (phytophagous) cause damage to commercial crops such as potato, ginger, rice and sugarcane. Considering the economic importance of *H. seticollis*, a simple and efficient means for monitoring the adult population is necessary, as it would yield correct and perfect timing for planning an effective management strategy.

Methods: In present study, light trap (VL white grub beetle trap; IN 290170) and pheromone trap (methoxybenzene, $\text{CH}_3\text{OC}_6\text{H}_5$) were compared for their relative efficacy and importance in monitoring the populations of *H. seticollis* at Experimental farm, ICAR- Vivekananda Parvatiya Krishi Anushandhan Sansthan (29.63° N , 79.63° E and 1250 m above mean sea level), Hawalbagh, Almora from 20th to 33rd standard meteorological weeks of 2020-2021. A specific synthetic attractant i.e., anisole (methoxybenzene) was used as lure to attract and trap males of *H. seticollis*. The traps were operated between 7:00 pm to 6:00 am daily and catches in both the traps were recorded on daily basis and the trap catch data were converted to $\log_{10}(n+1)$ and subjected to statistical analysis to evaluate the correlation between weekly catches of *H. seticollis* in light trap and pheromone trap.

Results: Both light and pheromone trap catches revealed that the emergence of *H. seticollis* started during second fortnight of May and continued till first fortnight of August, during both years (2020-21). However, catches in the pheromone trap were observed 2 weeks before that of light trap catches, when the *H. seticollis* population in the crop field was supposed to be very low. The second fortnight of June was recorded as the peak period for the emergence

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of *H. seticollis*. Although, light traps have been primarily used for monitoring the diversity and abundance of scarab beetles worldwide, because of their advantages in attracting both male and female insects, but the results from the present study indicate that species specific pheromone traps are more effective in monitoring *H. seticollis* population as 4,012 and 3,054 beetles were trapped in 2020 and 2021, respectively in pheromone traps while only 51 and 37 beetles were trapped in light trap during 2020 and 2021, respectively, thus resulting in wrong assumption. Although, light traps can be used for monitoring the presence of *H. seticollis* in a location but pheromone traps suit the most for assessing the abundance in a particular area. Moreover, the pheromone traps with synthetic attractant (anisole) constitute an effective tool for surveillance and monitoring adult *H. seticollis* populations with higher specificity and even at low pest population densities than a light trap.

Conclusion: In conclusion, pheromone traps could be used as an efficient tool for predicting the abundance of *H. seticollis* in a given locality and thus assist in planning and designing timely pest control strategies.

Key words: Scarabaeidae, White grub management, Light trap, Pheromone trap, *Holotrichia seticollis*, Pest abundance.

Weed management in yellow sarson under conservation agriculture based direct seeded rice - yellow sarsoon - greengram cropping system

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Purpose: Conservation agriculture (CA) is a viable alternate which is suitable for today's limited natural resources and changing climate. That's why it is becoming a common approach in rainfed areas for water and soil conservation. In CA, problem of weeds can be controlled by both manual weeding and/or by the use of herbicide. However, labour is becoming expensive and is rarely available at the critical time of weeding. To control weeds, herbicides are being extensively used in CA, but there is not a single herbicide that can be applied for several types of weeds present in agricultural fields. Hence, technique of integrated weed management is highly desirable to enhance sustainability of CA. Integrated approaches must be considered and optimized to have proper weed control in conservation agriculture. Keeping this in view, the present experiment was conducted to study the effect of tillage and weed management practices on weed growth and productivity of yellow sarson under conservation agriculture based DSR-yellow sarsoon-greengram cropping system.

Methods: A long term experiment on weed management in a conservation agriculture based direct seeded rice (DSR)-yellow sarsoon- greengram cropping system was initiated in 2015. The present experiment was conducted as 5th year cropping cycle during 2019-20 at Agriculture Farm, Visva-Bharati, Sriniketan, West Bengal. The experiment was laid out in a strip plot design with three replications. Four tillage practices comprising of conventional tillage (CT) (DSR) — CT (yellow sarsoon) — CT (greengram), CT (DSR) — zero tillage (ZT) (yellow sarsoon) — ZT (greengram), ZT (DSR) — ZT (yellow sarsoon) — ZT (greengram), ZT + residue (R) (DSR) — ZT + R (yellow sarsoon) — ZT + R (greengram) were allocated to the horizontal strip and three weed management practices, viz. recommended herbicides (RH) (pendimethalin at 1.0 kg/ha followed by bispyribac-sodium at 25 g/ha in direct-seeded rice, pendimethalin at 0.75 kg/ha each in yellow sarsoon and greengram), Recommended herbicides + hand weeding (HW) at 35 days after sowing (DAS), Unweeded control were assigned to the vertical strip.

Results: Results revealed that conservation tillage (i.e. zero tillage + residue) along with recommended herbicide (RH) (pendimethalin at 0.75 kg/ha)+ one hand weeding (HW) recorded the lowest values of total weed density and dry weight at 45 DAS. Conservation tillage (Zero tillage + residue) along with recommended herbicide (RH) (pendimethalin at 0.75 kg/ha) + one hand weeding (HW) also registered the highest value of seed yield of 1687 kg/ha in 2019-20. Conservation tillage i.e zero tillage along with residue retention resulted in 76.76% increase in yield of yellow sarsoon as compared to conventional tillage. It was also observed that seed yield of yellow sarsoon under unweeded control with conservation tillage was significantly higher than conventional tillage with recommended herbicide.

Conclusion: Thus, after 5th cycle of cropping it may be concluded that, conservation tillage with recommended herbicides alone in yellow sarsoon may be advocated for effective weed management, higher productivity of yellow sarsoon in conservation agriculture based direct seeded rice - yellow sarsoon - greengram cropping system in lateritic belt of West Bengal.

Key words: Yellow sarsoon, residue, conservation agriculture, weed management and pendimethalin

Effect of polythene mulching on moisture conservation, weed control, yield and economics of tomato

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Purpose: Tomato (*Lycopersicon esculentum*) is the most consumed vegetable in the world. Water is being a limited resource, its efficient and effective utilization through viable irrigation management is essential for tomato crop to attain sustainable yields. Weeds are one of the constraints that competes for space, light, water and nutrients with tomato crop and causes yield reduction. Polythene mulching has been emerged as potential management approach to maintain favorable soil moisture and to control or suppress weeds in tomato crop.

Methods: Rashtriya Seva Samithi (RASS) – Krishi Vigyan Kendra (KVK) has conducted thirty three demonstrations on ‘Moisture conservation and weed control in tomato using polythene mulching’ in Chittecherla and Deendarlapalli villages of Chinnagottigallu mandal, Chittoor district, Andhra Pradesh under National Innovations on Climate Resilient Agriculture (NICRA) project from 2015-16 to 2019-20 with an objective of soil moisture conservation and weed control during crop growing period thereby to improve productivity.

Results: The five years data revealed that 26.2 irrigations were given to farmers practice (without polythene mulch), whereas it was only 17.6 in the demonstration (with polythene mulch). Weed density was low under polythene mulch condition (37.94 per m²) in tomato than without mulch (59.52 per m²). Polythene mulching with drip irrigation in tomato significantly increased the number of fruits per plant (32.9) and individual fruit weight (72.83gm) there by higher fruit yield (65676kg/ha) as compared to the farmers practice (53324 kg/ha). The gross returns (Rs.387736/- per ha), net returns (Rs.222169/- per ha) and BC ratio (2.45) were more in the case of polythene mulched tomato when compared to without polythene mulch.

Conclusion: It can be concluded that the use of polythene mulch along with drip irrigation was significantly increased the growth, yield and economic parameters in tomato by conserving soil moisture, effective nutrient uptake and suppressed weed growth.

Key words: Tomato, Polythene mulch, Weed, Drip irrigation, NICRA, Gross returns, BC Ratio

Phyto-nutritional and medicinal values of tree leaves and potentiality as alternate roughages for dairy animals in Mizoram, India

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Purpose: Dairy farming, being the 2nd most preferred animal husbandry activity next to piggery, supports livelihood to nearly 50% of the rural population in Mizoram, India. Under intensive rearing, dairy animals are fed commercial concentrates or mixture of home-grown grains and by-products with various unconventional grasses/shrubs and tree leaves. Tree foliage plays significant role in meeting the roughage needs of the dairy animals.

Methods: Surveys were conducted on 120 dairy farmers of three rural development blocks of Mizoram, namely Tlangnuam, Thingsulthiah and Aibawk. Feeding practices of dairy animals were assessed and samples of tree foliage fed to dairy animals were collected following standard procedures. Analysis of phytonutrients and anti-oxidant properties of the tree leaves were assessed both qualitatively and quantitatively as per different standard methods of analysis.

Results: Forty different tree foliage were identified which were fed with local grasses and concentrate mixtures to the dairy animals. Twenty tree foliage were observed to be evergreen out of the forty identified. Study revealed utilization of tree leaves for different common ailments of gastrointestinal tract, skin lesions, kidney disease etc. by rural communities besides extensively utilizing as the main roughages for dairy animals throughout the year. Screening for phytonutrients revealed presence of polyphenols (4.30±0.79 to 61.55±3.91%) in 33 species, flavonoids (0.05±0.00 to 178.48±0.83 mg RE/g) in 25 species, all for terpenoids, 22 for saponins (10.07±0.33 to 112.50±2.15 mg DE/g), 13 for alkaloids (0.18±0.01 to 7.28±0.01 mg/g) and few tree species for glycosides, quinone, phlobatannins and reducing sugar. Analysis of aqueous extracts of tree leaves showed significant antioxidant properties in terms of Fe (III) to Fe (II) reducing activity and ascorbate-Fe (III) catalysed phosphor-lipid peroxidation. Utilization of tree leaves were observed to be based on experiences and local knowledge of Mizo communities without any scientific basis.

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Conclusion :The study created database on various aspects of tree foliage commonly fed to dairy animals in Mizoram, India and their chemical properties for optimum utilization towards meeting the forage demands of the dairy animals and warrants scientific propagation and conservation of all the promising tree species for cost-effective feeding in the days to come.

Key words: Tree foliage, dairy animals, phytochemicals, antioxidant, feeding value.

Assessment of genetic variation in fenugreek genotypes under different salinity regimes.

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Purpose: Fenugreek is grown in arid and semi-arid areas of the world. Majority of areas are facing salinity problems and these situation remains prevalent in most of the area during crop growth season. The salinity potential in many of the fenugreek growing areas prompted to conduct the present study which will help in understanding the effects of salt stress on plant growth in fenugreek.

Method: Ten genotypes of fenugreek were evaluated in laboratory under three levels of salinity. The salinity levels were 0.0%, 0.50% and 0.75% NaCl, created by adding 2.5 g and 3.75 g NaCl in 500 ml of double distilled water, respectively. Hundred seeds of each genotype were sown in two petri dishes containing fifty seeds each. These petri dishes were prepared for each genotype and replicated thrice. The temperature and humidity maintained in germinator chamber was 20±5°C and 90±5°C, respectively. The experiment was terminated on the 12th day and observation were recorded on germination percentage, shoot and root length, fresh and dry weight of shoot and root and seedling vigour index. The data on dry weight of shoot and root were recorded after drying them in hot air oven at 65°C for 48 hours.

Result: The genotypes exhibited significant difference in all the salinity levels for all the characters under study. Pooled analysis of variance indicated significant differences among genotypes, salinity levels as well as the interactions between genotype × salinity levels, indicating differential response of genotypes to salinity for all the characters. A wide range of variability was observed for all the characters. The mean values of all the characters varied along the salinity gradient. The value was maximum in the control that is in the absence of salt stress and was minimum at the highest salinity level for majority of characters. The reduction in mean value was more in shoot length, root length, fresh weight of shoot and root, dry weight of shoot and root and seedling vigour index. The reduction was less in 0.5% NaCl and was found more in 0.75% NaCl. Correlation coefficient analysis revealed that seedling vigour index is positively correlated with seed germination, shoot length, root length, ratio of shoot length to root length, ratio of fresh weight of shoot to fresh weight of root, dry weight of shoot, dry weight of root and ratio of dry weight of shoot to dry weight of root.

Conclusion: Based upon the performance rank of genotypes over different salinity levels, the genotype Nagaur Local was found to be most desirable followed by RMT-351 and RMT-305. Genotypes Nagaur Local, RMT-351 and RMT-305 could be exploited directly for seedling establishment in salt affected area with desirable yield.

Key words: Fenugreek, Genetic, NaCl, Salinity, Variability

BIOREMEDIATION OF SALT AFFECTED SOILS USING HALOPHILES

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Purpose: Soil health is one of the key factors for efficient agricultural production. Increased demand for agriculture commodities generates incentives to convert forests and grasslands to farm fields and pastures which results in increase in soil erosion. In addition to erosion, soil health and quality is affected by other aspects of agriculture. Among the soil degradation problems, salt-affected soil is one of the serious problems under arid and semi-arid lands. Soil degradation through salinity or sodicity is universal concern. The problem of salinity and sodicity in India is becoming more serious and is a matter of concern because of alarming increase in the area in the country under these soils. The reclamation of these soils requires additional agricultural inputs and practices like amendments, water and infrastructure for drainage, which is costly and resource consuming. One of the cheapest approach for reclaiming the salt affected soils is the use of microorganisms in the form of different formulations. A good quality formulation promotes survival of bacteria maintaining available population that are sufficient to exude growth promoting effects on plants. But the microbial strains available as biofertilizers for different crops do not perform effectively under salt stress and their activity decreases when used in salt affected soils due to osmolytic stress. Salt stress is responsible for obliteration of the microbial communities and carbon cycling in the soil. To overcome this, attempts have been made to develop bioformulation based on halophiles, that can replace regular biofertilizer applications in salt affected soils.

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Halophiles are salt-loving organisms that inhabit hypersaline environments. Halophilic bacteria have the ability to produce compatible solutes, especially glycine, betaines, and ectoines, which may be used as stress protectants against high salinity, thermal denaturation, desiccation and freezing as well as stabilizers of enzymes, nucleic acids, membranes and whole cells. They can produce enzymes that have optimal activity at high salinity. The use of halophilic bacteria in the recovery of saline soils is based on the hypothesis that microbial activities in saline soil may favour the growth of plants under salt stress. The application of salt tolerant plant growth promoting bacteria (Halophiles) include overcoming of ill effects of salt affected soils by directly supporting the growth of vegetation thus enhancing crop yields. These bioformulations play a greater role with salt tolerant varieties and further improve the crop produce and soil fertility.

OBJECTIVE: To assess the effect of application of microbial formulations on soil biological properties.

Method: The experiment was conducted at the Division of Soil Science and Agriculture Chemistry, Sher-e-Kashmir University of Agricultural Science and Technology, Chatha, Jammu (J&K). A pot-culture study was set up with Factorial Completely Randomized Design with three replications to test influence on soil biological properties using four halophilic bacterial bioformulations. Two factors were taken *viz.*, Soil types and Biofertilizers (halophilic bioformulations). Under soils, two types were taken i.e. normal rice growing soils and sodic soils. Five levels of 27 bioformulations were also taken. These levels were control (B0), Inoculation with Halo-Azo (B1), Inoculation with Halo-PSB (B2), Halo-Zinc inoculation (B3) and Inoculation with consortium of bioformulations (Halo-Azo+Halo-PSB+Halo-Zinc) (B4). There were a total of ten treatment combinations with 3 replications taking the number of pots to 30. The experiment consists of 150 seedlings of rice variety PR 113. Twenty-one days old seedling were selected. In each pot 5 plants are transplanted. Proper cultural practices were given to the plants during the entire course of study.

SOIL BIOLOGICAL PARAMETERS:

1. **Microbial biomass carbon:** Microbial biomass carbon (MBC) was determined using the chloroform fumigation extraction methods.

2 **Dehydrogenase enzyme activity:** Dehydrogenase activity was determined by monitoring the rate of production of triphenyl formazan (TPF) from tri-phenyl tetrazolium chloride (TTC).

3. **Phosphatase activity (PA):** The method of determination of phosphatase activity in soils involves colorimetric estimation of the p-nitrophenol released by phosphomonoesterases activity.

4. **Microbial Count:** The serial dilution and plating techniques was employed for isolation and identification of viable bacteria count.

Result: The mean microbial biomass carbon was significantly higher in normal soil ($113.8 \mu\text{g g}^{-1}$) as compared to sodic soil ($84.8 \mu\text{g g}^{-1}$). The highest soil microbial biomass carbon values in normal soil may be due to the highest counts of soil microbes and their activities, also high availability of organic carbon, nutrients, optimum moisture and aeration (Doran *et al.*, 2006). Both dehydrogenase activity and phosphatase activity was affected by the type of soil and application of halophilic formulations. In normal soils, only the dehydrogenase activity was significantly affected by application of bioformulations, while a visual rise was observed from phosphatase data which was not statistical higher than control. Arora *et al.* (2016) observed that with the inoculation of halophilic consortia, dehydrogenase activity was increased ($16.8 \mu\text{g TPF g}^{-1}\text{hr}^{-1}$) as compared to control ($12.4 \mu\text{g TPF g}^{-1}\text{hr}^{-1}$). Microbial count for both bacteria and fungi was significantly higher in normal soils as compared to sodic soils, as evident from overall mean values. The reduced and/or altered microbial activities in saline and sodic soils are likely either due to direct toxic effects of salts on microbial communities.

Conclusion: Halotolerant strains of bio-fertilizers *viz.* Halo-azospirillum, Halo-phosphorus solubilizing bacteria, Halo-zinc and Halo-mix (combination of all three) were found to be effective in sodic soils. Application of multi-strain bacterial growth consortia could be an effective approach and need to be further explored.

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Genetic polymorphism in leptin gene and leptin gene receptor and their association to obesity in population of Jammu, J&K

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Purpose: Obesity has become a global threat to mankind and is contributing to many diseases. With increase in socioeconomic development, obesity is also growing every year. Obesity is a condition that is controlled by many factors, and genetics playing a very important role in disease outcome. So, we intend to explore the association of SNPs in *leptin* gene and its receptor with obesity in population of Jammu region.

Methods: It has been observed that not all individuals suffering from obesity are prone to these comorbidities. The Adult Treatment Panel-III (ATP-III) categorizes obesity into metabolically healthy obesity (MHO) and metabolically unhealthy obesity (MUHO). Patients falling under MUHO are predisposed to high risk of complications like cardiovascular etc whereas MHO patients are not. Both MUHO and MHO obesity have difference in their etiologies and treatments. We have categorized obese individuals into MUHO and MHO group. Blood/saliva was collected for DNA isolation and DNA was subjected to SNP detection in the *leptin* gene and its receptor by sanger sequencing or TaqMan assay.

Results: Leptin is secreted by adipose tissue and regulates food intake, metabolism, and various other physiological functions. Leptin is encoded by LEP gene and exerts its biological actions by binding to its receptor, leptin receptor. The aim of this study is to investigate the prevalence of single nucleotide polymorphisms in LEP (2548 G/A (rs7799039) and 3' UTR A/C (rs11761556) and two SNPs in LEPR rs1137101 (Gln223Arg) and rs1137100 (Arg109Lys) and their association with Leptin level and obesity. We recruited 169 non-obese (body mass index [BMI] = 24.51-3.69 kg/m²) and 160 obese (BMI = 36-4.78 kg/m²) patients. For genotyping, we are doing sanger's sequencing and Leptin level was measured by ELISA. Linkage disequilibrium and possible Haplotypes for the given SNPs and statistical analyses will be performed after getting the genotyping results.

Conclusions: In conclusion, this study is very important to determine the association of LEP and LEPR gene polymorphism with obesity in the study population. Also, when combined in haplotypes, a synergic effect will be observed in Leptin levels and obesity risk. It will show the role of LEP (2548 G/A (rs7799039) and 30 UTR A/C (rs11761556) and two SNPs in LEPR rs1137101 (Gln223Arg) and rs1137100 (Arg109Lys) polymorphism to be associated with Leptin concentration in MHO and MUHO groups of the study population.

Key words: Leptin, Leptin receptor, obesity, polymorphism

Effect of plant growth regulators and chemicals on yield and economics parameters of acid lime (*Citrus aurantifolia* Swingle) cv. Vikram.

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Purpose: Acid lime (*Citrus aurantifolia* Swingle) is the 3rd important fruit crop after Mango and Banana. It is commonly called as *Nimbu*. It is the member of family Rutaceae and has chromosome no. 2n=18. The present study was therefore undertaken to investigate the effect of combinations of plant growth regulators viz., GA₃ and Cycocel, chemicals viz., KNO₃ and Thiourea on flowering and fruiting patterns of acid lime.

Methods: The experiment was conducted in Randomized Block Design (RBD) with 11 treatments replicated thrice. A total of 33 acid lime plants spaced at 3X3 m² were selected for the study. The citrus variety was used in the experiment “Vikram”. A total of 33 acid lime plants spaced at 3X3 m² were selected for the study.

Results: The present investigation was carried out at Experimental area, College of Agriculture, Gwalior (M.P.) during 2018-19 and 2019-20. T₁₀ (GA₃ 60 ppm + Cycocel 2000 ppm + Thiourea 2%) was found to be significantly superior to rest of the treatments under study but was reported to be at par with T₉ (GA₃ 60 ppm + Cycocel 2000 ppm + Thiourea 1%) for all the parameters like Number of fruits per shoot (39.25, 39.91 and 39.58), Number of fruits per tree (974.00, 970.33 and 972.17), Average fruit weight (37.92, 36.95 and 37.44 g), Yield per Plant (36.94, 35.86 and 36.40 kg), Yield per ha (410.29, 398.37 and 404.39 q) during first, second and pooled year respectively and as well as B: C ratio of 4.86 for better yield of successive crop.

Conclusions: Yield parameters like number of fruits per shoot, per tree, average fruit weight, and yield per tree and per hectare were affected significantly by various treatments. Among the treatments, T₁₀ (GA₃ 60 ppm + Cycocel 2000 ppm + Thiourea 2%) was found to be significantly superior to rest of the treatments under study. It was however followed closely by T₉ (GA₃ 60 ppm + Cycocel 2000 ppm + Thiourea 1%). T₁₀ (GA₃ 60 ppm + Cycocel 2000 ppm + Thiourea 2%) gave the maximum cost: Benefit ratio.

Keyword :- Acid lime, PGR's, Chemicals, Yield parameters, Economics parameters, Vikram etc.

ENRICHED VERMICOMPOST PRODUCTION TECHNOLOGY

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Purpose: The enriched vermicompost production technology that means, when there is a need to increase food and production to meet the demand of the growing populations, how we can enhance for improve the quality of the organic manures, so that they can meet the nutrient requirement of the crop by applying it in less quantity.

Methods: For enrichment of nitrogen, we can use cakes like groundnut,mustard cakes (7.3%N) etc. Rock phosphate, basic slag (17-20%P₂O₅) phosphorus. Sylvite, tobacco stem, babool wood can be added being the composting process for potassium enrichment.Use of microorganism like *Bacillus firmus* for potash releasing bacteria.

Results: Enriched vermicompost contain high nutrient status than conventional vermicompost production.Enriched vermicompost contains 1.4-1.5%totalN,2.9-3.5%P₂O₅,2.8-3.5%K,7-8%total Ca, Mg1.5-2.3% total Mg.*Urease* enzyme activity and *acid phosphatase* also increases in enriched vermicompost.

Conclusions: By adding enrich material, nutrient content of vermicompost increases, so less amount to be needed to apply to crops to full fill their nutrient requirement. Vermicompost help in increasing SOC, aggregates, WHC, restore fertility. Help in waste management, crop residue management.

Keywords: Composting, Phosphatase and Vermicompost

INTEGRATED PLANT NUTRIENT MANAGEMENT: TOWARDS SUSTAINABLE AGRICULTURE

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Purpose: Integrated plant nutrient management deals with the combined application of mineral fertilizers and organic manures to meet the nutritional requirement of crops. The adverse effects of the long-term application of mineral fertilizers on crop productivity and sustainability of crop production can be avoided by following integrated plant nutrient management.

Methods: In IPNM we include the use of FYM, Fertilizer, crop residues and farm waste, green manure, vermicompost,biofertilizer crop rotation etc. In different proportion to crop to fulfiltheirnutrient need for better growth and yield.

Results: As a result, the organic and inorganic fertilizers in combination with biofertilizers is not only used as a source of nutrients but also can be used as soil amendment to improve the soil organic carbon (SOC) content, aggregate stability, and moisture-retention capacity [Garai&Datta 2014].[Brady&Weil 2005] reported that 100 kg of dry soil that contains 1% organic matter can hold 30 kg of water, whereas soil with 5% organic matter can hold 195 kg of water. Which improves soil structure, aggregates and water use efficiency of soil.

Conclusions: Production is integrated into environmental, building, healthy landscapes. Maximum conservation for soil water quality. Help in restore soil fertility and nutritional value of crops Also help to increase income of farmer by applying organic source of fertilizerlike residues and farm waste as a source of nutrient for plant

Keywords: Amendment, Landscapes, Organic matter,Vermicompost.

Mutagenesis of Green pea (*Pisum sativum* L.) and the isolation of mutants for various traits and earliness in Gwalior region of Madhya Pradesh

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Purpose: Green pea is a legume species with recognized tolerance to several diseases and pathogen thus important for the improvement of related major legume crops. We aim to identify unique mutant among green pea, of quantitative character as well as morphological character.

Methods: A green pea worldwide collection of different characters for protein as well as sweetness in green pea and those charactrs was characterized under controlled conditions for response to. It is treated with Gamma radiations using Cobalt 60 at BARC, Mumbai to generate earliness in green pea.

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Results: Pea mutants for unique characters have been obtained by treating seeds with gamma radiations followed by 2 screening procedures. In one, mutants found to high branching, or with higher number of pods were obtained, whilst in the other 4 sickle shaped pod mutants with 5 times more pods than cv. Frisson and expressing a character of bunched pods were discovered. All mutations are under the control of single recessive genes also known as point mutation. Biochemical experiments showed the leaf pigmentation and phenotypes are associated with the pods in the respective genotypes and that phenotype is associated with the earliness in those genotypes.

Conclusions: The identified mutants here can be exploited in grass pea breeding for future prospectus, and due to pod yield and earliness to pea, potentially contribute to pea improvement.

Key words: A contextual sentence about your motivation behind your topic, A descriptive statement about the types of literature used in the review, Summarize your findings, Conclusion(s) based upon your findings

Antifungal Efficacy of *Ocimum*-based essential oils against some important seed-borne fungal pathogens

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Purpose: In order to find out environment friendly substitute of health hazardous fungicide, a comparative study was conducted to determine antifungal efficacy of essential oils derived from *Ocimum* species.

Methods: For evaluation of antifungal activity, 10 accessions of *Ocimum* sp. were selected (IC589191, IC589199, IC589222, IC599299, IC599325, IC599326, IC599334, IC599345, IC599351 and IC626384) against some important phytopathogenic fungi, namely *Bipolaris oryzae* (*Bo*), *Botryodiplodia theobromae* (*Bt*), *Colletotrichum capsici* (*Cc*), *C. gloeosporioides* (*Cg*), *Diaporthe helianthi* (*Dh*), *D. phaseolorum* (*Dp*), *Fusarium verticillioides* (*Fv*), *Macrophomina phaseolina* (*Mp*) and *Phoma sorghina* (*Ps*) using disc diffusion method. The crude essential oils were evaluated and inhibition per cent of mycelial growth of the pathogens were computed.

Results: Results revealed that all the 10 essential oils derived from *Ocimum* sp. were effective against only two pathogens, *B. theobromae* and *P. sorghina* showing more than 50 per cent growth inhibition. None of the oils were found effective against *D. helianthi*, *F. verticillioides* and *M. phaseolina* as growth inhibition was less than 50 per cent. Among *Ocimum* accessions, IC589191 was most effective as it showed potentiality of mycelial growth inhibition against most of the pathogens i.e. *Cc* (65.6%), *Bo* (64.4%), *Bt* (61.0%), *Ps* (60.5%), *Dp* (55.7%) and *Cg* (52.2%) followed by IC626384, IC599345 and IC599326 which was found effective against *Bo*, *Bt*, *Dp* and *Ps* with growth inhibition of more than 50 per cent.

Conclusions: Our observations have shown promising antifungal activity of essential oil derived from *Ocimum* sp. Because of restriction or ban on use of common fungicides, *Ocimum*-derived essential oils could be an effective alternative for management of seed-borne fungal pathogen by further enhancing their low fungitoxicity.

Key words: Antifungal efficacy, Essential oil, Seed borne fungal pathogen, *Ocimum* sp.

Promotion of microbes based technology for improved crop production among weaker section of society

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Purpose: Purpose of this study to disseminate microbe-fortified compost production technology standardized in house, among the rural and weaker section of society at Mau and Azamgarh districts. The high-value organic farm-input production using microbial bioconversion processes and its applications in the farmers' field for the production of high value crops especially commercial crops like vegetables, fruits, flowers and organic crops are eco-friendly options for farming as well as agro waste management. Microbes are better alternative for low input ecofriendly technologies in farming system.

Methods: In these district >20 villages based on the population of weaker section (SC community) have been selected and promotional activities were performed among the farmers. In addition to this, bioformulation singly or in combinations already tested at ICAR-NBAIM experimental farm were popularized in several villages of Mau through

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front line demonstrations (FLDs). In 2020-21 and 2021-2022 eight FLDs were conducted on wheat, rice, brinjal demonstrating the organic practice including application of microbial formulation with Bio-NPK, Trichoderma as well as compost with reduced chemical fertilizer practices. Besides, this 14 scientist representing 9 KVKs of eastern U.P were made award of fortified compost production technology for better dissemination among farmers. Representatives from 12 NGOs from Mau, Azamgarh and Gazipur, 1 SHGs, and 2 FPO representatives from Azamgarh were trained in the interventions to straighten the entire value chain the organised efforts have resulted in adoption of composting technology by 13 SC farmers from Mau and 2 farmers from Azamgarh

Results: Thirteen training and demonstration programs have been conducted in the Pipridih, Kahinaur, Patila, Kajha, Khargajpur villages of Mau, and at KVK Azamgarh for farmers of more than 12 villages. A total of 1813 farmers have been disseminated with the microbe-fortified compost production technology among rural population out of which 627 were women and 75 migrants. Promotion to use microbial inoculants for increasing compost quality was done and the microbe based bioformulation were provided during the training cum demonstration programs for free of cost along with technical bulletin in Hindi language. In microbes treated plant farmers not only obtained the crop yield equivalent to growth in plant treated with 100% FP, but interestingly also achieved approximately 5-8% increase in crop yield and economic outcome as well. The compost production by the farmers till now is ranging between 5-21 quintals. The beneficiary farmers at present are using the compost produced by them in their own field (field size in which compost application done ranging from 0.4 to 2 acre) and have reduced chemical fertilizer inputs gaining economic benefit ranging from Rs 1000 – Rs 8000/- per application. Besides this till date at least 10 women SHG group have included composting as one of the activities.

Conclusions: Microbes based technology is an effective way to improved crop production and sustainable agriculture as well. Bioformulation used in present study exhibited higher crop yield as compared to traditional farmer's practice. It helps to reduce consumption of chemical fertilizers which ultimately improves soil health. Higher crop yield eventually strengthens the economic status of farmers.

Key words: Microbial technology; Compost, dissemination, rural weaker sections, Eastern Uttar Pradesh

Role of traditional galactagogues on breastmilk production and infant development Vinutha U Muktamath*, SunandaItagi and PriyaHegde

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Purpose: Historically, herbs and foods have been used as galactagogues by breastfeeding women to maintain and increase milk supply. Breast milk production is a complex physiologic process involving physical and emotional factors and the interaction of multiple hormones, the most important of which is believed to be prolactin. Galactagogues (or lactagogues) are medications or other substances believed to assist initiation, maintenance, or augmentation of maternal milk production, because low milk supply is one of the most common reasons given for discontinuing breastfeeding, (Sjolin et.al., 1977). Both mothers and physicians in recent years have sought medicine to address this concern. Common herbs and foods used as galactagogues are numerous and varied which include almonds, asparagus, chicken soup, coconut, coriander, cumin, fennel, fenugreek, garlic, ginger, lettuce, millet, mushrooms, papaya, pumpkin, rice, sesame seeds and sunflower seeds (Marasco, 2008 and Nice, 2011). In India, breastfeeding is culturally well accepted but inadequately practiced due to lack of knowledge, prevailing misconceptions and cultural taboos that significantly contribute to undesirable maternal and infant outcomes. In view of this, the study was conducted to study the breastfeeding practices and to document the traditional galactagogues used by lactating mothers in Northern Karnataka and its influence on maternal and child outcomes.

Methods: The study was conducted in rural and urban areas of three districts of northern Karnataka viz., Dharwad, Vijayapura and Bagalkot. The sample of the study consisted of 900 Mother – infant dyads in phase-I, where the infants were in the age group of 3 months to 24 months and their mothers from rural as well as urban area of northern Karnataka to study the breastfeeding practices and document the galactagogues used by mother during lactation. Later in the phase-II, 180 infants were selected to examine the association between the use of galactagogues and breast feeding practices, mother's health and developmental outcomes of infants. Purposive proportionate random sampling method was used and a differential design was used to understand the difference between the groups. The tools used for the study included a self- structured questionnaire used to collect personal information of mother, breast feeding practices and document the galactagogues used. Bayley's scale of infant development- III (2006) was administered to measure the infant development outcomes and growth of the infant was assessed based on WHO growth indicators utilizing child's weight-for-age. The infants were classified by using corresponding Z-scores ranging from -3 to + 3 according to growth indicators

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Results: The age group of mothers ranged from 18-40 years and infants age ranged from 3 to 24 months wherein majority of the infants were in the age group of 12-24 months (55.33 %). With respect to birth weight, majority were in the normal category (88.22 %), followed by low birth weight infants (11.11 %) and only 0.67 per cent were very low birth weight children. Distribution of infants based on category of infant feeding practices which shows 42.22 per cent infants were exclusively breast fed for first six months, 34 per cent were predominantly breast fed, 22.22 per cent were complementarily breast fed for first six months and 1.56 per cent was never fed with breast milk. The common galactagogues used by mothers were wheat semolina, broke wheat, red rice, pulses, Alvi, garlic, methy, dryfruits, oilseeds like sesame, groundnut and green leafy vegetables specially shepu (dilleaves) and methy (fenugreek). The results indicated that majority of mothers who were encouraged to use galactagogues had better nutritional status and no anaemia (>11 Hb level and practiced exclusive breast feeding (62%) and in turn the infants of these mothers reported less incidence of illness (75.26 vs. 24.74 %). Bivariate analysis of association between consumption of galactagogues till first five months of delivery indicated better cognitive and psychomotor development among infants. The cognitive development was found to five times higher and psychomotor development upto 6.5 times higher in these infants when compared to the infants whose mothers did not consume galactagogues regularly.

Conclusions: Breastfeeding is an important woman's issue, human rights issue, health issue and feminist issue. Breastfeeding empowers women. It provides optimum nutrition to the infant. The study suggests that the maternal galactagogue supplementation seems to be useful for promoting and increasing breast milk production in early postnatal days and lactating mothers with complaints of insufficient milk may be advised to take the galactagogues like fenugreek, alvi, green leafy vegetables, dry fruits, etc., which have scientific evidence as a routine practice. However, use of any galactagogue should never replace lactation evaluation and counselling. Close follow-up of both mother and baby is essential even in instances of galactagogue support.

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SCREENING OF SOYBEAN VARIETIES FOR EFFECTIVE SYMBIOSIS WITH INDIGENOUS *RHIZOBIUM* Spp.

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Purpose: Soybean has potential to combat protein malnutrition in developing countries like India. New cultivars of soybean are being developed continuously. It is therefore important to screen these cultivars to determine their performance in terms of yield and adaptation to different ecologies. The yield of soybean (*Glycine max* L. Merrill) can be alleviated by developing promising genotypes for efficient symbiosis. The present experiment is being undertaken in order to understand nodulation ability of different soybean cultivars, as well as their symbiotic effectiveness to select excellent strains of indigenous *Rhizobium* for possible future use as commercial inoculants in Chhattisgarh. A field experiment was conducted at College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur with the aim of screening of soybean germplasm for effective symbiotic association with indigenous *Rhizobium sp.* in order to identify potential genotypes for subsequent breeding work focusing on promiscuous effective nodulation.

Methods: Eighteen soybean varieties grown in the Research field of College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya were evaluated during *kharif* 2019-20 on the basis of measured traits like biomass accumulation; nodulation, leghaemoglobin content and symbiotic performance of soybean genotypes. This study was conducted in College of Agriculture, Raipur located at 21° 16' N latitude and 81° 36' E longitude, at an average elevation of 298.58 meters above the mean sea level (MSL). Total of eighteen (18) Soybean varieties were chosen for screening study from the Soybean field. The replicated soybean varieties were collected randomly at 50 % flowering stage from the Research field of College of Agriculture, Raipur and taken from the field to the laboratory for the isolation of *Rhizobium* from nodules. The eighteen different soybean rhizobia isolates from 18 soybean varieties were taken as treatments. Biochemical characterizations were carried out for different soybean rhizobia. The soybean plant plants were carefully uprooted from each plot so that no nodules were left in the soil and tagged. The nodules were separated from the roots for nodulation studies. The quantification of leghaemoglobin was done by the procedure

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described by Wilson and Reisenauer (1963). The growth parameter study, shoot and root biomass accumulation were recorded (Solaiman and Hossain, 2006).

Results: Biochemical studies of indigenous soybean rhizobia isolates and microbial activities in Soybean rhizosphere soils, it is seen that SRh-1(isolated from Var. NRCSL 1), SRh-03 (RSC 11-03) , SRh-18 (RKS 18) , SRh-137 (NRC 137) and SRh-136 (NRC 136) were promising indigenous *Rhizobium* isolates. This type of study was also reported by (Deka et.al., 2006). Screening of indigenous strains as per local Chhattisgarh agro-climatic condition is being significant and can be used as bio-inoculants in Soybean crop cultivation for enhancing the productivity. Significant differences in the number of nodules, effective nodules, fresh and dry weight of nodules were observed among genotypes. A highly positive correlation was shown between dry weight of nodules and nodule number. Ten of the 18 genotypes were highly responsive to *Rhizobium* sp., with over 50 nodules per plant, over 80 mg dry weight of nodules. A highly positive correlation was shown between dry weight of nodules and nodule number. The maximum nodule dry weight was recorded from the soybean cultivar NRCSL 1 (230mg plant⁻¹) followed by RSC 11-03 (221mgplant⁻¹). The maximum shoot dry weight was recorded from the soybean cultivar NRCSL 1 (16.79g/plant) followed by RSC 11-03 (16.35g/plant). The highest leghaemoglobin content was recorded in the variety NRCSL 1 (1.77mg/g fresh weight of nodules) followed by RSC 11-03 (1.64mg/g fresh weight of nodules). Similar such reports on symbiotic performances of N₂-fixing plants was given by (Shivananda, et.al.; 2011)

Conclusions: This study proposed the five soybean genotypes NRCSL1, RSC 11-03, RKS 18, NRC 137, NRC 136 as potential genotypes over other varieties for effective symbiosis with indigenous rhizobia.

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Arsenic stress mitigation using *Bacillus mycoides* NR-5 in spinach plant (*Spinaciaoleracea*L.) Khan Mohd. Sarim¹, Renu^{1*}, Baljeet Kaur², Upasana Sahu¹, Manish S. Bhojar³ and Anil Kumar Saxena¹

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Purpose: In last few decades the geogenic activities added a large quantity of arsenic in aquifer system. The prolonged intake of Arsenic (As) contaminated water may cause arsenicosis, and serious impact on skin, lung, kidney, and even coronary heart disease. Management of arsenic through physico-chemical methods is inefficient but cost effective. On the other hand, microbial removal of arsenic is a sustainable approach. Hence, the goal of present study was to identify arsenic-resistant bacterial strains and to assess their ability to tolerate arsenic ions from polluted soil and water.

Methods: Polluted water samples were collected from Nag river (21°14'N longitude 79°20'E latitude), Maharashtra, and analysed for their physico-chemical properties. Bacterial isolates obtained from samples were tested for Minimum Inhibitory Concentration (MIC) against arsenite and arsenate. Highest As tolerating strain was selected, identified and evaluated for multiple metal and antibiotic tolerance, and plant growth promoting (PGP) attributes. Scanning Electron Microscopy (SEM), Transmission Electron Micrograph (TEM) and Fourier-transform infrared spectroscopy (FTIR) studies were carried out with selected bacterial strains in absence and presence of As (25ppm). Mechanism underlying for As tolerance were studied by screening using various metabolising gene primers. Ability of As tolerating strains for the mitigation of As stress in heavy metal hyper accumulating plant, spinach was studied in pot.

Results: A bacterium isolated from Nag River, Madhya Pradesh, India, exhibited high arsenic tolerance (1100 mg L⁻¹) and even multiple metal resistance, identified as *Bacillus mycoides* NR5. The bacterium was also found to possess plant growth-promoting attributes like P solubilization, siderophores, ammonia and nitrate reduction, and antibiotic tolerance as well. SEM results indicated that under As stress the bacterial cells were swollen and large in size that suggests the possibility of intracellular accumulation of heavy metal. It is further confirmed in TEM where NR5 cells showed surface deposition as well as accumulation of arsenic in inner membrane. In addition to this FTIR spectra of control and As treated NR5 also strengthen the observation of surface As biosorption and described that a strong peak at 3379.0 corresponds to amine which indicates the interaction of the metal with cell surface protein. Upon further validation at molecular level, the amplification of arsenic tolerant genes, arsenic reductase (*arsI*, *amt*) in NR5 suggests that in addition to biosorption and accumulation it also possesses ability to transform As(III) to As(V) at

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extracellular level. *B. mycooides* NR5 ability to alleviating As stress arsenic uptake in spinach was also evaluated and found that arsenic at 50ppm concentration in soil showed inhibitory effect and delayed germination reduce shoot, root length and flowering in comparison to *B. mycooides* NR-5 treated plants showed early germination, 19.71 and 36.84% increase in shoot and root fresh weight, respectively, and enhanced flowering resulting in alleviation in As stress. In addition to this the elevated proline accumulation in As stressed plants was also lowered down in bacterial inoculated plants.

Conclusions: *B. mycooides* NR5 exhibited high As tolerance. SEM, TEM, and FTIR studies the biosorption revealed as primary mechanism of As tolerance along with the transformation of As (III) to As (V). Modulation of crop plants with NR5 can help in alleviating effect of As stress and reduce the accumulation in plant parts. The finding indicates that *Bacillus mycooides* NR5 equipped with PGP attributes, high As tolerance and antibiotic resistance can be a good choice for As bioremediation in As polluted agricultural soil.

Key words: Arsenic, Heavy Metal, Biosorption, SEM, TEM, FTIR, *Spinaciaoleracea*

Efficacy of some biopesticides and synthetic insecticides against banana leaf and fruit scarring beetle, *Basileptasubcostatum* Jacoby (Coleoptera: Chrysomelidae)

Biraj Kalita and Inee Gogoi

Purpose: Banana is a wholesome fruit and is also known as “poor man’s apple”. It is the fifth most traded agricultural commodity in the world and second most important fruit crop in India. It got introduced and infested with an insect pest called leaf and fruit scarring beetle (*Basileptasubcostatum*), which has now become a key pest in the whole North-Eastern region of India. It has also paved its way to places like Bihar and Odisha and is now a national concern and threat to the banana export industry. We aim to decipher the best management practice, like the banana bell injection, foliar application and central whorl application of insecticides and bio-pesticides at the critical stages of the crop to curb the beetle infestation at initial stages so that the farmers can get a better price by increasing the fruit cosmetic value.

Methods: Increase and decrease in beetle population were recorded at all the critical stages of the crop before and after spraying and bell injection. Leaf scars were recorded from the photo synthetically important leaf along with the records of fruit parameters. Laboratory bioassay was conducted with banana midrib dip method. Randomized Block Design and Completely Randomised Design were used to carry out the research in field and laboratory, respectively.

Results: Among all the treatments, chlorpyrifos was the best in both field and laboratory in reducing the beetle population and bringing cent percent mortality, respectively. Among the biopesticides used, *Metarhiziumanisopliae* proved to be best out of all three. Meteorological data showed their highest incidence during monsoon. The bud injection method proved to be safer and competent preventive technique for reducing the percentage of blemished fruits.

Conclusions: The present study may help in rational selection of novel insecticide molecules, microbial and botanical insecticides, which can be taken advantage for developing integrated pest management (IPM) program for banana. To get solace from this pest and restrain its cryptic behavior, proper study of the beetle biology is necessary.

Key words: banana leaf and fruit scarring beetle, field bio-efficacy, bell injection, bio-pesticides, banana midrib dip method.

Identification of potential sunflower growing districts in India

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Purpose: Sunflower (*Helianthus annuus* L.) is an important oilseed crop of India. The crop has huge potential in reducing the edible oil imports. There was phenomenal growth in sunflower area, when the crop was introduced during 1970’s and by 2002-03, it had gone up to 1.63 million ha. There after the area continuously declined. It is important to identify the potential districts suitable for revival of the crop in India. RYI and RSI were estimated and 16 districts were identified as most efficient, 99 as efficient, 21 as moderately efficient and 45 as inefficient. In the second step, the current area under sunflower was superimposed with RSI and RYI values and a total of 24 districts were identified for increasing the area and production of sunflower in India and the concerted efforts should be made for each of the identified district either for area expansion or productivity enhancement. India is one of the major oilseed producing country in the world, it is very alarming that India is also a major importer of vegetable oil to the tune of nearly

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Rs.70,000 crores every year. India is able to cater only 40% of its domestic oil consumption and the remaining is being imported owing to increasing demand. Sunflower (*Helianthus annus* L.) is a versatile crop grown globally. The share of sunflower crop to the global oilseed production is 8.87 %. In India, sunflower contributes to a meagre 0.7 % of total oilseed production in India. Being a short duration crop, sunflower has huge potential for increasing area and production of oilseeds in India. The crop was introduced in India with huge hopes during 1970’s and the area continuously increased up to 1.63 million ha during 2002-03 and the trend reversed from 2005-06 and area drastically declined thereafter. The current area is around 2.28 lakh ha area with a production of 2.12 lakh tonnes. (*Indiastatagri: https://www.indiastatagri.com/, 2019-20*). The important sunflower growing states are Karnataka, Andhra Pradesh, Maharashtra, Telangana and West Bengal. In order to revive the crop, it is important to identify the potential districts suitable for its cultivation. Hence, the objective of the present paper was to identify the potential districts for increasing the area, production and productivity of sunflower in India.

Methods: For identifying efficient districts, Relative Yield Index (RYI) and Relative Spread Index (RSI) were estimated based on the methodology of Kanwar (1972). The district-wise secondary data related to area and productivity and total cultivable area of sunflower in major states (Karnataka, Andhra Pradesh, Maharashtra, Telangana, Bihar, Tamil Nadu, West Bengal, Punjab, Haryana, Uttar Pradesh, Madhya Pradesh) were collected for the period, 2014-15 to 2018-19 from the respective states (Directorate of Economics and Statistics, 2014-19). The following formulae were used for estimation of RSI and RYI values.

$$RSI = \frac{\text{Area of the particular crop expressed as \% of total cultivable area in the district}}{\text{Area of that crop expressed as \% to the total cultivable area in the country}} \times 100$$

$$RYI = \frac{\text{Mean yield of a particular crop in a district}}{\text{Mean yield of that particular crop in the country}} \times 100$$

The RSI and RYI values for all the districts of 10 major sunflower growing states were estimated based on five year data of area, production and yield. The districts were grouped into four categories based on the following criteria. RSI and RYI values of >250 & >125 for most efficient sunflower cropping districts, <250 & >125 for efficient sunflower cropping districts, >250 & <125 for moderately efficient sunflower cropping districts and <250 & <125 for inefficient sunflower cropping districts were considered, respectively. Ramamurthy *et al.*, (2018) indicated that the RSI and RYI values of 125 and Naidu *et al.*, (2015) had taken RSI and RYI values of 90 for categorization of efficient cropping zones. In order to have focussed and mission mode approach, RSI and RYI values of 250 and 125, respectively were considered in our study.

Results: By estimating the RYI and RSI values, 16 districts were identified as most efficient, 99 districts as efficient, 21 districts as moderately efficient and 45 districts as inefficient for sunflower cultivation. Based on the area under sunflower during 2019-20, the districts were categorized into two groups *viz.*, districts with >5000 ha area were identified for productivity improvement and the districts with >1000 ha were identified for area expansion. The low efficient districts can be ignored as the possibility for area expansion and yield improvement were very low. Accordingly, the number of districts identified were five, eight and two under most efficient, moderate efficient and inefficient, respectively under districts with >1000 ha area under sunflower. Two and nine districts were identified as most efficient and moderately efficient, respectively under districts with > 5000 ha of sunflower area. The identified districts were mutually exclusive. The districts under low efficient districts were ignored as the possibility for area expansion and yield improvement were very low. A total of 24 districts were identified for increasing the area and production of sunflower in India and concerted efforts should be made for each of the identified district either for area expansion or productivity enhancement.

Districts for Productivity Enhancement			
State /District	RSI	RYI	Area (ha)
Karnataka/Bagalkot	3552	94	39917
Karnataka/Koppal	4785	70	27762
Karnataka/Gadag	3677	52	14690
Karnataka/Bellary	1785	103	13688
Maharashtra/ Solapur	690	49	13610
Karnataka/Belgaum	793	100	12142
Karnataka/Bijapur	1802	77	8994

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Karnataka/Gulburga	1347	75	7472
West Bengal/24 Paraganas South	591	150	6490
Haryana /Kurukshetra	1041	361	6220
Karnataka/Chamarajanagar	2788	68	6028
Districts for Area Expansion			
Andhra Pradesh/ Kadapa	1051	163	4112
Karnataka/Raichur	2206	76	3990
Karnataka/Haveri	453	113	3876
Telangana /Nizamabad	352	195	3282
Haryana /Ambala	750	251	2840
Uttar Pradesh /Kannauj	263	184	2121
Punjab / Fatehgarh sahib	571	245	2000
TamilNadu /Thoothukudi	685	69	1813
Karnataka/Chikmagalur	489	78	1716
TamilNadu /Virudhunagar	834	107	1674
Bihar /Madhepura	989	186	1330
Maharashtra /Osmanabad	1178	46	1210
Karnataka/Chitradurga	1167	73	1083

Table: Districts identified for productivity enhancement and area expansion in sunflower

The strategies to be adopted for productivity enhancement in the identified districts were improving the seed replacement ratio, promoting use of high yielding hybrids, promoting micro-irrigation, optimum use of INM, IPM and IDM strategies, technology assemblage and its large scale demonstration.

The strategies to be adopted for area expansion in the identified districts were intensive cluster demonstrations by the KVKs, agricultural department and NGOs, timely access to quality seed and other inputs for the farmers by the seed producing agencies and research institutes, promoting remunerative sunflower based intercropping systems, ensuring assured remunerative prices by market forces and achieving convergence in transfer of technologies.

Conclusions: The study identified around 24 districts for either area expansion or productivity improvement of sunflower in India. Convergence and concerted efforts are required based on the category of the district for promotion of sunflower.

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IMPROVING THE LIVELIHOOD OF RESOURCE POOR LIVESTOCK PRODUCERS BY ALLEVIATING FODDER SCARCITY

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Purpose: Continuous supply of good quality feed and fodder is essential requirement for optimum livestock production. The three major sources of forage supply to the livestock are crop residues, cultivated fodder and fodder from common property resources like forests, permanent pastures and grazing land. The forage production and its utilization depend on the cropping pattern, climate, socio-economic conditions and type of livestock. At present, the country faces a net deficit of 35.66 % green fodder, 10.95 % dry fodder and 44% concentrate feed ingredients to feed the overall livestock population (IGFRI Vision 2050). India shares 20% of the livestock population of the world covering 2.3% geographical area. The supply and demand situation of feed and fodder indicate that what all efforts we make, is impossible to bring dairy development into a dairy of vision. To make a dairy more sustainable and more profitable, this fodder deficit need to be filled in near future. Increasing productivity, utilizing untapped feed resources, harnessing the wastelands, quality control and certification of forage seeds, strengthening the fodder markets and active involvement of extension services are some of the possible means that could bring valuable change in this

sector. An organized effort in this direction is therefore required to enhance the availability of fodder which could reduce dependency of farmers upon expensive concentrate feed, thus, reducing the cost of milk and meat production. This will also bring security and sustainability to livestock producers and keepers in dairy and allied activities.

Key words: Crop residue, Fodder production, Livestock, Livelihood

Livestock sector plays a major role in rural livelihood and employment since centuries. The dependence on livestock, with special reference to small and marginal farmers generates an additional income to fulfill the house-hold needs as well as the needs of the local market. This sector provides the best compensation for the remaining man days, when the farmers are virtually unemployed. Fact and figures highlight that small and marginal farmers own nearly 80% of total land holdings and control more than half of country’s cattle and buffalo population and two-thirds of small animals and poultry population. Their share has been increasing over few decades, up to a tune of about 10% in land holding and 10-25% in different livestock species. However, we are not able to achieve the set target of production for which our animals have been praised throughout the world in terms of performance. The reasons may be many, but one main issue which can be focused is non-availability of adequate and quality feed and fodder in different parts of country. Also there are regional and seasonal variations in fodder production and availability throughout the country.

Milk production scenario of country

India has been praised as the world’s largest milk producing country with a total milk output of 187.7 million tonnes from various organized and unorganized sectors comprising about 22% of the global milk production (GOI, 2019). The demand of milk and milk products is likely to grow further driven by more consumers, higher incomes and greater interest in nutrition. In urban areas, there are significant number of consumers who procure processed and packaged milk and milk products in daily life. The existing annual growth rate in milk production in fiscal year 2019 was over 6.47 percent which has been consistent, despite dips in growth rates in fiscal years 2014 and 2015 (Statista, 2019). Ohlan, 2014 while analyzing the annual growth rate in milk production, has reported that the dairy market in major milk producing countries is still very thin and volatile. Globally, it is predicted that future trends will fall short in fulfilling the actual demand of the nations in the next ten years. The main reason behind this can be attributed primarily due to increasing population pressure, reluctance of present generation to take dairy and related activities as means of employment, increase in the purchasing power due to raised level of income, etc (Rejeshwaran et al, 2014).

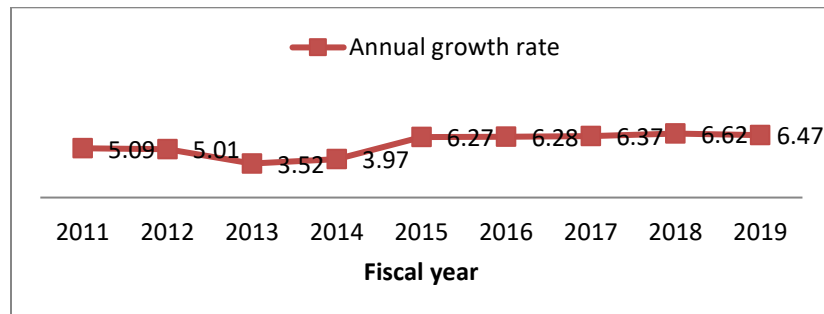


Fig 1: Annual growth rate in milk production in India

In International market, some of the milk exporting countries like Australia and New Zealand are the key players in exporting the milk in different countries. India too has potential to grab the opportunity of supplying milk and milk products in developing countries like China, South Korea, Singapore, Srilanka and several other Asian countries. The buoyant markets and trade liberalization will generate the necessity of another white revolution in India to begin. However, for tapping the economic benefits of growing demand of milk and milk products in national and international market we need to be more quality conscious in addition to developing infrastructures for production of hygienic value added dairy products.

Fodder production scenario of country

Fodder encompasses wide group of plant species that are raised to feed the livestock. At present, the country faces a net deficit of 35.66 % green fodder, 10.95 % dry fodder and 44% concentrate feed ingredients to feed the overall livestock population (IGFRI Vision 2050). India assists 20% of the livestock population of the world covering 2.3% geographical area. The supply and demand situation of feed and fodder indicate that what all efforts we make, is impossible to bring dairy development into a dairy of vision. To make a dairy more sustainable and more profitable, this fodder deficit need to be filled in near future. Increasing productivity, utilizing untapped feed resources, increasing land area (may not possible due to human pressure for food crops) or through imports may be some of the possible

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means to meet the current level of livestock production and its annual growth in population. The crop residues and availability of concentrate feed depend on the food crop production system and since the overall food crop production in the country has shown significant improvement, the area remains addressed. However, in recent years, with crop diversification and change in cropping pattern, there is likelihood of stagnation in traditional cereal crop production which is estimated to be at the tune of 30 million tonnes per year. In order to meet the feed requirements there is a need to improve productivity of these cereals. The common property resources (CPRs) is important source of livelihood and income for poor people in all the states. CPRs contribute and allow considerable access to all users, but not all the sections of the rural community are equally attracted by these potentials and opportunities.

The next important issue is quality of feed and fodder. Most of the fodder crops are deficient in CP and TDN (Dutta, 2013). The under quality feed and fodder is not able to exploit the genetic worth of animals in true sense and we are getting low productivity from the same animal which is performing tremendously in countries where they are exported. Over the recent years, the population of indigenous cattle especially males and to some extent low producing females have declined with a corresponding increase in crossbred and buffalo population. The production system under such situation demands improved technical inputs which increases the demand of green forage based rations for exploiting their genetic potential. Hence, the fodder supply needs to grow proportionately to the increasing level of commercial dairy enterprises.

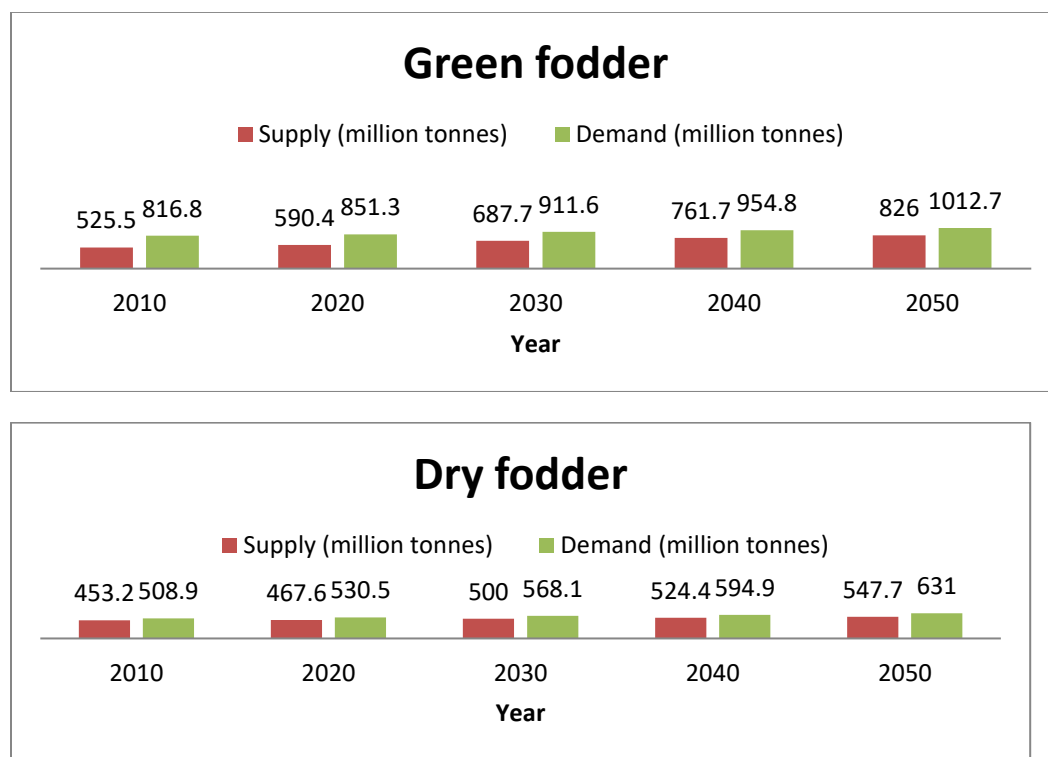


Fig 2: Supply and demand scenario of forages and roughages till 2050 (in million tonnes)
(Source: Based on Vision document 2050, IGFRI)

Role of women

In India, animal husbandry being largely shared by the small and marginal farmers, have poor resource base. Women, through their invisible works are helping in making this sector more viable. Although, their contributions are not considered as part of economic activity, their role cannot be neglected. Women usually face a double work day. Besides fulfilling the normal routine works and domestic responsibilities at home, they also take care of the livestock in all forms like, chaffing of the fodder, timely feeding, milking, hygiene maintenance and other related activities. Most of the women workers are found in the informal sector in the category of self employed, generally in agriculture, animal husbandry, dairy and other low earning household based activities. Casual workers also employ a large number of women workers. Low wages, least stability and security are the common feature of work for women in the work place.

Strategies to meet out the deficiencies:

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Always, there is a competition of land in terms of its utilization. The production of fodder and crops are mutually antagonistic. The growing demand of human beings for food, fiber and shelter has increased the gap between supply and demands of animal needs. Also day by day, there is depletion of ground water. Under these circumstances, to ensure the supply of fodder round the year, it is necessary to focus on certain issues that need to be addressed based on available resource situations. These can be discussed as under: Increasing the productivity of available land under fodder cultivation

Improve the efficiency of fodder utilization Fodder crops in wastelands Distribution of quality and certified forage seeds

Developing and strengthening the fodder markets Active involvement of extension services

Increasing the productivity of available land under fodder cultivation

The share of small and marginal farmers in land holdings is 83% (Chand et al, 2011). They have a very limited knowledge of fodder production and utilization. There may be several reasons like unawareness of suitable forage crops to suit the local agro-climatic conditions, non-availability of good quality certified seeds, lack of knowledge about cultivation practices, lack of opportunities for forage utilization, etc., contributing to the poor response to forage production. In addition to it, the frequent seasonal variations over a region, problematic soils, soil fertility, moisture level in the soil, inadequate facilities may still lead reduced fodder yield. The farmers are cultivating only few important fodder crops like sorghum, maize, lucerne, berseem etc. to feed their livestock in limited amounts. They are either not aware or not willing to take other forage crops, which have special advantages under adverse agro-climatic conditions. The resource poor farmers often cultivate forage on low productive soils and have very limited means of soil amendment. They should be prepared to boost their yield by applying low cost input measures like compost, vermi-compost and other categories of bio-fertilizers.

Improve the efficiency of fodder utilization:

a) Plant varietal selection and demonstration: Presently, almost about 54% of the fodder needs of the Indian livestock are met from various crop residues (Hegde, 2010). Still, no serious efforts are presently made to either increase the yield or quality of this fodder. The plant breeders and agronomists targeted release of high yielding varieties by reducing the plant height, leaf biomass and stalk yield. The policy although marked a new chapter in green revolution of the country to fill every belly, it failed to address the needs of the animals. The farmers were ready to adopt these varieties just for getting the better returns. The situation became more worse as these crop residues were purchased at lower rates and utilized in industrial purposes or other such uses rather than feeding the animals. However, couple of years back, with the development of dairy husbandry particularly in urban and peri-urban areas as a commercial enterprise, crop residues are again gaining the importance. With such demand, farmers have started shifting back to the old varieties with higher stalk yield. This has now set a new mandate in the field of breeding and selection of plant varieties, in order to develop a variety which have higher fodder quality and yield, without any significant reduction in the grain yield. The plant breeders as well as agronomists now focus on popularizing the food-fodder based production system in the farmers community rather than sole cereal or millets or pulses based production system. Various efforts have been initiated at central and state level with a joint mandate of selection of new genotypes and varieties of food crops having high forage value without reduction in food grain yield. This collaborative approach further needs to be popularized among the farmers demonstrating the added benefits in farm as well as field level. While breeding and selection of these varieties, major consideration should also be given to their ability to tolerate drought situations, shade resistance and harsh soil conditions instead of simply judging on the basis of their yield performance only. Seed production of elite genotypes should also be taken up on a large scale to meet the demand.

b) Timely harvest and post-harvest management: Timely harvesting of fodder crops and proper post harvest techniques are a must to improve the efficiency of fodder utilization. In addition, proper storage conditions maintains the quality of produce and minimize wastage. Harvesting of fodder crops at 50% flowering stage is considered optimum for direct feeding of livestock as the nutritive value is comparatively high at this stage. Later, the stalks may become fibrous with a poor nutritive value in addition to more generation of methane by the ruminants

Similarly, the crop residue should undergo suitable treatments before feeding to livestock so as to improve utilization efficiency. There are various methods of treating the crop residues to improve its nutritional value. It has been reported that even chaffing of stalk before feeding, can reduce the emission of methane by 10% while saving the wastage by 25-30%. Further treatment of crop residues by way of soaking in water and treating with steam under pressure, can also improve the nutritive value and palatability. There are other methods like urea treatment in addition to molasses and physico-chemical methods like urea ammonisation, by storing the urea treated straw in anaerobic condition which can further improve the quality. The fodder production and utilization may become more remunerative if we adopt certain techniques that help in reducing the bulk and keeping the quality better through extended shelf life. Also, it will act as a buffer during the period when there is fodder scarcity. Some of the most proven techniques include baling

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and densification of crop residues, making complete feed block, preparing feed pellets, leaf meal technology, etc. Such techniques are extremely helpful in easy storage and transport of the feed material and providing to the animals during lean periods. It is also necessary to set up fodder banks in fodder surplus areas and process into various value added products either directly or in addition to concentrates and minerals. Such products can also be easily transported to different parts of the country which are facing fodder shortage. Hence fodder banks established in fodder surplus areas need to keep a watch and look out for opportunities to supply to regions facing seasonal shortage, which are unpredictable and not location-specific.

Fodder crops in wastelands

Facts and figures on land utilization pattern indicate that there are large stretches of wastelands, marginally productive lands and denuded community lands present in our country. These underutilized lands are not only lying idle but are also accelerating soil erosion, surface run off of rain water and hosting a wide range of pests and diseases. As per land use statistics 2016-17, it is estimated that out of 328.73 million ha of countries' geographical area, over 100 million ha are presently underutilized. These lands include over 25-30 million ha of degraded forest lands, 45-50 million ha of agricultural lands unsuitable of crop production, 9-10 million ha sodic wastelands while the rest are ravines, pasture lands and revenue wastelands. Development of these lands by introducing various non-traditional fodder crops and trees will not only ensure enhanced supply of superior quality forage but also help in conserving the natural resources and recharging ground water, while improving the bio-diversity. Many such hardy grasses and legumes like *Stylo*, *Seratro*, Hedge lucerne, *Sehima*, *Cenchrus*, *Lasiurus* etc. can be grown on wastelands without irrigation. Such fodder and tree species can also be established on field bunds and along the farm boundaries.

a) Utilization of community lands: Community grazing land are mostly culturable waste and part of fallow land that are used legally for free grazing. There is dearth of information about community grazing lands in India. Also it is not identified specifically in land use statistics published by Government of India. Pandeya, 1988 reported that generally all the other categories of lands except the cropped areas are legally or illegally used for free grazing as and when opportunity arises. In some states like, Himachal Pradesh, Jammu and Kashmir, Meghalaya, Nagaland, Arunachal Pradesh, Orissa etc., forest areas are also utilized for grazing with very nominal user fees applied.

Reports from various sources confirm that primary productivity of these community lands in Asian subcontinent is as low as 0.5 t/ha/yr in the desert area to as high as 16 t/ha/yr in warm grasslands (Pandey and Singh, 1988; Deb Roy 1995, Pathak and Roy, 1994, Katewa 1994). In addition to this low average of productivity, the unscientific, uncontrolled grazing of these lands beyond their carrying capacity has converted the natural pastures into barren masses. Such lands can be developed under silvi-pastoral approach involving the efforts of local people and local bodies. The major activities include the establishment of live hedges, gully plugging, contour bunding, sowing of forage seeds such as *Cenchrus setigirus* (Dhaman grass) and *Stylosanthus hemata* (Stylo) before the onset of monsoon. Saplings of *Lucaena*, *Acacia* and *Prosopis* (*Khejdi*) can be planted on field bunds. The stray grazing by the animals should be prohibited. This will result into a sufficient grass cover in few days yielding 25-40% increase in dry matter per ha. The grasses could be harvested time to time for feeding the livestock round the year. Apart from it, animals will avail the opportunity for judicious grazing over these lands sparing the seeds to mature. This will also help in improving the biodiversity and microclimate of the region.

b) Developing the wastelands: The agroforestry and the agri-horti-forestry approach in developing wastelands is another concern in alleviating the scarce situation. The poor fertile land can be rejuvenated by plantation of hardy, drought tolerant horticultural species such as mango, cashew, custard apple, tamarind, Indian gooseberry, etc. The bunds and borders of these plots can be used for growing fodder and fuel tree species like *Subabul*, *Gliricidia*, *Acacia*, *Sesbania*, etc. Such species can be a potent and reliable source of fodder, particularly during summer and monsoon, when other sources of green fodder are nearly absent. The interspace between fruit plants can be used for either food crop production or forage production, depending on soil productivity and moisture level. In case the soil productivity is low, farmers can prefer to grow fodder instead of growing agricultural crops and maintain some cows or buffaloes to boost their income further.

c) Watershed development programmes: Watershed development programmes in the country can also provide an excellent opportunity for promoting fodder production. In the watershed development programmes implemented under various projects run by government and non-government organization in several state and districts, showed immediate results in the form of regeneration of various native grass species on field bunds and borders. The results were beyond anticipation both for the implementing agencies and local bodies. However, after realizing this potential, seeds of hardy legumes were sown on field bunds, along water channels and on barren lands to enhance forage production while promoting soil and water conservation.

4. Distribution of quality and certified forage seeds

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Seed is the most critical and important input to enhance the production potential of all agricultural crops, including fodder. The efficacy of other inputs is largely dependent on availability and timely sowing of quality seeds of improved genetics. Therefore, an assured supply of fodder seeds of improved varieties/hybrids to farmers at a reasonable price is crucial for enhancing fodder production. These seeds should have good germination and vigour, resistance to diseases and have potential to give higher yields. They should be properly treated, bagged and labeled, should have safe levels of moisture content, be relatively free from physically damaged and diseased seeds and also be free from seeds of other fodder varieties, crops and weeds as well as inert material. For the commercial production of fodder crops, use of only certified and truthfully labeled seed bagged as blue tag and opal green tag, respectively, should be used. Serious thought should also be given for developing a forage seed distribution network, at least in selected pockets where dairy husbandry has developed as an economic activity.

4. Developing and strengthening the fodder markets

Fodder markets are the ready markets which can supply any quantity of fodder as per the local demands. It can be a real boon in the areas where there is frequent fodder scarcity throughout the year or even in the areas having much of population pressure such as dairying in urban and semi-urban areas. These are particularly important for the poorest and landless segments of communities that have very limited ability to produce their own fodder, and need access to quality fodder at reasonable prices to be able to produce milk economically and at competitive cost. The fodder trading can also be an important part of livelihood activity for the poor who engage in it directly or who are employed in the fodder production chain. However, developing such markets needs a better understanding of the various production systems, fodder demand-balance systems, the extent of impact of fodder scarcity, the status of existing fodder market in an area, as well as other factors along the fodder market chain. Also to operationalise such decentralised units on an economically viable scale, these can be operated by local livestock keeper groups who have a major stake in procurement, distribution and its viability.

4. Active involvement of extension services

There should be organized set up for extension services in the country to help farmers in solving the problems they are facing. There has been a wide communication gap between the forage development programme and the farmers who are the ultimate beneficiaries. As a result, there is no free flow of information from either side. A well established communication network would help the forage scientists to understand the problems of the dairy farmers and offer suitable interventions. Under existing situations, there is immediate need of extension support to popularize farmer friendly techniques, taking due care of nutrient availability, quality and impact on animal health. The major areas under concern are (i) improving the silage quality through improved fermentation techniques e.g. addition of fermentable substrate, multi-species inoculants and other commercially available low cost products, (ii) use of locally available alternate plant species and byproducts in silage making e.g., Pineapple fruit residue as animal feed, Arca sheath for livestock feeding (iii) Complete feeds/ TMR (iv) Area specific mineral mixture (ASMM) (v) Popularization of *Azolla* in farmers community (iv) Ready reckoner feed chart and technically supported softwares for ration balancing e.g. Feed soft.

Conclusions: To match the recent population trends of India with the required trend of livestock growth, lot of work is needed in the field of fodder production and utilization. This will have an overall impact in improving the productivity of our animals by alleviating fodder scarcity. An organized effort is to be made to enhance the availability of fodder utilizing scientific fodder production and linking it through proper marketing techniques. The ultimate beneficiaries i.e. livestock producers and keepers will feel more secured in continuing the dairy and allied activities sustainably.

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Mithun the lesser known animal of India

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Purpose: India at large and specifically the North-East India is the hotspot of floral and faunal biodiversity and the habitat of a number endemic species. Of these species, Mithun (*Bos frontalis*) is an important one which needs support for healthy propagation. However, due to denudation of free range along with the biotic and a biotic stress, there is urgent need of scientific intervention for proper management as well as conservation of this beautiful hill animal through implementing an effective conservation programme. Biotechnologies such as cryopreservation of semen and embryos, coupled with artificial insemination and embryo transfer are important potential tools for the preservation of animal biodiversity. Frozen semen technology offers a very potent means of *in vitro* conservation of male germplasm. Mithun is a massive semi-domesticated rare ruminant species mainly reared for meat. This strongly built hill animal of Southeast Asia plays an important role in the socio-economic and cultural life of the local population (Simoons 1984, Mondal and Pal 1999, Mondal et al 2004, 2005a-e, 2006a-f, 2008, 2010). In India, Mithun meat is considered to be more tender and superior over the meat of any other species. At present, Mithun farmers rear this animal at an altitude of 1000 to 3000 meters above mean sea level under free grazing condition in its natural habitat. Due to gradual denudation of forests (natural habitat of Mithun) and tremendous socio-economic and cultural importance of Mithun in the life of the local tribal population, very recently initiatives are being taken to popularise economic Mithun farming under semi-intensive condition with controlled breeding.

Scientific Classification

Kingdom:	Animalia
Phylum:	Chordata
Class:	Mammalia
Order:	Artiodactyla
Family:	Bovidae
Genus:	Bos
Species:	<i>B. frontalis</i>

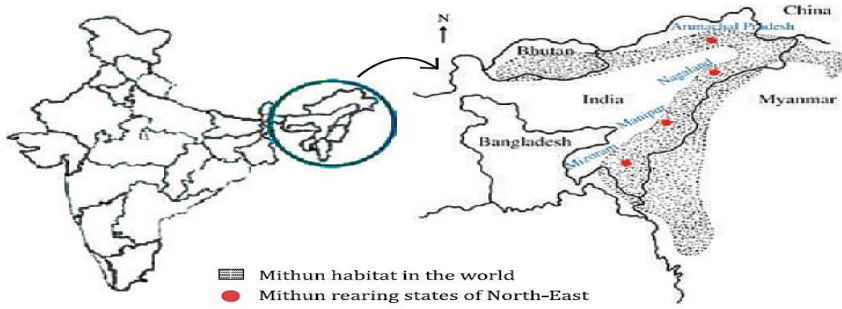


Chromosome No.: 29 pairs

Distribution (GLOBAL)

Mithun is believed to have originated more than 8000 years ago and considered to be descendent from wild Indian gaur (Simoons 1984, Mondal and Pal 1999). Mithuns are found over a large area of Southeast Asia. Beside meat, Mithuns are reared for sacrificial purposes and/or for barter trade. Their natural habitat is the forests of highlands. In some folklore, Mithun has been said to be the descendent of the Sun. Different interesting and divergent legends are available on the origin of Mithun among different tribes. Even today, Mithun is used as a holy sacrificial animal to appease the Gods by the tribesman. Mithun, a unique bovine species has a limited geographical distribution. It is mainly found in the tropical rain forests of North Eastern hilly states of Arunachal Pradesh, Nagaland, Manipur and Mizoram of India

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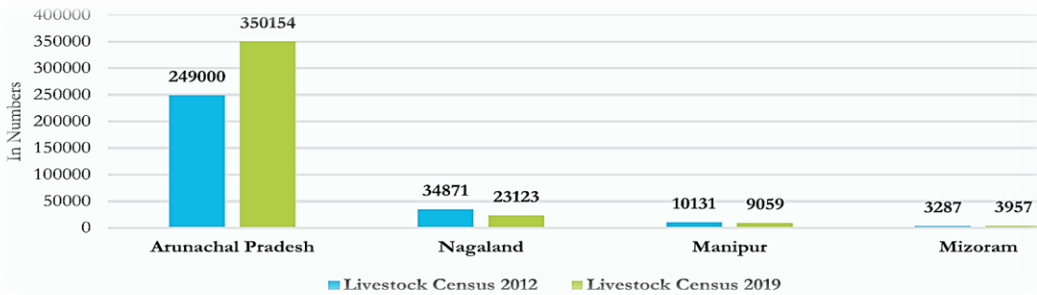


Status in India

Arunachal Pradesh	90.642%
Nagaland	5.986%
Manipur	2.345%
Mizoram	1.024%
J&K	0.003%



Distribution of mithun in j&k (lsc 19)



Changes in Mithun population in major States

Strains of Mithun

As described by Verma (1996), two distinct types of Mithuns are available in India and they were named after the name of the State where they belong (Nagami and Arunachali). These two distinctive types have also been reported by Arora (1998). However, Bhusan et al (2000) have identified four distinct strains of Mithun and named them as Arunachalee, Mizorami, Nagami and Manipuri strain. The names indicate their home tract in northeastern States of

India. As per the survey conducted by the National Research Centre on Mithun to identify different strains of Mithun in North Eastern Hills of India, four different strains have been identified. Characterization of these four different strains has been done based on 37 phenotypic characters and genetic characterization was done through RAPD. Results were suggestive of genotypic difference among four different strains

District	Population
Doda	2
Pulwama	44
Udhampur	11
Total	57



Arunachalee



Manipuri



Nagami



Mizorami

Milk composition of compared to other species

Parameter (%)	Mithun	Cow	Buffalo	Goat	Sheep	Yak
Fat	10.2	4.4	8.0	3.5	6.0	7.2
Protein	6.7	3.4	4.5	3.1	5.4	5.3
Lactose	4.6	4.8	4.9	4.4	5.1	5.0
Total Solids	22.6	12.6	17.4	11.0	16.5	17.5
SNF	13.4	8.2	9.4	7.5	9.5	10.3
Ash	0.9	0.7	0.8	0.8	1.0	0.9

Socioeconomic importance of Mithun

This animal plays an important role in the social, cultural and economic life of the local tribal population. The ownership of Mithun is considered to be the sign of prosperity and superiority of an individual in the society. Farmers mainly rear Mithun for meat purpose. Besides, this animal is also used as marriage gift and sacrificial animal for different social and cultural ceremonies. Though at present farmers do not consume its milk, this animal produces highly nutritious milk. Being a meat animal the growth rate of Mithun is the prime concern of farmers. With adequate feeding the growth rate of this animal varies from 300 to 600 g/ day, which is comparable with cattle and buffalo. However, the plasma growth hormone concentration (30-90 ng/ ml) (Mondal et al 2004, 2005d, 2006a,c,d) is much higher in Mithun than in any other domesticated animals. The consumption of Mithun meat is not a regular practice in tribal society.

These animals are sacrificed for meat only during important social ceremonies and festivals. However, there is a great demand for Mithun meat and consumers consider this meat as more tender and superior over the meat of any other species except pork. The dressing percentage in Mithun varies from 48 to 54 % in different age groups. However, to achieve an optimum dressing percentage, it is suggested to slaughter Mithuns at 4 to 5 years of age. There is a great

scope to utilize this meat to make some value added meat products. The National Research Centre on Mithun has already standardised the process of making some value added products of meat like meat nuggets, meat powder, meat Patties as well as meat block. The organoleptic test conducted by the institute on these products revealed high scoring of 6-7 in the scale of 1-8. Presently, the consumption of Mithun milk is not an accepted practice among its rearers. Mithun produces around 1 to 1.5 kg milk per day. However, Mithun milk is nutritionally superior to any other domesticated species as it contains high fat (8 to 13%), solid-not-fat (18 to 24%) and protein (5 to 7%). Hence, Mithun has a scope to be promoted as moderately good milk animal for home consumption in these hilly areas. Due to high fat and protein content in Mithun milk, it may be used for the preparation of different value added milk products such as paneer, various sweet products, ghee, cream, curd and cheese. The National Research Center on Mithun, the premier Institute of Indian Council of Agricultural Research, has successfully standardized the process of making paneer, barfi, rasgulla, curd and lassi from Mithun milk.

Scientific rearing system

Currently farmers rear Mithun under free-grazing condition in the forest area without any additional housing or feeding facilities. Occasionally, farmers bring back the female Mithun just before parturition and send it back to the forest following parturition. However, it is suggested that even under a free-range system, a temporary housing structure using locally available materials can be constructed in some strategic locations in the Mithun rearing area. Mithun can also be trained to come to the shed at a particular time every day by providing little bit of concentrate and salt. This will be helpful for farmers to supervise, provide additional feeding and medication to their animals. Besides, farmers will also get an opportunity to look after the individual animal regularly for any kind of discrepancy or disorder



Feeding management

Mithun thrives on the jungle forages, tree fodders, shrubs, herbs and other natural vegetations (Das et al 2010). Farmers do not provide any additional feeding. Though the animals are owned by the farmers, they are kept under natural forest in a semi-wild condition. However, farmers occasionally provide common salt, especially at the time of restraining for some purposes. Each individual owner can identify his Mithuns even though they do not bear any identification marks and similarly each Mithun knows his owner which is reflected in the fact that the Mithun approaches the owner periodically for salt. In other words, the owner does not have to invest anything in his Mithun as they are simply let loose in the forest which constitutes around 50 percent of total land area of the region

Breeding management

Like cattle, Mithun is a poly-estrus animal. The healthy adult female Mithun show repeated estrus cycles at an interval of 19 to 24 days unless it is pregnant. The Mithun breeds throughout the year and no definite breeding season is observed in this species. The length of gestation period, service period and calving interval in Mithun varies from 270 to 290 days, 50 to 100 days and 350 to 400 days, respectively. The age at puberty and age at first calving varies from 27 to 36 months and 40 to 48 months, respectively. The Mithun bulls become mature to breed at 3 to 4 years of age. Under free-range system, a practical approach for selective breeding in Mithun is the introduction of superior and tested bulls (1 bull for 10 breedable females) in the herd. Bellowing is not generally observed in Mithuns during estrus. The genital organ of Mithun cows during estrus reveals relaxed and open os externa of cervix, turgid uterus and ovaries having palpable follicles. However, it is suggested to use healthy Mithun bulls to detect heat. In Mithun, ovulation occurs between 20 to 31 hour after the onset of estrus (Mondal et al 2006b, e,f).

Conservation of Mithun

Keeping in view the dwindling population of Mithun over the years, it is of great priority for the Mithun inhabited states to conserve and propagate quality Mithun germplasm at faster rate to stabilize its population. There are three ways for the conservation of Mithun genetic resources: i) through cryopreservation of genetic material like living ova, embryos or semen; ii) preservation of genetic information as DNA; and iii) conservation of live population (*in situ* conservation).

The need for parallel conservation of Mithun genetic resources along with live animal conservation, as raw material for future breeding programmes, should be recognized and has become an important issue in planning of Mithun husbandry. Conservation is of particular concern in the Mithun inhabited regions where there is effort for agricultural change, thereby the risk of gradual replacement of indigenous stocks and farming methods by new techniques. These areas, where climatic extremes and particular parasitic conditions may result in genetically modified and unique local stocks which are able to survive under extreme conditions, need to be given proper attention.

Such conservation efforts are particularly important in the light of predicted global climate change, and the ability of microbial and insect parasites to evolve and adapt to modern chemical control methods.

Ex situ conservation

In effect, this is the storage of animal genetic resources, which farmers are currently not interested in using. It includes cryogenic preservation and the maintenance of breeds from domesticated species as live-animal populations in parks, zoos and other locations away from the environment in which they are being developed. The global programmes on *ex situ* conservation strategy is still being developed, but it is based on the use of live-animal populations wherever practicable, supported by cryopreservation where technology exists or can be developed, combining within-country gene banks with global repositories of last resort. This strategy is in keeping with the Convention on Biological Diversity. A range of animal health issues must be overcome, however, before much international storage of and access to such material can be effective for the domestic animal species. The technology required for storing both male and female gametes of all species of interest is not yet developed. Of course, interested governments, non-governmental organizations, research institutions and private enterprises will be encouraged to maintain *in vivo* samples of breeds at risk, with national inventories being established and kept up to date so that the genetic resources are readily available for use and study.

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Conclusion: Mithun husbandry is an important component of the livestock production system in North Eastern hill region of India, Mithun plays an important role in the socio-economic & cultural life of the local tribal population. Mithun is a source of protein & extra income to the poor farmers. Mithun meat can be a good alternative for beef across the country. Mithun husbandry in North Eastern hill region of India is an important component of the livestock production system. Scientific rearing of this species will not only support the need of protein but also help to generate extra income to the poor Mithun rearers for their livelihood. The need of the hour is, therefore, to popularize scientific farming in the states where Mithun rearing is an age-old practice

Recommendations

Awareness regarding the scientific farming practices. Research for increasing the milk production. Conservation & popularization of mithun in J&K where population is decreasing at a drastic rate. Research on performance of mithun in J&K and other hilly states of India needs to be done. Reintroduction of mithun in Himachal Pradesh where population has decreased to zero over the last inter-census period. Finance by banks for mithun-farming to support the livelihood of the farming community is the need of the hour.

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Maitra ANRCM at a glance 2020

Screening for resistance and susceptibility of some beetroot cultivars to root-knot nematode, *Meloidogyne javanica*

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Purpose: The present study was conducted to identify resistance and/or susceptibility of beetroot cultivars against root-knot nematode, *Meloidogyne javanica*.

Methods: In this study, seven beetroot (*Beta vulgaris* L.) cultivars were screened against the root-knot nematode, *Meloidogyne javanica* at inoculum level of 1500 second stage juveniles (J2s) per pot. Four replications of each cultivar of beetroot were used for screening and kept in a completely randomized design (CRD) at a temperature of 25 ± 2 °C under greenhouse conditions. The data were subjected to one-way analysis of variance (ANOVA) using SPSS-17 statistical software (SPSS Inc., Chicago, IL, USA). Mean values were statistically compared and separated according to Duncan's Multiple Range Test (DMRT) at P ≤ 0.05.

Results: The results revealed that all seven cultivars of beetroot showed varying degree of resistance and/or susceptibility to *M. javanica*. Among all cultivars, three were found to be moderately resistant i.e., CG, DDR and Red Ace with the minimum number of galls (4.0, 8.0 and 7.0) and two were moderately susceptible i.e., Atlas and Red Queen (28 and 22) and one was susceptible i.e., Red Ruby (84) and one was highly susceptible i.e., Red Express with the maximum number of galls (126). None of the cultivars was found highly resistant or immune.

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Conclusion: All cultivars exhibit a significant decline in plant growth due to *M. javanica* infestation compared to their respective controls. The maximum reduction in growth parameters was reported in cultivar Red Express while the minimum reduction was found in CG, DDR and Red Ace. A positive and significant correlation was found between the number of galls and per cent reduction in plant growth parameters. From the results, it can be recommended that the use of resistant cultivars is an environment-friendly approach that can be used to manage the nematode density below the economic threshold level.

Keywords: Beetroot, Cultivars, *Meloidogyne javanica*, Resistance, Screening

PHYSICO-CHEMICAL AND BACTERIOLOGICAL ANALYSIS OF SURFACE WATER QUALITY IN AROUND KURUKSHETRA “A MULTI LOCATION STUDY”

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Purpose: Water is one of the important natural resource useful for developmental purposes in both urban and rural areas for the very ancient time. Most surface water resources accessible to Haryana, India are used in irrigation, livestock, industrial area and devotional purposes. Kurukshetra district is known as land of Mahabharata. There is a universal admiration to water in almost all of the major religions of the world. Most religious beliefs involve the use of "holy" water. The purity of such water, the belief in its known historical and unknown mythological origins, uplifts its importance even further. The present study is to bring into notice the importance of maintaining adequate water quality standards of surface water bodies taking such hollowed water bodies as sample sites. Surface water pollution is often caused by nutrients, pathogens, plastics and chemical substances that are used in holy ceremonial activities.

Objectives: The current study was conducted to carrying the water quality tests on these surface water bodies for finding out the suitability of water for the purpose of taking bath, drink and other rituals. That's why we aim to test physico-chemical and bacteriological analysis of surface water quality of the selected sites.

Methods: Surface Water samples were collected from different ponds in sterile sample bottles. The samples were analyzed for colour, pH, TDS, TSS, BOD, COD, Hardness, Alkalinity, Chloride, Calcium, Magnesium, Ammonia Nitrogen, Nitrate, Orthophosphate, faecal coli form and bacterial plate count. These water parameters were determined by following the methodology given by Garg et.al (2002) and APHA (2005)

Results: The range of different physico-chemical parameters is important to decide the water quality of different sites. Temperature and pH range were recorded in between the 30-40°C, 8-9.5 respectively. The range of BOD was lie in between the 25-50 mg L⁻¹. Total hardness and alkalinity were recorded in between the 150-250 mg L⁻¹, 300-400 mg L⁻¹ respectively. TDS and TSS were 50-100 mg L⁻¹, 200-250 mg L⁻¹. Chloride, calcium and magnesium range were recorded 50-100 mg L⁻¹, 150-200 mg L⁻¹ and 25-50 mg L⁻¹ respectively. During the present study ammonia, nitrate and orthophosphate were ranging between 1.0-2.5 mg L⁻¹, 0.5-5 mg L⁻¹ and 0.05-0.10 mg L⁻¹ respectively.

The value of pH, BOD, calcium, ammonia, orthophosphate and coliform count are elevated from permissible values. Bacteria and coliform group are considered as the primary indicators of faecal contamination. These have been correlated with incidence of gastrointestinal disorders. Because of presence of coliform group high values of BOD was also observed.

Conclusion: The results of current study depict that major parameters like pH, BOD, calcium, ammonia, orthophosphate, presence of coli form and value of MPN index are beyond their permissible limits. Thus, the water of these holy sites is observed to be injurious to human health. So, proper measures must be taken to control the quality of water from getting deprived.

Keywords: surface water, water quality parameters, devotional water bodies, coliforms

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Efficiency of Arbitrary and Semi Arbitrary Markers for Assessing Genetic Diversity in Natural Populations of *Tecomella Undulata*- An Important Timber Yielding Tree Species of Rajasthan

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Purpose: The present study was conducted to compare the efficiency of two different molecular marker systems (RAPD and ISSR) for evaluating the genetic diversity of the *Tecomella undulata* growing in Rajasthan.

Methods: The genetic variability and relationships among 120 *Tecomella undulata* genotypes representing twelve natural populations of Rajasthan were analyzed using ten RAPD and twenty two ISSR markers.

Results: RAPD markers were found to be more efficient than the ISSR assay in respect to polymorphism detection, as they detected 96.10% polymorphism as compared to 91.02% for ISSR markers. But, multiplex ratio (MR), heterozygosity (h), marker index (MI), average PIC value, resolving power (RP), total number of genotype specific marker loci, H, I, Ht, Hs and G_{ST} were observed more for ISSR than RAPD markers. Further, the dendrogram constructed based on the ISSR marker were able to segregate the twelve populations much clear and distinct, compared to RAPD markers.

Conclusion: Data obtained in the present study supports ISSR markers as robust marker system suitable for genetic diversity studies and also equally effective for characterization of the populations of *Tecomella undulata* from different geographical regions.

Keywords: Genetic Variability, Molecular markers, Polymorphism, *Tecomella undulata*,

Weed management strategies in transplanted paddy

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Purpose: Rice (*Oryza sativa* L.) is one of the most important food crops in Asia where 90% of this crop is grown and consumed. In India contribution of rice is about 40% of total food production. Among several constraints, weeds are the major factor responsible for yield reduction in rice. Several methods are used to manage weeds to an extent of below ETL level but any single method is not as effective as a combination of two or more methods hence this research is conducted to see the effect of the combination of bispyribac sodium @ 25 g/ha at 10 DAT and conoweeder at 40 DAT.

Methods: A field experiment was conducted during Kharif 2019 at Instructional Research Farm, Krishinagar, Adhartal, Department of Agronomy, JNKVV, Jabalpur. The experiment was laid out in randomized complete block design with six integrated weed control treatments comprising of moc 0.5 t/ha + bispyribac sodium 25 g/ha, bispyribac sodium 25 g/ha + conoweeder, moc 0.5 t/ha, moc 0.5 t/ha + conoweeder, hand weeding twice (20 and 40 DAT) and weedy check (control) replicated four times. The rice variety Kranti sown in the nursery with a seed rate of 30 kg/ha and transplanted at 20 cm X 20 cm spacing.

Results The results were obtained from the experiment are that among all kinds of monocot as well as dicot weeds *Echinochloa colona* was the most dominant with a mean relative density of (27.98%) followed by *Cyperus iria* (22.60%), *Cynodon dactylon* (18.79%), *Cyperus defformis* (18.52%), *Alternanthera sessilis* (12.11%). Maximum weed control efficiency at 40 DAT was registered under hand weeding twice (95.52%) at 20 and 40 DAT followed by bispyribac sodium @ 25 g/ha + conoweeder with weed control efficiency of (89.78%) followed by moc 0.5 t/ha + conoweeder (86.28%) at 40 DAT. Growth parameters of rice (viz. number of tillers/m, LAI, dry matter accumulation), as well as yield attributes (viz. panicle length, filled grains/panicle, grain yield) were higher under hand weeded plots followed by plots receiving bispyribac sodium @ 25 g/ha + conoweeder. Application of bispyribac sodium @ 25 g/ha + conoweeder found more remunerative as it received a higher B: C ratio (2.37) respectively, relative to other treatments.

Conclusion From the above experiment, it was concluded that application of bispyribac sodium @ 25 g/ha at 10 DAT and conoweeder at 40 DAT was most effective in sense of weed control practices among all treatments and also economically sound better.

Keywords: Bispyribac sodium, Conoweeder, Weeds

Analysis of Yield and Extension gap through Frontline Demonstration in Rapeseeds-mustard

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Purpose: In India among all the edible oilseeds crops rapeseeds - mustard immerse the foremost position reckoning nearly millions of hectare of land under cultivation. The trails for Front line Demonstrations were conducted to study the actual yield gap and extension gap among the small and marginal farmers of the adopted village.

Methods: Seeking this demonstration was conducted during two consecutive years i.e. 2017-18 and 2018-19 for clear interpretation of the results. The comparisons were made between the improved practices and the farmer practice. In principal the control practices were nothing but the farmers practice. By using the formula yield gap, extension gap analysis, technology index and technology gap was thus calculated for interpretation of results of study conducted

Results: The result obtained revealed that the average yield of the demonstration thus obtained was 18.37 q/ha as compare to farmer practices which was 14.37 q/ha with an additional yield of 4.00 q/ha. with an average percentage increase in production by 28.12 %. The average extension gap for two years was recorded to be 4.10 q/ha followed by technology gap and technology index which was reported to be 2.37 q/ha and 14.84 % respectively.

Conclusion: The decreasing trend of extension gap and technology gap in the study clearly indicates the good education level of the small as well as marginal farmers of the concerned village and also the satisfactory rate of adoption of improved technologies regarding cultivation of rapeseeds - mustard crop of the district.

Keywords: - Rapeseeds-mustards, small and marginal farmers, extension gap, technology gap, technology index and Frontline Demonstration

Study the role of structural and functional variations in Capsaicinoid biosynthesis genes causing contrasting fruit pungency in *Capsicum* species

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Purpose: Pungency is a distinct trait in *Capsicum*. *Capsicum chinense* (Ghost chilli, California reaper etc.) are the most pungent species while *C. annuum* is the most widely cultivated species with zero, low, medium and high pungent varieties. Study of the structural and functional variability of capsaicinoid biosynthetic genes causing contrasting phenotypes is necessary for breeding pungency traits in *Capsicum* species.

Methods: Sequences of capsaicinoid biosynthetic genes from *C. annuum*, *C. chinense* and *C. baccatum* were retrieved from NCBI and the sequences were aligned to see variations in nucleotide sequences. Based on the variations, primers were designed and genotyping was done using those primers. Different *Capsicum* varieties of *C. annuum* and *C. chinense* showing contrasting pungency traits were grown in greenhouse. For expression analysis, fruits at early green, breaker and mature stages were harvested. RNA was isolated and cDNA synthesized using kit. Relative expression of capsaicinoid biosynthetic genes were analyzed between *C. annuum* and *C. chinense* using qRT-PCR.

Results: Our analysis showed variation in pungency biosynthesis genes at structural and functional level. We observed SNPs and Indels and their associations of pungency traits are being validated using contrasting pungency phenotypes. Early stage of fruit development showed the highest expression of pungency genes and expression further decreased with maturity. Furthermore, the majority of the pungency biosynthesis genes showed the highest expression in extremely pungent Ghost chilli (*C. chinense*) compared to low pungent *C. annuum* genotypes.

Conclusion: The findings of SNPs, Indels and expression variations indicated that while breeding for pungency traits we need to consider structural and functional aspects of pungency biosynthesis genes. Our results present the first step towards complete understanding and breeding pungency traits in *Capsicum* species.

Keywords: *Capsicum*, Pungency, qRT-PCR

Evaluation of the Influence of Certain Types and Doses of Organic Manures on Seed Germination and Seedling Growth of Foxglove (*Digitalis purpurea* L.) at Temperate Hill Ranges of Bharsar, Uttarakhand

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Purpose: Digitalis commonly known as foxglove, it is a biennial or perennial belongs to the family Scrophulariaceae. Uttarakhand is by default an organic state due to lack of access of farmers to chemical fertilizers. Thereby, a good scope for cultivating Foxglove organically can clearly be seen in the state.

Methods The present investigation entitled “Effect of Different Doses of Organic Manures on Seedling Growth of foxglove (*Digitalis purpurea* L.)” was carried out at MAP Block of VCSG UHF, Bharsar, Pauri-Garhwal Uttarakhand. The experiment consists of ten treatments viz., T₁ (Control), T₂ (FYM @ 5 t/ha), T₃ (FYM @ 10 t/ha), T₄ (FYM @ 15 t/ha), T₅ (Compost @ 5 t/ha), T₆ (Compost @ 10 t/ha), T₇ (Compost @ 15 t/ha), T₈ (Vermicompost @ 5 t/ha), T₉ (Vermicompost @ 10 t/ha), T₁₀ (Vermicompost @ 15 t/ha) and three replications.

Results: obtained in present investigation showed that the treatment T₁₀ (Vermicompost @ 15 t/ha) was better in providing better seed germination and growth attributes. The minimum time taken for initial germination (4 days), maximum mean daily germination (2.14 % seeds per day), highest germination energy per cent (24.66 %), maximum germination per cent (77.33 %) were recorded in T₁₀. Tallest plant height of 3.10, 5.43, 6.68, 7.62 and 8.63 cm at 30, 45, 60, 75 and 90 DAS, respectively; longest leaf length measuring 3.72, 4.46, 5.30, 5.97 and 6.64 cm at 30, 45, 60, 75 and 90 DAS, respectively; maximum number of leaves per plant i.e., 5.33, 7.60, 8.73, 9.26 and 9.73 at 30, 45, 60, 75 and 90 DAS, respectively were witnessed under T₁₀. The widest plant spread was also noticed in T₁₀ measuring 4.10, 6.37, 7.80, 9.26 and 11.22 cm at 30, 45, 60, 75 and 90 DAS, respectively. The maximum total fresh biomass (2.73 g/plant), highest fresh weight of shoot and root (2.37 g/plant) and (0.35 g/plant) respectively, highest total dry biomass (0.71 g/plant), dry weight of shoot and root (0.51 g/plant) and (0.20 g/plant) respectively were yielded from T₁₀. Maximum leaf area (15.36 cm²), longest root length (10.80 cm) and highest root diameter (1.67 mm) were also recorded in T₁₀.

Conclusion: Based on present investigation, it is drawn as a conclusion that foxglove plant can derive the maximum beneficial results in terms of germination and vegetative growth under greater dose of vermicompost @ 15t/ha, as it witnessed superior performance so far, the germination and vegetative parameters under the study are concerned. Hence, the present investigation recommends @ 15t/ha dose of vermicompost for cultivation of Foxglove under temperate hill ranges of Bharsar, Uttarakhand.

Key words: Foxglove, germination, FYM, compost, vermicompost

Bioassay of some aqueous plant extracts against leaf and fruit scarring beetle, (*Nodostomasubcostatum* Jacoby, Coleoptera: Chrysomelidae)

Baishali Boruah, Bijon Chandra Dutta, IneeGogoi

Purpose: The diverse agro-climatic zones of Assam offer great potential for the cultivation of banana. But the productivity of banana in Assam is far below the national average. It may be due to several reasons, out of which attack of insect pest is a major limiting factor. Synthetic insecticides are useful tools for the control of pests, but their excessive use has led to negative consequences such as toxicity against farmers, consumers and both wild and domestic animals. So, plant extracts can be used as an alternative to chemical pesticides. Keeping view of the above, the present investigation has been undertaken to evaluate the efficacy of some aqueous plant extracts against banana leaf and fruit scarring beetle under laboratory condition.

Methods: Matured leaves of selected plants viz., *Melia azedarach* L. (Ghura neem), *Polygonum hydropiper* L. (Pothorubihlongoni) and *Carica papaya* L. (Papaya) were collected from the natural habitat from Jorhat district, Assam during 2018-19. Desired number of adults of the target insects were collected from the banana growing areas of Jorhat district and nearby areas. The population of insects was higher during the morning time and it was easy to collect as the insects were not very active during the morning period.

Preparation of aqueous plant extract

Collected plant parts were washed thoroughly with tap water, shade dried under room temperature for around 8-10 days and grinded into powder using an electric grinder and passed through a 60 fine-mesh net and then kept in an air-tight container. The aqueous extracts of three different plant materials were prepared in the laboratory on a per cent

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basis as per the method given by Gahukar (1996) and Sharma *et al.* (1997). Then kept in glass bottles for further use, which were further diluted serially to obtain desired concentrations for subsequent use in the experiment.

Effect of aqueous plant extracts against adult *N. subcostatum*

To determine the efficacy of aqueous extract in laboratory culture the adult mortality was recorded for which, ten numbers of adult beetles were released onto mature banana leaf parts into each petri dishes and sprayed with plant extracts at different desired concentrations. For the bioassay, spraying method given by Roy *et al.* (2014) was applied with slight modification. A final count of them were taken after 4 hours of proper settlement. Mortality counts were made after 24, 48 and 72 Hours after treatment. Each treatment was replicated three times. Per cent beetle mortality in each treatment was worked out. From the observed adult mortality corrected per cent mortality was calculated using Abbott's formula.

Results: The present study revealed that the aqueous extracts of three plants were evaluated against *N. subcostatum* under laboratory condition showed the lethal effect. From the average mortality percentage we observed that the extracts caused significant mortality on the target insect and adose – and time – dependent mortality was observed from the bioassay with the highest mortality was recorded at 10.00% concentration at 72 hours after treatment (HAT) for aqueous plant extracts. Among, all the aqueous plant extract *P. hydropiper* was found most effective against *N. subcostatum* recording lowest LC₅₀ value (0.754) followed by *M. azedarach* (1.378) and highest LC₅₀ value recorded in *C. papaya* (2.801) with lowest mortality. The present study reports that among three aqueous plant extracts, *P. hydropiper* has the most effective insecticidal activity to reduce the *N. subcostatum* followed by *M. azedarach* and *C. papaya* has the least effective insecticidal activity.

Conclusion: Botanicals plants may be grown by farmers with minimum expense and extracted by indigenous methods. Thus, Present investigation exploring efficacy of *M. azedarach*, *P. hydropiper* and *Carica papaya* against *N. subcostatum*, which can be taken advantage for developing integrated pest management (IPM) program for banana. Further studies, regarding isolation and purification of novel bioactive component from the plant parts can be done which can depict the precise potential of the plants. Also, Confirmatory identification, estimation and elucidation of the bioactive principles could lead to product formulation and commercialization. So, plant extracts may be utilized as potential insecticides for the management of leaf and fruit scarring beetle of banana.

Key words: *Nodostomasubcostatum* Jacoby, aqueous extract, management, *Melia azedarach* L. (Ghura neem), *Polygonum hydropiper* L. (Pothoruabihlongoni), *Carica papaya* L. (Papaya), LC₅₀

Studies on poultry egg adaptation and hatching at high altitude region of Leh-Ladakh

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Purpose: Harsh climatic conditions of Leh-Ladakh like hypobaric-hypoxia, cold stress, oxidative stress and dry environmental conditions adversely affect eggs fertility and chicken growth in the non-adapted breeds of low-altitude. Therefore, in different exotic poultry breeds and with their subsequent generations grown at high-altitude may have imparted with adaptations in egg and affects development of embryo in these tough conditions. Therefore, changes in eggshell microstructure, different constituent of egg and effect of microenvironment manipulation on hatching are require to study to achieve high egg hatching rate which will help achieving successful breeding management in the high-altitude region leading to the development of region specific broiler strain of poultry.

Methods: Eggs are collected from DIHAR poultry research unit from Red & White line breeds up to F2 generation. Measurements of egg physical parameters and eggshell microstructure study were done using various analytical techniques. To evaluate egg hatchability at high altitude conventional and normobaric hatchery (novel technology developed by DIHAR-DRDO) were used.

Results: Significant changes were found in egg adaption studies vis increase in water content and decrease in pore numbers suggests that to cope up with the high water loss during incubation at high altitude this could be an adaptation strategy in order to increase its reproductive fitness. Significant decrease in weight of eggshell + membranes suggests that adaptive changes incurring in the eggs tends to increase the gas conductance across the eggshell to maximize the respiration efficiency of embryo during incubation. As compared to hatching in natural conditions hatching rate increased from 00% to 70% by using normobaric hatchery.

Conclusion: Egg adaptation studies revealed that with subsequent generations high altitude imparts adaptive changes in eggs. These adaptive changes increase the reproductive fitness of the birds by increasing the hatching rate by using normobaric hatchery. Thereby, using normobaric hatchery high altitude specific/strain can be developed at the region of Leh-Ladakh.

Prevalence of major diseases in vegetable and fruit crops and management of powdery mildew in capsicum under polyhouse conditions

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During the year 2013-14, survey was conducted in vegetable and fruit crop growing areas in Kurnool district of Andhra Pradesh. In Kurnool district, more intensity of purple leaf blotch (25.5) disease was observed in Kharif season in onion crop and low intensity of disease (20.5) was recorded in Rabi-2013-14. Early blight disease (26.54) and Bud necrosis virus (15.0%) observed in tomato crop. Fruit rot & Die back (18.0%), Wilt (5%) and Powdery mildew (15.0) diseases were observed in chillies. Canker disease incidence (28.50) was more in acidlime. Gummosis disease incidence was observed in sweet orange. Penconazole @ 0.5 ml/L was found to be superior in controlling the powdery mildew in capsicum under polyhouse conditions (7.28) and more yield was (16.28 t/ha) recorded.

Key words: capsicum, powdery mildew, survey

Introduction: Vegetable crops are becoming an important alternative in diversification of agriculture and also playing a significant role in food, nutritional and health security of ever growing population in India. Banana, Turmeric, Mango, Citrus, Tomato, Brinjal, Bendi, Chillies and Onion are the major Horticultural crops in Rayalaseema Zone of Andhra Pradesh. Heavy application of fertilizers and introduction of new hybrids in larger areas may leads to occurrence of diseases. Leaf spots, Leaf blotch, Bacterial wilt, Dieback and Fruit rot, Root rot and wilt, early blight, yellow vein mosaic, rhizome rot, powdery mildew, anthracnose, twig blight and mosaic complex were found to be major diseases in Horticultural crops. The intensity of these diseases may vary from season to season and variety to variety. Some unknown diseases may also occur in addition to the common diseases. Hence, it is necessary to carryout survey for the diseases in scarce rainfall zone to have complete knowledge on the incidence and intensity of the diseases. Powdery mildew of capsicum caused by *Erysiphe cichoracearum* is a country wide problem occurring every year in serious proportion and causes yield loss. The disease is highly air borne in nature and the fast rate of multiplication of conidia leads to heavy inoculum load in environment during the cropping season.

Methods: A field experiment was conducted at Horticultural Research Station, Mahanandi, Kurnool, (A. P.) to survey and monitor the diseases occurring in important/major Horticultural crops. Roving survey in major Horticultural crops of Rayalaseema Zone –. Diseased plant samples were collected randomly from the farmer’s fields from different locations of the above stated districts of A.P. In each district three mandals and in each mandal, three villages were surveyed for the wilt disease. In each field row, each 10 meters long were selected randomly.

Rating scale for assessment of Leaf spot disease by using 0-5 scale (Sharma, 1986)

- 0 - No disease symptom
- 1 - A few spots towards tip covering 10 percent leaf area.
- 2 - Several purplish brown patches covering upto 20 percent of leaf area.
- 3 - Several patches with paler outer zone covering upto 40 percent leaf area.
- 4 - Leaf streaks covering upto 75 percent leaf area or breaking of the leaves from center
- 5 - Complete drying of the leaves or breaking of leaves from center

Rating scale for assessment of Powdery mildew disease (Mayee and Datar, 1986.)

Grade	Description of the symptoms
0	No symptoms of powdery mildew disease (PMD) on leaf
1	Less than 1% leaf area showing PMD symptoms
3	1 -10% of leaf area showing PMD colonies
5	11 – 25% area of leaf showing PMD colonies
7	26 – 50% area of leaf showing PMD and development of colonies on petiole and pedicel of fruit
9	Above 50% area of leaf affected and yellowing and drying of leaves; Powdery growth of the fungus covers the pedicel.

The percent disease index of powdery mildew and leaf spots were calculated using the following formula:

$$\text{Percent Disease Index (PDI)} = \frac{\text{Sum of the individual diseases grade} \times 100}{\text{Number of Branches or fruits observed} \times \text{Maximum Disease grade}}$$

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The percent disease incidence of Fruit rot and Wilt/Root rot were calculated using the following formula:

No. of plants infected

$$\text{Percent Disease Incidence} = \frac{\text{No. of plants infected}}{\text{Total No. of plants}} \times 100$$

Results: During the year 2013-14, survey was conducted in vegetable and fruit crop growing areas in Kurnool of Andhra Pradesh. In Kurnool district, more intensity of purple leaf blotch (25.5) disease was observed in Kharif season in onion crop. Low intensity of disease (20.5) was recorded in Rabi-2013-14. Early blight disease (26.54) and Bud necrosis virus (15.0%) observed in tomato crop. Fruit rot & Die back (18.0%), Wilt (5%) and Powdery mildew (15.0) diseases were observed in chillies. Canker disease incidence (28.50) was more in acid lime. Gummosis disease incidence was observed in sweet orange. Penconazole @ 0.5 ml/L was found to be superior in controlling the powdery mildew in capsicum under polyhouse conditions (7.28) and more yield was (16.28 t/ha) recorded. The results were in agreement with the following reviews. Purple leaf blotch caused by *Alternaria porrii* one among the serious fungal diseases that affect onion, causing heavy yield loss ranging from 2.5 to 87.8 per cent during *kharif* season (Srivastava *et al.*, 1994). This disease caused substantial loss of bulb and seed yield of onion growing countries (Ahmed and Hossain, 1985; Meah and Khan, 1987; Rahman *et al.*, 1988). Polyhouse production has been proven as more profitable protected technique for capsicum cultivation (Aruna and Sudagar 2010). According to Singh Amar and Banyal (2011), on capsicum the incidence of powdery mildew was recorded in epidemic form followed by bacterial wilt (5-40%), collar rot (10-20%) and cercospora leaf spots (5-25%). Incidence of bacterial wilt of capsicum was high in the polyhouses having light soils. Disease severity of cercospora leaf spot of capsicum was high during rainy season. The incidence of gray mold was also recorded in some polyhouses which were experiencing high dew drops formation and poor ventilation. Raju *et al.* (2017) carried out an experiment to know the effect of different fungicides including recommended fungicides against powdery mildew disease of capsicum (F1 hybrid ‘Indra’) in polyhouse during 2015 in Karnataka. Among the 10 treatments, propiconazole at 0.1% proved to be best for the management of powdery mildew with minimum per cent disease index (9.64%), which was superior over all other treatments with maximum fruit yield of 98.00 t/ha which is followed by 0.1% of myclobutanil (11.90 PDI), tridemefon (13.03 PDI) and hexaconazole (15.86 PDI) with fruit yield of 94.62, 92.33, and 92.15 t/ha, respectively. Maximum per cent disease index (76.33%) was recorded in untreated control with less fruit yield (45.83 t/ha).

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Table-1: Disease incidence in different vegetable and fruit crops in different areas for the year 2013-14

S.No	Village/ Mandal	Crop/Variety	Disease	Kharif – 2013 Disease Incidence / Intensity	Rabi 2013-14 Disease Incidence/ Intensity
1	Aluru Aspari Kurnool Nandikotkuru	Onion - (Bellary Red) Vegetative state and Bulb stage	1. Purple leaf blotch PDI (0-5 scale) 2. Damping off (%) 3. Smut PDI (0-5 scale) 4. Basal rot (%)	25.5 5.0 10.5 8.9	20.5 3.0 8.8 5.5
2	Aspari Orvakallu Aluru	Tomato - (NP 5005) Fruiting stage	Early blight PDI (0-5 scale) Bud necrosis (%) Mosaic (%) Wilt (%)	26.54 15.0 6.0 4.0	21.55 12.0 9.0 10.0
3	Sirivella Velugodu Allagadda	Chillies- (Super Delux) Fruiting stage	Fruit rot & Die back (%) Wilt (%) Powdery mildew PDI (0-5 scale)	18.0 5.0 15.0	- - -
4	Gadivemula Nandyal	Brinjal - (Polur local) Fruiting stage	Leaf spot PDI (0-5 scale) Wilt (%)	16.5 18.0	25.5 25.0
5	Chagalamarri Allagadda	Okra - (ArkaAnamica) Vegetative stage	Yellow vein mosaic virus (%)	14.0	-
6	Mahanandi Nandyal	Turmeric - (Mydukur) Vegetative stage	1. Leaf spot PDI (0-5 scale) 2. Rhizome rot (%)	22.5 15.5	- -
7	Atmakur Gadivemula	Mango - (Baneshan) Flowering stage	Anthraco nose PDI (0-5 scale) Powdery mildew PDI (0-5 scale) Sooty mould (%)	- - -	24.5 15.0 23.28
8	Marripalli Allagadda Atmakur	Acid lime	Canker PDI (0-5 scale)	-	28.50
9	Orvakallu Komarolu Allagadda	Sweet orange	Phytophthora Gummosis (%) Diplodia Gummosis (%)	- -	12.50 10.28

Table : 2 Management of powdery mildew in capsicum under polyhouse conditions 2013-14

S.No	Treatment	Percent Disease Index	Yield (t/ha)
T1	Triadimefon@ 2.5 g/L	08.89 (17.26)	14.82
T2	Tebuconazole @ 1.25 ml/L	10.55 (18.91)	13.95
T3	Dinocap @ 2 ml/L	07.53 (15.89)	15.85
T4	Penconazole @ 0.5 ml/L	07.28 (15.56)	16.28
T5	Difenconazole + Azoxystrobin @ 1 ml/L	09.26 (17.66)	14.15
T6	Azoxystrobin @ 1 ml/L	10.98 (19.28)	12.55
T7	Flusidazole @ 1ml/L	09.85 (18.24)	14.05
T8	Control	14.25 (22.14)	10.24
	SEm	0.74	
	CD at 5 %	2.25	

SCREENING OF RICE GENOTYPES AGAINST BACTERIAL LEAF BLIGHT

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Purpose: Bacterial leaf blight (*Xanthomonas oryzae* pv. *oryzae*) is an important foliar disease of rice causing considerable loss in yield under favourable weather conditions. The disease yield loss was estimated approx 81.3% in India (Prasad *et al.*, 2018). The Symptomatology of the disease may be

characterized in two phases *i.e.* leaf blight phase and Kressek phase. Under leaf blight phase the leaf blade turned pale yellow before drying up due to the severity of the disease. While under severe conditions yellow to white stripes appeared just inside the margins of the leaf blades which later on turned to pale yellow and become necrotic (Ou, 1985). Where as during “Kressek” phase the leaves of rice plant become grayish green to whitish and suddenly withered (Goto, 1992). In this phase usually, symptoms appear on foliar parts, related those on younger plants yet the rotting of the stem also reaches the upper part of the leaf. Host plant resistance is an ecofriendly and economical alternative for the management of the disease. Therefore it is a pressing need to develop rice varieties with desirable traits and in built bacterial leaf blight resistance. Keeping this in views, screening programme was carried out under artificial inoculation conditions with the promising entries selected from advance generation breeding material (LSVT, SSVT, aromatic and other state varietal trials). These inbuilt resistant genotypes can be further used in crop improvement programme.

Methods: The screening trial was carried out with 74 rice genotypes including 2 susceptible checks (1 NC + 1 LC) found promising against bacterial leaf blight during previous year trials. These selected genotypes were again evaluated for three years (*Kharif*-2018 to 2020) against the disease under artificial inoculation and high disease pressure conditions in the field to find out the source of stable resistance against the disease at Main Rice Research Station, Anand Agricultural University, Nawagam, Kheda, Gujarat, India. The field was prepared for sowing by leveling thoroughly. The nursery of all genotypes was grown on raised beds. The recommended agronomical practices were adopted for raising the nursery of all genotypes. The experiment was established under transplanting conditions in the spacing of 20x15 cm. The row length of each genotype was 1.5 m along with two replications. The one row of each susceptible variety *i.e.* TN-1 and GR-11 was transplanted after every 5 tested genotypes. In addition to this the experimental plot was surrounded by border rows of susceptible variety GR-11. The basal application of NPK at 40:25:00 Kg/ha was applied at the time of transplanting. Whereas 60 kg/ha nitrogen was applied as top dressing in two splits at 25 days after transplanting and at panicle initiation stage. Manual weeding was adopted to keep the experimental field free from weeds. Plant protection measures adopted only to prevent insect-pests damage to the crop. The need based irrigation was applied. The observations were recorded through screening by adopting 1–9 SES (Standard Evaluation System).

SES Scale (2013) for bacterial leaf blight

Score	Description(affected lesion area)
1	1 - 5 %
3	6 - 12 %
5	13 - 25 %
7	26 - 50 %
9	51 - 100%

Results: The results showed that out of 60 rice genotypes including 2 susceptible checks (1 NC + 1 LC), none of the genotype was found immune towards the disease. Whereas only three genotypes were showed resistant reaction, ten genotypes were showed moderately resistant reaction and forty one genotypes showed moderately susceptible reaction, seventeen genotypes showed susceptible reaction and three genotypes including 2 susceptible checks (1 NC + 1 LC) were showed highly susceptible reaction. The consistent resistant reactions was found in the genotypes NWGR-14035, NWGR-14084 and NWGR-11002 against bacterial leaf blight. The genotype can be used in breeding programme for developing bacterial leaf blight resistant varieties resistant varieties.

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Disease rating scale	Response	No. of entries	Germplasm/ Genotypes
0	Immune	Nil	Nil
1	Resistant	3	NWGR-14035, NWGR-14084 and NWGR-11002
3	Moderately resistant	10	NWGR-12002, NWGR-11048, NWGR-13087, NWGR-12041, NWGR-13055, NWGR-8001, IET-24426, Im. S Masuri , GAR-14 and Mahi Sagar
5	Moderately susceptible	41	IET-23330, NWGR-9147, NWGR-12080, NWGR-10046, NWGR-12009, NWGR-7023, NWGR-9078, NWGR-12056, NWGR-12089, NWGR-12015, NWGR-13008, NWGR-13010, NWGR-13052, NWGR-14005, NWGR-14059, NWGR-14071, NWGR-13131, NWGR-14036, NWGR-14072, NWGR-14031, NWGR-12016, IET-25342, IET-25341, IET-25310, IET-24954, IET-25125, IET-26121, IET-27281, IET-25625, IET-25970, IET-24977, IET-24985, IET-26124, IET-24968, Krishna Kamod, Sarbati, SahiDabat, P-203 and Gurjari
7	Susceptible	17	IET-22212, IET-24329, NWGR-12047, NWGR-14021, NWGR-14030, NWGR-14060, NWGR-14048, NWGR-14056, NWGR-14057, IET-24425, IET-24692, IET-25602, IET-25336, NWGR-14027, Kamod-118, Hawabeen and Naha
9	Highly susceptible	3	TN-1, GR-11 and HR-12

Conclusion: Growing concern about the health issues due to pollution, minimized use of fungicides is being discussed, which for some reason is not practical. Host plant resistance is most promising to combat bacterial leaf blight of rice. Based on above findings it is concluded that the consistent resistant reactions observed in the genotypes NWGR-14035, NWGR-14084 and NWGR-11002 against the bacterial leaf blight of rice. The genotypes can be used in breeding programme for developing bacterial leaf blight resistant varieties. Further the study and time to time field evaluation of rice genotypes against bacterial leaf blight is entertained.



NWGR-14035

NWGR-14084

NWGR-11002



TN-1

GR-11

View of experimental plot

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Assessment of gamma irradiation-induced mutations for improvement of inflorescence traits in lentil (*Lens culinaris* Medik.)

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Purpose: Enhancing the number of pods per inflorescence appears to be an appealing strategy for increasing grain legume yield. Lentil (*Lens culinaris* Medik.) is an excellent target crop for mutation breeding experiments since it is a self-pollinated crop with a limited genetic base. The purpose of the research was to induce, identify, and characterise distinct inflorescence mutations which have a significant effect on lentil yield and yield stability.

Methods: *Lens culinaris* Medik. cultivar Pant L 406 seeds were irradiated with 100, 200, 300, and 400 Gy of gamma rays to induce desirable genetic variations. To screen for stable mutations in the lentil inflorescence architecture, the mutagenized populations were advanced up to mutant generation fourth (M₄). In following mutant generations, the selected mutant 'multipod' phenotype, i.e. multiple pods per peduncle, was morphologically characterised and quantified.

Results: The morphological characterisation of the 'multipodding' mutant indicated that gamma ray irradiation caused significant phenotypic alterations. The yield per plant (g) difference between the mutant and parent cultivar Pant L 406 was found to be non-significant owing to a significant reduction in seed weight.

Conclusions: The new 'multipodding' mutant generated in this study might be useful in deciphering the genetic network that controls legume inflorescence phenotype as well as in genomics-assisted breeding for superior lentil cultivar improvement.

Keywords: Induced mutagenesis; gamma irradiation; inflorescence traits, multipodding mutant; lentil (*Lens culinaris* Medik.)

Evaluation of insecticidal properties of Karanj (*Pongamia glabra*) against banana leaf and fruit scarring beetle (*Basileptasubcostatum*) (Coleoptera: Chrysomelidae)

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Purpose: Banana is one of the most important fruit crops, cultivated by man from pre-historic times in India with great socio-economic significance. Banana is attacked by more than 200 species of insect and non-insect pests. Insect attack noticed from planting to harvest at different stages of crop growth. Among the insect pests, banana leaf and fruit scarring beetle *Basileptasubcostatum* (Coleoptera: Chrysomelidae) is considered as one of the most economically important pest in Assam and some other parts of India also. Botanical plays an important role in agricultural pest management because of their biodegradable, systemic, ecofriendly and non-toxic nature to natural enemies. Thus, the present study was carried out to evaluate the efficacy of plant extract against the leaf and fruit scarring beetle of banana.

Methods: Collection and preparation of extract The matured leaves of *Pongamia glabra* were collected from different locations of Jorhat, Assam for preparation of extract. The leaves were shade dried and powdered by using an electric grinder and passed through a 20 mesh sieve and kept in container. Then the powder was extracted with chloroform using Soxhlet extraction. The extract was dried with rotary vacuum evaporator and dissolved in acetone by w/v basis to make 100% stock solution.

Maintenance of *B. subcostatum* culture The leaf scarring beetles were collected from Experimental Farm of Assam Agricultural University, Jorhat and the culture was maintained in the laboratory. Fresh banana leaves of 5 cm² were placed on petri plates and then adults were released in the petri plates. Bioassay against adult *B. subcostatum* From the stock culture, 10 number of healthy *B. subcostatum* were released onto healthy detached matured banana leaves. A final count of them were taken after 4 hours of proper settlement. Each concentration was directly sprayed on the surfaces of the leaf. The number of live insects were counted at 24, 48 and 72 hr after treatments. Each treatment was replicated three times.

Results: The present study revealed that the chloroform extracts of *Pongamia glabra* evaluated against *B. subcostatum* under laboratory condition showed the lethal effect. The data revealed that the extract cause highest of 93.33% adult mortality of *B. subcostatum* at 7% concentration after 72 hours of treatment as compared to the lowest of 6.67% mortality at 0.5% concentration after 24 hours of treatment.

Conclusions: The present study revealed that among all the concentrations of *Pongamia glabra* the LC₅₀ value was found at 1.62% concentration after 72 hours of treatment. Thus present investigation gives a way to reduce the toxic effect of chemical by incorporating the plant extract which are found to be less hazardous and ecofriendly.

Keywords: Insecticidal property, *Pongamia glabra*, *Basileptasubcostatum*, LC₅₀, Chrysomelidae.

Development of multinutrient-rich maize hybrids through genomics-assisted stacking of *lpa-1*, *opaque2* and *crtRB1* genes

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Purpose: Micronutrients like iron (Fe), zinc (Zn), vitamin-A, and essential amino acids (lysine and tryptophan) assume great significance for nutritional security. Maize grains possess 80-90% phytic acid which acts as an anti-nutritional factor by reducing the bioavailability of Fe and Zn. Further, traditional maize possesses low provitamin-A (1-2 ppm), lysine (0.150-0.250%) and tryptophan (0.030-0.040%). Hence, reduction of phytic acid, and increase of provitamin-A, lysine and tryptophan through marker-assisted selection (MAS) in maize provides sustainable and cost-effective solution to malnutrition.

Methods: Four elite maize inbreds viz. PMI-PV5, PMI-PV6, PMI-PV7 and PMI-PV8 were targeted for introgression of *lpa1-1* allele through genomics-assisted backcross breeding. These inbreds are enriched with provitamin-A (>8 ppm), lysine (>0.350%) and tryptophan (>0.07%) due to presence of favourable allele of *opaque2* and *crtRB1* genes. These inbreds serve as the parents of four biofortified hybrids viz., APQH1, APQH4, APQH5 and APQH7 developed at IARI, New Delhi. Markers associated with *lpa1-1*, *crtRB1* and *opaque2* genes were used for the genotyping of BC₁F₁, BC₂F₁ and BC₂F₂ generation. Background selection was carried out using >100 SSRs. The selected inbreds were used to reconstitute the hybrids. Hybrids were evaluated at three diverse locations (Bajaura, Delhi and Jhansi) for grain yield, agronomic traits, and quality traits such as kernel phytic acid, lysine, tryptophan and provitamin-A.

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Results: SNP marker linked to *lpa1-1* was successfully used in BC₁F₁, BC₂F₁ and BC₂F₂ generations. SSR and InDel markers associated with *crtRB1* and *opaque2* genes, respectively also helped in genotyping of the populations. While *lpa1-1* and *crtRB1* genes showed segregation distortion, *opaque2* showed Mendelian segregation as per expectation. Heterozygotes (*lpa1⁺lpa1-1*) were selected in backcross generations, while homozygotes (*lpa1-1 lpa1-1*) were selected in selfed generation. In case of *opaque2* and *crtRB1* genes, homozygotes (*o2o2/crtRB1crtRB1*) were selected in BC₁F₁, and validated their presence in homozygous condition during BC₂F₁ and BC₂F₂. Background selection led to the recovery of >90% of the recurrent parent genome. The MAS-derived inbreds and hybrids possessed similar agronomic and DUS characters as observed in their original version. The newly developed inbreds and reconstituted hybrids possessed >30% reduction in phytic acid, with higher lysine (>0.350%), tryptophan (>0.070%) and provitamin-A (>8.00 ppm).

Conclusions: The newly developed maize hybrids having favourable allele of *lpa1-1*, *opaque2* and *crtRB1* possessed significantly lower phytic acid, and enhanced level of provitamin-A, lysine and tryptophan. These novel hybrid combinations would pave the way for alleviating malnutrition through holistic approach. This is the first report of development of multi-nutrient rich maize hybrids that address malnutrition pertaining to Fe, Zn, protein quality and provitamin-A.

Key words: maize, low phytate, vitamin-A, lysine, tryptophan, micronutrients, bioavailability, biofortification

Supply Chain Analytics in Agribusiness: Prospects and Challenges

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Purpose: Agribusiness involves a wide range of different enterprises connecting farmers, processors, traders and retailers. It depends on inputs from different geographical locations and sources. Supply chain analytics, plays a key role in improving the performance of supply chain by improving visibility of supply chain, handling unpredictability and reducing variability in cost. The present paper focus on prospects and challenges of supply chain analytics in agribusiness.

Methods: The paper is based on secondary data and information, which were collected from different sources like magazines, newspapers, books, published research papers, journals, websites etc.

Results: Supply chain analytics in various important sector of agribusiness helps in improving effectiveness and reducing overall cost and it lead to overall maximizing profit for the organization. Moving to smarter logistics to improve supply chain visibility, managing unpredictability through demand and management of inventory and reducing cost fluctuations by improving sourcing and logistics activities of the supply chain are the key role of supply chain analytics. Management of supply chain covers both the aspects of flow of information horizontal as well as vertical in organizations.

Conclusions: Supply chain analytics helps in reducing product losses in transportation and storage and provides better information and decision making about the flow of products, market and technology. Supply chain analytics, plays a key role in improving the performance of supply chain by improving visibility of supply chain, handling unpredictability and reducing inconsistency in cost.

Key words Agribusiness, supply chain analytics, prospects, importance

Isolation and Screening of PHB- producing microbes from different ecological niches.

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Purpose: The aim of this work was to isolate and screen potential PHB producing microorganism. Polyhydroxybutyrate (PHB) are the macromolecules integrated by microorganism, are inclusion bodies which accumulate as reserve material when the microbes face stressed conditions.

Methods: Isolation of bacteria and fungi were carried out by using Nutrient Agar and Potato Dextrose Agar respectively. The Mineral Salt Medium for bacteria and fungus respectively were used to isolate PHB-producing microbes. Screening was also performed through staining method with the addition of Sudan Black B and Acridine orange dye.

Results In present study, sixteen PHB producing microbes were isolated from different ecological niches using mineral salt medium. Then, screening was performed by using Sudan Black B and Acridine orange dye. It resulted that colonies turned into blue-black color by primary staining i.e. Sudan Black B dye and yellow-orange color by secondary staining i.e. Acridine orange. Among these sixteen isolates, eleven bacterial and five fungal isolates were positive in respect to PHB accumulation.

Conclusions: We concluded that the eleven bacteria and five fungi were potent PHB-accumulating strains and these isolates will be considered as good candidates for industrial production of PHB and further bionanocomposites will be prepared and characterized.

Key words Polyhydroxybutyrate, Nutrient agar, Potato Dextrose Agar, Sudan Black B and Acridine orange.

Analysis of fungal biodiversity in soil samples from Orissa regions and assessment of Plant Growth promoting traits

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Purpose: Soil fungi represent one of the most important microbial groups that are actively involved in the enhancement of environmental quality and plant nutrient supply. Fungi are the most different and adaptable group of living beings. In the present study an attempt was made to study the isolation and identification of different soil fungi from various places of Orissa.

Methods: The soil samples were collected from different agricultural land of Orissa Region (Latitude: 19.48° N to 21.76° N, and Longitude: 84.72° E to 86.86° E) of Kailsahi, Khandapada, Nayagarh, Navkhal, Ganjan, Daringabad, Pattamundai, Rajkanika, Ramchandrapur, Rajendra narayanpur, Parandpu and Bhaitarkanika. The soil sample serially diluted and spreaded on PDA (pH 5.6 ±0.2), CZA (pH 7.3±0.2), and RBA (pH 7.2±0.2) media. The purified isolates were identified on the basis of ITS1 gene and identified isolate were submitted to NCBI. The fungal isolates was further screened for plant growth promoting activity

Results: The population of fungus based on the culturable study ranged between 45 to 185 CFUg⁻¹ of soil. Total 243 pure fungi isolates were obtained from collected soil samples. The highest number of morphotypes (24) was obtained from samples collected from Bhaitarkanika, whereas it was minimum (7) in Rajendra narayanpur soil, respectively. The purified isolates were identified through sequencing of ITS 1 gene region and as *Aspergillus terreus*, *Penicillium janthinellum*, *Fusarium oxysporum*, *Aspergillus niger*, *Aspergillus flavipes*, *Trichoderma afroharzianum*, *Trichoderma harzianum*, *Penicillium janthinellum*, *Talaromycespurpureogenus*, *Penicillium canescens*, *Aspergillus nomius*, *Penicillium simplicissimum*, *Talaromycespinophilus*, *Fusarium proliferatum*, *Talaromycesbarcinensis*, *Aspergillus ustus* etc. The sequence was submitted to NCBI and isolates. Further, 42 fungal isolates were characterized for different PGP attributes like zinc, phosphate and potassium solubilization and siderophore production. Among them 9 isolates found positive for zinc, 10 for phosphate and 6 for potassium solubilization and 36 were found positive for siderophore production.

Conclusions: The fungal flora of the selected region have the Plant growth promoting activity.

Keywords: Fungal Diversity, Siderophore, PDA and PGP

Turmeric and Its Associated Fungal Endophytes

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Purpose: *Curcuma longa* L. (Turmeric) is a member of Zingiberaceae family, belongs to one of the oldest cultivated spice, is indigenous to the Indian sub-continent, and is one of the most powerful herbal medicinal plants. Turmeric has been associated from wide variety of microorganisms. Turmeric rhizomes interact with a large numbers of rhizospheric-associated fungal species, and some enter the plant tissue and act as endophytes. Generally, fungal endophytes are recognized as the rich source of secondary metabolites of their multifold importance in medical, agriculture and pharmaceutical fields.

Methods: The present study focuses on the isolation and morphological identification of fungal endophytes from healthy plant parts (rhizome, roots, stem and leaf) of *Curcuma longa*.

Results

Results: Out of 38 isolates, most of the fungal endophyte from the turmeric plant belong to the genera of *Penicillium* sp., *Fusarium* sp., *Aspergillus* sp., *Pestalotiopsis* sp., *Cochliobolus* sp., *Cladosporium* sp., *Vorticillium* sp., *Alternaria* sp. and sterilia mycelia.

Conclusions: The fungal endophytes are known to produce an array of bioactive molecules with diverse activities. The isolated fungal endophytes are further proceeded to check their potential for antibacterial, antioxidant, antidiabetic, and immunomodulatory activities. Currently, there is a demand for health services in developing countries due to emergence of drug resistance by pathogenic microorganisms. Therefore, endophytic fungi are the ideal targets as they are widely used for its various biological activities. However, more work in the field of endophytic fungi can exert a profound effect in the search of novel bioactive.

Keywords: *Curcuma longa* L., Endophytic fungi, Biological activities.

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A Temporal Analysis of Forest and Forest Products in Rajasthan in Post Reform period

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Purpose: A study was carried out to better understand the changes in Rajasthan’s forests over time. The objectives were to look at the changes in forest area and cover over time, as well as changes in ecological sector, production pattern and revenue from selected timber and non-timber forest products.

Methods: Simple statistical tools such as mean, percentage, compound annual growth rate, instability index (Coefficient of variation and Cuddy Della Valle index), tabular analysis and net change in ecological sector through land use model were used to analyse the data. From 1995 to 2019, the study was conducted over a 24-year period.

Results: The findings revealed a significant compound annual growth rate of 0.30 per cent in total forest area. The area of reserved forest, protected forest and unclassified forest saw significant compound growth rates of 0.90 per cent, 0.80 per cent and -5.10 per cent, respectively. Unclassified forest area had 8.57 per cent instability, followed by protected forest area (1.55%), reserved forest area (1.24%) and total forest area (0.70%). The percentage changes in total forest cover, dense forest, open forest and scrub forest were 25.23%, 19.82%, 27.24% and -30.92%, respectively. The desirable ecological sector increased by 234732 hectares, while the forest and land under miscellaneous tree crops and groves increased by 301942 hectares and 10407 hectares, respectively, whereas permanent pastures and grazing lands decreased by 77617 hectares. Changes in undesirable ecological sector were found to be negative, as barren and unculturable land decreased by 274121 hectares between 1995 and 2019. The average production of firewood was 3.92 lakh quintals and timber (2.95 lakh quintals), bamboo (14.80 lakh numbers) and tendu leaves (3.64 lakh standard bags). The average revenue from 1995 to 2019 for timber, firewood, bamboo and tendu leaves was recorded as ₹38.99, ₹1761.94, ₹235.06 and ₹1377.51, respectively. However, contribution of timber declined from 5.56 per cent to 0.43 per cent, firewood grew from 10.14 per cent to 43.70 per cent, bamboo decreased from 15.33 per cent to 4.26 per cent and tendu leaves decreased from 68.97 per cent to 51.44 per cent in revenue during the study period.

Effect of Parental Stress among Single Mothers

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ABSTRACT

Purpose: The growing number of single parent families is creating the stress on the lone parent for taking the double responsibility of the child. . A single parent family indicates that the lone parent is whole and soul responsible for running the family and rearing the children with or without the support system. Single parenthood can bring added pressure and stress to the job of raising children. With no one to share day-to-day responsibilities or decision-making, single parents must provide greater support for their children while they themselves may feel alone. The demands of parenting can create stress for almost all parents. Parenting stress and demands of being a parent occurs when the demands of parenthood exceed the perception of available resources to meet those demands (Abidin, 1995; Deater-Deckard, 1998). In this view the effect of parental stress on single mothers has been carried out.

Methods: A differential research design was used to know the differences in parental stress among the single mothers by locality and correlation design was used to know the influence of age and socio-economic status on parental stress among single mothers from rural areas of seven districts. While the target populations of the study comprised of single parent families from rural areas of University of Agricultural Science, Dharwad (UAS) Jurisdiction namely Dharwad, Haveri, Gadag, Belgaum, Uttar Kannada, Bagalkot and Vijayapur District of Karnataka, India. Among each district two taluks were randomly selected and from each taluk two villages were randomly selected for the study. Among each village 15 single mothers were selected which comprised of totally 420 single parent families. The criterion for selecting the single mothers was that they should have at least one child/ children aged from 6-25 years. Parental Stress Scale developed by Berry and Jones (1995) was used to know the levels of stress experienced by parents which account positive and negative aspects of parenting. The Socio Economic Status developed by (Aggarwal *et al.*, 2005) was used to assess the SES of respondents.

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Results: The results indicated that 74.76 per cent reported death of their spouse was one of the major reasons for being single parent followed by separated (12.85 %) and divorce (12.38 %). Among the single parents 60.95 per cent had medium parental stress followed by 29.76 per cent single parents had high parental stress and remaining 9.28 per cent had low parental stress and there was highly significant difference between the localities with respect to parental stress. The reason could be that the single parents and their children have one-to-one relationship and the children were dependent on the lone parent for love and affection which would ease the single parents in parenting their children all alone. As the days pass the single parents have gained greater self-confidence and sense of independence in parenting alone which in turn help the children for better foundation for their future in respect to working hard and face the hardships in life from an early age and learn how to deal with life on its own terms. When compared between the groups of single parents there was no significant association found in parental stress. There was significant relationship between the age, socio economic status with parental stress.

Conclusion: The major reason for singlehood was death of the spouse followed by separation and divorce, while among the seven districts majority of the single parents had medium level of parental stress and there was highly significant difference and influence of localities with respect to parental stress. When compared between the groups of single parents there was no significant association found in parental stress. There was significant relationship between the age, socio economic status with parental stress.

Key words: Single parents, Parental stress, Widow, Separated and Divorced

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Banana pseudo stem sap: An eco-auxiliary for textile finishing

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ABSTRACT

Purpose: Banana (*Musa paradisiaca*) is one of the most important gigantic and oldest cultivated fruit crops grown almost everywhere in India. Banana is the second largest produced fruit contributing about 16 per cent of the world’s total fruit production (FAO, 2009). Abundantly available banana pseudo stem has been traditionally used for fibre extraction for products diversification and the sap is one of the most important bio agent for various applications has not been utilising properly either by farmers or industrialist. Hence the present study is designed with the objective, extraction and characterization of banana pseudo stem sap of local varieties and application of optimised sap on cotton fabric.

Methods: The banana pseudo stem sap of Grand Nain and Ney Poovan varieties were characterized for total phenolic content (TPC), fourier transform infrared spectroscopy (FTIR), antioxidant assay and bioassay test. Based on characterization Ney Poovan variety was selected for finishing of cotton fabric. The finished cotton fabric was assessed for physical properties viz., cloth count, cloth thickness, cloth weight, cloth stiffness and cloth crease recovery and functional properties viz., cloth tensile strength, elongation, cloth drapeability, antimicrobial, UV property and the finished cotton fabric is characterised by FTIR.

Results: Results revealed that, the total phenolic content and antioxidant activity exhibited greater in Ney Poovan pseudo stem sap than Grand Nain pseudo stem sap. The FTIR spectrum of banana pseudo stem sap (Grand Nain) exhibited presence

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of C-Br stretching attributed to presence of bromine compound and Ney Poovan pseudo stem sap exhibited presence of N-O stretching and S=O stretching specifies the presence of nitro and sulfoxide compound. The optimised BPS treated cotton fabrics became significantly thicker, heavier, softer, pliable and good drape than control fabric. The cloth tensile strength and elongation were found to be significantly greater in BPS treated cotton fabric. The BPS treated cotton fabric exhibited increased ultra violet protection factor with decreased UVA and UVB resulting into good to excellent protection category and also exhibited good antimicrobial properties than control fabric. The FTIR of BPS treated cotton fabrics exhibited additional medium peaks at varied wavelengths resulting into formation of intermolecular bonding between fibre and BPS compounds which yields UPF properties.

Conclusion: BPS treated fabrics can be suitable for summer apparels, health care and home textiles. The processed sap can be used as eco auxiliaries for functional finishing of textiles and optimum utilization of biowaste provides an immense help to the farmers and entrepreneurs to create employment opportunity among the banana growers and doubling the farmer's income.

Key words: Banana pseudo stem, total phenolic content, antioxidant activity, Fourier transform infrared spectroscopy (FTIR), physical property, antimicrobial assay and ultra violet protection factor.

Immunomodulatory activity of asparagus racemosus with particular reference to cytokines' induction in chicken splenocytes

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ABSTRACT

Purpose: Several anti-inflammatory agents used for the treatment of inflammation impart side effect. This demands for the plant derived natural immunomodulators. Asparagus racemosus (family Asparagaceae) also known as Shatavari is a well known plant in Ayurveda. Present study was conducted to investigate the immunomodulatory potential of hydromethanolic extract of Asparagus racemosus (ARE) in chicken lymphocytes culture system through quantitative real time PCR analysis of IL-4, IFN- γ , IL-6, IL-10 and iNOS.

Methods: The maximum non-cytotoxic dose (MNCD) of ARE was confirmed in the chicken lymphocytes through MTT assay. Total Antioxidant Capacity, Reducing Power Capacity, Hydrogen peroxide Scavenging Assay, NO radical scavenging assay were carried out to assess the antioxidative potential of ARE. Immunomodulatory potential was evaluated through lymphocyte proliferation assay (LPA) followed by antioxidant analyses (LPO, GSH, SOD and NO) in ARE treated chicken lymphocytes. Further, expression analysis (IL-4, IFN- γ , IL-6, IL-10 and iNOS) was conducted through quantitative real time PCR to explore the underlying molecular mechanism behind immunomodulatory potential of ARE in chicken lymphocytes.

Results: MNCD of ARE was found to be 300 μ g/ml. ARE displayed significant increase in B and T cells proliferation in case of mitogen stimulated cells. There was substantial decrease in the percent Lipid peroxidation and NO content whereas GSH and SOD levels were significantly increased in the chicken splenocytes treated with ARE. ARE treatment to chicken lymphocytes down regulated the expression of IL-6 and iNOS, whereas, IL-4, IFN- γ and IL-10 expression levels were significantly upregulated.

Conclusion: The results obtained in the study indicated that ARE treatment significantly enhanced B and T cells proliferation and improved the antioxidant status of cells. In vitro exposure of ARE led to increased expression of anti-inflammatory cytokines and diminished the expression of pro-inflammatory mediators. Taken together, these findings ascertained that ARE boosted both cellular and humoral immunity and possessed anti-inflammatory activity.

Key words: Asparagus racemosus; Anti-inflammatory; Immunomodulatory; Cytokines; Chicken lymphocytes.

Influence of different cultivation method on Green House Gases (GHGs) emission in rice ecosystem

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ABSTRACT

Purpose: Global warming due to enhanced Green House Gas (GHG) effect is the most important environmental issue across the world. The emission of greenhouse gases (GHGs) is increasing at alarming rate due to increasing population and development. The emission of GHGs is highest in the transportation sector due to fossil fuel combustion in the world as well as in India. Among the various sources of GHGs, agriculture is considered a major contributor primarily through the emission of methane (CH₄) and nitrous oxide (N₂O). Among the agriculture rice cultivation ranks second after livestock emission in India. Rice is the most important staple food crop in India and is being grown from Kashmir to Kanyakumari by following different cultivation methods. The growing demand for food due to increasing population urges us to increase food grain production. At this juncture, there is need to quantify the GHGs emission in the different rice cultivation methods so that we could able to find suitable method of cultivation with low emission without sacrificing yield.

Methods: Estimation of methane and nitrous oxide emissions:

Methane and nitrous oxide emissions from paddy fields and uplands will be measured by acrylic chamber (length 40 cm, width 40 cm and height 100 cm). Methane and nitrous oxide emission rates will be determined at hourly interval for measuring the changes of methane nitrous oxide concentrations (the net change between greenhouse gas emission and sink) in acrylic chamber. The sample were taken during vegetative period, active tillering stage, flowering and maturity stage. The average emission were taken for to calculate seasonal GHGs emission. Methane and nitrous oxide will analyzed by gas chromatograph using FID and ECD, respectively. Methane and nitrous oxide emissions from paddy fields and uplands will be calculated from the experimental data and estimated by the following equation at each growth stage (Rolst)

$$F = (V/A) (\Delta C / \Delta t)$$

Where F is the methane or nitrous oxide emission rate (mg m⁻² h⁻¹),

V is the volume of chamber above soil (m³),

A is the cross-section of chamber (m²),

ΔC is the concentration difference between zero time and time t (mg m⁻³),

Δt is the time duration between two sampling period (h).

Results: The gas sample were collected from TNAU- Wetland during the year 2014-15 and the collected sample has been analyzed in Gas Chromatography for methane and Nitrous oxide. The preliminary results shows that nitrous oxide emission was high at SRI method (12.13 Kg/ha/Season) followed by convention method (10.04 Kg/ha/Season) and low in Drum seeded rice (8.24 Kg/ha/Season). At the same time the methane Emission was high in Conventional method (84.27 Kg/ha/Season) followed by drum seeded paddy (57.09 Kg/ha/Season) and the low emission observed in SRI method (24.76). The more methane emission in conventional method was due to maintaining anaerobic at field, which created redox state in the soil though which the high quantity of methane gas was produced. At the same time the nitrous oxide emission is less in

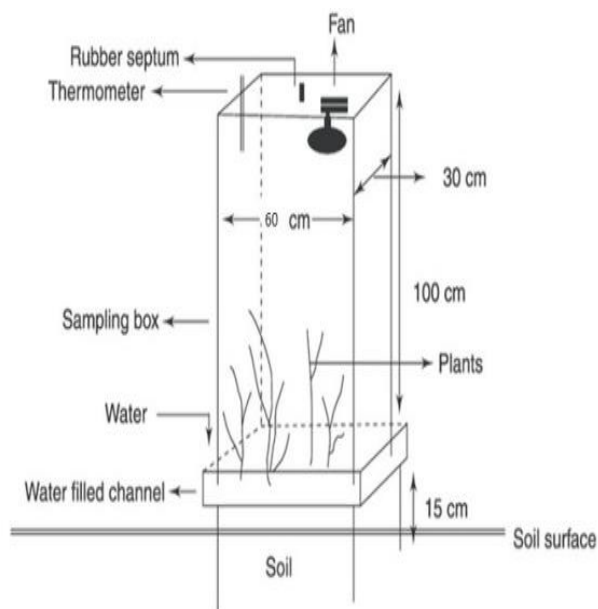


Fig 1. Acrylic GHGs collection chamber

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conventional methods due to anaerobic condition prevailed throughout the season. The nitrous oxide emission is more in SRI method of cultivation was mainly due to aerobic conditions prevailed during alternate wetting and drying method as well as during conoweeding and rotary weeding operation.

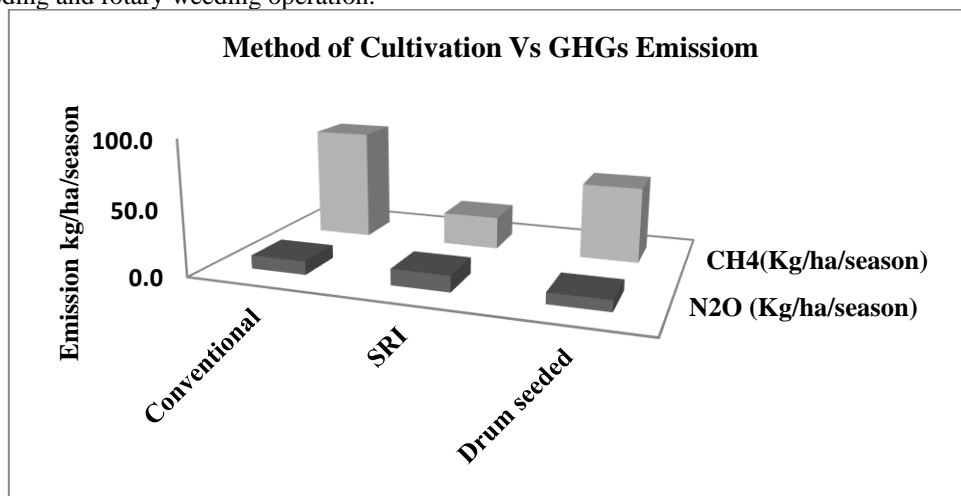


Fig.2. Method of cultivation on GHGs emission

In the drum seed method cultivation had emitted low amount of nitrous oxide compare to other methods of cultivation.

Conclusion: The GHGs emission in the rice field was depended on the water and nitrogen management. The methane emission was more conventional method and nitrous oxide emission was more in SRI method of cultivation. There was reduction in N2O emission, when ammonium chloride applied as nitrogen source and application of compost also reduces the emission of CH4 and N2O in all cultivation method. Further studies would be on nitrifying microbes and methanotrophs on different rice cultivation method to sustain the production and reduce the emission of GHGs.

Key words: CH4, N2O, GHGs, rice

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Overcome nutritional deficiencies employing food to food fortification with wild edible berries of Kumaun Himalaya, India

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ABSTRACT

Purpose: Uttarakhand state is still in its infancy of development more specifically the mountain region of Himalaya observe malnutrition, poverty and other associated nutritional deficiencies which is a big challenge to policy makers and people them-selves, though this region is endowed with a great floral diversity and a big repository of medicinal plants since Vedic times. This area is popularly known for many wild fruits including variety of less known wild edible berries.

Methods: Protein quantification was done by the BSA standard protocol; carbohydrates and mineral content were estimated by the AAS.

Results: These underutilized berries are not only delicious and refreshing, but also a good source of nutrients and therapeutic compounds. Apart from nutrition and therapeutics they could be a great source of immunobooster and immunoregulators. Therefore, the use of wild edible berries for food to food fortification could be an effective approach to address various nutritional deficiencies.

Conclusion: Investigations on such berries are suggested to be identified as candidate source to explore the possibilities of fortification and promotion of their domestication leading to commercial scale production.

Key words: Food Fortification, Wild Edible Berries, Uttarakhand Himalaya, Malnutrition, Immunobooster

Biodegradation of carbosulfan pesticide by using novel indigenous *Bacillus cereus* strain T5 under subtropics

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ABSTRACT

Purpose: The potential of root-associated rhizobacteria to grow in pesticide-contaminated sites are of great interest; nevertheless, their ability to thrive in pesticide-contaminated agricultural soils and promote plant growth is still unknown. In this study, we explored the degradation mechanism of carbosulfan pesticide and plant growth promotion characteristics by rhizobacteria in minimal salt medium and soil.

Methods: Isolation of potential plant growth promoting bacteria by using enrichment culture technique and analyse for PGPR properties and pesticide biodegradation in different medium like MSM, sterile and natural soil.

Results: Results revealed a rhizobacterial strain *Bacillus cereus* T5 (NCBI accession no. MW208058) showing luxuriant growth in pesticide contaminated medium was identified on the basis of 16S rDNA sequencing. A microcosm study with strain T5 in MS medium, sterile soil, and natural soil showed carbosulfan degradation up to 95%, 78% and 85% in MSM, sterile and natural soil respectively in 30 days of incubation quantified by high performance liquid chromatography (HPLC). The plant growth promoting characteristics such as phosphate solubilization, potassium solubilization zinc solubilization, IAA production, HCN production, Ammonia production by strain T5 in carbosulfan amended medium showing positive results. The quantitative estimation of PGP characteristics showing $46.721 \pm 2 \mu\text{g mL}^{-1}$ IAA production, $23.971 \pm 2 \mu\text{g mL}^{-1}$ HCN production, $19.772 \pm 2 \mu\text{g mL}^{-1}$ ammonia production, $55.219 \pm 2 \mu\text{g mL}^{-1}$ phosphate solubilization, $54.714 \pm 2 \mu\text{g mL}^{-1}$ potassium

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solubilization, and $41.179 \pm 2 \mu\text{g mL}^{-1}$ Zinc solubilization by strain T5 in their respective media amended with carbosulfan.

Conclusion: Hence findings of the study clearly suggested that strain T5 could be a promising tool for reducing the pesticide (carbosulfan) load in agriculture soils as well as a promising candidate for plant growth promotion in pesticide contaminated soils.

Key words: Biodegradation, Pesticide, Carbosulfan, PGPR, *Bacillus cereus*

Influence of different tillage on the root growth

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ABSTRACT

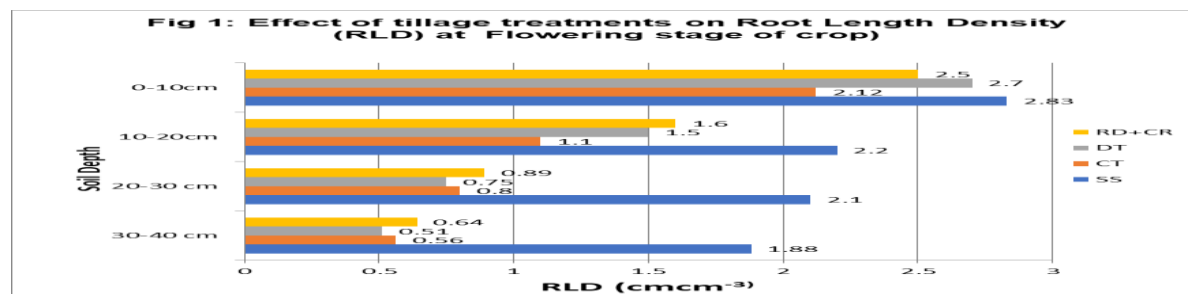
Purpose: The aim of tillage in crop production is to produce favorable physical conditions for seed germination and plant growth. However, intensive soil tillage can lead to degradation of soil structure, due to the gradual loss of stable aggregates, leading to soil erosion and compaction, which will result in low moisture availability for plants.

Methods: Two sets of root samples were collected: the first, on 65 days after planting when the crop was at pod filling stage. A core sampler was used to extract 76.2-mm-diam soil cores 0, 10, and 20 cm from the planted row to a depth of 60cm. Cores were subsequently sectioned in 15 cm increments. Roots were separated from soil using a modification of the washing technique described by Ward et al. (1978). Roots were separated from organic debris and stored in a 50% (V/V) ethanol-water solution until DM and length measurements were made. Root length was estimated according to Newman's (1966) line intercept method. A plastic disk imprinted with a 20-mm-square grid was laid over the washed roots, which were uniformly distributed on a 150-mm-diam filter paper. Number of intersections between gridlines and roots were counted manually. Numbers of intersections were converted into Root Length Density (RLD):

$\text{RLD} = \text{root length (km)} / \text{sample volume (m}^3) = 15.7 \text{ 14 X N} / \text{sample volume,}$

Where, N is the number of counts per sample (Tennant, 1975). After measuring root length, roots were dried at 80°C and weighed for DM.

Results: The data on root length density as influenced by different treatments have been depicted from the figure. It is evident from the figure that at surface layer (0-10 cm) the highest RLD was obtained in case of T1-SS (2.83 cm cm^{-3}) followed by T3-DT (2.70 cm cm^{-3}), T4-RT+ CR (2.50 cm cm^{-3}) and lowest in case of T2-CT (2.12 cm cm^{-3}). Similarly, at 10-20 cm soil depth Highest RLD was observed in case of T1-SS (2.20 cm cm^{-3}), followed by T4-RT+CR (1.60 cm cm^{-3}), T2-CT (1.50 cm cm^{-3}) and lowest in case of T3- DT (1.10 cm cm^{-3}). At 20-30 m depth and 30-40 cm soil depth almost similar trend were observed. RLD was the highest in case of T1-SS i.e 2.10 cm cm^{-3} and 1.88 cm cm^{-3} , at 20-30 and 30-40 cm soil depth, respectively. The average RLD up to 40 cm soil depth was 96%, 60% and 65% higher in case of T1-SS as compared to T2-CT, T3-DT and T4-RT+CR, respectively.



Conclusion: The use of subsoiler developed at JICA, College of Agriculture, Indore has been found effective in braking compact layer which enhances root growth.

Key words: Tillage, Subsoiler, Root growth, Compaction.

Effect of Landuse Landcover Types on Soil Nitrogen Stock in an Entisol of Terai Region of West Bengal

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ABSTRACT

The relative abundance of plant available NH_4^+ and NO_3^- form of nitrogen (N) in soil depends on rate of mineralization of native and applied N which in turn depends on many factors such as soil temperature, soil moisture content, and activity of microorganisms in soil and also on the land use landcover (LULC) type. The LULC type is an important factor for controlling soil N levels by affecting the quantity and quality of litter input (both below and above ground), litter decomposition rates and stabilization of organic matter containing organic nitrogen compounds. Natural forests, forest plantation, agro-forestry, grasslands and cultivated lands are the major ecosystems whose soil stores different amount of the total nitrogen. We aimed to examine the effect of different land uses and landcovers on stocks of various forms of N in soil.

Methods: The research work was conducted at the Pundibari campus of Uttar Banga Krishi Viswavidyalaya which is spread over 300 acres of land and it hosts four different kinds of land uses- agricultural croplands, grasslands, plantation croplands and human interfered lands. Soil mineralizable N was estimated by the method proposed by Keeney and Bremer (1966). Soil N stock was calculated by following the equation given by Ellert and Bettany (1995).

Results: The soils were mostly acidic irrespective of LULC type and low in bulk density ($1.02 - 1.27 \text{ g cc}^{-1}$). The estimation of several forms of nitrogen viz, available nitrogen, ammoniacal nitrogen, nitrate nitrogen, total nitrogen, nitrogen stock, C:N ratio, etc. indicated that there were variations in these forms under different LULC types. Significant variations were found for ammoniacal nitrogen and organic carbon content in different LULCs. Both ammoniacal and nitrate nitrogen were found to follow the order- grasslands > agricultural croplands > plantation croplands > human interfered lands. Higher quantity of total nitrogen was noted in plantation cropland soils than any other LULC classes. The C:N ratio was observed higher in human interfered lands followed by plantation croplands, grasslands and agricultural croplands. Nitrogen stock was found highest in grassland soils and lowest in the human interfered land soils.

Conclusion: The N content in soil were found to be affected by the LULC types. Conversion of plantation croplands and grasslands into agricultural croplands could decline in the N status of the soils.

Key words: LULC, nitrogen stock, C:N ratio, resource map

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Effect of fly ash on growth and survival of sulphur oxidising bacteria

Nandni, Savita Rani*, Gourav Chopra and Leela Wati

ABSTRACT

Purpose: Microbial sulphur oxidation is beneficial to soil fertility, resulting the formation of SO_4^{2-} , which can be used by the plants, while the acidity produced by process of oxidation is used to solubilize other plant nutrients. Fly ash has great potentiality in agriculture due to its efficacy in modification of soil health and crop performance. So, the present investigation was conducted to study the effect of different concentration (0.5- 5%) of fly ash on growth and survival of sulphur oxidizing bacterial isolate SOB3.

Methods: Nutrient broth was supplemented with fly ash at different conc. (0.5-5%) and the viable counts of sulphur oxidizing bacterial isolate SOB3 was observed at different time intervals. Survival of bacterial isolate in soil was studied by amending sterile soil with fly ash at different conc. (0.5-5%) inoculated with culture of SOB3 and taking viable counts at different time of intervals by dilution and plating of soil samples.

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Results: Fly ash at 3% concentration was found to be better for growth and survival of bacterial isolate SOB3. Maximum viable count of SOB3 was 8.303 log cfu/ml after 24h of incubation and eventually decreased with further incubation. Similarly, the bacterial isolate SOB3 survived upto 3% fly ash conc. with viable count 8.249 log cfu/g after 24h of incubation that decreased thereafter.

Conclusion: Amalgamation of soil with fly ash and sulphur oxidizing bacterial isolate SOB3 could further be exploited to study its effect on plant growth.

Keywords: Sulphur, Oxidation, Fly ash, Solubilize, Survival

Isolation and screening of zinc solubilizing bacteria for use as biofertilizer for onion crop

Shivi Choudhary, Baljeet Singh Saharan* and Shubham Kumar

ABSTRACT

Purpose: Zinc (Zn) is an essential and prime micronutrient needed in small amounts by agricultural crops for complete growth, development, and nutrition. It acts as an essential and key constituent of a variety of enzymatic reactions, carbohydrate metabolism, synthesis of proteins and auxin in plants and influences the development of root, grain yield, uptake of water etc. Zinc solubilizing microbes can be utilized as prospective alternatives to conventional less-efficient fertilizer application for enhanced Zn availability in soils. The present study was aimed to isolate Zn solubilizing bacteria to increase the availability of native zinc for onion plant assimilation and eventually plant growth promotion.

Methods: In present study, the bacterial cultures were isolated from onion rhizospheric soil by dilution plate technique using zinc minimal medium containing insoluble zinc sources (ZnO and ZnCO₃). The isolates were screened on the basis of zone formation around the colonies and measured as solubilization index.

Results: A total of nineteen zinc solubilizing bacteria (ZSC1-19) were isolated from soil using zinc minimal medium. Among these, four isolates (ZSC1, ZSC3, ZSC11, ZSC12) exhibited negligible solubilization zone on zinc minimal medium. Maximum Zn solubilization index (SI) observed for ZSC5 and ZSC10 was 4.5 and 4.3 after 5th day of incubation at 30°C using ZnO.

Conclusion: Zinc solubilization ability of these isolates will be further assessed for plant growth promoting beneficial traits and could be explored as biofertilizer for onion crop.

Keywords: Zinc Solubilizing Bacteria, Zinc Minimal Medium, Solubilization Index, Onion Crop

Effect of fly ash on growth and survival of mineral solubilising bacteria

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ABSTRACT

Purpose: Fly ash can be used for soil reclamation and enhance the crop productivity depending upon the nature of soil and fly ash. It may improve physicochemical and biological properties of soils and enhance the availability of macro and micronutrients for plants. Mineral solubilizing bacteria (MSB) can solubilize minerals and convert insoluble minerals to soluble form and makes available for plant uptake. In present study, the effect of fly ash on growth of mineral solubilizing bacteria of wheat crop was studied under *in vitro* conditions.

Methods: Nutrient broth was supplemented with fly ash at different conc. (0.5-5%) and viable counts of bacterial isolate MSB2 was counted at different time intervals. Survival of MSB2 in soil was studied by sterile soil amending with fly ash at different concentrations (0.5-5%) inoculated with bacterial culture of MSB2 and taking viable count at different time of intervals by dilution and plating of soil samples.

Results: The viable count of bacterial isolate MSB2 increased with increase in fly ash conc. from 0.5 to 3.0% and decreased with further increase in fly ash conc. upto five percent. Maximum viable count was observed as 7.637 log cfu/ml for MSB2 at 3% fly ash concentration after 72h of incubation. Similarly, the bacterial isolate MSB2 survived upto 3% fly ash conc. with viable count 8.494 log cfu/g after 72h of incubation that decreased thereafter.

Conclusion: Application of soil with fly ash along with mineral solubilizing bacteria MSB2 could further be exploited to study its effect on plant growth.

Keywords: fly ash, mineral, growth, survival, solubilize

Factors influencing the adoption of agroforestry practices among tribal farmers in kolli hills of Tamilnadu

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ABSTRACT

Agroforestry provides both environmental protection and socio-economic benefits. Agroforestry systems provide a symbiotic relationship between agriculture crops, tree species, and livestock rearing on the same area of land. Agroforestry develops as a fruitful tool for upgrade the rural economy due to low investment, efficient profit and ability to generate significant amount of income. The potential benefits of Agroforestry includes reduced poverty through enlarged production of wood and other products, enhanced food security by restoring soil fertility for food crops, multifunctional site use, reduced global warming and hunger risk by growing the number of drought-resistant trees and the successive production of fruits, nuts and edible oils, decreased deforestation and pressure on woodlands by supplying farm-grown fuel wood, reduced need for toxic chemicals, increased human nutrition through more diversified farm outputs, etc.

Purpose: This study will give farmers a greater understanding of the level of adoption of agroforestry species and the major factors influencing their adoption in Kolli hills of Tamil Nadu. The objectives of this study were the following:

To determine how environmental factors such as soil erosion management, improved soil cover, and soil fertility impact farmer’s decision to use agroforestry species.

To assess how economic aspects including household income, timber diversity, feed, and stakes influence farmers decisions to employ agroforestry species.

Evaluate how social and cultural factors, such as education and agricultural extension, impact farmers' decision to use agroforestry species.

To identify the challenges encountered by farmers during adoption of agroforestry tree species.

Methods: The present study was carried out in Namakkal district of Tamil Nadu state. So Namakkal district has been administratively divided into seven taluks and fifteen blocks. Higher populations of tribes were noticed about adoption of agroforestry in Kolli hills from these taluks and blocks. The selected Kolli Hill study area has a total geographical area of 37961 hectares. It is at a height of 1200 meters above sea level. It stretches 29 km from North to South and 19 km from East to West. Forests cover 44 per cent of the total surface area and agricultural practice occupies 51.6 per cent. This study was carried out from January to March, 2020. The list of farmers’ household from each selected village was acquired from the Gram Panchayat office and also from the Department of Agriculture and Horticulture. Data was obtained from 240 households using simple purposive random sampling to select the farmers of six revenue villages (Ariyurnadu, Valapurnadu, Bailnadu, Valavanthiandu, Gundurnadu and Selurnadu) of Kolli hills. The information was acquired through the use of structured questionnaire. The Freidman test was applied to evaluate the correlation between the factors influencing the adoption of agroforestry species among farmers using Microsoft Office Excel and the Statistical Package for the Social Science (SPSS).

Results: The findings revealed that the Agroforestry species planted on farmland were Silver oak with Tapioca (78%) and Silver oak with Minor millets (65.3%). The Freidman test showed that Silver oak with Tapioca is more preferred by farmers with 2.46 mean rank. The most influencing factors, soil erosion reduction has a mean rank of 5.02 followed by nitrogen fixation, waste assimilation, changing climatic conditions, increasing soil fertility, soil cover improvement, carbon storage and then improving soil structure with mean rank of 4.27, 4.15, 4.08, 3.56, 3.27, 2.65 and 2.12 respectively. Diversification of products was one of the most significant economic factor

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driving farmers to adopt Agroforestry species with a mean rank of 2.94 with training and agricultural extension with 2.57 as mean rank as the primary social factors motivating farmers to adopt Agroforestry species. The inadequacy of seedlings was the most critical constraint experienced by farmers in adopting Agroforestry species with 3.43 mean rank value. Agroforestry nursery establishment, training on Agroforestry practices and availability of bank credit loan were the major suggestions given by respondents to address the identified constraints with respective percentages of 88.23, 61.21 and 32.45.

Conclusion: The central and state governments and wood based enterprises are promoting agroforestry on a large scale with precision silvicultural practices and constant price mechanism. These efforts not only help the domestic and economic demands of the farmers and also produce several ecological benefits. Finally, agroforestry techniques are required to maintain the forest resources and agrarian identity at domestic and national level.

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The effect of root endophytic fungus *Piriformospora indica* on *Zea mays* (maize) plants

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ABSTRACT

Piriformospora indica (*P.indica*), a multifaceted root colonizing fungus promotes growth and enhances the stress tolerating capacity of the plants. *P.indica* was prepared in Kaefer media, along with macro and micro nutrients and then applied to roots of maize seedlings. Data was subjected to statistical analysis and non-colonized (control) and colonized (*P. indica*) plants were compared for significant difference and presented as mean±SE. Root fresh weight varied greatly from 0.48g to 0.61g and was significantly affected by air temperature and relative humidity. The shoot length of non inoculated maize plants was 11.38± 0.39 which increased to 29.97 ± 0.42 in treated plants.

Introduction: *Piriformospora indica*, a root endophyte basidiomycete shows a symbiotic relationship with wide variety of monocots and dicots. This filamentous fungus is the member of the order *Sebacinales* which is the diverging branch of the Agaricomycetes. *P. indica* was isolated from the woody shrubs *Prosopis juliflora* and *Zizyphus nummularia* in the Thar Desert, Rajasthan, India (Varma et al., 1998). *P. indica* provides resistance to biotic and abiotic stresses in many plants. (Baltruschat et al., 2008; Sun et al., 2010; Husaini et al., 2012; Zarea et al., 2012; Ansari et al., 2013; Unnikumar et al., 2013). Plants colonized by *P. indica* displays beneficial effects like enhancing host growth, promoting adventitious roots in cuttings and enhance nitrate and phosphate assimilation.

This symbiotic interaction has a biotrophic growth phase, in which carbon source is transported from the plant to the fungus, whereas fungal hyphae serve as a fine link between the roots and the rhizosphere and improve the supply of the plant with inorganic nutrients (Harrison et al. 2002, Bucking and Heyser 2003, Karandashov et al. 2004). *Piriformospora indica* has its well defined roles in the protection of plants against a range of biotic stress factors such as pathogenic fungi, bacteria and virus (Waller et al., 2005; Serfling et al., 2007; Oelmüller et al., 2009; Camehl et al., 2010, 2013; Molitor et al., 2011; Dolatabadi et al., 2012;).

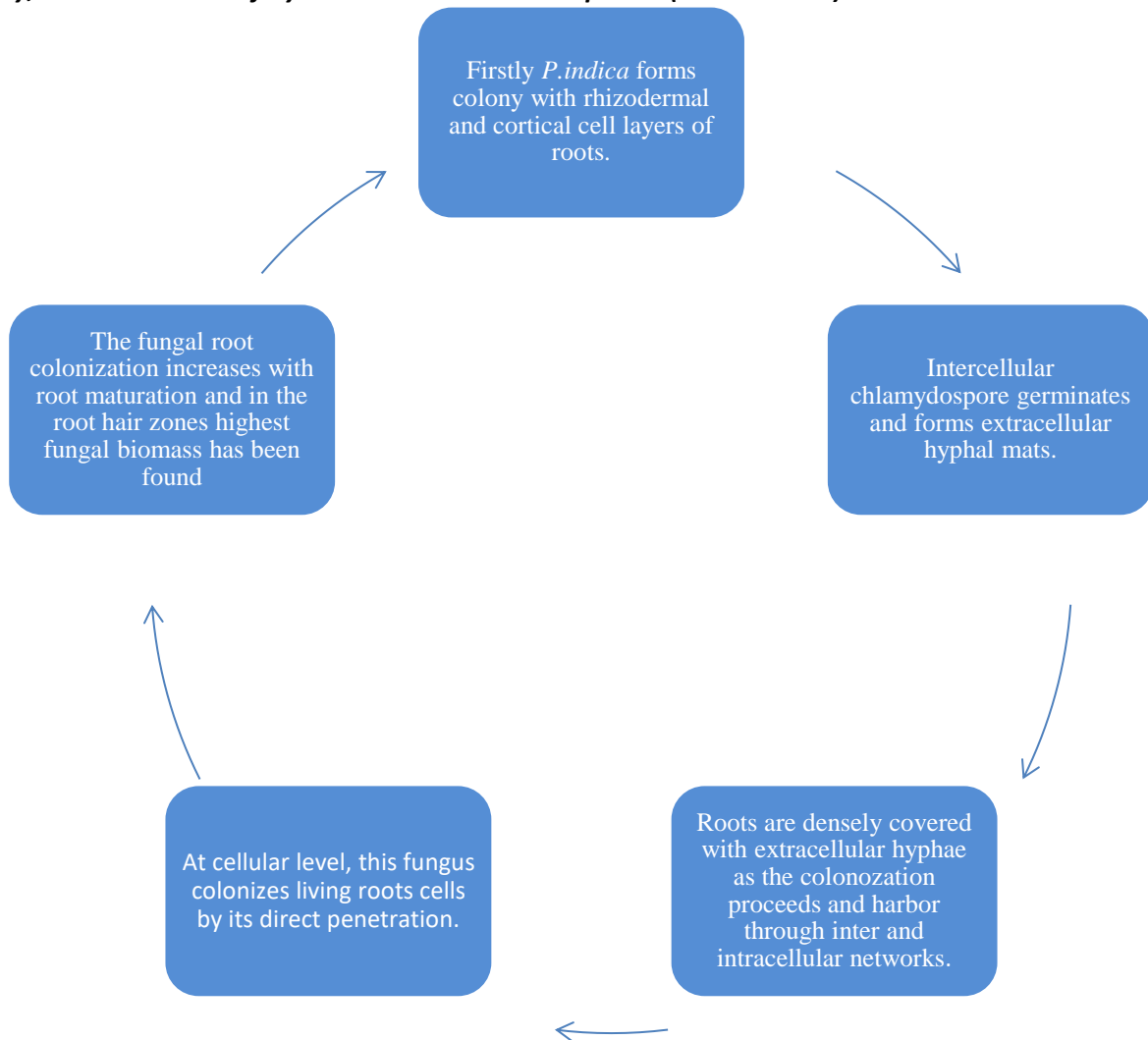


Fig.1. Mechanism of Colonization – *P. indica* colonizes with the plants in the following steps (Modified from - Gill *et al.*, 2016)

Methods: The fungus *P.indica* was inoculated in flasks (250 ml) having liquid Kafer medium (100 ml) . The flasks were kept for 15 days in a rotatory shaker at 28 °C at 120 rpm. After 15 days, fungus mycelia were harvested by filtering the culture through Whatman filter paper. Seeds of *Zea mays* were surface sterilized with sodium hypochlorite (0.1% v/v) for 10 min, and then washed thoroughly (4–6 times) with double distilled water and then grown in a seedling tray, after the proper initiation of root system took place this inoculum was added to the seedlings to observe colonization.

Result: Following study was done to check the effect of *P. indica* on maize plants by determining the shoot length, shoot weight, root length and root weight. Two types of determination are most commonly used i.e. root fresh weight (Heijnen *et al.*, 1993; Olivares *et al.*, 1996; Bouillant *et al.*, 1997) and root dry weight (Chanway and Holl 1994; Sturz and Christie 1995; Bashan *et al.*, 1998). The roots of *P.indica* inoculated maize plants were hard, thick, brownish, and higher in number as compared with non-inoculated plants. In general, we have observed that *P. indica* colonization enhanced root and shoot length as well as the fresh and dry weights of the maize plants (Table 1 and Table 2). This variation in growth promotion effects between fresh and dry weights could be explained by the inconsistent water content in plant tissues between non-inoculated control and inoculated

treatments (Zahed *et al.*, 2015; Tank and Saraf., 2010). *P. indica* promotes growth of the inoculated plants when compared to non- inoculated plants.



Fig.2. (A) non-inoculated maize plants (B) inoculated maize plants

Root length

The colonized plants had enhanced root length and volume to higher absorption for water and nutrients as *P. indica* is a root colonizing fungus. There was an increase of 55 % when inoculated plants were compared to non-inoculated plants of maize. Root fresh weight varied greatly from 0.48g to 0.61g and was significantly affected by air temperature and relative humidity (Table 1 and Table 2).

Shoot length

As the colonized roots would provide more minerals and nutrients to the plant parts, there was an increased growth of shoot length. The shoot length of non inoculated maize plants at was 11.38 ± 0.39 which increased to 29.97 ± 0.42 (Table 1 and Table 2).

Table 1: Fresh and Dry Weight of controlled plants (without *P. indica*)

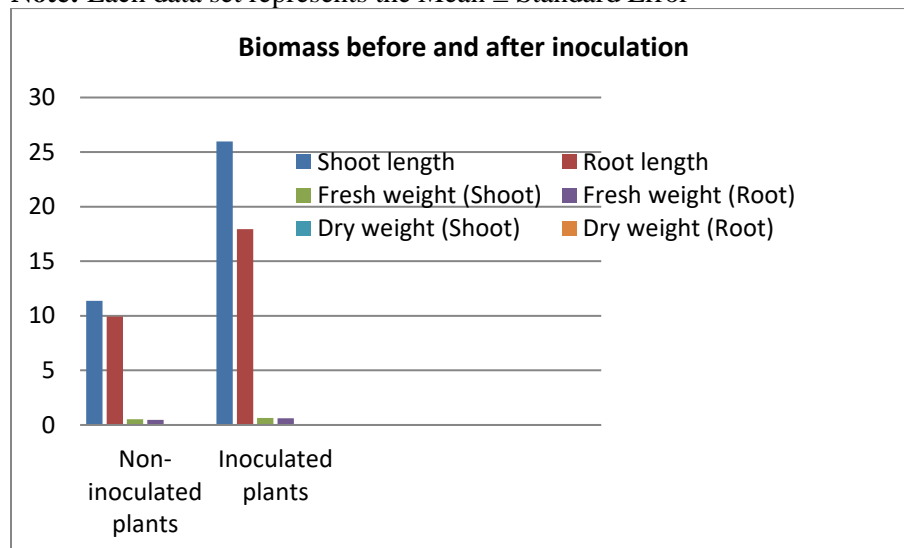
	Shoot Length (S.L)	Root Length (R.L)	Fresh Weight (Shoot)	Fresh Weight (Root)	Dry Weight (Shoot)	Dry Weight (Root)
Number of Plants	15	15	15	15	15	15
Mean±Standard Error	11.38 ±0.39	9.93 ±0.75	0.54±0.06	0.48±0.03	0.0675±0.0039	0.06±0.0073
Standard Deviation	1.51	2.89	0.22	0.11	0.01534	0.2845

Table 2: Fresh and Dry Weight of inoculated plants with *P. indica*

	Shoot Length (S.L)	Root Length (R.L)	Fresh Weight (Shoot)	Fresh Weight (Root)	Dry Weight (Shoot)	Dry Weight (Root)
No. of Plants	20	20	20	20	20	20
Mean±Standard Error	25.97±0.42	17.93±0.99	0.65±0.13	0.61±0.11	0.081±0.0028	0.07±0.0024

Standard Deviation	1.89	4.43	0.13	0.03	0.0107	0.0127
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Note: Each data set represents the Mean ± Standard Error



Conclusion: In the present study we agree that, *P. indica* promotes growth of the inoculated plants when compared to non-inoculated plants. It was observed that the colonized plants had enhanced root length and volume to higher absorption for water and nutrients as *P. indica* is a root colonizing fungus. There was an increase of 55 % when inoculated plants were compared to non-inoculated plants of maize. Root fresh weight varied greatly from 0.48g to 0.61g and was significantly affected by air temperature and relative humidity. The shoot length of non-inoculated maize plants was 11.38 ± 0.39 which increased to 29.97 ± 0.42 in treated plants.

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Microwave based Seasoning of Bamboo.

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ABSTRACT

Purpose: Bamboo known as green gold & poor man’s timber is an important alternate species in terms of forest’s natural resources. Bamboo and Bamboo derived/manufactured products hold the key to economy booster and will reduce the pressure of already over-exploited regular timber sources. In this study we have aimed to reduce the moisture content of bamboo with reducing the amount of time to mere hours from days.

1. The main objective of the study is to reduce the moisture of bamboo in lesser time than conventional seasoning.
2. Few literature was used in conducting the research as not much work has been done on same.
3. Moisture of bamboo was reduced and no seasoning defects were observed

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Methods: Bamboo samples converted to 1 meter length were exposed to microwave on three different intensities with different conveyor speeds. Cyclic microwave exposure and cool down time was used to season the bamboo samples. Moisture loss was observed after each cycle and recorded based on weight loss of bamboo.

Results: Volumetric heating in respect to dielectric effect based on moisture content was observed. Moisture loss with consecutive cycles was found. The drying rate was found higher in high intensity and vice-versa. Bamboo didn't bend or change its shape and also retained its natural colour.

Conclusion: Microwave seasoning of bamboo is feasible and time saving process to enable quick manufacturing and processing of bamboo without any adverse effect & value addition.

Key words: Microwave, Dielectric, Bamboo, Moisture loss.

Studies on Genetic Variability in Coriander (*Coriandrum Sativum* L.)

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ABSTRACT

Purpose: India is well known as "land of spices" across the world since long back. Coriander (*Coriandrum sativum* L.) also called cilantro or dhanial is an annual herb, belong to the family Apiaceae, is a native of Mediterranean region. The basic chromosome number of this genus is $x=11$ and *Coriandrum sativum* is diploid with $2n=22$. India is the largest producer, consumer and exporter of seed spices in the world.

Methods: The experiment was conducted in a randomized block design with 24 genotypes and replicated thrice. The total coriander plants spaced at 30×20 cm² were selected for the study. The randomization of treatments was done with the help of 24 genotypes was used in the experiment.

Results: The present investigation was carried out at Experimental area was conducted at Horticulture Research Center, Chauras Campus, and Department of Horticulture, H.N.B. Garhwal University, Srinagar, Garhwal (Uk) during 2016-17. The analysis of variance indicated highly significant differences for all the 10 characters among 24 genotypes of coriander. Maximum day of 50% germination was recorded in Acr-1, whereas minimum in Heera, JD-1, RCr-41, RCr-436, RCr-446, RCr-475, RCr-728. Maximum plant height was recorded in Acr-1 whereas minimum in Hisar Surbhi. Maximum number of branches per plant was recorded in RCr-446.

Conclusion: Yield parameters like days to initiation of germination, day of 50% germination, plant height (cm), number of branches per plant, days to initiation of flowering day to 50% flowering, umbel per plant, umbellates per umbel, seed per umbel, seed yield per plant (g) and test weight (g), and biological yield. The analysis of variance indicated highly significant differences for all the 10 characters among 24 genotypes of coriander. Genotype Mahak produced the highest seed yield per plant followed by RCr-435, Acr-1 and Hisar Anand. Genotypes RCr-20 followed by RCr-436, Hisar Anand, Hisar Surbhi, Azad Dhaniya1, RCr-435, RCr-446, and RCr-728 were found to be early as they required lesser number of days to 50% flowering.

Key words: Coriander, Yield parameters, Economics parameters, 10 Characters among 24 Genotypes of coriander

ABSTRACT

Purpose: To characterizes and classify the chickpea genetic stocks into different groups for morphological traits
To characterize and grouping of chickpea genetic stocks into various categories for yield traits.
To determine the extent of heritable genetic variation for quantitative traits.
To know the relationship between seed yield and its contributing characters in chickpea.
To assess diversity in genetic stock.

Methods: The present investigation “Assessment of diversity in genetic stock of chickpea (*Cicer arietinum* L.)” was carried out during Rabi season of 2017-2018 in the field of R.A.K. College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Sehore (M.P.). The experimental material for the present investigation was comprised of 200 accessions of Desi and Kabuli chickpea. These genotypes were sown in Randomized Complete Block Design with two replications, to observed qualitative and quantitative observation. Observations were recorded on the basis of five random competitive plants selected from each genotype separately for qualitative and quantitative observation were evaluated as per standard procedure.

Results: On the basis of results, the present investigation is summarized as follows:

At plant level, the expression of three morphological characters was observed to categorize the genotypes/ genetic stocks. Plant vigor, leaf colour and plant growth habit are the most stable and uniform distinguishing characters for verification of genetic stocks of chickpea. Flower colours are the uniform characters but their expressions are observed by the some degree of fluctuating environment. Therefore, these traits should be used only as an indicator not as marker to verify the genetic purity.

Analysis of variance revealed highly significant variance for all the traits depicting greater variability in the existing material. The variation was highest for pods plant-1, secondary branches plant-1, plant height and seed index.

The PCV was higher than the GCV for all the characters. The PCV and GCV was highest for characters viz., secondary branches plant-1, pods plant-1 and seed index, indicating that selection can be predicted to improvement in the chickpea for these characters. High heritability coupled with high genetic advance for traits like secondary branches plant-1, followed by pods plant-1, seed index and seed yield plant-1. Suggested that the preponderance of additive genes. It also indicated higher response for selection of high yielding genotypes as these characters are governed by additive gene actions.

The association studies indicated that the advantages of upgrading chickpea genotypes through simultaneous selection for pods plant-1 and seed index.

Path coefficient analysis revealed that pods plant-1, seed index and plant height are the most important characters contributing towards seed yield and hence purposeful and balanced selection based on these characters would be made rewarding for improvement of chickpea. Direct selection of secondary branches plant-1 and days to 50 per cent flowering should be avoided instead of indirect selection.

Study of genetic divergence revealed a high inter cluster distance between cluster V (ICC11266, ICC12159, ICC1232, ICC13185, ICC14225, ICC14484, ICC153, ICC16187, ICC16201, ICC2338, ICC3458, ICC5086, ICC5391, ICC5899, ICC6122, ICC6659, ICC9023, ICC991, ICCV10, ICCV10, IG69441, IG7432 and JG11) and cluster VI (ICC11766, ICC11904, ICC13200, ICC14199, ICC15547, ICC15551, ICC16637, ICC16822, ICC5504, ICC6831, ICC8923, ICC8962, IG10578, IG10633, IG5875, IG5990, IG69597, IG70413, IG70990, IG71814, IG71941, IG71967, IG73287, IG73322, IG73341, IG9810, KAK2, KAK2 and KAK2) were identified as genetically diverse parents, which can be utilized for future crop improvement programme may lead to maximum diversity in the segregating population and develop high yielding varieties in chickpea.

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Antixenosis and antibiosis components of resistance in castor to semilooper (*Achaea janata*) and tobacco caterpillar (*Spodoptera litura*)

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ABSTRACT

Purpose: Castor (*Ricinus communis* L.) is the most important non-edible oilseed crop of India. Its seed oil is used in the production of a wide range of industrial products. Despite the fact that India's castor productivity is higher than the global average, there are several production constraints. One of the major constraints that limit castor productivity is the excessive damage caused by lepidopteran pests, the major ones being castor semilooper, *Achaea janata* L. (Noctuidae: Lepidoptera) and tobacco caterpillar, *Spodoptera litura* F. (Noctuidae: Lepidoptera) (Duraimurugan and Lakshminarayana, 2014). The lepidopteran pests are active during the vegetative stage and over 50% defoliation is common in certain favourable years (Lakshminarayana and Duraimurugan, 2014). To develop insect resistant/tolerant cultivars, it is important to understand the contributions of different components of resistance, and therefore, the antixenosis and antibiosis components of resistance were studied in selected castor genotypes to the lepidopteran pests.

Methods: Caged pot and laboratory experiments were conducted under no-choice and multi-choice conditions to assess mechanism of resistance in the castor genotype, ICS-295 against semilooper and tobacco caterpillar along with six other castor genotypes having different waxy blooms.

Results: Caged pot experiment revealed that ICS-295 showed antixenosis (non-preference) mechanism of resistance for oviposition to *A. janata* (23.3 and 34.7 eggs) and *S. litura* (1.3 and 4.3 egg-masses) as compared to the other castor genotype, VP-1 (114.3 and 145.3 eggs by *A. janata*; 14.3 and 13.3 egg-masses by *S. litura*) under free-choice and no-choice tests, respectively. Studies on feeding preference of *A. janata* and *S. litura* larvae using free-choice tests under laboratory conditions revealed lowest larval attraction in ICS-295 (5.0 and 6.7%, respectively) as compared to 23.3 to 33.3% and 20.0 to 23.3% attraction in M-574 and VP-1, respectively at 24-hrs after release. Antibiosis mechanism of resistance was observed when the larvae of *A. janata* and *S. litura* were reared on leaves of ICS-295 with significantly prolonged larval and pupal duration and reduced weight of larvae. Larval growth index of *A. janata* and *S. litura* was the lowest on ICS-295 (6.21 and 5.21, respectively) as compared to M-574 and VP-1 (7.52 to 7.58 and 6.56 to 6.76, respectively).

Conclusion: The castor genotype, ICS-295 could be utilized in breeding programmes for developing pests resistant/tolerant cultivars to these pests.

Key words: Castor, Genotypes, Resistance mechanisms, Semilooper, Tobacco caterpillar

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Role of landscape heterogeneity in conservation of avian diversity at Harike wetland

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ABSTRACT

Purpose: Harike wetland enjoys the status of Ramsar site that attracts hundreds of migratory species every year. Although water bird census is done every year but none of the study is available for overall avian diversity in last one decade in and around wetland.

Methods: The present study was done from the April 2019 – March 2021 to evaluate the avian composition in agricultural (A), riparian (R) and wetland water (W) of the Harike wetland. Monthly surveys were conducted using point count where each sampling site consisted of 10 random points with a straight-line difference of 300 m between two sampling points. The data was compiled and divided into three seasons i.e. summer (s), monsoon (m), and winter (w) to address species richness, species evenness, Shannon-wiener diversity index, and simpson index using Vegan-2019 package (Oksanen et al., (2019) on statistical software R (version 1.2.5033).

Results: A total of 42,377 birds were sighted belonging to 246 species under 20 orders including 9 near threatened, 1 vulnerable and 1 endangered species. Species richness was 152, 196, 217 in summer, monsoon and winter respectively. Maximum of 85 migratory species were recorded in winter during the study period in the wetland habitat. Maximum species richness was observed in riparian zone (142 in w) followed by wetland (131 in w) and agricultural area (115 in w) adjacent to wetland. The Shannon-Wiener Diversity Index varied from 3.968(A,s) to 4.604 (R,w) and Simpson Index from 0.971 (A,s) to 0.987 (R,s). The species evenness varied between 0.877546 (A,s) and 0.931347 (R,s). Richness and abundance of water birds significantly increases in winter due to arrival of migratory birds nevertheless the riparian zone of the river adds more species richness to the wetland habitat.

Conclusion: Low avian diversity in agricultural fields exposes the threat to habitat specialist ornitho-fauna of the region. In general wetlands are known for abundance and richness of water birds however present study provide concrete evidence that the riparian zone of wetlands also harbor rich avian diversity therefore riparian habitat specific conservation measures should be incorporated in wetland management strategies.

Key words: Harike wetland, Riparian zone, Species richness, Species evenness, Ornitho-fauna

Studies on genetic variability in Okra (*Abelmoschus* sps.)

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ABSTRACT

Purpose: Okra [*Abelmoschus esculentus* (L.) Moench], is an imperial vegetable crop of the Malvaceae family in the tropics, sub-tropics and warmer portions of the temperate region of the world on a varying scale. Low yielding potential of current varieties due to yield plateau and reduction in yield due to frequent attacks of pests and diseases, especially the fruit and shoot borer (FSB) and yellow vein mosaic virus (YVMV) has become one of the serious problem in okra. Further, being a potentially self pollinated crop, the cultivated okra has a narrow genetic base and concerned efforts, are therefore, required for exploring the full potential of available okra

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germplasm resources in the gene bank. Hence we aim to evaluate the variability in the unexploited germplasm of okra collected from NBPGR and use the best among them for further breeding.

Methods: Twenty six accessions were sown in a randomized block design of three replication during summer 2018 at DBSKKV, Dapoli. The data were subjected to analysis of variance as per the method described by Fisher and Yates (1974) and Panse and Sukhatme (1985). Various variability parameters like mean, range, coefficient of variation, PCV, GCV, genetic advance and heritability were calculated using their respective formulae.

Results: The analysis of variance (ANOVA) for 26 genotypes of okra revealed significant differences for all the 14 traits under study. Fruit yield per plant has recorded high PCV (32.07), high GCV (28.41), high heritability (78.48%) and high GAM (51.85).

Conclusion: Significant differences among the genotypes of okra justified the presence of variability as depicted by ANOVA. Knowledge of nature and magnitude of variation existing in the available breeding materials are requisite to choose characters for effective selection of desirable genotypes to undertake planned breeding programme.

Key words: variability, heritability, genetic advance, okra

Food security among farming households: a study in coastal Odisha

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ABSTRACT

Purpose: Farming households are the most affected in terms of food insecurity and poverty. The coastal part of the state is vulnerable to periodic recurrence of natural calamities giving rise to a situation of chronic food insecurity particularly among the marginal farmers, and landless labourers. Several studies have evolved the food security status of agricultural workers to be unsatisfactory. Hence, the present study is an attempt to assess the poverty and food security of farming households in coastal districts of Odisha with the objective to analyze the socio-economic status and food security status among farming households.

Methods: A total of 350 households were selected for the study from the five coastal districts which had similar agro-climatic zone namely Puri, Khurdha, Jagatsinghpur, Kendrapada and Nayagarh during 2016-17 to assess the food security status among farming households. Married couple & who were above the age of 35 years and the women of the house were engaged in agricultural activity. For assessment of food security status Household Food Security/Insecurity Assessment Scale, FAO (2013) was used.

Results: Based on land holding size households were categorized as semi medium farmers (n=82) small farmers (n=87), marginal farmers (n=94) and landless labourers (n=87). Information on socio-economic status, food security of the respondents from each category were collected by a structured and pre tested questionnaire. The mean land holding size of the marginal farmers was 0.34ha. The small farmers and the semi medium farmers were having mean land of 1.40ha and 3.90 ha respectively. The mean age of the male farmers was 45.94 years and the female farmers it was 38.58years. The mean expenditure (Rs. 3219.77±182.00) was very close to the average monthly income (Rs. 3459.74±274.00) of the households. Majority of the households were found to be food insecure in terms of quantitative availability of foods(59.43%), food preference (60.00%), diversification of foods(60.57%), reduction in frequency of meal consumed (64.85%), choice of foods(65.71 %) and reduced quantity of food consumed (68.58%). The mean score for quantitative availability of food(2.68±0.46), food preference (2.44±0.63), diversification of foods(2.38±0.08), reduction in frequency of meal

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consumed (2.00 ± 0.10), choice of foods (2.33 ± 0.09) and reduced quantity of food consumed (2.12 ± 0.09) was found to be significant higher among the landless labourers compared to other categories of farmers.

Conclusion: Majority of the respondents were food insecure both in terms of quality and quantity. It was more prevalent among the landless labourers followed by marginal farmers.

Key words: Food security, Nutrition security, Body Mass Index, Nutritional Status

Immunomodulatory activity of *Asparagus racemosus* with particular reference to cytokines' induction in chicken splenocytes

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ABSTRACT

Purpose: Several anti-inflammatory agents used for the treatment of inflammation impart side effect. This demands for the plant derived natural immunomodulators. *Asparagus racemosus* (family Asparagaceae) also known as Shatavari is a well known plant in Ayurveda. Present study was conducted to investigate the immunomodulatory potential of hydromethanolic extract of *Asparagus racemosus* (ARE) in chicken lymphocytes culture system through quantitative real time PCR analysis of IL-4, IFN γ , IL-6, IL-10 and iNOS.

Methods: The maximum non-cytotoxic dose (MNCD) of ARE was confirmed in the chicken lymphocytes through MTT assay. Total Antioxidant Capacity, Reducing Power Capacity, Hydrogen peroxide Scavenging Assay, NO radical scavenging assay were carried out to assess the antioxidative potential of ARE. Immunomodulatory potential was evaluated through lymphocyte proliferation assay (LPA) followed by antioxidant analyses (LPO, GSH, SOD and NO) in ARE treated chicken lymphocytes. Further, expression analysis (IL-4, IFN- γ , IL-6, IL-10 and iNOS) was conducted through quantitative real time PCR to explore the underlying molecular mechanism behind immunomodulatory potential of ARE in chicken lymphocytes.

Results: MNCD of ARE was found to be 300 μ g/ml. ARE displayed significant increase in B and T cells proliferation in case of mitogen stimulated cells. There was substantial decrease in the percent Lipid peroxidation and NO content whereas GSH and SOD levels were significantly increased in the chicken splenocytes treated with ARE. ARE treatment to chicken lymphocytes down regulated the expression of IL-6 and iNOS, whereas, IL-4, IFN- γ and IL-10 expression levels were significantly up-regulated.

Conclusion: The results obtained in the study indicated that ARE treatment significantly enhanced B and T cells proliferation and improved the antioxidant status of cells. *In vitro* exposure of ARE led to increased expression of anti-inflammatory cytokines and diminished the expression of pro-inflammatory mediators. Taken together, these findings ascertained that ARE boosted both cellular and humoral immunity and possessed anti-inflammatory activity.

Key words: *Asparagus racemosus*, Anti-inflammatory, Immunomodulatory, Cytokines, Chicken lymphocytes

Immunopotentiating efficacy of *Trigonella foenum-graecum* L. In chicken lymphocytes through nfat pathway

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ABSTRACT

Purpose: *Trigonella foenum-graecum* L. (fenugreek) is an annual plant belonging to the family of Leguminosae. Seeds and leaves of this plant have been used for centuries not only as food but also as an ingredient in traditional medicine. The plant also has a wide variety of therapeutic potential and is used as a traditional functional food. Therefore, the current study aimed to investigate the immunoenhancing effects of *Trigonella foenum-graecum* L. seed extract in chicken lymphocytes through quantitative real time PCR analysis of NFAT-1, IL-2, IL-4 and IFN- γ .

Methods: The hydromethanolic extract from dried seeds of *Trigonella foenum graecum* L. (TFE) was prepared and maximum non-cytotoxic dose (MNCD) was confirmed in the chicken splenocytes through MTT assay. The messenger (m) RNA expression of NFAT-1, IL-2, IL-4 and IFN- γ was analysed in chicken lymphocytes after plant extract treatment through quantitative real time PCR.

Results: MNCD of TFE was found to be 300 μ g/ml Immunomodulatory markers assessment through Real time-PCR analysis indicated a significant increase in NFAT-1, IL-2, IL-4 and IFN- γ expression.

Conclusion: The results of the present study indicated that treatment of *Trigonella foenum graecum* L. extract on chicken lymphocytes induced the transcription of NFAT-1, which plays significant role as transcription factor in coordinating the expression of immunomodulatory cytokines in immune cells. TFE displayed *in vitro* immunostimulatory activity on chicken lymphocytes by modulating immune response via IL-2, IL-4 and IFN- γ . IL-2 has central role in the differentiation and survival of CD4+ T helper subsets and CD4+ T regulatory cells and in activation of cytotoxic effector lymphocytes. Similarly, IL-4 is involved in B cell differentiation and act as a stimulatory factor, during the immune responses IL-4 critically regulate T cell differentiation. Further *in vitro* and *in vivo* investigation into molecular mechanisms modulated by herbal extract should be undertaken to shed light on the development of novel immunomodulating therapeutic strategies.

Key words: *Trigonella foenum-graecum*, Immunomodulation, qRT-PCR, Chicken lymphocytes, Cytokines

Assessment of biological response and semi-lethal dose of EMS for fenugreek cv. Rmt-1

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ABSTRACT

Purpose: The fenugreek (*Trigonella foenum-graecum* L.) is an annual legume leafy vegetable and a traditional spice and aromatic crop that has been grown for centuries across the Indian subcontinent. It being an inbreeder is short of genetic variability due to which the scope for improvement is also narrowed down. The induced mutagenesis is one of the effective ways to generate genetic variability in the crop. The alkylating agent, Ethyl Methane Sulphonate (EMS) C₃H₈SO₃, is the most common chemical mutagen used in mutagenesis.

Methods: An experiment to ascertain the semi-lethal dose of EMS was carried out in the Department of Horticulture, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh since the overdose of mutagen would kill the seedlings while the under dose would be insignificant, the assessment of semi-lethal dose (LD₅₀) is highly essential to initiate a mutation breeding work on any crop. Seeds

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of one of the common cultivars in Madhya Pradesh, cv. Rmt-1 were subjected to mutagenic treatments. The mutagenic treatment comprised of 21 treatments including control of various concentrations of EMS (0.10%, 0.15%, 0.20%, 0.25% and 0.30%) with different treatment duration (2h, 4h, 6h and 8h). The experiment was laid on a completely randomized design.

Results: Since there is no information on the semi-lethal dose of EMS in fenugreek, the experiment was set up to assess the same. The seed germination and the survival of seedlings (as percentage) were used to calculate the LD₅₀. Through this investigation, it was found that the mutagenic treatment EMS 0.15 per cent at 2 hours produced superior results when compared to the control, indicating its potential to induce desirable polymorphisms and point mutations. The semi-lethal dose of EMS for fenugreek cv. Rmt-1 was found to be EMS 0.30 per cent at 8 hours.

Conclusion: A steady decrease in the germination, growth and vigor of the seedlings was observed as the dose of the mutagen increased. The information generated through this investigation would facilitate further mutagenesis-related research in fenugreek.

Key words: Induced mutation, EMS, Fenugreek, biological response, LD₅₀, GR₅₀

Comprehensive Study of Logistics Management of Mentha oil in Central Awadh Region (Barabanki) of U.P. and Export performance of Indian Mentha oil

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ABSTRACT

Purpose: Barabanki District having most potential district of Uttar Pradesh in context of Mentha oil Production. Study was purposive because Barabanki district has best factors of production of mentha i.e. soil, climate, geographical regions which gives a unique place in production of mentha oil in Uttar Pradesh and India as well but due to less involvement of farmers in direct export, farmers cannot capitalize more income as compare to present. Less aware about better package and practices of mentha cultivation at farmer level.

Methods: Multistage, purposive and random sampling was adopted in Research area. Specifically, tabular presentation was followed in the study of socio-economic profile of sampled respondents supported by frequency, percentage, median, mean, chi-square test and other related tools. The emphasis on marketing channels, marketing costs and margins, marketing efficiency was analysed by Acharya's model. Growth rate analysis of mentha oil was analysed by C.A.G.R. model using exponential method. Coefficient of determinants and direction of India's mentha oil export was also analysed by using Markov chain analysis. Constraints related to production, marketing, infrastructure and trade were figure out by Garret Ranking Technique.

Results: Most of the respondents were belongs from small size of farm group having less than one hectare land. Respondents having middle age group was found more as compare to other age group. Sampled farmers found to be moderate having primary education. Respondents are likely with nuclear families. Agriculture is the main source of income and provides maximum occupation to the respondents. Experienced farmers were found which are not associated with their level of education. Processing/distillation of mint plants are being done with water and steam distillation process. Two major marketing channels were identified in study area. Positive C.A.G.R. (values of mentha oil) was found during the year of 2010-11 to 2019-20. In the stability of India's mentha oil export, U.S.A. was found most stable country in both term values and quantity. The major constraints being faced by farmers have been reported that unstable yield of mentha, less productive infrastructure, regulated marketing and lack of awareness in export of mentha oil.

Conclusion: Study was concluded with the statement that Mint growers have moderate level of socio-economic characteristics. Barabanki district has few organized marketing channel of Mentha oil marketing that is less profitable to farmers. Specific policy for mentha oil producer should be initiated. Direct involvement of farmers in export will give better income to the farmers.

Key words: Mentha, Marketing channel, Export performance, Socio-economic, Barabanki, Processing.

Management of potato black scurf caused by *Rhizoctonia solani* Kuhn through host resistant and chemical

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ABSTRACT

Purpose: Potato (*Solanum tuberosum* L) is an annual, herbaceous and dicotyledonous plant belonging to genus *Solanum* and family Solanaceae. It is a main source of starch and carbohydrates. Potato is infected by many diseases of fungal, viral and bacterial in origin. Among them, black scurf and stem canker caused by *Rhizoctonia solani* Kuhn is an economically important disease of potato. The *Rhizoctonia* disease complex is common and occurs in potato production areas throughout the world. The management of *R. solani* is difficult due to its soil-born nature. Dependable sources of resistance to *Rhizoctonia* have not been stated, though difference in disease expression of potato cultivars/varieties have been reported which encouraged screening for varietal differences in susceptibility. presently most farmers use fungicides for the management of black scurf disease but the use of fungicides is not safer for human health as well as soil and environment. Research is needed on management of this disease by safer and cost-effective treatment

Methods: Eighteen potato genotypes/varieties listed in table 5 were evaluated to find out the disease reaction against *R. solani* under artificial black scurf infested field. The experiment was laid out in Randomized block design with three replications during Rabi 2015-16 and 2016-17 at Central Potato Research institute, Maharajpura, Gwalior. The efficacy of Carbandazim + Mancozeb @ 0.1 %, Alum @ 1, 2, 3 and 4 %, Boric acid @ 1, 2 and 3 %, and potassium permagnate @ 0.5 and 1 % were assayed by poisoned food technique. The experiment was laid out in completely random design with three replications. For determination the efficacy of chemicals against black scurf of potato, a pot experiment was conducted in natural conditions, naturally heavily infected tubers of potato cv. Kufri chandrmukhi showing scurfy surface were given dip and spray treatment in different chemicals viz., Alum @ 1, 2 and 3 % dip and spray, boric acid @ 3 % dip and spray and Carbendazim and Mancozeb @ 0.1 % spray.

Results: Out of eighteen varieties, three varieties viz., Kufri Surya, Kufri Pushkar and Kufri Anand expressed immune response. Seven varieties namely Kufri Jawahar, Kufri Sinduri, Kufri Himsona, KufriKhyati, Kufri Lalima, Kufri Chipsona-2 and Kufri Kanchan found resistant. Six varieties viz., Kufri Frysona, Kufri Chipsona-3, Kufri Jyoti, Kufri Chipsona-1, Kufri Lavkar and Kufri Chandrmukhi found moderately resistant. Kufri Ashok and Kufri Pukhraj expressed moderately susceptible and highly susceptible reaction respectively. None of the variety showed susceptible reaction. In laboratory experiment, Boric acid @ 2%, Boric acid @ 3%, Alum @ 3%, Alum @ 4%, and Carbandazim +Mancozeb @ 0.1% absolutely checked the growth of *R. solani* with 100 per cent inhibition. In pot experiment, the disease severity was reduced from 11.22 % in untreated (diseased) control to 0.65 % in tuber dip treatment with Carbendazim + Mancozeb @ 0.1% followed by, 0.72 % in tuber dip in Boric acid @ 3%, 0.90 % in tuber dip in Alum @ 3%, 1.61 % in tuber spray with Boric acid @ 3 % and 2.12 % in tuber dip Alum @ 2 %.

Conclusion: In screening trials, only three varieties viz., Kufri Surya, Kufri Pushkar and Kufri Anand expressed immune response, while seven varieties were found resistant against black scurf of potato. Boric acid @ 2%, Boric acid @ 3%, Alum @ 3%, Alum @ 4%, and Carbandazim +Mancozeb @ 0.1% were found effective against *R. solani* under *in-vitro* condition. Carbendazim + Mancozeb @ 0.1% was found most effective against the black scurf disease of potato under pot experiment followed by tuber dip in Boric acid @ 3%, tuber dip in Alum @ 3%, tuber spray with Boric acid @ 3 % and tuber dip Alum @ 2 %.

Key words: Potato, Black scurf, varieties, Boric acid, Alum, Carbendazim + Mancozeb

Biochemical analysis of leaves of *Moringa oleifera* collected from five seed sources in Haryana, India

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ABSTRACT

Purpose: *Moringa oleifera* (Lam.), family Moringaceae is a plant that possesses high medicinal value and a rich source of nutrients. The aim of this study was to evaluate the mineral contents in the leaves of *Moringa oleifera* from different seed sources.

Methods: The leaves of *Moringa oleifera* were collected from trees grown in different areas of Haryana (Rewari, Panchkula, Sirsa, Fatehabad and Hisar) and mineral contents were determined by the method described in the Practical Manual for Soil and Plant Analysis, CCS HAU, Hisar (2002). The Zn in acid digest of plant samples was determined with the help of Atomic Absorption Spectrophotometer (AAS).

Results: The present study revealed that Moringa leaves contain calcium (1786.67 mg 100g⁻¹), magnesium (2875.50 mg 100 g⁻¹), potassium (833.33 mg 100g⁻¹) and zinc (3.42 mg 100 g⁻¹). Sirsa seed source was best and it was followed by Fatehabad seed source based on nutritional contents like potassium and zinc.

Conclusions

These findings suggest that Moringa leaves are rich source of potassium, calcium, magnesium and zinc, thus can be used as feed resource for animal and human consumption.

Key words: calcium, haryana, leaves, magnesium, *Moringa oleifera*, zinc

Non-Timber Forest Genetic Resources (NTFGRs) and its role in Agroforestry Systems

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Introduction: Tree based land-use systems including Agroforestry play a vital role in serving the society in the form of food, nutrition, fuel-wood and timber resources along with ecological and environmental security. Agroforestry provide various kinds of resources to the farmers within a piece of land by growing tree species along with agricultural and fodder crops. Incorporation of trees into agriculture system also help in increasing farm income. The challenges to the farmers are what kind of tree species, how to incorporate these perennial crops, how to sequencing these tree resources along with agriculture crops along with their management practices in order to obtain higher farm income and variety of products from same of piece of land. Many farmers have already started adopting agroforestry system in their farmland and many of those questions are resolved by practicing agroforestry system.

On other hand, NTFPs (Non-timber forest produces) play a vital role in Indian economy and it accounts about 68% of the export in the forestry sector. Nearly 20-40% of the annual incomes of forest dwellers are made from NTFPs (from forest area) through collection, primary processing and sale. Many forest dwellers staying inside or in the fringes of forests are landless communities and they highly depend on forests for food, fibre, nutrition and medicine; therefore, their annual income is highly depends on NTFPs. Most of the NTFPs are collected, processed and sold by women; hence, it may be a major source of income for women. Moreover, it provide an employment opportunities among the local persons that leads to reduced poverty and increased empowerment in the backward districts of India.

NTFPs as Food, Nutritional and environmental security

Traditionally, people living inside the forests as well as adjacent area are generally collecting many NTFPs as food resources from surrounding forests. These wild edibles are rich in macronutrients, fats, proteins, carbohydrates and other essential micronutrients like vitamins and minerals. Many herbaceous plants are being used for vegetables, whereas fruits, pods as well as leaves of forest trees and shrubs are also used as edibles. Even young shoots of some bamboo species are still used as vegetables. Minor or wild fruits are serves as nutrition, where many of them are directly consumed as edible fruit and vegetables and some of them are used in preparation of medicine through traditional knowledge.

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Apart from these wild edibles, other NTFPs like medicinal plants, aromatic plants, Tree based spices, Gums and Resins are commercially traded in both domestic and international market. Such commercial tree species can be grown in farmlands along with its routine cropping system. At local market, there is a huge demand for bamboo and rattans, even such plants can also be incorporated in the agriculture system. Among various agroforestry systems (AFs), home-garden system provide variety of foods and other resources, which includes many NTFPs. Apart from this, agroforestry incorporated with non-timber forest genetic resources (NTFGRs) provide ecological security like wind break, shelterbelt, soil fertility, shelter, *etc.* and ecosystem services like pollination (through apiculture), carbon sequestration (through trees), *etc.* There are potential multipurpose species of NTFPs which can fulfil the ecological needs and environmental security. Agroforestry system also act as conservation importance, since many high traded medicinal plants and other NTFPs are in endangered condition/ threatened category and some of such plants are already cultivating/planting in the farmlands.

Many animals like insects depend on the trees for their food, forage and shelter. Such resources like honey, lac, silk are fetching higher value; therefore, it may provide very good income to the farmers and other stakeholders. Therefore, honey and lac are being harvested/ cultivated from cultivated area to obtain additional income.

Commercial trees and linking NTFPs to Agroforestry

Tree species like sandal wood (for sandal oil), redsanders wood (for natural red dye and as medicinal purpose), bamboo (for furniture and agarbatti industries), Khair (for katha and cutch production), wild-fruits (*Garcinia* sp., myrobalans, jackfruit, *etc.*), tree spices (*Cinnamon, Clove, Nutmeg, etc.*) and TBOs are major potential NTFGR species having commercial value.

There are tree wastes obtained from NTFP resources, which are grown under agroforestry system and those wastes can potentially be used for production of value added products. For example, branch wood, bark and dried leaves can be used for char-coal making and pelleting, which can be used for energy purposes. Waste wood can also be used for making particle boards or other wood based products. One of the best example is preparation of wooden or bamboo articles from wood and bamboo wastes. Through NAHEP-CAAST project, at NAU, more than fifty different wooden articles are prepared and some of them fetches premium price in the market. The farmers can also utilize these resource for making value added such products from NTFP species during non-seasonal period and additional income can be made out from such value added products.

The study bridges the forest genetic resources into cultivated area in order to harvest potential forest resources out-side the forest area for the purpose of crop diversification, variety of resources including food and fodder, enhancing farm income and provide ecological and economical security among farm community and sustainable development of existing cropping system through incorporation NTFPs into Agroforestry system.

Conclusion: Non-timber forest products (NTFPs) includes fruits, flowers, seeds, bark, leaves, roots, gums, resins, oleoresins, bamboo, cane, medicinal plants, animal products, grasses, fodder and other resources provide ecological, economical, nutritional and livelihood security. Major NTFPs like Gums, resins, essential oils, medicinal plants, products of bamboo, cane, honey and lac considered as high traded resources of natural forests. However, other NTFPs are essential for goods, foods, products and other services to mankind. Only few of these resources are cultivated and rests of them are collected from wild. Unscientific way of collection of these resources from natural forests lead to destruction of plant genetic resources. Hence, there is a need to take-up essential requirement of protection and conservation of non-timber forest genetic resources. Agroforestry is one of the possible ways for cultivation, conservation and utilization of NTFP resources, where farmers can avail varieties of wild resources from their-own land and that provide food, fodder, timber, nutritional and environmental security.

Identification of co-expressed genes in different fungal species used as biopesticide

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ABSTRACT

Purpose: Microbes are rich in diverse chemicals. With the development of microbe biotechnology, a considerable number of research activities are focused on bacteria and fungi-derived biopesticide. Biocontrol agents or biopesticides are exploited in a number of ways, some meddle with the mating process, while some other use plant extracts to trap insects. The present study deals with protocol to identify differentially expressed genes (DEGs) in the fungi *Beauveria bassiana* and *Metarhizium anisopliae* to study their expression pattern.

Methods: The methodology involves conversion of raw FASTA files to gene count files in order to analyse differential gene expression. Case and control samples for *Beauveria bassiana* (SRR15043384, SRR15043385, SRR15043386) and *Metarhizium anisopliae* (ERR3089216, ERR3089217, ERR3089218, ERR3089219) were taken from NCBI SRA to perform transcriptome analysis. All the samples were subjected to quality check and trimming prior to alignment on Galaxy server. Further, reference genome was provided in order to generate count data for DEGs analysis. The DeSeq2 statistical method provided by Network Analyst tool was used for identification of DEGs.

Results: Results lead to the identification of total 437 significant genes in *Beauveria bassiana* and 204 genes in case of *Metarhizium anisopliae* at p-value 0.01.

Conclusion: The results obtained from the study suggest that the significantly expressed genes in both the above-mentioned fungi can be a probable reason for their biopesticide activity.

Keywords: Differential gene expression, Biopesticides, *Metarhizium anisopliae*, *Beauveria bassiana*, Transcriptome analysis.

Improving livelihood and nutritional security of tribal communities through aquaculture and fisheries in Dindori, Madhya Pradesh

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ABSTRACT

Purpose: Inland fisheries and freshwater aquaculture having huge potential for livelihood, food and nutritional security, especially in tropical areas and South Asian countries where poverty is much more alarming. Dindori district of Madhya Pradesh, India is dominated by ethnic community commonly known as Adiwasi or scheduled tribes (65%) have limited access to resources, technology, institutional finance, government or non-government organization (NGOs) for help. But on the other side, natural resources are plenty. So this is high time to go for not the mass production from these resources but production by masses which will really help them by increasing production, consumption where it can take care of nutritional security, gainful employment opportunity and they can enhance the income and live decent quality of life.

Methods: The study was conducted with the help of secondary source of information to know the fish production scenario and the role of different organization on livelihood improvement of tribal fishers/ fish farmer of Dindori district, MP. The primary data were collected using a pre-tested survey schedule to understand the levels of literacy, income and livelihood security of the farmers / fisher folk. Primary and secondary data were utilised for strengths, weaknesses, opportunities, and threats (SWOT) analysis.

Results: It was found from the study that different government organization like State Department and Krishi Vigyan Kendra actively work on fish farming in Dindori. Farmers/ fishers were adherent to the local practices resulted in low adoption of scientific aquaculture practices. A strengths, weaknesses, opportunities, and threats (SWOT) analysis were carried out for guiding the policymaker, researchers and different government and non-

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government organization for implementation of sustainable fisheries and aquaculture development programmes for rural livelihood, food and nutritional security. The present fish production of the Dindori with reference to national fish productivity and aquaculture & fisheries enhancement depicts a marginalized picture of aquaculture and fisheries development in the district with vibrant future potential for development and suggests the technical measures to accelerate the horizontal and vertical expansion of aquaculture activities to boost the fish production and productivity.

Conclusions: Even though fisheries and aquaculture in Dindori is lagging behind in terms of productivity and yield per unit area compared to national scenario, but having huge potential for enhancement of livelihood, food and nutritional security through systematic optimal utilization of resources with resilient and sustainable fisheries development. The present paper address the issues, challenges and concerns related to fisheries, aquaculture and environmental sustainability to enhance the decentralized production by masses especially through small-scale fisheries. This paper will help to sensitize all the stakeholders involved in espousing the cause of poor farming community.

Key words: Livelihood security, Nutritional security, Small scale aquaculture & fisheries, Sustainable development, livelihood diversification, Technical support.

Chitosan-metal nanocomposites as time temperature indicators

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ABSTRACT

Purpose: The temperature abuse of products during storage and transportation is a major issue faced by food and pharmaceutical industries. This leads to loss of quality of products and often categorised as adulteration in food products. Hence there is a need for development of an indicator to detect the temperature abuse.

Methods: Metal nanoparticles were synthesised for development of indicators for frozen storage. Chitosan extracted from shrimp shell was used as reducing and stabilising agent. Characterisation of nanoparticles formed were done using UV-Vis spectral analysis and Zeta analyser. The nanoparticles were exposed to different abusing temperature conditions and respective colour changes were recorded.

Results: Metal nanoparticles were synthesised using chitosan and the confirmation of the nanoparticle formation was obtained using characteristic surface plasmonic resonance peak in UV-Vis spectra. The exposure to abused temperature was studied on exposure to room temperature for different time intervals and the samples studied were found to successfully indicate the abuse by visible colour changes. The UV-Vis spectra have shown red shift in the SPR peaks of the nanoparticles upon exposure to room temperature.

Conclusions: The metal nanoparticles synthesised using chitosan can efficiently be used as indicators of temperature abuse for food and pharmaceutical products

Key words: Metal nanoparticles, smart packaging, temperature abuse

Assessment of escapement pattern of *Stolephorus indicus*, *Leiognathus dussumieri* and *Metapnaeus dobsoni* from 27m shrimp trawl

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ABSTRACT

Purpose: Considering the fact of conservation, trawls are designed to operate at increased speed and reduced drag by net. This process comes at the cost of losing catch from different regions of trawl. But at optimum conditions, desired catches can be retained without loss of fuel. The study conducted will give the amount of

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catch lost from each parts of net so that modifications can be made on the design to achieve optimum catch. Such information will help to improve trawl design in order to retain the desired catch.

Methods: Experiment was carried out onboard departmental research vessel M F B Matsyakumari-II off Cochin with 27m shrimp trawl. Individual hauls were analysed to segregate the three species (*Stolephorus indicus*, *Leiognathus dussumieri*, *Metapenaeus dobsonii*.) from codend and collections at pockets sewn to various parts of trawl. Assuming that the coefficients of the mesh gapes are identical on the whole surface of a given segment, the quantity of fish getting out beyond the range of the given segment and the bag (u) may be calculated using equation of proportionality, $u = (g/m) \times M$ (Kg); where: g-quantity of specimen in catchers sewn on the segment (kg), m-number of meshes on the surface of the inlet of the catchers sewn on the segment, M- number of meshes on the whole surface of the given segment. Knowing the amount of caught fish (kg), the amount of fish (kg) getting out to the outside of the trawl, the percentage of individuals escaping to the outside of the trawl was calculated.

Results: Results shown that 20-25% of the catch escaped through wing portion of net, followed by throat (0.02 to 0.11%) and codend (1.6 to 6.2%) irrespective of the species. It has been observed that greatest quantities of species escaped from first segment of the trawl (wing) which is also higher in mesh size. Wing is the first zone of contact of gear with catch and maximum escapement was occurred through the same. Hence wing portion has led to maximum escapement of *M. dobsonii* among the species. Throat and codend portions shown highest escapement of *Leiognathus sp.*

Conclusion: Mesh size gradually decreases towards codend from wing, but lowest escapement is observed from throat denotes that accumulation of catch at codend gradually pushes smaller organisms out of the net resulting in throat functioning as a funnel. Hence reducing mesh size of wing portion may retain the catch but smaller meshes at wing will reduce speed of trawling. It is suggested that mesh size of wing may be increased when fast swimming fishes are targeted and regarding shrimp trawling, reducing wing mesh size will be beneficiary.

Key words: Trawl, escapement, selectivity, demersal trawl

Studies on economics of predominant *Rabi* crops followed by paddy

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ABSTRACT

Rice fallows offer good scope for area expansion of pulses and oilseed crops through crop intensification to utilize the moisture still retained in the soil. Development of oilseeds suiting to rice fallows coupled with improved agrotechnology will boost production, and thus improve income and livelihood security of farming community. Moreover, introduction of oilseed i.e. Mustard, linseed, lathyrus can provide a sustainable production base to the continued rice mono-cropping system leading to decline in total factor productivity and also provide much needed nutritional security. While enhancing production and productivity of food grains in the region, equal importance should be given to sustainable use of natural resources and suitable intensification of short duration crops like Mustard or rape seed, linseed, lathyrus etc. in rice fallows (Mangal Deep *et al.* 2018). The residual moisture left in the soil at the time of rice harvest is often sufficient to raise short-duration pulses and oilseed crops, and rice fallows can be converted into productive lands. This also provides an opportunity to increase cropping intensity through taking extra crop of mustard, lathyrus, linseed during lean period after *Kharif* rice. Introduction of pulses and oilseeds in rice fallows can augment the domestic availability pulses and oilseeds, which are in short supply and also help in restoration of the soil health (Singh and Satapathy 2019).

Methods: An experiment was conducted at AICRP on Linseed and Mustard College of Agriculture, Nagpur during 2020-21 in Factorial Randomized block design with three replications. The treatment details are main plot consist of different maturity group of paddy i.e. Early variety - Sindewahi-1, Mid-late variety – PKV HMT, Late variety – PDKV Tilak and sub plots consist of *Rabi* crops i.e. Mustard, Linseed, Lathyrus. Paddy was transplanted during *Kharif* season, and *Rabi* crop sown in zero tillage after harvest of paddy in line sowing of 30 cm. Two protective irrigation is applied at critical growth stages.

Results: The plant height, number of capsule and yield per plant and per hectare of rabi crops was significantly maximum when rabi crops sown after early paddy as compared to mod-late and late paddy. Among the different rabi crops linseed recorded maximum crop yield which at with mustard crop in different rabi crops. The interaction effect on plant height, number of capsule/silique/pod per plant and yield kg/ha was found significant. Mustard crop has recorded significantly superior plant height, number of capsule and yield kg/ha grown after early paddy. Linseed and lathyrus were also recorded maximum plant height, number of capsule and yield kg/ha grown after early paddy.

Sowing of rabi crops after early paddy was recorded maximum gross monetary returns. The maximum net monetary returns were recorded in linseed crop which at par with mustard crop and highest B:C ratio was recorded in mustard crop which is followed by linseed crop. Among the rabi crops linseed and mustard has recorded maximum returns, this might be due to the more yield and cost of produce. The interaction effect was found significant on net monetary returns of rabi crops. Linseed crop has observed significantly maximum net monetary returns which at par with mustard crop grown after early paddy. But B:C ratio was highest in interaction of mustard crop grown after paddy, this might be due to the less amount of cost of cultivation in mustard. System yield and economic returns was significantly maximum in sowing of rabi crops after early paddy. Among the rabi crops linseed has recorded maximum system yield and returns which at par with mustard crop, this might be due to the more yield of linseed and mustard after paddy cultivation. The interaction effect was found significant on system net monetary returns of rabi crops. Linseed crop has observed significantly maximum system net monetary returns which at par with mustard crop grown after early paddy. But B:C ratio was highest in interaction of mustard crop grown after paddy, this might be due to the less amount of cost of cultivation in mustard.

Paddy Equivalent yield (1752 kg/ha), Production efficiency (16.98 kg ha⁻¹ days⁻¹) and Economic efficiency (Net returns Rs. 212 day⁻¹) was significantly maximum in sowing of rabi crops after early paddy. Among the rabi crops linseed has recorded maximum Equivalent yield (1941 kg/ha), Production efficiency (14.90 kg ha⁻¹ days⁻¹) and Economic efficiency (Net returns Rs.188 day⁻¹) which at par with mustard crop, this might be due to the more yield of linseed. The interaction effect was found significant on Equivalent yield (kg/ha) and Economic efficiency (Net returns Rs. day⁻¹) of rabi crops. Treatment combination of sowing of linseed crop after early paddy system has observed significantly maximum Equivalent yield (2147 kg/ha) at par with mustard crop grown after early paddy and sowing of linseed crop after mid late paddy also at par with mustard crop grown after mid late paddy. Economic efficiency (Net returns Rs. 242 day⁻¹) was highest in interaction of sowing of linseed crop after early paddy at par with mustard crop grown after early paddy, this might be due to the less amount of cost of cultivation in mustard.

Conclusion: Linseed or mustard crop was found predominant rabi crop after paddy on economic return basis. Linseed or Mustard crop was found economically viable after paddy as compare to lathyrus crop. Equivalent yield (kg/ha), Production efficiency (kg ha⁻¹ days⁻¹) and Economic efficiency (Net returns Rs.day⁻¹) was maximum in Early paddy-linseed or Early Paddy-mustard cropping system. The interaction of Mustard crop grown after paddy was recorded highest in B:C ratio in system economics followed by interaction of linseed grown after paddy.

Key words: Economics, Maturity group of paddy, Mustard, Linseed, Lathyrus

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Biochemical factors responsible for resistance in tomato against fruit borer, *Helicoverpa armigera* (Hubner)

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ABSTRACT

Purpose: The tomato fruit borer, *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae) is the main bottle neck as it attacks the cashable part of the plant i.e. fruits, leading to low market price and makes them unfit for human consumption. It has been estimated that the crops worth Rs.1000 crore are lost annually by this pest. Present investigations were carried out during the Rabi season of the year 2017-18 and 2018-19 to find out how biochemical contents of the plant affect the biology and behavior of tomato fruit borer feeding on the plants.

Methods: The biochemical analysis of the parameters viz., per cent titratable acidity, total soluble sugar content (mg/g), total phenol (mg/g), pH of fruit pulp, per cent nitrogen, per cent phosphorous, total chlorophyll (mg/g) and lycopene (mg/100 g) was done on five randomly selected plants from each row. The leaf samples for analysis were collected from the young shoot of 30-day-old plants after transplanting, while the fruit samples for analysis were collected on 7th day from the first appearance of fruiting. Moreover, all the parameters were correlated with mean larval population and percent fruit weight loss respectively.

Results: The biochemical analysis of tomato leaf viz total phenol and per cent phosphorous displayed negative correlation while total soluble sugar content, per cent nitrogen, per cent protein and total chlorophyll displayed positive correlation with mean larval population. The biochemical analysis of tomato fruit viz., per cent titratable acidity, total phenol and per cent phosphorous displayed negative correlation while total soluble sugar content, pH of fruit pulp, per cent nitrogen, per cent protein and lycopene content displayed positive correlation with per cent fruit weight loss.

Conclusions: The selected Resistant (R) varieties/germplasms viz., Pb Barkha-1, Pb Barkha-2, DVRT-1, DVRT-2, Kashi Sharad, Pusa Rohit were found to be best over other varieties/germplasms by recording 0.1-10 per cent fruit weight loss.

Key words: Tomato fruit borer, *H. armigera*, variety/germplasm, biochemical analysis

Identification and development of microsatellite markers in *Dendrocalamus strictus*

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ABSTRACT

Purpose: Bamboos are woody grass species containing important economic and ecological values. In India, *Dendrocalamus strictus* (solid bamboo) is the most commonly used bamboo, occupying 53 % of the total bamboo area. It has a remarkable life history with little genetic characterization. Microsatellite markers are used as tools for assessing genetic variation and dissecting complex traits. However, existing SSR marker resources are not enough for various genotyping studies to draw concrete conclusions across the bamboo complex. In view of this, the present study aims to develop robust microsatellites markers, which were not yet reported in this bamboo specie due to lack of genome sequence information.

Methods: The genome of *D. strictus* was sequenced using Illumina paired-end sequencing technology and approximately 6 GB raw data was obtained, which was further de novo assembled into contigs. Totally 39473 SSRs were identified and primers were successfully designed using Primer 3. Based on high GC %, no. of bp and unit size, a subset of 100 SSRs was selected and synthesised for validation.

Results: Based on the experimentation carried out, the PCR amplification conditions and annealing temperature was standardised for each primer. Out of 100 SSRs, 71 primers were successfully amplified within expected product range. Amplified SSRs were further screened for polymorphism on 20 randomly selected *D. strictus* genotype. The results showed that, 35 SSRs were polymorphic in nature.

Conclusions: The present study provides SSR resources that can be useful for dissecting complex traits in solid bamboo. The markers can further be checked for their cross transferability in other genus or species.

Microbiological analysis in food as raw material and finished product

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ABSTRACT

Purpose: In order to check the growth of microbial pathogens and to ensure a pathogen free and potent food and pharmaceutical product, it is mandatory to apply microbiological techniques for microbial analysis (from the area of production to the finished product) so that safe food products, beverages & cosmetics products comes in market and the customers could consume it fearlessly.

Methods: Microbial Limit Tests (M.L.T) are performed to check the microbial load in the Products preparations. Preservative Efficacy Test (P.E.T) was applied to finished products. Microbial Monitoring of aseptic area by Expose Plate Media. Microbial monitoring was done to evaluate presence of total microbial count in control or uncontrolled area. Following media were used for microbial monitoring- Soybean Casein Digest Agar, Sabouraud Dextrose Agar, Chloramphenicol Yeast Glucose Agar, Plate Count Agar. Culture Media Performance Test. Culture media allowed the proper growth of microorganism and media (Soybean Casein Digest Agar) had enhancing properties to check microorganism’s performance in the laboratory.

Result: The present course of study has been done to evaluate product materials for total bacterial count, total fungal (yeast and molds) count, and total *Enterobacter* count. There are huge numbers of microbial pathogens and all of them could not be detected at same time. So we have considered only those microbes which are commonly responsible for products contamination and are associated with humans such as *E.coli*, *Salmonella* sp., *Pseudomonas aeruginosa*, *Staphylococcus* etc.

Conclusion: Microbial contamination means presence of viable bacterial and fungal cells in the products and associated materials. It is necessary to enumerate total microbial count in finished products as their presence indicates the poor quality of products. The main source of bacterial and fungal contaminations in food, pharmaceutical industries are from the unhygienic area, unprocessed water, contaminated equipment and containers, person itself and contaminated material being used for product formation.

Keywords: Microbial techniques, pharmaceutical products, microbial limit test, colony counter etc.

Prioritization of Surana Tons watershed Doon Valley Uttarakhand

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ABSTRACT

Purpose: Morphometric analysis gives a quantitative description of drainage basin. The main aim of the present study is to identify the morphometric parameters of a watershed of Surana Tons Watershed, Dehradun district of state Uttarakhand, India, and to prioritize the sub-Watershed. The work outlines the significance of digital elevation model for assessment of drainage pattern and extraction of relative parameters. Basin has been divided into 10 sub-watershed namely SW1 to SW10. The stream order of watershed ranges from first to fifth order and have dendritic drainage pattern means homogeneity in texture and lack of structural control. Further, each parameter has been assigned their ranks according to their value. The basin with lowest parameter value is ranked as first. It was considered as high priority for adopting conservation measure as well. The suitable locations for conservation measure structures in highly prioritized sub-watersheds were also identified for the appropriate land and water management plane. The relevance of work shows the appropriate measure structure locations for preventing the soil from getting eroded from the highly prioritized sub-watershed.

Method: The ASTER DEM was utilized for evaluation of morphometric constraint of Surana Tons: Bifurcation ratio (R_b), Drainage density (D_d), Stream frequency (F_s), Stream length ratio (R_l), Mean stream length (L_μ), Form factor (F_f), Elongation ratio (R_e), Circulatory ratio (R_c), Basin relief (R_r) etc. The comprehensive implement scheme is expressed through flowchart (Figure 1). Table 1 explains the method utilized for quantitative resolution of morphometric constraint.

Result: The results revealed that Surana Nadi, Nun Nadi & Karwapani microwatershed constituting 45.75 % of whole study area falls under High priority category. Biras Rao, Rami Rao and Ramgarh, occupying 13.31 % of

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the total area of all the sub-watershed have been categorised under Medium prioritized category and 4 sub-watersheds; Jhajra ,Nimi Rao , Nanota Nadi and Bhainswala Rao covering an area about 40.87% of the entire study area fall under the category of Low priority as for as soil management is concerned. The sub-watersheds exhibiting high priority have high drainage density and higher bifurcation ratio with low elongation ration and form factor that chiefly contribute to soil erosion and vice versa for low priority sub-watersheds.

Conclusion: The Surana Tons Watershed and its catchment exhibited a diverse topography. It is obvious from DEM analysis that the area is relatively less peaked with low basin relief which is less than 150 m. Its surface process is dominantly controlled by its altitude, slope, rainfall, soil, geography and geology. The catchment of Surana Tons watershed is constituted of ten micro watersheds. The drainage system is dendritic type, which exhibit 7th stream order as per the Strahler’s method. The total stream length of the entire basin is 2399 Km. the drainage density of the study area is very coarse with average drainage density of 2.52 Km/Km².

Key words: Prioritization, Remote sensing, Morphometric, Surana Tons, Watershed.

Grade wise yield and economics involved in potato *c.v* kufri chipsona-1 under different nutrient treatments.

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ABSTRACT

Purpose: The experiment comprised of treatments combinations of inorganic fertilizers viz., (100% NPK), (75%NPK) and (50% NPK), farm yard manure and biofertilizers (Azotobacter and PSB) tested on potato processing cultivar Kufri Chipsona-1, for yield and economics parameters.

Methods: The present experiment was conducted at the, Department of Horticulture, College of Agriculture, RVSKVV, Gwalior (M.P.) during the *Rabi* season of two consecutive years 2017-18 and 2018-19. The experiment was laid out in Randomized Completely Block Design (RCBD) with three replications. The tubers were sown in plots of size 3 x 3 m at a spacing distance of 60 x 20 cm. Observations for yield parameters were grade wise yield of tubers (kg/plot), processing grade tuber yield (T/ha), marketable tuber yield and total yield (T/ha) of potato tubers.

Results: The treatment combination I₃O₂B₃ (100%NPK+FYM 20 t/ha + PSB2.5kg/ha+ Azotobacter 2.5kg/ha) resulted in maximum ‘A’ grade tubers (8.2 kg/plot) and maximum ‘B’ grade tubers (7.5 kg/plot) during the pooled mean data, of the experiment. The treatment combination I₃O₂B₃ also resulted in maximum total yield (22.6 t/ha). Whereas minimum total yield (15.6 t/ha) was obtained in treatment I₁O₁B₂.

Conclusion: The highest benefit cost ratio was recorded (2.56) with treatment I₃O₂B₃ followed by (2.47) treatment I₃O₂B₁.

Key words: A’, B’, C’ grade tubers, *Kufri Chipsona-1*

Biological Controls of Aflatoxin Contamination of Crops (Rice)

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ABSTRACT

Fungi are significant destroyers of food stuffs and grains during storage, rendering them unfit for human consumption by retarding their nutritive value. Aflatoxins produced primarily by two closely related fungi. *Aspergillus flavus* and *Aspergillus parasiticus* are mutagenic and carcinogenic in animals and plants. Aflatoxins (AFs) are mycotoxins, predominantly produced by *Aspergillus flavus*, *Aspergillus parasiticus*, *Aspergillus nomius* and *Aspergillus pseudo tamarri*. They are secondary metabolites produced and are organic compounds with lower molecular weight typically produced by fungal mycelia and accumulated in conidia and sclerotia. They contaminate a wide range of crops including corn, oil seeds, rice and nuts. Aflatoxin contamination in cereals may occur during pre or post-harvest stages. High temperature and high humidity stimulated fungal growth in fields and storage. Contamination by AFs is responsible for substantial commercial losses throughout the world.

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Introduction: In present time application of chemical compounds is considered as the most inexpensive and common method in plant disease control. These methods have adverse effects on human health and environment, forcing man to produce natural pesticides. The herbal products symbolize safety in contrast to the synthetics that are regarded as unsafe to human and environment.

Extracts of medicinal plants are effective against fungal and bacterial pathogens meanwhile they are biodegradable compounds which have high potential for using in integrated pest management programs (Soylu, 2006). The use of biological compounds extracted from plants to be used conventionally fungicides to control phytopathogenic fungi, due to their being bioactive chemicals such as flavonoids, phenols tannins, alkaloids, quinones, saponins and sterols (Burt, 2004). Extracts of many higher plants have been reported to exhibit antibacterial, antifungal and insecticidal properties.

Materials and Methods: Rice samples were collected from Pusa (Bihar), using agar plate method. Aflatoxins producing mycoflora were isolated from these samples. Seeds were surface sterilized with chlorax (0.1) and washed with distilled water twice. Seeds were plated on one half strength PDA medium. The plates were incubated at room temperature and presence of *Aspergillus* spp. was observed after six days. For identification of aflatoxin, *Aspergillus* isolates were grown on potato dextrose broth (PDB), Yeast Extract Sucrose and *Aspergillus flavus* & *Aspergillus parasiticus* (AFP) medium for 7 days at room temperature.

Culture filtrate were filtered through Whatman No.1 filter paper and aflatoxins were extracted with chloroform (1:1 ratio). The extracted aflatoxins were loaded on to silica gel plates and thin layer chromatography was done using chloroform and methanol solvent system, later spot was identified.

Examples: Plant extract of *Allium sativum*, bulb extract, neem (*Azadirachta indica*) leaf extract, Eucalyptus teriticornis leaf extract, biocontrol agents viz., *Trichoderma viride* (MTCC 800), *T. harzianum* (MTCC 2050), *T. virens* (MTCC 794), *T. reesei* (MTCC 2480) and *T. koningi* (MTCC 796), and fungicides viz., propineb 70 WP, bitertanol 25 WP, carbendazim 50 WP and tricyclazole 75 WP, were tested for their efficacy on the growth of *Aspergilli*.

Result and Discussion: Four different species of *Aspergillus* were identified. They are parrot green and olive green coloured *A. flavus*, *A. niger* and *A. ochraceus* (Table 1).

The contamination level of individual species of *Aspergillus* is varied from 0 to 100 percent. All fungicides were significantly effective in reducing the growth of *Aspergillus* spp. over control. Study on effect of plant extracts on *Aspergillus* shows that garlic bulb at 5% concentration was the most effective treatment in reducing the growth of *Aspergillus* spp.

Table 1. Occurrence of *Aspergillus* spp. in seed samples

Sample	Storage	Per cent contamination			
		<i>A. flavus</i> isolates		<i>A. ochraceus</i>	<i>A. niger</i>
		Olive green	Parrot green		
Pusa (Bihar)					
PS-1	OEF	12	60	24	17
PS-2	OEF	0	4	41	3
PS-3	OEF	1	6	70	1
PS-4	OEF	1	1	0	1
Mean		3.5	17.8	33.8	5.5

So, all the plant extract used by us is reducing the growth of all the three *Aspergillus spp.*

Table 2. Effect of plant extracts on mycelial growth of *Aspergillus spp.*

Plant extract (%)	<i>Aspergillus flavus</i>		<i>A. niger</i>			
	Parrot green isolate		Olive green isolate			
	RG (mm)	INH (%)	RG (mm)	INH (%)		
<i>Allium sativum</i> (bulb)						
1	78	13	81	10	81	10
2	62	30	66	26	65	28
3	51	43	60	33	40	55
4	31	65	40	55	19	78
5	0	100	0	100	0	100
<i>Azadirachta indica</i> (leaf)						
5	90	0.0	90	0.0	72	19
10	80	11	85	5	60	32
15	80	11	68	25	60	32
20	65	28	65	28	58	35
<i>Eucalyptus tereticornis</i> (leaf)						
5	72	19	67	25	90	0.0
10	70	22	68	24	73	18
15	60	32	65	28	73	18
20	53	40	60	32	56	37
<i>Pongamia pinnata</i> (kernel)						
5	72	19	67	25	70	22
10	68	24	62	31	55	39
15	53	40	53	41	33	63
20	38	57	23	74	16	82
Control	90	-	90	-	90	-
CD (P≤0.05)	5	-	4	-	4	-
CV (%)	4	-	4	-	4	-

RG= radial growth; INH = inhibition over control

Table 3. Effect of *Trichoderma* culture filtrates on mycelial weight of *Aspergillus spp.*

Culture filtrate (%)	<i>Aspergillus flavus</i>				<i>A. niger</i>	
	Parrot green isolate		Olive green isolate		MDW (g)	INH (%)
	MDW (g)	INH (%)	MDW (g)	INH (%)		
<i>T.harzianum</i>						
5	4	44	4	34	4	50
10	3	50	4	34	4	50
15	3	50	4	34	4	50
<i>T.koningii</i>						
5	6	0	5	17	6	25
10	6	0	5	17	6	25
15	6	0	5	17	6	25
<i>T. reesei</i>						
5	6	0	5	17	5	38
10	6	0	5	17	5	38
15	5	17	5	17	5	38
<i>T.virens</i>						
5	1	84	1	84	3	63
10	0.6	90	0.5	92	2	75
15	0	100	0	100	0	100
<i>T.viride</i>						
5	5	17	5	17	6	25
10	5	17	5	17	6	25
15	5	17	5	17	6	25
Control	6	-	6	-	8	-
CD (P≤0.05)	5	-	1	-	1	-
CV (%)	7	-	2	-	2	-

MDW = mean dry weight; INH = inhibition over control

Key words: Rice, *Aspergillus spp.*, aflatoxin, plant extracts, *Trichoderma spp.*, fungicides

Residential Built Environment of Uttarkashi District of Uttarakhand

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ABSTRACT

Purpose: Built environment has longstanding connection between the way we develop our buildings, organize our neighbourhood, cities, and to the health status of residents and local community. The purpose of the study was to find out the relationship between existing housing condition in terms of physical feature, housing style, architectural features, and indoor/outdoor environment quality and the health status of the family.

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Methods: Descriptive research design and purposive sampling design was used to conduct the study. Total sample consisted of 120 family families/houses. The data were analyzed using frequency, percentage, mean and s.d. and Chi- square test were used for testing. The entire data analysis was done on the basis of economic status of the family, where three income groups (Low Income Group, Middle Income Group and High Income Group) were formulated.

Results: Study revealed that maximum houses were near to national highway, site prone to landslide and near river catchment area. More houses were located down end of the slope which may suffer slope failures such as slide; debris flow and mud flow when material move downside and cause accidents to houses as well as people. Large number of houses were having colony of fungus and mould on it due to this mostly the children suffered from running nose, cold and even some were diagnosed with humidifier fever.

Conclusions: Housing of hill is one of the most important concerns for India as hills of India are very fragile and eco sensitive. With swelling population and migration from villages to these suburban areas there is scarcity of living space, which is resulting in overcrowding, unhygienic living, poor indoor/outdoor quality.

Key words: Slope failure, overcrowding

Seasonal Abundance of Chilli mites in Marathwada Region of Maharashtra

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ABSTRACT

Chilli, (*Capsicum annuum* L.) Chilli occupies a pride place among the vegetables for its delicious taste and pleasant flavour. India is rich in maximum diversity of chilli varieties i.e. heatless and hot varieties with different quality factors. Several sources concordantly put the origin of chilli in Bolivia or Brazil (Andrews, 1984 and Paterson, 2000). It was first introduced to India from Brazil by the Portuguese towards the end of fifteenth century and its cultivation became popular in the Seventeenth century and since then, it has gained importance as an important spice and vegetable crop and also become a key element in many cuisines (Greenleaf, 1986). Reason which attributes to low productivity of chilli is infestation of insect pests and diseases. Over 53 species of insects and mites have been reported as pests of chilli in India which includes thrips, mites, whiteflies, fruit borers, cutworms, plant bugs, mites and other minor pests (Sorensen, 2005). Chilli mite (*Polyphagotarsonemus latus* Banks) is a tiny spider like creature that is found in large numbers on the underside of leaves, covered with fine webs. Both nymphs and adults suck the cell sap and devitalize the plants (Butani, 1976). Feeding of *P. latus* causes different types of physical deformities like thickening, brittleness and shortening, twisting, downward curling and crumpling of young leaves. Midrib of young infested leaves bend in a zigzag fashion, ventral surface becomes silvery, petiole of mature leaves elongates and the plant becomes stunted with rosette symptoms. Infestation at flowering stage caused falling of flower bud. (Karmakar, 1997). so the present investigations were planned and carried out with objectives to study chilli mites status on chilli in Marathwada region of the Maharashtra state, to provide a comprehensive picture on it's population build up and behavior which can help in it's sustainable management.

Methods: For this purpose Randomly fields were sampled from each Tahsil of chilli growing areas following survey procedure i.e. collecting data of mites infestation from five random plants from five random spots in each field, representing all the cropped area by visiting twice in the season at same location. Data was collected and compiled and mean population of mites in each tahasil was worked out and final figure was used for assessing pest status in the region.

Results: Results indicated that Mites infestation on chilli was noticed in the range between 2.02 to 8.86 and 4.42 to 8.96 mites/leaf during 2016-17 and 2017-18 respectively during survey and least intensity of mites was observed in 2016-17 at Bhokardan tahasil of Jalana districts and Phulambri tahasil of Aurangabad districts in 2017-18 and maximum infestation was recorded at Dharmabad and Naigaon tahasils of Nanded district. during 2016-17, the mites population first appeared during 36th SMW (5-11 Sept.) and it was gradually increased and

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attained peak (6.98/leaf) during 46th SMW (14-20 Nov.) when the prevailing maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, evaporation, bright sunshine hours and wind velocity were 30.3°C, 12.1°C, 76 per cent, 32 per cent, 4.1 mm, 9.6 hrs and 2.5 kmph, respectively. Then activity of mites was declined by the end of season i.e. 4th SMW (22-29 Jan.).

During 2017-18, the activity of mites initiated during 39th SMW (26 Sept.-02 Oct.) with gradual increase in its population and reached peak of 8.46 mites/leaf during 47th SMW (21-27 Nov.) when the prevailing maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, evaporation, bright sunshine hours and wind velocity were 32°C, 17°C, 77.0 per cent, 42.0 per cent, 4.5 mm, 7.4 hrs and 2.4 kmph, respectively. Thereafter during 48th SMW the population declined and again increased up to 5.96 mites/leaf in 49th SMW (5-11 Dec.). Afterwards, the population gradually decreased but sustained up to 3rd SMW (15-21 Jan.).

Conclusion: Mites was found to be major pest of chilli and it’s presence was moderate to high during the experimental period and it’s population was at peak during intial growth period.

Table No. 1 Status of chilli mites on chilli in Marathwada during 2016 and 2017

Sr. No.	Districts	Tahsils	No. of Fields visited		Mites/leaf		Visit Period (MW)	
			2016	2017	2016	2017	2016	2017
Scarcity zone								
1	Aurangabad	Gangapur	5	3	4.32	6.84	40&50	43&52
		Vaijapur	4	2	4.48	8.62	40&50	43&52
	Mean		5	2	4.40	7.73		
*	Assured Rainfall zone							
1.	Aurangabad	Phulambri	2	4	6.02	4.42	40 50	43&52
		Sillod	8	5	8.42	8.18	42&51	43&52
2	Hingoli	Sengaon	3	4	8.00	6.68	42&51	42&50
3	Jalna	Ambad	3	2	8.06	6.18	40&50	43&52
		Bhokardan	4	7	2.02	6.04	40&50	43&52
		Ghasawangi	5	4	2.46	5.38	40&50	43&52
4	Latur	Ahmadpur	4	3	4.84	8.44	43&52	44&51
		Renapur	2	3	5.86	8.68	43&52	44&51
5	Nanded	Biloli	5	8	3.38	4.48	42&51	42&50
		Deglur	4	5	6.56	5.86	42&51	42&50
		Dharmabad	7	5	8.86	8.12	42&51	42&50
		Naigaon	4	3	4.28	8.96	42&51	42&50
6	Parbhani	Gangakhed	4	5	8.80	8.06	42&51	42&50
		Parbhani	4	6	8.04	8.42	42&51	42&50
		Purna	2	4	8.52	6.96	42&51	42&50
	Mean				6.27	6.99		
Moderate rainfall zone								
1.	Hingoli	Basmat	3	2	8.38	6.58	42&51	42&50
2	Nanded	Mudkhed	3	5	6.82	8.62	42&51	42&50
		Umri	4	4	8.42	8.86	42&51	42&50
	Total Visits		80	84				
	Mean Visits		3	4	7.87	8.02		

Average pest population are mean of two visits

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Gulabjamun prepared from buffalo milk with incorporating *Amaranthus hypochondriacus* and soy flour

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ABSTRACT

Purpose: Soybeans have served as a major source of all the three-macro nutrients *i.e.*, complete protein, carbohydrate, fat and moisture as well as vitamins and minerals. Soy protein being low in saturated fat and cholesterol free and having all the nine essential amino acids. Fortification of food products with soy flour will improve protein quantity as well as improve the amino acid balance in food. On the other hand, Amaranth seed is gluten-free and may be used to prepare nutritious and suitable food products for people which have food allergy with gluten.

Methods: Gulabjamun was prepared by following standard method of developing Gulabjamun. The major ingredients were khoa prepared from buffalo milk, refined wheat flour, soy flour and *Amaranthus hypochondriacus*. The modification in standard development procedure was done by using different ratio of *Amaranthus hypochondriacus* and soy flour. After sensory evaluation of product, estimation of protein content, fat content and texture behavior were analyzed.

Result: In the prepared Gulabjamun, texture behavior such as hardness, gumminess, chewiness, cohesiveness, springiness was increased with the increase in the soy flour ratio. Appearance, colour, texture, flavour and overall acceptability of the Gulabjamun was also improved by addition of soy flour. On the other hands, addition of *Amaranthus hypochondriacus* also showed improvement in sensory and rheological properties of prepared gulabjamun. In prepared Gulabjamun, protein and fat content were significantly increased by addition of soy flour and *Amaranthus hypochondriacus* in different ratio as well as it was gluten free because of the presence of *Amaranthus hypochondriacus*.

Conclusion: The prepared final food product *i.e.*, Gulabjamun prepared from buffalo milk's khoa, soy flour and *Amaranthus hypochondriacus* showed high protein content with sensory acceptability and nutritional properties. It was a boost for people having gluten allergy.

Key words: Gulabjamun, Soy flour, *Amaranthus hypochondriacus*

Optimization, sensory and nutritional quality evaluation of cookies incorporating tamarind kernel (*Tamarindus indica* L.) : an under-utilized legume

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ABSTRACT

Purpose: Tamarind seed (*Tamarindus indica* L., family Fabaceae) a by-product of tamarind pulp industry is the most underutilized and undervalued nutritious legume. Tamarind kernel, obtained after the removal of seed coat, is a good source of nutrients specially protein with good amount of essential amino acids, minerals like: iron, phosphorus, magnesium and significant phenolic content and antioxidant activity. Therefore, in the present study potential of tamarind kernel powder (TKP) to be used as a food source was explored by its incorporation into cookies.

Methods: Tamarind seeds were dried at 160°C for 35 minutes in hot air oven and were allowed to cool followed by removal of seed coat using mortar and pestle. Tamarind kernels were then ground into powder using electric

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grinder. Cookies were prepared using eight different flour blends of whole wheat flour (WWF) : TKP : lentil powder (LP) (100:0:0, 90:5:5, 80:10:10, 70:20:10, 60:30:10, 50:30:20, 40:40:20, 30:50:20) with ingredients viz. sugar, butter, amla candy chips, vanilla essence and water. Cookies were allowed to cool and subjected to sensory evaluation using score card method.

Results: Results of sensory evaluation revealed that cookies prepared with WWF scored highest for all the sensory parameters namely; color, appearance, taste, crispness, after taste and overall acceptability. A non – significant difference ($p < 0.05$) was observed in the color, appearance and overall acceptability values for cookies with flour blend up to WF:TKP:LP::60:30:10. However, for taste and crispness parameters, all the cookies prepared with eight different blends were found to have non - significant difference ($p < 0.05$) with WWF cookies. Further, WWF cookies and cookies prepared with WWF:TKP:LP::30:50:20 blend were evaluated for nutritional quality on calculation basis. Incorporation of 50% of TKP increased crude protein, total ash, crude fibre, energy, iron and magnesium content of cookies in considerable amount when compared with WWF cookies.

Conclusion: The present study revealed that TKP incorporated cookies were highly acceptable. TKP incorporation resulted in non - significant difference in the taste and crispness values of cookies. Also, TKP incorporation improved the nutritional quality of cookies as compared to WWF cookies.

Key words: tamarind kernel powder, flour blends, cookies, sensory evaluation, nutritional quality

Characterization of human serum albumin's interactions with Caffeic acid and Chlorogenic acid from *Cichorium intybus* using molecular docking techniques

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ABSTRACT

Purpose: Human serum albumin is the most abundant plasma protein in human blood. It solubilizes and transports drugs and other substances to the target tissues in the body. Caffeic acid and Chlorogenic acid are two major phytochemical ingredients obtained from *Cichorium intybus*. It has anti-inflammatory, anticancer, antiviral, antioxidant, hypoglycemic, hypolipidemic and other pharmacological properties. Aim of this study was to predict the predominant binding mode(s) of caffeic acid and chlorogenic acid with human serum albumin protein's known 3D structure and the binding characteristics such as affinities, sites, forces etc for their future development as an anticancer, antiviral, anti-inflammatory or hypolipidemic therapeutic agent.

Methods: Docking of human serum albumin protein with caffeic and chlorogenic acid was performed via Mastero (schrodinger, USA) software. LigPrep module, version 2.4, 2019, was used for geometrical refining of chemical structures of ligands and protein preparation wizard using Maestro software. Receptor grid, generated by using in-built module and based on receptor grid, flexible docking was performed using the extra precision (XP) feature of Glide module, version 12.1, 2019. The interaction of protein and ligand was visualized by the ligand interaction viewer.

Results: In-silico molecular docking studies revealed that human serum albumin protein interacts with the caffeic and chlorogenic acid with the lower energy -6.46kcal/mol and -7.42kcal/mol, respectively. Total 3 hydrogen bonds were formed by the caffeic acid at Arg117, Tyr161, Phe134 and 1 Pi-Pi stacking at Phe134 and 1 salt bridge with Arg117. Total 3 hydrogen bonds and 1Pi-Pi stacking were formed by chlorogenic acid at Leu115, Tyr161, Arg117 and Phe134, respectively.

Conclusions: These results confirmed the formation of HSA stable complexes with caffeic acid, chlorogenic acid and contributed to our understanding for their binding characteristics such as affinities, sites, modes, force etc and structural changes upon interactions. It was proved that HSA can solubilize and transport both compounds in blood to target tissues. The results are also of high importance in determining the pharmacological properties of both compounds and for their future developments as therapeutic agents.

Key words: *Cichorium intybus*, Caffeic acid, Chlorogenic acid, Human serum albumin, Docking

Effective practice of INM on increment of ragi yield in red soil under natural resource management

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ABSTRACT

Soil is the most precious natural resource that supports millions of households. Soil has several roles to play in agricultural production system as it is the resource which bears the brunt of all agricultural related activities like anchoring of roots, supplying of water and nutrients to plants, serves as a sieve for purifying polluted water and sequestering carbon for moderating the adverse impact of climate change. Red soils denote the third largest soil group of India covering an area of about 3,50,000 sq.km (10.6% of India's area). Integrated Nutrient Management (INM) refers to maintenance of soil fertility for sustaining desired crop productivity through optimization of the benefits from all possible sources of plant nutrients in an integrated manner. Finger Millet (ragi) is a hardy popular food and wonder grain crop next to wheat, maize and rice in India. This grain is valued as staple food. It is also known as dry land crop cultivated in both tropical and sub tropical regions and mainly cultivated in Andhra Pradesh, Karnataka, Tamilnadu and Kerala.

Methods: In an experiment conducted at the pot-culture yard of Dept. of SS&AC, Annamalai University, the objective was to explore the integrated effect of inorganic fertilizers, neemcake, pressmud compost and chelated micronutrients on yield attributes and yield of ragi. The design adopted in the present study was completely randomized block design with ten treatments and three replications. The surface (0-15 cm) soil was collected from Farmers Field at Meethikudi, Chidambaram Taluk, Cuddalore District of Tamilnadu. The soil sample was air dried, powdered and then used for pot culture experiment. The soil belongs to red colour, Alfisols in order and the taxonomic classification of *Typic haplustalfs*. The treatments were control, 50% RDF, 75% RDF, 100% RDF, Neemcake, Pressmud and Chelated micronutrients and its different combinations.

Results:

Yield attributes

1. Number of productive tillers hill⁻¹

Among the different treatments, application of 100% recommended dose of NPK fertilizers, neem cake, pressmud and chelated multi-micro nutrients (T₁₀) recorded significantly highest number of productive tillers hill⁻¹(6.17) compared to (3.16) T₁ (control).

2. Number of fingers earhead⁻¹

Significant differences in number of fingers ear head⁻¹ was noticed due to various treatments. Application of 100% recommended dose of NPK fertilizers, neemcake, pressmud and chelated multi-micro nutrients (T₁₀) recorded significantly highest number of fingers ear head⁻¹ (7.38). This was followed by T₇ (7.29), T₉ (7.04), T₈ (6.63) and T₆ (6.38).

3. Length of ear head (cm)

The highest length of ear head of 10.65 cm was found with T₁₀. The treatment T₇ registered the second highest length of ear head of 10.61 cm. The control (T₁) registered the lowest length of ear head of 7.21 cm.

4. Weight of ear head

Weight of ear head was significantly increased due to the application of different levels of NPK fertilizers, neemcake, pressmud and chelated multi-micronutrients as compared to control which recorded the lowest weight of ear head (1.25 g). Treatments T₁₀ and T₇ were recorded the weight of ear head of 2.71 and 2.65 g, respectively.

5. 1000 grain weight

1000 grain weight of ragi which ranged between 1.80 g and 2.80 g. This was followed by T₇(2.73 g), T₉ (2.62 g), T₈ (2.49 g), T₆ (2.42 g) and T₅ (2.42 g). There was no significant difference between the treatments. The findings of the present study was in agreement with the Subramani and Solaimalai (2000).

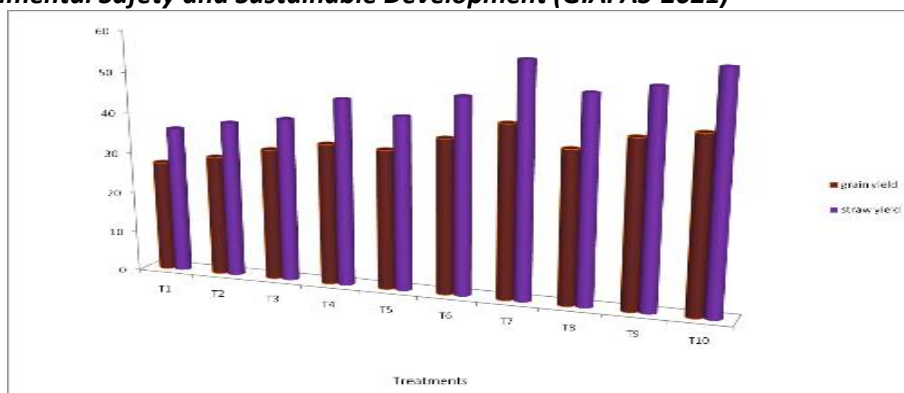


Fig.1. Effect of different levels of inorganic fertilizers, neemcake, pressmud and chelated multi-micro nutrients on yield of ragi cv. CO 13

Grain yield

The grain yield under various treatments ranged from 27.35 g pot⁻¹ (T₁) and 42.60 g pot⁻¹(T₁₀). There was significant increased in grain yield due to the application of different levels (0, 50, 75 and 100%) recommended dose of NPK fertilizers, neemcake, pressmud and chelated multi-micro nutrients. The above results are in conformity with the findings of Krishnaprabu (2002).

Conclusion: From the present investigation, it can be concluded that application of 100% RDF+ NC+ PMC+ CMN (T₁₀) registered the significantly highest yield parameters and grain yield of ragi in red soil. This was on par with with T₇. Hence, it is inferred that it is sufficient to apply 75% RDF+ NC+ PMC+ CMN to get maximum yield attributes and yield of ragi in red soil.

Key words: INM, NRM, Ragi, Yield attributes and yield

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Response of mustard varieties to different nitrogen levels

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ABSTRACT

Purpose: Mustard is the most important oil seed crop of the World, Effects of different nitrogen levels with different varieties were measured in terms of various quantitative indices viz. Growth and development (Number of shoots metre⁻¹ row length, plant height and dry matter accumulation in plants can assess.

Methods: Application of different nitrogen levels treatments significantly increasing dry matter accumulation per metre row length, yield attributes, spike length, number of spikes per metre row length, grains per spike and test weight as well as grain and straw yield.

Results: Result is concluded that variety RH-30 fertilized with 72 kg N ha⁻¹ produced significantly higher seed yield under the agro-climatic conditions of Jhajjar district of Haryana. The variables involved in this study were four rates of nitrogen (100, 110, 120 and 130% RDN 60, 66, 72 and 78 kg N ha⁻¹).

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Conclusion: Thus, in all 16 treatments combinations were compared in a “split plot design “having rates of nitrogen in main plots and varieties in sub- plots with three replications. The soil of experimental field was sandy loam and was well drained with a pH-8.13. The soil was low in available nitrogen (158.0 kg ha⁻¹), medium in available phosphorus (20.0 kg P₂O₅ ha⁻¹) and rich in potash (251.6 kg K₂O ha⁻¹); only 12.4 mm rains were received in the crop season.

Effects of different herbicides on weed and Yield of wheat ((*Triticum aestivum*)

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ABSTRACT

Purpose: Wheat (*Triticum aestivum* L.) is the most important grain crop of the World, Effects of different herbicide combinations on weed were measured in terms of various quantitative indices viz. Growth and development (Number of shoots metre⁻¹ row length, plant height and dry matter accumulation in plants can assess .

Methods: The experiment was conducted in R.B.D with three replications comprising ten treatments of weed management, clodinafop 60 g a.i ha⁻¹, sulfosulfuron 25 g a.i ha⁻¹, metribuzin at 105 g a.i ha⁻¹, carfentrazone 40 g ai ha⁻¹, clodi.+ metri 60 + 122.5 g a.i ha⁻¹ , clodi.+ metri 60 + 105 g a.i ha⁻¹ , sulfo.+ metri 25 + 105 g a.i ha⁻¹, sulfo.+ carfen. 25 + 40 g a.i ha⁻¹ as post emergence and weed free and weedy.

Results: The results indicated that chemical methods of weed control significantly reduced the weed population and dry weight effectively over weedy treatment. The tallest plants, maximum number of tillers/meter row length, highest weed control efficiency and highest grain yield (55.13 q/ha⁻¹) were recorded with the application of sulfosulfuron + Metribuzin 25 + 105 g a.i ha⁻¹ as post emergence established its superiority over rest of the herbicides. Similarly application of sulfosulfuron + metribuzin 25 + 105 g a.i. ha⁻¹ as post emergence resulted into higher gross return, net return and B: C ratio.

Conclusions: Concluded that application of Sulfosulfuron.+ metribuzin @ 25 + 105 g a.i ha⁻¹ as post emergence followed by clodinafop.+ metribuzin @ 60 + 122.5 g ai ha⁻¹ as post emergence proved superior than other treatment with respect to grain yield and economics of wheat.

Compensating nitrogen fertilizer requirement of wheat (*Triticum aestivum* L.) Through vermicompost and FYM under late sown condition

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ABSTRACT

Purpose: Wheat (*Triticum aestivum* L.) is the most important grain crop of the World, Effects of rates of nitrogen with vermicompost 3 tonnes ha⁻¹ and FYM 5 tons ha⁻¹ were measured in terms of various quantitative indices viz. Growth and development (Number of shoots metre⁻¹ row length, plant height and dry matter accumulation in plants can assess.

Methods: Application of different nutrient treatments like Vermicompost, FYM and RDN at different application rate significantly increasing dry matter accumulation per metre row length, yield attributes, spike length, number of spikes per metre row length, grains per spike and test weight as well as grain and straw yield.

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Results: On the basis of one year results it may be concluded that application of 80% RDN (120 kg N ha⁻¹) with vermicompost 3 tons ha⁻¹ may be replaced 100% RDN (150 kg ha⁻¹), because it produced significantly higher grain yield under late sown conditions of Jhajjar district, Haryana. Effect of rates of nitrogen with vermicompost 3 tons ha⁻¹ and FYM 5 tons ha⁻¹ were measured in terms of various quantitative indices viz. Growth and development (Number of shoots metre⁻¹ row length, plant height and dry matter accumulation in plants of 25 cm row length, days to 75 per cent flowering and days to physiological maturity of the crop. Yield and yield attributes (Number of spikes metre⁻¹ row length, length of spike, number of grains spike⁻¹, weight of grains spike⁻¹ and 1000 grain weight, biological, grain and straw yield ha⁻¹ and harvest index. The salient findings are summarized below.

Conclusion: Application of 80% RDN (120 kg N ha⁻¹) with vermicompost 3 tons ha⁻¹ required significantly more days to 75 per cent flowering and also to physiological maturity than control and 60% RDN with vermicompost 3 tons ha⁻¹ and FYM 5 tons ha⁻¹.

Key words: Vermicompost, FYM, RDN, yield.

Regeneration of plants via organogenesis in fungal screened callus tissues from leaf and nodal segments of *Dalbergia sissoo*

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ABSTRACT

Purpose: *Dalbergia sissoo* is a valuable timber species in the Northern India. In the past years, a large scale decline of Shisham trees of all age groups had been reported from India as well as from neighboring countries. *Fusarium solani* (Mart.) Sacc. f.sp. *dalbergiae* Bakshi and Singh has been reported as one of the primary pathogenic fungi causing mortality in *D. sissoo* due to vascular wilt. Considering the large scale economic loss caused by wilt pathogen (*F. solani* f.sp. *dalbergiae*) in Shisham plantations, we aim to screen 10 genotypes of *D. sissoo* *in vitro* against *F. solani* f.sp. *dalbergiae* and callus tissues that can withstand the selection pressure were further multiplied. A complete plant regeneration protocol was developed from these callus tissues via organogenesis.

Methods: Ten genotypes grown at Vegetative Multiplication Garden at New Forest, Forest research Institute, Dehradun were used as explants in the present study. Nodal segments and leaf were used as source material for micropropagation. Various combinations of phytohormones viz., BAP, 2,4 D, IBA and NAA in MS medium were tested for their effect on callus induction, organogenesis and plantlet regeneration. *Fusarium solani* f.sp. *dalbergiae* strains (isolate no. 1145 and 1149) were cultured in Petri dishes (9cm) on potato dextrose agar (PDA) medium at 25±2C.

Results: An efficient protocol was developed for *in vitro* callus induction, organogenesis and plantlet regeneration from fungal screened callus tissues from leaf and nodal segments of *Dalbergia sissoo*. Callus tissues of 10 genotypes multiplied *in vitro* and inoculated with conidial suspension of two strains of *Fusarium solani* f.sp. *dalbergiae*. Callus tissues of genotypes 14 and 66 significantly restricted the fungal mycelium growth, whereas callus tissues of remaining 8 genotypes were completely infested with fungal mycelium. Callus tissues of genotypes 14 and 66 obtained after screening was further multiplied on MS medium fortified with PGRs; BAP, 2, 4-D and NAA. The multiplied callus tissues exhibited shoot organogenesis after a period of 7 months. Maximum 71% shoot induction with highest mean shoot number (2.29) and (2.36) was observed in MS medium supplemented with 4.44 µM BAP + 2.26 µM 2, 4 D from leaf and nodal callus respectively. Maximum number of roots (2.86) and (2.71) per shoot was observed in half strength MS medium comprising 2.46µM IBA. The well rooted plantlets were acclimatized to a mixture of soil: sand: manure (1:1:1).

Conclusion: The selected pathogen tolerant callus tissues from nodal and leaf explants of genotypes 14 and 66 were transferred to plant regeneration medium. Regeneration of complete plants from callus still presents a big problem particularly in woody plants. In some cases, the callus may remain undifferentiated though showing prolific growth regardless of hormones and metabolites to which they are exposed. In the present investigation, however callus induction and multiplication was achieved on MS medium supplemented with BAP and 2, 4-D and subsequent shoot differentiation was achieved on the fresh medium of same combination without encountering any problem of callus undifferentiation.

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Key words: *Dalbergia sissoo*, *Fusarium solani* f. sp. *dalbergiae*, Fusarium wilt, nodal segments, leaf segments, callus, organogenesis, regeneration

PEG mediated destabilization of holo α -Lactalbumin Probed by *in silico* and *in vitro* Studies: Deviation from Excluded Volume Effect

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ABSTRACT

Purpose: To understand the stability and folding behavior of non heme proteins under various physiological conditions and assessment of effects of the crowding agents on non-heme proteins will be planned in this piece of work. Estimation of biophysical properties under crowding environment (in the presence of different size of PEG) will be helpful to understand the underlying mechanism and therapeutic implications in neurodegenerative disease due to protein misfolding.

Methods: Studies were performed at different pH monitored by various techniques for structural characterization and thermal stability.

Results: Structural characterization at different pH using Trp-fluorescence, near-UV CD and far-UV clearly shows perturbation of tertiary and secondary structure of protein by crowder. However, the dynamic light scattering measurement shows that the protein is homogeneous under all conditions. Further, the heat-induced denaturation profile shows destabilization in terms of T_m and ΔG_D^0 .

Conclusions: Current findings and many works done by other groups suggest that crowding effects were subjected to both the excluded volume effect and non-specific protein-crowder interactions.

Key words: Macromolecular crowding; Soft interaction; Structural characterization; Thermal stability

Effect of climatic condition, altitudinal gradient and aspects on physiological traits of *Cedrus deodara* (Roxb.) G. Don in north-western Himalaya

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ABSTRACT

Purpose: Species performance may be affected in response to altitudinal gradient and aspects variations; climate change can modify these variables and at the lower limit of species distributions, individuals may become stressed and their health performance hampered. Hitherto no study has been carried out to show the effects on physiological traits of *Cedrus deodara* at past. Therefore, the present study entitled with effect of climatic condition, altitudinal gradient and aspects on physiological traits of *Cedrus deodara* (Roxb.) G. Don in north-western Himalaya.

Methods: The samples of needles were collected from two different climatic conditions viz., Wet temperate (temperate areas of Shimla, Sirmour, Solan and Kullu district) and Dry temperate (Kinnaur) from four different altitudinal ranges <1800m asl (L_1), 1800-2100m asl (L_2), 2100-2400m asl (L_3) and >2400m asl (L_4) and three aspects western (A_1), northern (A_2) and northwestern aspect (A_3).

Results: Variation in physiological traits was significantly influenced due to the average effect of climatic conditions, altitudinal ranges and aspects. The highest total nitrogen (0.52%) and total carbon (0.72%) was found at <1800 m (L₁) followed by L₂, L₃ and L₄, respectively. And maximum total phenol (2.07 mgGAE/gm) was found at >2400 m (L₄) followed by L₃ (1.49 mgGAE/gm), L₂ (1.34 mgGAE/gm) and L₁ (1.21 mgGAE/gm). The highest chlorophyll (2.61 µg/ml), total sugar (7.76%) and total starch (9.61%) content was found at 1800-2100 m (L₂) and the lowest content was observed in L₁ (3.45%) and (5.30%), respectively. Total sugar and starch content and chlorophyll of tree needles were found maximum in northern aspect at 1800-2100m asl. The needles collected from the trees growing in the dry temperate climatic conditions accumulated more chlorophyll content than wet temperate.

Conclusion: It is concluded that the physiological traits of trees of *C. deodara* is being reflected in the needles' nutritional status, which are measures in the form of total sugar, starch and chlorophyll contents. The northern and north-western aspects are in better health conditions than those appearing on the western aspect,

Key words: altitudinal gradients, aspects, physiological traits, *Cedrus deodara*

Quantitative analysis of DNA from human samples under temperature and incubation period variations

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ABSTRACT

Purpose: DNA is the blueprint for life. Isolation is one of the most basic & essential techniques in study of DNA. The extraction of DNA from cells and its purification are of primary importance to the field of research in life sciences (mainly biotechnology, microbiology & forensics). The present study was designed to study the quantitative effect of temperature variations and incubation period variations on the human DNA from blood, hair and saliva samples. This study provides an idea to process forensic and valuable samples that can't be collected again from original sites.

Methods: DNA was extracted using different combinations of lysis buffers (LB1, LB2, LB3 & LB4) with SDS as the prime ingredient for sample studies. The lysis buffers consisted of varied concentrations of mainly sodium chloride (NaCl) and ethylenediamine tetra acetic acid (EDTA) with 20% SDS and proteinase K buffered at pH 8.0. The samples were pre-processed with respective lysis buffer at 37 °C & 56 °C for 1.5 hours, 4 hours and overnight incubation period. These samples were then subjected to DNA extraction using SDS extraction method (Ballinger Crabtree *et al.*, 1992). The quantity and quality of DNA was checked using NanoDrop spectrophotometer and agarose gel electrophoresis.

Results: The best peak for DNA isolation from hair at 56 °C appeared when incubation period was of 4 hours while at 37 °C, the best peak appeared when incubation period was of overnight. For DNA isolation from blood at 56 °C, there was a slight variation among all the three incubation periods while at 37 °C, the best peak appeared when incubation period was of 1.5 hours. Whereas for DNA isolation from saliva at 56 °C, the best peak appeared when incubation period was of 4 hours while at 37 °C, the best peak appeared when incubation period was of overnight.

Conclusions: From the current study it can be concluded that for DNA isolation at 56 °C, the best amount of DNA appears at 4 hours incubation period. However, for DNA isolation at 37 °C, the best amount of DNA appears at overnight incubation period.

Keywords: DNA, qualitative analysis, quantitative analysis, SDS extraction, Molecular diagnosis

Synthesis of Chitosan-TPP loaded Propyl Paraben Nanoparticles

Ritika, dolly rani and Neeraj dilbaghi

ABSTRACT

Purpose: Propyl paraben is a hydroxybenzoate used as a preservative. Propyl paraben is N-Propyl ester of p-hydroxyl benzoic acid is found in many plants. This is an antimicrobial agent, preservative and flavoring agent. Parabens are hydrophobic molecules whose antimicrobial activity seen in many cosmetics and pharmaceuticals. Parabens are effective preservatives in many formulas. Parabens are widely used for their fungicidal and bactericidal activities. They are found in various cosmetics like shampoo, shaving gels and sunscreens. They are also used as food additives to enhance the shelf life. They are cost effective as preservative and their use from long time explains why they are so commonplace. In present study, we aim to assess the activity of Nanoparticles formed from the Propyl Paraben coated with Chitosan-TPP.

Methods: Propyl paraben loaded chitosan-TPP nanoparticles synthesized by ionic gelation method. In this method negatively charged TPP particles interact with positively charged chitosan nanoparticles. Synthesis involves preparation 100 ml solution of 5% propyl paraben in ethanol. Chitosan was placed on magnetic stirrer having a magnetic bead at 1000 rpm drug was added dropwise. After this 2.5 ml tween 80 added to solution. Now 20 ml TPP solution added and kept on stirrer for 2 h. after completion of all this characterization of formed nanoparticles were by PSA, ZETA SIZER, EE, FTIR and TEM were evaluated.

Results: Particle size of formed nanoparticles were found to be 280 nm and having good homogenous dispersion in suspending medium. Zeta potential were +30.3 V which confirm that these nanoparticles can be stable for long period of time. EE (encapsulation efficiency) was 89 % which shows that the entrapment of propyl paraben in chitosan-TPP. TEM micrograph of these nanoparticles displayed semi-spherical in shape with diameter ranging from 290-380 nm.

Conclusion: These nanoparticles were found to be stable and effective after characterization and suitable for use as a better preservative due to high EE and its stability.

Key words: Nanoparticles, Chitosan, TPP, Propyl Paraben

Onion Storage: A critical study

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Introduction

Onion is important spice commodity consumed in India almost every day in every kitchen. Unlike other vegetables their requirement is daily in the kitchen and therefore, augmentation of daily supply in the market at reasonable prices for both producers as well as consumers is highly essential. However, onion is harvested twice or thrice in a year. Unless stored for some time, daily supply, irrespective of season is not possible. Therefore, storage of onion becomes inevitable for regular supply to consumers as well as value addition for farmers and exercising control over price fluctuations. The present storage capacity of onion is about 4.6 lakh tonnes.

The total production of onion is available in three different seasons. About 20% production is from monsoon *kharif* crop in the month of October-November, 30% onion is available as late *kharif* crop during January-February and 50% produce is available as winter (*rabi*) crop or main crop countrywide during April-June. Kharif and late Kharif produce is consumed during one or two months as there is heavy demand from domestic market as well as export and therefore, does not require storage. Further, the produce of kharif and late kharif has no storage capacity and hence required to be marketed immediately. Rabi harvest is from April to June and is in high quantity available countrywide. Since availability and supply is more, the rates are low from April to July. Since, there is no next harvest till November; these bulbs need to be stored for augmenting regular supply till November

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and further till February, if *kharif* fails due to monsoon vagaries. The farmers, if they sell during April to July are looser as the prices are low. They need to store their produce to add value on it.

Methods: A survey of onion storage structures was conducted in major onion and garlic growing areas of Madhya Pradesh i.e. Indore, Ujjain, Dewas, Ratlam, Mandasaur, Sagar, Rahli, Khurai, Chhindwara, Seoni, Balaghat and nearby villages. The information received from the farmers (Primary data) was noted in the questionnaire and the average/ mean was calculated.

Results: In Indore, Ujjain, Dewas and their nearby villages most of the structures are concrete structures with side and top ventilation (Fig.1). In these areas storage is done on the iron wire mesh placed 20-25 cm above the ground with the help of bricks, to provide bottom ventilation. Farmers are storing Rabi onion in these structures for about 3-4 months. Farmers are also using exhaust fans during hot summers. Sorting of rotted bulbs will start 1 month after storage and afterward it will be done at 15 days interval. About 25-30 % losses were observed by the farmers, when they stored onion for 3 months. After 3 months of storage there is sudden increase in rotting and sprouting, hence farmers will sell their product within 3 months of storage.

In Ratlam and their nearby villages most of the structures are concrete structures with bottom and top ventilation (Fig.2). In these areas storage is done in onion nylon bags and these bags are placed in specific batches containing 100 bags followed by a blank space of 1 M for ventilation. Farmers are storing Rabi onion in these structures for about 2-3 months. About 20-25 % losses were observed by the farmers, when they stored onion in these structures for 3 months.

In Mandasaur and their nearby villages most of the structures are Bamboo structures with bottom and top ventilation (Fig.3). In these structures storage of onion is done by filling in the bin shaped structures. Farmers are storing Rabi onion in these structures for about 2-3 months. About 25-30 % losses were observed by the farmers, when they stored onion in these structures for 3 months. The cost of construction of these structures is low as compared to concrete structures.

Conclusion: Temperatures during April to June increase respiration and there is weight loss. During July to September due to high humidity and warm temperature fungal diseases get activated and create rotting to the tune of 10-12 percent. During October –November low night temperatures help releasing Gibberellic acid in bulbs which breaks dormancy of bulbs and there is sprouting of bulbs. This is qualitative loss which accounts for 10-20%. In short, total storage losses are to the tune of 40 to 49 percent.

Storage is a function of genotypes, cultural practices and storage environment maintained during storage time. There are genotypic differences about storage. Certain varieties that are specifically bred for winter season have better storage than monsoon season varieties. For higher yield and better storage varieties like Bhima Kiran, Bhima Shakti, AFLR, Pusa Red, Arka Niketan should be used. Cultural practices like fertilizer doses and quality fertilizers along with irrigation scheduling decide the storage behavior. Low nitrogen more of sulphur, moderate irrigation through drip, withholding of irrigation 15-20 days before harvest, field curing of bulbs along with top, cutting of tops with long neck, grading and shed curing for 15 days enhance the storage life. And finally the storage environment mainly decides the storage behavior.

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ABSTRACT

Purpose: In order to check the growth of microbial pathogens and to ensure a pathogen free and potent food and pharmaceutical product, it is mandatory to apply microbiological techniques for microbial analysis (from the area of production to the finished product) so that safe food products, beverages & cosmetics products comes in market and the customers could consume it fearlessly.

Methods:

Microbial limit tests (m.l.t) are performed to check the microbial load in the products preparations.

Preservative efficacy test (p.e.t) was applied to finished products.

Microbial monitoring of aseptic area by expose plate media

Microbial monitoring was done to evaluate presence of total microbial count in control or uncontrolled area.

Following media were used for microbial monitoring- Soybean Casein Digest Agar, Sabouraud Dextrose Agar, Chloramphenicol Yeast Glucose Agar, Plate Count Agar.

Culture Media Performance Test

Culture media allowed the proper growth of microorganism and media (Soybean Casein Digest Agar) had enhancing properties to check microorganism’s performance in the laboratory.

Results: The present course of study has been done to evaluate product materials for total bacterial count, total fungal (yeast and molds) count, and total *Enterobacter* count. There are huge numbers of microbial pathogens and all of them could not be detected at same time. So we have considered only those microbes which are commonly responsible for products contamination and are associated with humans such as *E.coli*, *Salmonella* sp., *Pseudomonas aeruginosa*, *Staphylococcus* etc.

Conclusion: Microbial contamination means presence of viable bacterial and fungal cells in the products and associated materials. It is necessary to enumerate total microbial count in finished products as their presence indicates the poor quality of products. The main source of bacterial and fungal contaminations in food, pharmaceutical industries are from the unhygienic area, unprocessed water, contaminated equipment and containers, person itself and contaminated material being used for product formation.

Key words: Microbial techniques, pharmaceutical products, microbial limit test, colony counter etc.

Histopathological impact of vitamin-C on sodium fluoride exposed Amur carp (*Cyprinus carpio haematopterus*)

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ABSTRACT

Purpose: The aims of the present study were to examine the histopathological alterations induced by sodium fluoride exposure in the various tissues of Amur carp (*Cyprinus carpio haematopterus*) and also to evaluate the ameliorative effect of dietary supplementation with vitamin C on NaF-induced toxicity in Amur carp.

Methods: The experiment was designed for 90 days with 150 fish divided into 5 groups of 30 which were housed in triplicate with 10 fish per tank. The groups included

G1 (control group)

G2 (exposure to 100 ppm NaF)

G3 (fed with 100 ppm vitamin C supplemented diet)

G4 (exposure to both 100 ppm NaF and 100 ppm vitamin C supplemented diet) and

G5 (exposure to 100 ppm NaF for the first 60 days and then 200 ppm vitamin C supplemented diet for the last 30 days)

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Results: Tissue samples of the gills, liver, spleen, intestine and kidney were collected after every 15-day interval for histopathological examination. In groups G1 and G3, no histopathological changes were observed in any of the tissues examined throughout the experimental period. G2 showed more intense microscopic lesions compared to G4. In G5, the severity of the histological lesions was similar to group G2 from the 15th DPT (day post treatment) to the 60th DPT (the end of the NaF exposure) whereas from the 75th to the 90th DPT the severity of the lesions was not increased.

Conclusion: The study concluded that sodium fluoride exposure has caused adverse effects on the tissues of Amur carp exposed to 100 ppm NaF and supplementation with 100 ppm vitamin C can be recommended in aquaculture systems to prevent the adverse effects of NaF exposure at 100 ppm. Treatment with 200 ppm vitamin C is not able to not reverse the damage already caused by 100 ppm NaF.

Key words: Vitamin C; Amur carp, Sodium fluoride; Histopathology; Amelioration

Assessment of the effect of compost amendment on sorption of sulphonamide antibiotics in sandy loam soils of Delhi

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ABSTRACT

Antibiotics are widely used in human and veterinary therapeutic applications. The antibiotics are introduced into the environment through animal excreta, hospital wastes, etc. The antibiotic residues are detected in different environmental matrices like soil and water. Sulphonamide antibiotics are a group of having relatively high polarity and water solubility. The effect of the use of compost as soil amendment on sorption behaviour of two antibiotics namely sulfamethazine and sulfamethoxazole were investigated in sandy loam soil of Delhi.

Methods: Sorption study was conducted as per OECD procedures. Sandy loam soil was collected from Delhi and was characterised. The sorption study was conducted at five different initial concentrations at a soil: solution ratio of 1: 3. The effect of compost dosage on sorption was assessed at three levels The sorption was also assessed by amending the soil with 10% compost.

Results: When compost was used as the sorbent, the sorption of antibiotics was found to increase with the compost dose. The sorption of sulphonamides increased from 37 to 81% on increasing the compost dose from 150 mg to 1000 mg. Among the two antibiotics, highest adsorption was exhibited by sulfamethoxazole owing to its lower water solubility. At the compost dose of 1000 mg, both the antibiotics exhibited nearly 90% sorption at lower initial concentrations. The average K_d values were also quite high when the compost dose was increased to 1000 mg indicating stronger adsorption. The antibiotics exhibited sorption of 43-50% in compost amended soil as compared to 21-25% in sandy loam soil. Sorption data was found to fit into non linear Freundlich isotherm indicating heterogenous sorption of the selected antibiotics onto the compost amended soil. The retardation factor, the resistance to movement of antibiotics through the soil, indicated that the amendment of soil with compost will reduce the leaching of antibiotics. Since manure also act as source for antibiotics, proper composting of the manure need to be done before introducing them to the field.

Conclusions: The use of properly composted organic amendments can prevent the leaching of antibiotics and prevent the ground water pollution.

Key words: Sulphonamides, sorption, sandy loam soil, compost

Reclamation of degraded lands through *Melia dubia* based agroforestry system

Krishma Nanda, Sandeep Arya

ABSTRACT

Purpose: Trees in agroforestry systems offer a great relief to farm soil by providing ample amount of nutrients, intangible benefits and by ameliorating the environment for raising of crops. With the increase in agricultural innovations human intensification of agriculture has increased food production to a greater extent but along with this it has caused extreme deterioration to environment. The Physico-chemical properties of soil improve through decomposition of leaf litter added by perennial tree species. Tree species like *Melia dubia* have a significant impact on soil properties, which could help to nurture farm lands through addition of large amount of leaf litter.

Methods: Laboratory investigations on the physico-chemical characteristic of a soil under agro forestry at three depths (0 to 15cm, 15 to 30 cm and 30 to 45cm), were carried out in the CCSHAU, HISAR. The present study was conducted in an already established four-year old plantation of *Melia dubia* plantation raised at a spacing of 3 m × 3 m at village Gillan Khara in the district of Fatehabad in western part of Haryana. Five barley varieties were raised in four replication plots during Rabi season of 2018-19 in the interspaces of the trees.

Results: Available N, P, K content was found higher under *Melia* based agri-silvicultural system as compared to control. Values of N, P, K were recorded higher at soil depth of 0-15 cm in comparison to soil depth 15-30 cm. Improvement of water permeability, water holding capacity, improvement of infiltration rate, soil fertility and other features are characteristics of soil as influenced by tree species. Agroforestry improves soil productivity apart from providing an assurance to the farmers against any uncertainty.

Conclusions: *Melia dubia* trees grown in semi-arid environment of Haryana in an agroforestry system showed positive effects on soil health. The nutrient content increased in the intercropped system. Moisture content was higher under trees compared to open conditions and this factor contributed to overall changes showing improvement of soil fertility. Overall this very intercropping system could be suggested for its number of benefits such as recycling through litterfall, improvement in soil fertility and environmental benefits.

Key words: *Melia dubia*, Soil nutrients, Soil moisture, Agroforestry

Effect of nitrobenzene on plant growth, yield and minerals content of tomato

Nahid Sultana, Md. Abdul Owhab Mridha, Tuhin Suvra Roy and Rajesh Chakraborty

ABSTRACT

Purpose: Tomato (*Solanum lycopersicum* L.) belongs to the family Solanaceae is one of most popular and nutritious vegetables of Bangladesh. The low yield of tomato in Bangladesh; however, is not an indication of low yielding ability of this crop, but of the fact that low yielding variety, low standard crop management practices and lack of better technologies. My aim to identify, the activity and effect of plant growth retardant nitrobenzene in crop production to improve plant growth and yield by increasing fruit set, fruit number and weight and their significant roles in the development of tomato fruit.

Methods: The experiment comprised of two factors. Factor 1- Tomato varieties, V₁ (BARI Tomato- 1) and V₂ (BARI Tomato-2) and factor- 2- Plant Growth Retardant viz, nitrobenzene doses (4 Doses): T₁= 0 ppm, T₂=1.5 ppm, T₃=2 ppm, T₄=2.5 ppm was outlined in Randomized Complete Block Design (RCBD) with four replications and there were all together 32 plots. Application of nitrobenzene significantly influenced the height, yield and minerals content of tomato.

Results: Regarding correlation studies, It can be easily stated that, variety V₂ (BARI Tomato-2) showed maximum leaves number, maximum branch number, days of 1st flowering from transplanting, flower per cluster,

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flower per plant, fruit per cluster, fruit per plant, single fruit weight, fruit yield per plot, yield per hectare and nutrient content. On the other hand, 2mL dose of nitrobenzene application performed excellent among the nitro benzene treatment applied in terms of all parameters. Besides the combination, variety (BARI Tomato-2) treated with 2mL dose of nitrobenzene performed as the best combination in case of mineral nutrients, maximum mineral (Na, K, P) found in (T₂) treatment and Ca found in (T₁) where minimum found in (T₃).

Conclusions: To sum up, it can be said, combination treatment of variety BARI Tomato-2 and 2mL dose of nitrobenzene (V₂T₂) was the best for growth, yield and quality attributes of tomato. These results might be helpful for further research to establish a new growth retardant in tomato.

Key words: Growth Retardant, yield, quality, mineral content, nutrient content

Alleviation of adverse effects of salt stress in tomato by foliar application of salicylic acid
Md. Abdul Owahab Mridha, Nahid Sultana, Tuhin Suvra Roy and Rajesh Chakraborty

ABSTRACT

Purpose: Tomato (*Solanum lycopersicum* L.) belongs to the family Solanaceae is one of the world most important and widespread crop with adverse effects of salinity which reduced tomato yield but improved fruit quality traits, such as total soluble solid and color I want to identify the best combinations of salinity and salicylic acid for better yield attributes, yield and quality of tomato to reduce the soil salinity problem observed both in coastal zone and inland is a pervasive threat to agricultural production and the environment in view of its adverse effects on sustainable use of land and water resources.

Methods: The experiment comprised of two factors: Factor-1. Salinity levels: 0, 3, 6 and 9 dSm⁻¹ and Factor- 2. Rate of salicylic acid: 0 mM, 0.5 mM, 1 mM and 1.5 mM. BARI tomato -14 was used as the test crop. Data were taken from different parameters. When single effect was considered, salinity adversely affected most of the growth and yield parameters and nutrient content except Na, but application of salicylic acid elevated all the mentioned parameters.

Results: Regarding correlation studies of this experiment, salinity levels (S₀) showed maximum tallest plant height, leaves number, maximum branch number, days to flower, flower cluster⁻¹, flower plant⁻¹, fruit cluster⁻¹, fruit plant⁻¹, single fruit weight, fruit yield plot⁻¹ and nutrient content. On the other hand, (SA_{1.5}) doses of salicylic acid application performed excellent among the salicylic acid treatment applied in terms of all parameters.

Conclusions: This study concluded with the fruit weight of tomato gradually decreased by the increase of salinity levels and this reduction rate was decreased by foliar application of salicylic acid and tomato showed significant variation to salinity levels and salicylic acid doses. To sum up, it can be articulated that (S₀) was the most outstanding salinity levels and (SA_{1.5}) of salicylic acid application and combination treatment (S₀SA_{1.5}) was the best for growth, yield and quality attributes of tomato.

Key words: Salicylic acid, salinity, yield, quality, mineral content, nutrient content, foliar application

Impact of Krishi Vigyan Kendra Dehradun on Women Empowerment: A Study

Kiran pant, A .K. Sharma, Pravin Kumar

ABSTRACT

Purpose: The skill development is an important agenda for empowering rural women which ultimately lead to new small scale enterprise development. Training has been one of the important means of upgrading professional skill of practicing farmers and rural women. This is very essential in the area of agriculture where the technologies are changing day by day and the knowledge of the farming community including women need to be upgraded at a comparatively quicker pace. Today, a number of organizations are focusing on women regarding starting their own ventures by providing them skilled training and knowledge. Krishi Vigyan Kendra (KVK) that provides vocational training to the rural women for making them self-dependent which ultimately help to empower them. KVK Dehradun was established in the year 2004 and its functioning started in the year 2005. Since its inception this KVKs is performing multidimensional roles, starting from core activities such as technology backstopping, introduction of cutting-edge techniques, and up-scaling at one end, and envisioning entrepreneurial opportunities in rural areas, providing vocational/skill training to rural youth, women folks on the other end. Time and again, there were empirical evidences to prove that the KVK System has positively impacted the quality of life of farming community in terms of income, yield, productivity, and above all capacity for optimal utilization of resources etc

Methods: To study the role of KVK Dehradun in empowerment of rural women a study was undertaken by collecting comprehensive data for the last 5 year .The primary data were collected with the help of interview schedule from those trainees who participated in the any of the programmes conducted for the farmers, and annual, quarterly and other reports served as the secondary source for data collection.

Results: The responses so gathered are that majority of the respondents (70 %) stated their knowledge and skill developed after getting vocational trainings from KVKs. Majority of the members were having training exposure (78 %) and membership of their SHG was in between 10-15 years (92%), while 36% of the members were directly involved in income generating activities by means of dairy, craft, stitching etc.. Sixty eight per cent stated that supplementing the family income as most important factor behind joining SHGs. They are associated (88%) with one or other organizations for the cause of skill development, financial assistance for income generation activities, marketing etc. to run their own micro business They are strengthen to market their products within and outside the state by participating in different fairs. Few of them are selling their products online also.

Conclusions: Though, the percentage of respondents reported their family income raised which lead to upgrade their socio economic status is low (25%) ,but at the same time its very satisfactory that with the efforts of KVK the rural women are coming forward to participate in the developmental programmes/schemes in a larger number now.

Keywords: Self Help groups, Women Empowerment, skill Training, Krishi Vigyan Kendras

Assessing the impact of elevated ozone and ozone protectants on yield of garlic

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ABSTRACT

Purpose: Tropospheric ozone is becoming censorious issue day by day, due to its escalating concentration levels that provide route to decline in agricultural productivity. It is a short lived greenhouse gas as well as a secondary pollutant formed via the photochemical oxidation of carbon monoxide, methane or non-methane volatile organic carbons emitted from vehicles, solvents, industries etc. O₃ at higher concentration enters in to the crops through stomata, which increased the transpiration rate and O₃ flux within the cells of foliage. This increased the ROS (Reactive Oxygen Species- peroxides and free radicals) production and accumulation resulted in phytotoxicity in the internal leaf tissue of plants, which reduced, growth and yield (product synthesis) as well as their quality. To keep pace with increasing global population, crop production has to magnify by 2050, whereas the target to pull off is more challenging, which is liable with the outcome of climate change and air pollution. Thus there is necessity in studying the increasing concentrations of surface ozone impacts on yield of agriculture to feed the growing population.

Materials and methods

Experimental Site and Design

The experiment was conducted by growing Garlic in pots under open top chamber during September to December of 2018 at the experimental farm of TNAU- Indian Space Research Organization- Climate Change Observatory, Woodhouse Farm, Horticultural Research Station, Nilgiris.

Treatments

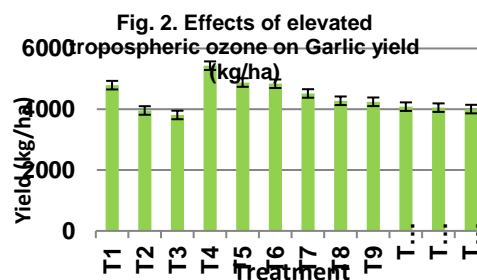
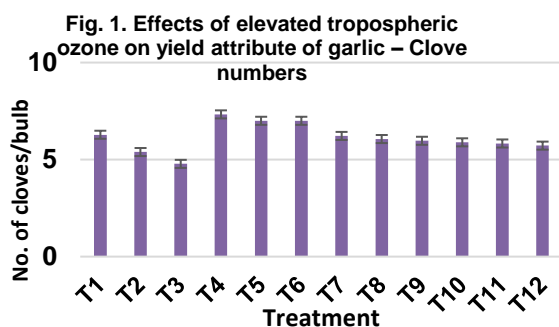
The experiment was carried out by growing garlic in pots and exposed to different levels of ozone in open top chamber (OTC) with treatments arranged in completely randomized block design (CRD) with three replications.

Table 1. Treatment details

Experiment: Garlic Replication : Three	Design : CRD No. of Treatments : 12
T ₁ – Ambient ozone level	T ₇ – Elevated ozone exposure @ 150 ppb + foliar spray 3% Panchagavya
T ₂ – Elevated ozone exposure @ 150 ppb	T ₈ – Elevated ozone exposure @ 150 ppb + foliar spray 3% Neem oil
T ₃ – Elevated ozone exposure @ 200 ppb	T ₉ – Elevated ozone exposure @ 150 ppb + foliar spray 0.1% Ascorbic acid
T ₄ – Ambient Ozone level + foliar spray 3% Panchagavya	T ₁₀ – Elevated ozone exposure @ 200 ppb + foliar spray 3% Panchagavya
T ₅ – Ambient Ozone level + foliar spray 3% Neem oil	T ₁₁ – Elevated ozone exposure @ 200 ppb + foliar spray 3% Neem oil
T ₆ – Ambient Ozone level + foliar spray 0.1% Ascorbic acid	T ₁₂ – Elevated ozone exposure @ 200 ppb + foliar spray 0.1% Ascorbic acid

Observations were recorded on garlic plant after harvest for four characters namely, diameter of bulb (cm), average bulb weight (g), number of cloves per bulb and yield (kg/ha).

Results: At the experimental site, monitored O₃ data depicted that ambient O₃ levels exceeded the AOT 40. Accordingly, most of the yield and yield attributes were significantly affected at higher levels of ozone, where the treatment with ambient ozone exposure with ozone protectants were superior in all parameters. Significantly highest values of number of cloves (7.33/ bulb), diameter of garlic (3.46 cm), weight of bulb (8.15 gm) and yield of garlic were recorded in the treatment ambient ozone exposure with 3% panchagavya (T₂) followed by ambient ozone exposure with 3% neem oil (T₃) and ambient ozone exposure with 0.1% ascorbic acid (T₄). With the elevated O₃ treatments the number of cloves (6.22/bulb), diameter of bulb (2.65 cm), weight of bulb (6.75 gm) and yield of garlic, significantly recorded highest in the treatment elevated ozone exposure @ 150 ppb with foliar spray of 3% panchagavya (T₇) compared to other elevated ozone level, whereas the lowest values were recorded in elevated ozone exposure @ 200 ppb (T₆). This showed that the drastic increase in concentration of O₃ decreases the yield of garlic.



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Table 2. Effects of elevated tropospheric ozone on yield attribute of garlic – Bulb diameter (cm) & Bulb weight (gm)

Treatments	Diameter of bulb (cm)	Weight of bulb (gm)
T ₁ – Ambient ozone level	2.93 ± 0.029 ^{cb}	7.19 ± 0.252 ^{cb}
T ₂ – Elevated ozone exposure @ 150 ppb	2.04 ± 0.087 ^{fe}	5.94 ± 0.271 ^{ed}
T ₃ – Elevated ozone exposure @ 200 ppb	1.99 ± 0.081 ^f	5.72 ± 0.300 ^e
T ₄ – Ambient Ozone level + foliar spray 3% Panchagavya	3.46 ± 0.128 ^a	8.15 ± 0.119 ^a
T ₅ – Ambient Ozone level + foliar spray 3% Neem oil	3.23 ± 0.059 ^{ba}	7.32 ± 0.061 ^b
T ₆ – Ambient Ozone level + foliar spray 0.1% Ascorbic acid	3.05 ± 0.079 ^b	7.26 ± 0.460 ^{cb}
T ₇ – Elevated ozone exposure @ 150 ppb + foliar spray 3% Panchagavya	2.65 ± 0.301 ^{dc}	6.78 ± 0.616 ^{dc}
T ₈ – Elevated ozone exposure @ 150 ppb + foliar spray 3% Neem oil	2.37 ± 0.089 ^{ed}	6.42 ± 0.147 ^{ed}
T ₉ – Elevated ozone exposure @ 150 ppb + foliar spray 0.1% Ascorbic acid	2.16 ± 0.023 ^{fe}	6.37 ± 0.030 ^{ed}
T ₁₀ – Elevated ozone exposure @ 200 ppb + foliar spray 3% Panchagavya	2.39 ± 0.025 ^{ed}	6.13 ± 0.055 ^{ed}
T ₁₁ – Elevated ozone exposure @ 200 ppb + foliar spray 3% Neem oil	2.25 ± 0.030 ^{fe}	6.08 ± 0.182 ^{ed}
T ₁₂ – Elevated ozone exposure @ 200 ppb + foliar spray 0.1% Ascorbic acid	2.05 ± 0.035 ^{fe}	6.01 ± 0.147 ^{ed}
P value	0.000	0.000

Conclusion: The increase in concentration of tropospheric ozone in the atmosphere affects the yield and quality of crops. From the study concludes that increase in the concentration of tropospheric ozone showed detrimental effects on yield attributes (diameter of bulb, weight of bulb and no. of cloves per bulb) and yield of garlic whereas the ozone protectants (panchagavya, neem oil and ascorbic acid) helped in scavenging the ozone in the apoplast of the leaves of garlic, among them panchagavya performed well followed by neem oil and ascorbic acid. Moreover, the tropospheric ozone effects on yield and quality of both agricultural as well as horticultural crops requires more attention to withstand productivity for future climatic change scenarios and identification of suitable remedial measures against tropospheric ozone to sustain our food production for ensuring food security.

Key words: Ambient Ozone, Elevated ozone, Ozone protectants, Garlic, Panchagavya

Effect of invigoration treatment of different soaking periods on germination performance of bottle gourd seeds

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ABSTRACT

Purpose: This current experiment was conducted in a Seed Testing laboratory, Department of Genetics and Plant Breeding Sam Higginbottom University of Agriculture Technology and Sciences, Allahabad, Uttar Pradesh during January 2021 with calabash, so as to subsume the foremost method of invigoration of priming specific to calabash.

Methods: Method of invigoration as in priming viz., halopriming were assessed by checking a different period of durations and chemical concentrations viz., 1st treatment– Unprimed seeds (control), 2nd treatment - 50 ppm KNO₃ for 12 hrs, 3rd treatment - 50 ppm KNO₃ for 18 hrs, 4th treatment -100 ppm KNO₃ for 12 hrs, 5th treatment -100 ppm KNO₃ for 18 hrs, 6th treatment -125 ppm KNO₃ for 12 hrs, 7th treatment- 125 ppm KNO₃ for 18 hrs. Experiment perform by between paper method and by sand method at control condition and where, the statistical data was done by using factorial experiment allocate by Completely Randomised Design (CRD).

Results: In this experiment it was found that, treatment 6th 125 ppm KNO₃ for 18 hrs., has the noteworthy result as compared to all the other treatments accompanying the seedling parameters, the highest germination %, seedling length, weight and vigor index I & II. This study showed that Seed priming with KNO₃ found to increases the seed quality parameters.

Conclusions: In this study demonstrated the market high paying and most reasonable method. This study makes possible to improve the worth and interpretation of seeds with the help of seed priming with KNO₃ treatments which have effect on market price rate and budgetary, innocuous, nature-friendly sources.

Key words: Bottle gourd, Potassium Nitrate (KNO₃).

Floristic diversity, aboveground biomass and carbon stock in coffee-based agroforestry system and adjoining natural forests of Central Western Ghats, India

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ABSTRACT

Purpose: Kodagu is one of the greenest landscapes in India with 81% of the geographical area under tree cover contributing to the rich biodiversity representing about 8% of India's plant wealth. The study was aimed to assess and compare the floristic diversity, biomass and carbon between coffee-based agroforestry system and adjoining natural forests.

Methods: We used random sampling technique for field data collection and 50 sample plots of 40 m x 40 m (0.16 ha.) were laid, of which five in adjoining evergreen forests and 45 in coffee-based agroforestry system, during the year 2018-19.

Results: Total of 102 tree species in coffee agroforests and 50 tree species in adjoining forests were recorded. Shannon's diversity was highest in coffee agroforests (3.60) compared to the natural forest (3.32). Higher tree density (351 ± 19.35 stems ha⁻¹) was recorded in coffee agroforests compared to natural forests (287 ± 13.53

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stems ha⁻¹). Conversely, basal area was found to be higher in natural forests (39.53 ± 0.38 m² ha⁻¹) compared to coffee agroforests (29.54 ± 1.34 m² ha⁻¹). Amount of carbon stored in adjoining natural forests was to the tune of 88.84 ± 2.90 Mg ha⁻¹ while in coffee-based agroforestry system it was found to be 77.39 ± 3.30 Mg ha⁻¹. Management of coffee agroforests, particularly shade tree management, plays an important role in carbon storage and dynamics. *Artocarpus integrifolia* (23.11%) was the dominant tree species in coffee agroforests whereas, *Elaeocarpus tuberculatus* (28.25%) was dominant in natural forests. Girth class distribution showed the pattern of inverted J shape curve, while in agroforests it was positively skewed.

Conclusions: Based on the results of this study, we conclude that traditional coffee-based agroforests are floristically richer than adjoining natural forests and these land-use systems offer greater opportunities for biodiversity conservation as well for higher carbon storage in this region.

Key words: Western Ghats, Coffee based agroforestry system, Floristic diversity, Above-ground biomass, Carbon stock.

Assessment of High Yielding Varieties of Linseed (*Linum Usitatissimum* L.) Through Front Line demonstration in Dindori District

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ABSTRACT

Linseed (*Linum usitatissimum* L.) is a traditional oilseed crop in Dindori district that represents a valuable alternative for cropping systems because of the high quality of the seed oil, which is being increasingly appreciated by consumers, food, cosmetic and eco materials industries. The aim of this study was to evaluate the influence of linseed variety and year of production in relation to weather conditions on seed yields, oil content and its quality, with a focus on human nutrition value, through a field study carried at 3 different locations in Dindori district viz. Russamal, Ghundisrai, Dhanras. The seed yield was significantly affected by the year of production (523 kg/ha higher in 2020 compared to 2019), the location and the variety. The environmental factors that negatively affect seed yield are high temperatures in summer, water shortage and wet and cold soil in spring. The highest seed yield was reached at mid-heavy soil in the region with higher precipitation amount, while the lowest on light soil in the region with a lower precipitation amount. JLS66 would be recommendable for Dindori environmental conditions. JLS 66 variety gave the significantly highest oil yield.

Keywords: *Linum usitatissimum* L.; linseed; seed yield; nutrition quality; oil; field production; growth conditions

Method and Material

The Front line demonstration were carried out in linseed with different location of Dindori district, Madhya Pradesh India to evaluate the difference between demonstrated technologies vis-a-vis practices followed by the local farmers in linseed crop at randomly selected villages of Dindori during rabi 2019 and 2020. Before conducting FLD's a list of farmers was prepared from group meeting and specific skill training was imparted to the selected farmers regarding different aspects of cultivation. The selected farmers of the demonstration area were of small and marginal in nature. Front line demonstration of linseed variety JLS 66 was conducted in 20 ha area in each year 2019 and 2020. 50 farmers were selected from different villages in each year 2019 and 2020. The soil samples from each adopted farmer were analyzed. It was found to be sandy to clay-loam in texture with pH 5.9, medium in organic C high in available nitrogen and medium in available phosphorus. No. of

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capsules/plant, plant height at maturity (cm) was measured and branches (No.) were counted. The purpose of this FLD'S was to know the yield gap between improved practice and farmers practice, to determine the difference in their yield attributing characters, to find out the extension gap and to know reasons for low yield and specific constraints with the practicing farmers. Finally the extension gap, technology gap along with the benefit cost ratio were worked out. The technology gap, extension gap and technology index were calculated using the following formula.

Extension gap = Demonstration yield - farmers practices yield.

Technology gap = Potential yield of variety – Demonstration yield.

Technology index (%) = Technology gap x 100/Potential yield.

Results and Discussion

Yield of linseed under improved practices was 6.2 and 6.7 q/ha, whereas yield under farmers practices was 3.9 and 4.7 q/ha during 2019 and 2020 respectively. The yield enhancement due to technological intervention was 58.97% and 42.96% during 2019 and 2020 respectively over farmers practice. Grain yield was found positively correlated with yield-attributing traits. Use of improved variety, seed treatment before line sowing, soil test based optimal supply of nutrients and other agro-techniques might have helped in better crop growth and portioning of photosynthates. Higher gross returns (Rs. 28520 and 30820/ha), net returns (Rs. 13716 and 16510 /ha) and returns per rupee invested (1.93 and 2.15) were recorded with technological intervention during 2019 and 2020, respectively. Innovative practices increased the gross returns by 58.97 and 42.55%, net returns by 72.27 and 64.12% and B: C ratio by 7.22 and 14.9% during 2019 and 2020 respectively compared to farmer's practice. The higher profitability under innovative practices was attributed to higher values of yield attributes and grain yield of linseed compared to farmers practice. Costs of cultivation were higher under innovative practice during both the year owing to sowing by seed drill, costs of improved seed and fungicides used for seed treatment. Higher growth and yield attributes, grain yield and economics of linseed with response to line seeding, seed treatment, balanced fertilization and other agro-techniques has also been advocated.

Conclusion

The above results showed that the integration of improved technology along with active participation of farmers has a positive effect in increase the seed yield and economic return of Linseed crop production. The suitable technology for enhancing the productivity of Linseed crop and need to conduct such demonstration may lead to the improvement and empowerment of farmers. The demonstration traits also enhance the relationship and confidence between farmers and KVK scientists. The recipient farmers of FLD's also play an important role as source of information and quality seeds for wider dissemination of the improved varieties of Linseed for other nearby farmers. It is concluded that the FLD's programme is a successful tool in enhancing the production and productivity of Linseed crop through changing the knowledge, attitude and skill of farmers.

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Impact of intervention on functional ability among rural elderly

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ABSTRACT

Purpose: Healthy ageing looks beyond physical health; it tries to get older people motivated, to be satisfied with their life, to carry out physical activity and to have a relationship with their family and the environment of physical, mental and emotional decline (Quiñones et.al,2020). “Aging can be defined as a series of time related processes occurring in the adult individual that ultimately bring life to close. It is the most complex phenotype and the only example of generalized biological dysfunction. Aging influences an organism’s entire physiology, impacts function at all levels, and increase susceptibility to all major chronic diseases.” (Vijg, Jan 2007).

WHO (2020) defines healthy ageing as “the process of developing and maintaining the functional ability that enables wellbeing in older age.” Functional ability is about having the capabilities that enable all people to be and do what they have reason to value. The intervention in ageing should be aimed at promoting personal growth and development by facilitating environments that prevent physical, psychological and social deterioration. The promotion of active ageing is necessary to produce health benefits through physical activity. Older people guided through active ageing not only improve their physical condition, but also improve their quality of life as they get older, reinforcing their physical, psychological and social well-being. Hence an attempt has been made to undertake an intervention strategies that study the elderly people of Urban and Rural areas with a view to promote physical, psychological and functional abilities among elderly of Dharwad Taluk.

Methods: An exploratory study was conducted in urban and rural areas of Dharwad Taluka. A randomly selected sample of 540 elderly (270 each from Rural and Urban) of both the gender, in the age group of 60-74, 75-84 and 85 & above were selected. A phenomenological and narrative analysis was used to have in depth and holistic understanding of physical and psychological changes among rural and urban elderly. Personal information schedule was used to elicit auxiliary information of the subjects regarding demographic variables. To explore the functional changes of elderly, Ageing schedule developed by Badiger and Kamat (2009) was used. Socio Economic Status Scale by (Aggarwal et al., 2005) was employed to assess the SES of the family. On the basis of the results that indicated a large number of elderly with functional problems, an intervention programme was conducted on a non experimental group with a designed educational training program. The impact was assessed through a single pre and post test design.

Results: Results showed that 58.50 percent of rural elderly belonged to lower middle SES and 47.40 percent of the urban elderly belonged to upper middle SES. With respect functional dimensions majority of the elderly in case of physical, psychomotor and sensory, cognitive, socio-emotional and behavioural indicated very few changes. Age is significantly associated with physical functioning and cognitive functioning. In case of physical functioning majority of the elderly from age group young old (80.5%) showed very few changes and 82.8 per cent young old elderly had some changes in case of cognitive functioning in comparison to their old old and oldest old counterparts, Correlation was found to be negative and significant in the physical functioning, psycho-motor and sensory functioning and cognitive functioning levels. significant difference between the age groups and domains of functional ability like physical functioning, psycho-motor functioning and cognitive functioning was observed among elderly. Among rural elderly belonging to young old age group (51.8%) and elderly from urban area with age group old old (64.2%) showed very few changes in functional abilities. Significant difference between rural male elderly with respect to their functional abilities before and after intervention such as cognitive (t-value, 3.86**), socio-emotional (t-value, 14.19**), behavioural (t-value, 15.96**) and overall functional abilities (t-value, 15.94**). Whereas no such significant difference was found in the physical functioning and psychomotor and sensory functioning after intervention. Indicating, the functional abilities like cognitive, socio-emotional, behavioural and overall functioning abilities have significantly improved in the rural male elderly after

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intervention. Whereas rural female elderly showed significant difference in the domains of functional abilities such as physical (t-value, 4.24**), psychomotor and sensory (t-value, 2.90**), cognitive (t-value, 4.02**), socio-emotional (t-value, 15.27**), behavioral (t-value, 16.74**) and overall functional abilities (t-value, 16.35**) after intervention. Indicating, better functional abilities of the rural female elderly after intervention.

Conclusion: The intervention provided to the rural male and female elderly group was effective in improving their physical, psychological health status and functional ability. Indicating that the female and male elderly were positively benefitted by the intervention programme in enhancing their physical health status, social participation, psychological health and functional ability through educational training programme.

Key words: Ageing, Elderly, Functional changes, Cognitive functioning, Intervention

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Effect of soil salinity on growth Parameters and antioxidant activity in Two Genotypes of Egg Plant (*Solanum melongena* L.)

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ABSTRACT

Purpose: Eggplant (*Solanum melongena* L.) is a traditional vegetable crop in many tropical, subtropical and Mediterranean countries. Abiotic stress such as salinity of soil and water is causes it’s yield loss. Eggplant (*Solanum melongena*) is moderately sensitive to salinity but more attention to salinity is required in the agricultural production of eggplant and its varieties. Knowledge of salt tolerance in vegetable plants is necessary to increase productivity and profitability of crops irrigated with saline wastewaters. The effects of salinity on plant growth can vary depending on the plant species and also on different genotypes of a species. The main aim of this study was to investigate the salt tolerance potential of selected genotypes at the early stage (germination and seedling) of plant growth.

Methods: To identify the stable source, 30 accessions of eggplant (*Solanum melongena* L.) were screened. Among 30 genotypes the highest seed germination (90-100 %) was observed in two genotypes [IC354140 (GT25); IC 354562 (GT26)]. Therefore, for further study these two genotypes of the eggplant were selected. 30 days old seedlings of GT25 and 26 were treated with the different salt concentrations (0, 25mM, 50mM, 75mM, 100mM, 125mM, 150mM).

Results: The data of present study revealed that germination percentage reduced significantly. (35%) in GT26 compared to GT25 with increasing levels of salinity (EC, pH). Egg plant seedling length, dry and fresh weight of radicle and hypocotyls, number of leaves decreased with increasing soil pH and increasing soil EC ($P < 0.001$). The total chlorophyll, flavonoid contents were gradually decreased with increase the salinity. SOD and POD

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antioxidant where increased with salt stress. GT26 showed highly stressful effects on the seedling growth in 100mM NaCl application, whereas GT25 showed comparative better growth in same concentration.

Conclusion: High salt concentration (100mM) affect the germination of eggplant seeds, also retard the seedling growth in the early phases. GT26 genotype can considered as salt sensitive genotype (SSG), while GT 25 was found to be most tolerant genotype (STG) to salt stress among the all 30 genotypes.

Key words: Salinity stress, Egg plant, Solanum melongena, Genotypes, Germination, Chllorophyll, Flavanoid, Chlorogenic acid, Antioxidant activity.

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Effect of probiotic induced fermentation on the polyphenol content and bioactive properties of Terminalia chebula (Fruits) methanolic extract.

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ABSTRACT

Purpose: To study the effect of fermentation based biotransformation on bioactive properties of *Terminalia chebula* (Fruits) methanolic extract.

Methods: Different assays were performed for determining total polyphenol content and antioxidant activities namely; total phenol content was determined using Folin-Ciocalteu’s phenol reagent (Chang *et al.*, 2001), total flavonoid content was estimated according to the method described by Lamaison and Carnet 1996. 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay, Reducing power assay, Chelating power on ferrous (Fe²⁺⁺) ions, Superoxide scavenging activity, Hydroxyl radical scavenging activity and Ferric reducing antioxidant power (FRAP) assay were performed for evaluating antioxidant activity. α -amylase and α -glucosidase inhibitory assays were performed for determining the anti-diabetic activity. Acetylcholinesterase activity assay was performed for determining anti alzheimer activity.

Results: The fermentation of *Terminalia chebula* (Fruits) methanolic extract significantly enhanced total polyphenol content and biological activities. Among the five different probiotics used in the above study, *Lactobacillus plantarum* was found to be the best in enhancing bioactive constituents and biological activities of *Terminalia chebula* (Fruits) methanolic extract followed by *Saccharomyces cerevisiae*, *Bacillus subtilis*, *Lactobacillus acidophilus* and *Lactobacillus casei*.

Conclusions: The present study concludes that probiotic induced biotransformation can be used as alternative natural mechanism for improvement of phytochemical constituents and bioactive properties of *Terminalia chebula* (Fruits) methanolic extract.

Key words: Fermentation, biotransformation, polyphenol content and antioxidant activities.

Efficacy of liquid and carrier based biofertilizers along with chemical fertilizers on yield and yield attributes of Tomato (*Solanum lycopersicum* L.)

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ABSTRACT

Tomato (*Solanum lycopersicum* L.) is one of the most commonly grown solanaceous vegetable crops in India belongs to the family solanaceae and native of Peru Equador region. Tomato is considered as "protective food" because of its nutritive value and most versatile vegetable with wide usage in Indian culinary tradition. Ripened fruits are good source of organic acid and minerals like potassium and sodium. Tomato is also an excellent source of vitamin A and C and called as “poor man’s orange”. Lycopene, a major component of red tomatoes, which has strong antioxidant properties can act against human diseases such as cancer and heart problems.

Introduction

Biofertilizers (nitrogen fixing bacteria, phosphate solubilizing bacteria and potassium solubilizing bacteria) are known to improve growth, yield as well as productivity of crops. They are low cost, renewable sources of plant nutrients and have the ability to use freely available solar energy, atmospheric nitrogen and water. Biofertilizers enrich soil fertility, ensure environmental safety and play a significant role in increasing crop yield. According to Choudhury and Kennedy (2005), biofertilizers are gaining momentum recently due to increasing emphasis on maintenance of soil health, minimization of environmental pollution and the use of chemicals in agriculture.

Research work related to carrier based biofertilizers has been conducted in India and abroad on large scale. However, limited studies have been made on effect of liquid formulations on yield and yield attributes of tomato in India. Liquid biofertilizers are liquid formulation containing the dormant form of desired microorganisms and their nutrients along with the substances that encourage formation of resting spores or cysts for longer shelf life and tolerance to adverse conditions (Verma *et al.*, 2011).

Now-a-days farmers are using drip irrigation system, hence application of carrier based biofertilizers through drip has become cumbersome, substituting them with liquid formulations if found efficient is beneficial to the farmers. Keeping these points in view, the present investigation was planned with the following Objectives:

Objectives

To study the influence of biofertilizers along with chemical fertilizers for gaining maximum production and productivity of tomato

To study the effect of carrier based and liquid formulations of NSB (*Azotobacter*), phosphate solubilizing bacteria (*Bacillus megaterium*) and potassium solubilizing bacteria (*Bacillus mucilaginosus*) on yield of tomato

Methodology: The experiment was laid out in Factorial RBD with three replications. The first factor consisted of three levels of RDF (100 %, 80 % and 60 % of RDF) and the second factor consisted of three different combinations of biofertilizers (NFB + PSB + KSB liquid biofertilizer, NFB + PSB + KSB carrier based biofertilizer and without biofertilizers) comprising of nine treatment combinations *viz.*, T₁ (100 % RDF + NFB + PSB + KSB carrier based biofertilizers), T₂ (100 % RDF + NFB + PSB + KSB liquid biofertilizers), T₃ (100 % RDF + NFB + PSB + KSB without biofertilizers), T₄ (80 % RDF + NFB + PSB + KSB carrier based biofertilizers), T₅ (80 % RDF + NFB + PSB + KSB liquid biofertilizers), T₆ (80% RDF + without biofertilizers), T₇ (60 % RDF + NFB + PSB + KSB carrier based biofertilizers), T₈ (60 % RDF + NFB + PSB + KSB liquid biofertilizers), T₉ (60 % RDF + without biofertilizers). The seedlings were transplanted at a spacing of 120 cm x 50 cm in a single row. The salient findings with respect to yield parameters are summarized below.

Results: Among yield parameters, the application of 80 % RDF (F₂) showed significant differences in number of flowers/cluster (7.88), number of clusters/plant (8.56), number of fruits/cluster (4.44), number of fruits/plant (51.03), fruit length (5.40 cm), fruit width (5.01 cm), average fruit weight (88.77 g), fruit yield/plant (6.59 kg)

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and yield/hectare (109.83 t/ha) while, the application of 100 % RDF recorded significant differences in fruit set % (88.47 %) when compared to other treatments. The tomato plants treated with all the three biofertilizers in liquid formulations (B₂) recorded significant differences in number of flowers/cluster (8.07), number of clusters/plant (8.55), number of fruits/cluster (4.37), number of fruits/plant (54.35), fruit set % (92.02 %), fruit length (5.34 cm), fruit width (5.09 cm), average fruit weight (89.24 g), fruit yield/plant (6.72 kg) and yield/hectare (112.05 t/ha) over the control (B₃) without biofertilizers. The interaction effect of (F₂B₂) 80 % RDF + NFB + PSB + KSB (liquid biofertilizers) resulted in significant differences in number of flowers/cluster (8.86), number of clusters/plant (9.90), number of fruits/cluster (4.90), number of fruits/plant (60.00), fruit set % (98.34 %), fruit length (5.83 cm), fruit width (5.45 cm), average fruit weight (96.96 g), fruit yield/plant (7.27 kg) and yield/hectare (121.16 t/ha) when compared to other interactions. The results obtained might be a reflection of the application of biofertilizers, which increased the vegetative growth by production of growth substances and in turn promoted yield characters.

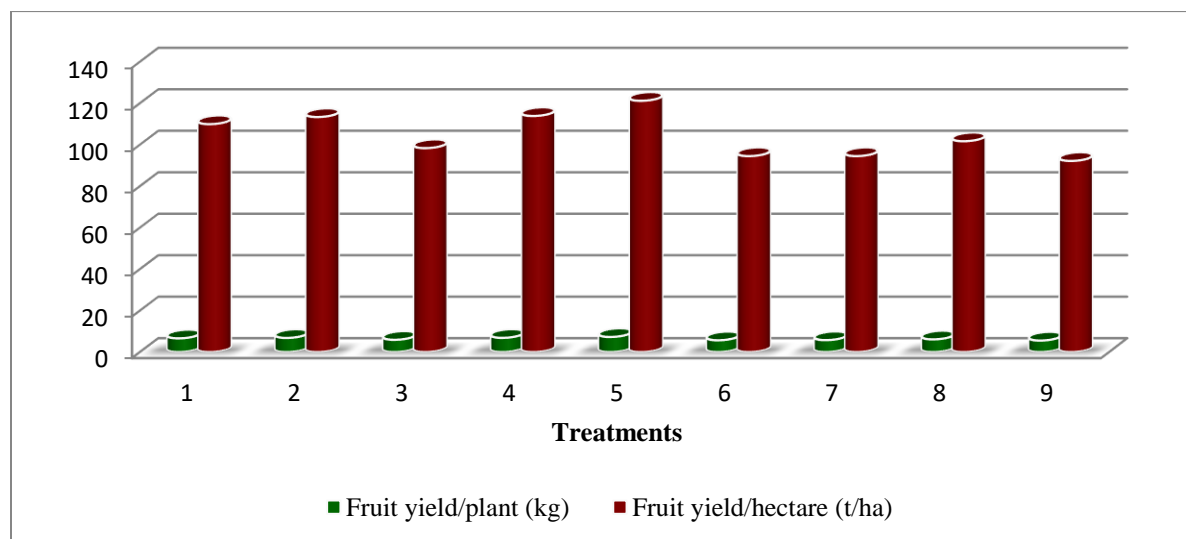


Fig.1. Effect of biofertilizers in combination with different levels of NPK on fruit yield per plant (kg) and fruit yield/ha (t/ha) in tomato hybrid Arka Samrat

Conclusion: Based on the results obtained in the present investigation, it was concluded that the biofertilizers in liquid formulations were more effective than the carrier based formulations in promoting plant growth and yield and application of liquid based formulation of biofertilizers along with application of 80 % RDF recorded maximum number of flowers/cluster, number of clusters/plant, number of fruits/cluster, number of fruits/plant, fruit yield/plant and yield/ha.

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Synthesis and evaluation of Benzimidazolyl chromones against *Sclerotium rolfsii*

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ABSTRACT

The use of synthetic pesticides has undoubtedly played an important role in augmenting crop yield. However, due to the increasing resistance in some of the currently available pesticides, efforts are being made to look for new, alternative active compounds. Chromones and their structural analogues are important intermediates of pharmacophores of a wide range of bioactive molecules and have evoked great interest. Numerous remarkable biological properties of this type of compounds have been described, including cytotoxic (anticancer), antimicrobial, antifungal, and antioxidant activity. In the field of heterocyclics, benzimidazole derivatives are of wide interest because of their diverse biological activity and applications. The idea behind present study was to see the effect of combining benzimidazole and chromone moieties on fungicidal activity.

Methods: A series of 16 alkoxy / halo substituted 3-Iodochromones was synthesized by condensation of 2-hydroxyacetophenone derivatives with dimethylformamide dimethylacetal to get enamines which were cyclised directly to corresponding 3-iodochromones. Conjugated addition of these synthesized 3-Iodochromones with benzimidazole resulted in 2-(N-benzimidazolyl) chromones. All the synthesized compounds were screened for their fungicidal activity against *Sclerotium rolfsii* by poison food technique using PDA. Percent inhibition in radial growth (I) was calculated using the formula $I(\%) = (C - T)/C \times 100$. ED₅₀ (ppm) value were calculated using Probit analysis package.

Results: The synthesized compounds were successfully characterized by IR, ¹HNMR and ¹³CNMR and LC-HRMS spectroscopic techniques. All benzimidazolyl chromones showed good activity, 6-chloro,7-methyl derivative was found most active (ED₅₀ = 5.26 ppm). Among alkoxy derivatives, methoxy derivative was found most active and it was observed that with increase in carbon chain length there was decrease in the fungicidal activity.

Conclusions: The introduction of benzimidazole moiety resulted in improved fungicidal activity of chromones against *S. rolfsii*.

Key words: Chromones, *Sclerotium rolfsii*, Fungicidal, Benzimidazole

Sensitivity of a fresh water teleost *catla catla* to some organophosphate pesticides through bioassay studies and fish behaviour

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ABSTRACT

Purpose: Pesticides are contributing in current agriculture to fulfil the need of raising population. Use of pesticides is not limited to agriculture but they are also used to control over domestic pest, disease insect vectors and home gardening. *Dimethoate* and *malathion* are widely used pesticides in India. The pesticides find their way to aquatic ecosystem by three major routes: 1. Water column; 2. Organic substrates such as aquatic fauna; and 3. Inorganic substrate, e.g. soil. Standing water has higher concentration than running water. *Catla catla*, major south Asian carp of family *Cyprinidae* is a fast growing major food fish having high nutritive value. It is generally cultivated in ponds. Objective of the present study is to focus on some factors which deteriorate the habitat of this food fish. In this study, effects of two organophosphates-*dimethoate* and *malathion* are observed on the fish through bioassay tests and fish behaviour.

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Methods: The test chemicals- *dimethoate* and *malathion*- are soluble in water. Therefore, for bioassay tests, the *dimethoate* and *malathion* were dissolved in water to get required concentration. Dosage mortality studies were conducted at room temperature ranging 13.7°C to 27.5°C ($\pm 2.0^\circ\text{C}$) in a static water condition as described by Duodoroff and Katz (1950) for 24, 48, 72 and 96 hours. The other parameters like pH of the water (7.0 ± 0.2) hardness (72 mg/l), dissolved oxygen ($7.0 \pm 0.5 \text{mg/l}$) and CO_2 ($4.1 \pm 0.2 \text{mg/l}$) were also measured for the water used for bioassay studies and 1/3, 2/3 and 1/5 sublethal concentrations are used for chronic exposure. Fish behaviour observed when exposed to different concentrations of *dimethoate* and *malathion*.

Results: The results of Bioassay tests for *Catla catla* are as follows:

Lc50 for Malathion

24 hours – 0.122 ppm

48 hours – 0.084 ppm

72 hours – 0.073 ppm

96 hours – 0.047 ppm

Lc50 for Dimethoate

24 hours – 0.0123 ppm

48 hours – 0.0097 ppm

72 hours – 0.085 ppm

96 hours – 0.007 ppm

Fish Behaviour

Exposure to even lowest concentrations of *dimethoate* and *malathion* enables the fish sluggish, alteration in swimming ability, increased in mucus secretion making them more susceptible to pathogens and secondary infections, and vulnerable to diseases.

Interpretation of schooling behaviour of fishes was observed and it results the fish to be more susceptible and easily preyed by other fauna present in its habitat. So we do not get desired fish production. Pesticides hamper its growth because they reduce their ability to feed. As *Catla catla* is a surface feeder and sustain on the food available on surface, the exposure of pesticides increases the movement of opercula, rapid jerk movement, and loss of equilibrium, hyper excitability. The fish tend to sink to bottom and thus feeding of the fish affected badly.

Conclusion: During the study it was found that *Catla catla* shows more sensitivity towards *dimethoate* than *malathion*. So it is suggested that while making use of these pesticides in agriculture their concentration should be carefully monitored so that we can save our fish food. There is a need to decrease the application of chemical pesticides and to make use of herbal pesticides in farming which don't have negative impact on the health of fish.

Evaluation of Probiotic potentials of *Lactobacillus casei*

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ABSTRACT

Purpose: Probiotics are live gut microorganisms which provides health benefits to host body when adequate in proper amount. The gut environments having different acidity, pH, temperature, and salt concentration etc. in different time periods. So, a good probiotic culture should have a potential to be viable and active in different conditions in gut to provide health benefits.

Methods: In the present study, *Lactobacillus casei* culture was evaluated for probiotic potentials with different parameters to check the resistant in culture for different concentrations of bile salt, NaCl and phenol and different ranges of pH and temperature. All the tests were done by following standard methods with little modifications.

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Results: The *Lactobacillus casei* culture showed resistant for all tested concentration of bile salt and phenol concentration and temperature range but in case of NaCl concentration, culture showed activity and viability in only 1% to 7% NaCl concentrations whereas in different pH range *Lactobacillus casei* showed good growth in pH 3 to pH 8. An increment in NaCl concentration up above 8% and pH range above then 8 showed no growth.

Conclusion: The selected culture showed probiotic potentials in selected and tested parameters and it was concluded that the selected culture is a good candidate for further in vivo studies to clarify their potential health benefits to be used as promising probiotic bacteria. To know the stability of the strains in food manufacturing processes additional studies will also require.

Key words: *Lactobacillus casei*, Probiotic potentials, pH, Bile salt concentration, Temperature

Bio-preservation of Foods using bacteriocins

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ABSTRACT

Purpose: Bio -preservatives are commonly used in food products to satisfy the increasing demand of consumers with increasing advancement in food and technology. The foods with chemical preservatives are now being neglected by the people and they prefer products which are generally recognized as safe (GRAS). Thus, as a result food industry is using naturally produced preservatives to increase the shelf life of product without any new technology. The most commonly used bio-preservatives are bacteriocins, essential oils, herbs and spices, vinegar, fermentation and sugar and salt. They exhibit growth inhibition of various microorganisms when added at different concentrations so as to preserve food products.

Methods: Inoculation of lactic acid bacteria in the food where bacteriocins are produced in situ. Here, the ability of the starter culture to grow and conditions to produce bacteriocins in the products is very critical for its successful application. Addition intact bacteriocins, which may be purified or semi-purified as food preservatives. Use of a food product earlier fermented with a bacteriocins producing strain as an ingredient in food processing.

Results: Lactic acid bacteria (starter/protective cultures), which produce organic acids and other compounds that, in addition to antimicrobial properties, also confer unique flavors and textures to food products. Such peptides are effective to kill only closely related microorganisms and very sensitive in nature, they are inactivated by proteases in the GIT.

Conclusions: Bacteriocins are the antimicrobial ribosomally synthesized peptides produced by LAB and other bacteria. The bacteriocins can effectively be used to inhibit some gram-positive bacteria, spore-forming bacteria, and foodborne pathogens.

Key words: Bio-preservation, bacteriocins, essential oils, herbs and spices, vinegar, fermentation, salt and sugar.

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Gender Involvement in Agricultural and Animal Husbandry Sectors

Komal, Kiran Singh, Nigam Rani and Poonam Kumari

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ABSTRACT

Purpose: Agriculture is the backbone of the Indian economy. India’s 70 per cent of the population is involved in agricultural sector for their livelihood. Women also play a vital role in building this economy and actively involved in operations relating to crop and animal production, as well as in post-harvest processing and marketing also. The aim of the study was to find out the gender roles and responsibilities in agriculture sector.

Methods: Study was planned in the *Budak* village under the NASF –ICAR Project as it is adopted village by the project. A total of 600 population of male and female were selected purposively and only adult population was taken as the sample. A well structured schedule was used to collect the information regarding the involvement of people in agricultural activities.

Results: Result show that females had negligible participation in plantation of crops, fertilizers and insecticide sprays as well marketing of grains. Results also present that female members were involved in making dung cake (80.00%) followed by cleaning of animal habitat (79.40%) and dung collection (78.80%).

Conclusion: It is concluded that most of the female were participated in the animal husbandry activities but role of female was negligible in the agricultural activities.

Keywords: Agriculture, Animal husbandry, Gender, Participation, Women.

Micronutrient malnutrition in india: magnitude and consequences

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Introduction

Micronutrients are used to signify essential vitamins and minerals required from the diet, needed in very small quantity to maintain virtually all cellular and molecular functions of the body for attaining optimal growth, development and physiological functions. The impact of the insufficiency of these micronutrients on human health are critical, and, deficiency in any of them contributing to the low productivity and a vicious cycle of malnutrition and other nutritional deficiencies which may lead severe and even life-threatening conditions of the person. It is also referred as 'Hidden Hunger' that affects the health, learning ability as well as productivity owing to high rates of illness and disability. In the current scenario, micronutrient deficiency is a global public health issue that affects more than one-fourth of the world's population. Several programmes have been instigated in India over the years for improving the nutritional and health status of the population, however, a large section of the population is still affected by micronutrient deficiency. It is estimated that around two billion people in the world are deficient in one or more micronutrients.

In India, various surveys have been carried out at district and national level such as - District Level Household Survey (DLHS), Annual Health Survey (AHS), National Family Health Survey (NFHS), and, National Nutrition Monitoring Bureau (NNMB) for assessing the health and nutritional status of the population in the country. The objective of this study focussed on the current situation of micronutrient status in the country, based on national surveys and recent studies.

Micronutrient malnutrition

Micronutrient malnutrition is a term used to refer to diseases, caused by a dietary deficiency of vitamins or minerals. More than 2 billion people in the world today affected by micronutrient malnutrition. In India 44% of children under the age of 5 are underweight, 72% of infants, and, 52% of married women have anaemia. Research has conclusively shown that malnutrition during pregnancy causes the child to have increased risk of future diseases, physical and mental retardation and reduced cognitive abilities. The major micronutrient malnutrition

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issues affecting populations in developed and developing countries addressed in the WHO Guidelines are shown in Table 1.

Table 1. Micronutrients Deficiency Conditions and Their Worldwide Prevalence

Micronutrient	Deficiency Prevalence	Major Deficiency Disorders
Iodine	2 billion at risk	Goiter, hypothyroidism, iodine deficiency disorders, increased risk of stillbirth, birth defects infant mortality, cognitive impairment
Iron	2 billion	Iron deficiency, anemia, reduced learning and work capacity, increased maternal and infant mortality, low birth weight
Zinc	Estimated high in developing countries	Poor pregnancy outcome, impaired growth (stunting), genetic disorders, decreased resistance to infectious diseases
Vitamin A	254 million preschool children	Night blindness, xerophthalmia, increased risk of mortality in children and pregnant women
Folate (Vitamin B6)	Insufficient data	Megaloblastic anemia, neural tube and other birth defects, heart disease, stroke, impaired cognitive function, depression
Cobolamine (Vitamin B12)	Insufficient data	Megaloblastic anemia (associated with Helicobacter pylori induced gastric atrophy)
Thiamine (Vitamin B1)	Insufficient data, estimated as common in developing countries and in famines, displaced persons	Beriberi (cardiac and neurologic), Wernicke and Korsakov syndromes (alcoholic confusion and paralysis)
Riboflavin (Vitamin B2)	Insufficient data, est. to be common in developing countries	Non specific – fatigue, eye changes, dermatitis, brain dysfunction, impaired iron absorption
Niacin (Vitamins B3)	Insufficient data, estimated as common in developing countries and in famines, displaced persons	Pellagra (dermatitis, diarrhea, dementia, death)
Vitamin B6	Insufficient data, estimated as common in developing countries and in famines, displaced persons	Dermatitis, neurological disorders, convulsions, anemia, elevated plasma homocysteine
Vitamin C	Common in famines, displaced persons	Scurvy (fatigue, hemorrhages, low resistance to infection, anemia)
Vitamin D	Widespread in all age groups, low exposure to UV rays of sun	Rickets, osteomalacia, osteoporosis, colorectal cancer
Calcium	Insufficient data, estimated to be widespread	Decreased bone mineralization, rickets, osteoporosis
Selenium	Insufficient data, common in Asia, Scandinavia, Siberia	Cardiomyopathy, increased cancer and cardiovascular risk
Fluoride	Widespread	Increased dental decay, affects bone health

Source: Adapted from Allen L et al.: Table 1.2 pp 6-10.2

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The reasons for nutritional micronutrient deficiencies in India may range from an improper diet to an unhealthy lifestyle. There are many micronutrient deficiency problems exist which affect vast segments of our population. Iron deficiency anaemia, Vitamin A deficiency, and iodine deficiency disorders are the most widespread forms of micronutrient malnutrition which are common contributors to poor growth, intellectual impairments, perinatal complications, and increased risk of morbidity and mortality.

IRON DEFICIENCY ANEMIA (IDA): Anemia is a global public health problem which affects 1.62 billion (24.8%) people worldwide. It is the most common form of micronutrient deficiency which affects infants, preschool children, adolescent girls, pregnant women and lactating mothers. It can be caused due to deficiencies of micronutrients such as iron, folic acid and vitamin B₁₂, with iron deficiency being the most common cause of anaemia. The latest National Family Health Survey (NFHS4) carried out by the Ministry of Health and Family Welfare in 2015 - 16, reported the prevalence of anaemia as 58.6, 53.1, 50.4 and 22.7 percent, among children aged 6-59 months, women aged 15-49 yr, pregnant women aged 15-49 yr and men aged 15-49 yr, respectively. The deficiency of iron in the body occurs when iron intake is inadequate, absorption of iron is insufficient, bio-availability of dietary iron is reduced, need of iron is increased or there is chronic blood loss. Blood loss in childbirth is very dangerous for anaemic women and is the main cause of about 20 percent of maternal deaths. Maternal anaemia also leads to foetal growth retardation, low infant birth weight and increased perinatal mortality. Anaemia in infants and children is associated with retarded physical growth, reduced resistance to infections and slow development of learning abilities. In adults it causes fatigue and reduced work capacity and may cause reproductive impairment. Since, nutritional anemia is a serious problem, the Government of India launched National Nutritional Anaemia Prophylaxis Programme (NNAPP) in 1970, as a part of Family Planning Programme to prevent nutritional anaemia among children, expectant and nursing mother. The programme was later renamed in 1991 as National Nutritional Anaemia Control Programme, targeting women in reproductive age group, especially pregnant and lactating women and preschool children, because if untreated, these can affect next generation child resulting in increased morbidity and mortality and decreased productivity.

VITAMIN A DEFICIENCY (VAD): Vitamin A deficiency is highly prevalent health concern, associated with substantial morbidity and mortality, mostly affecting young children in impoverished regions throughout the world. Insufficient intake of absorption leads to deficiency and compromise of essential physiologic processes. VAD primarily affects children, worldwide. It causes night blindness, delayed dark adaptation, lowers resistance to infections and, eventually, produce blindness as a permanent disability (xerophthalmia). Young children below the age of 3 years and pregnant and lactating women are most vulnerable to VAD. It also contributes to retarded physical growth and impaired resistance to infections, resulting in high rates of sickness and death among young children. Regular consumption of vitamin A-rich foods such as animal products, orange and yellow fruits and vegetables, dark green edible leaves, could prevent VAD.

The Government of India launched the National Prophylaxis Programme in 1970 against Nutritional Blindness caused due to VAD, targeting the children in the age group of 1-6 yr with the specific aim of preventing nutritional blindness occurred due to keratomalacia. The programme was modified in 1994, under the National Child Survival and Safe Motherhood Programme, where, the target group was restricted to 9-36 months children. The age of the target group was later modified in 2006 as 6 to 59 months.

IODINE DEFICIENCY DISORDERS (IDD): Iodine deficiency disorders constitute the single largest cause of preventable brain damage, affects about 2 billion people, worldwide. Majority of consequences of IDD are invisible and irreversible but at the same time these are preventable. It is most common in developing countries where people may lack access to enough healthy food. But it can also affect people in developed countries who lack an adequate diet or whose bodies don't correctly process iodine. In India, the entire population is prone to IDD due to deficiency of iodine in the soil of the subcontinent, and, consequently the food derived from it. In pregnancy, iodine deficiency either causes spontaneous abortions, stillbirths and infant mortality or may interferes with the brain development of the foetus, result in birth of iodine deficient babies who may be cretins; characterized by mental disorder, hearing defects, squint and stunted growth. So, they require more iodine than any other group of people, because they may experience a deficiency if they don't make a conscious effort to

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consume high-iodine foods. Realizing the magnitude of the problem, the Government of India launched National Goitre Control Programme, which was later renamed as National Iodine Deficiency Disorders Control Programme (NIDDCP).

Conclusion: Micronutrient insufficiency is a serious public health concern across the world, with anaemia impacting almost half of the population, although vitamin A deficiency and IDD have improved over time. The population's micronutrient status is projected to improve in the future years as a result of recent government measures and the improvement of current health and agriculture systems.

Key words: micronutrient, anemia, vitamin, mineral, iodine

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Laccases from *Coriolus versicolor* MTCC-138 and *Trametes versicolor* HBB-7328: Characterization, production and immobilization

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ABSTRACT

Purpose: Laccases have been the subject of intense research over the past decades due to their broad substrate specificity. Immobilization of enzymes provides several advantages for enzyme-based catalysis because the storage and operational stability of enzymes are often enhanced. Including this, the reusability of immobilized enzymes shows a significant advantage with respect to free enzymes. In this study, we discuss the production and characterization of laccases from unknown and known fungi *Coriolus versicolor* MTCC-138 and *Trametes versicolor* HBB-7328. Immobilization of laccases was done on the glass beads and second time between the poly acrylamide gel and then activity of immobilized enzymes was recorded by adding substrate in the gel.

Methods: Characterization, production and immobilization of laccases was performed by using Malt Extract and CMC culture media. Identification of unknown fungi, effect of temperature and pH on growth of fungi and enzyme production was also checked. Immobilization was done by using different size glass beads and poly acrylamide gel.

Results: Immobilization of enzyme reduced its activity in comparison to free enzyme. Within the two-immobilization system, the highest activity of the immobilized enzyme was observed in case of glass beads (92%) and in case of polyacrylamide gel it was 86%. Fungi produced maximum enzyme in 10 days. The fungi were found cellulase and protease positive and amylase, lipase & xylanase negative. The laccase activity was found to be increased with increase in pH (peak at pH 3). However, further increase in pH caused rapid inactivation of the enzyme. The enzyme activity was found to be maximum at 70 °C with rapid denaturation of enzyme on further increase.

Key words: Laccases, immobilization, reusability, poly acrylamide gel, glass beads, activity units

Identification of marker associated qtl for yield and its components in Rice (*Oryza sativa* L.)

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Introduction

Cultivated rice (*Oryza sativa*) is endowed with a rich genetic variability. In spite of such a great diversity, the modern rice cultivars have narrow genetic base for most of the agronomically important traits. The breeders are utilizing less than 15% as they continue to depend excessively for decades on cultivar germplasm for needed variability. The reports on the discovery of marker associated yield QTLs in land races and wild species of rice and of their potential to increase genetic yield level by about 18% without delaying maturity or increasing plant height suggest that the innovative use of molecular markers can alter the way we utilize wild and exotic germplasm (Xiao *et al.*, 1998). The present study was undertaken keeping in view the fact that wild *sp*/primitive cultivars present potential donor sources for complex traits such as yield with the following objectives.

- i. Developing the mapping population using a primitive cultivar as one of the parent.
- ii. Genotyping and phenotyping the mapping population (RIL).
- iii. Identification of molecular marker associated QTLs for yield and yield contributing characters in a prospective primitive cultivar of Asian rice *O. sativa*.

Methods: Jaya, the popular semi-dwarf, medium duration, high yielding variety, was used as female parent while INRC10066 a tall, lodging prone, photosensitive, medium duration traditional landrace collected from Chattisgarh belt was chosen as male parent. Recombinant Inbred (RI) population (F₇) developed by Single Seed Descent method (fig.1) was evaluated phenotypically under field conditions at two locations *viz.*, Agricultural Research Institute (ARI), Hyderabad and Regional Agricultural Research Station (RARS), Maruteru, Andhra Pradesh under two levels of nitrogen *i.e.*, 100 kg/ha (N₁) and 150 kg/ha (N₂) for yield related traits *viz.*, plant height, number of productive tillers/plant, panicle length, filled grains per panicle, spikelets per panicle, percentage spikelet fertility, test grain weight, biomass, yield per plant and harvest index. Construction of linkage map and QTL mapping: Parents were screened with 736 rice microsatellite markers and 76 were found to be polymorphic and distributed throughout the genome. Genotyping of the mapping population was carried out with 52 polymorphic markers and linkage map was constructed using MapDisto v 1.7. The same population was used to map quantitative trait loci (QTLs) relating to yield and its component traits. QTLs were identified using both Simple Interval Mapping (SIM) and Composite Interval Mapping (CIM) methods of QTL Cartographer v 2.5. A LOD score of 2.5 was used as the threshold for detecting QTLs.

Results: The mapping population was normally distributed for all the traits studied. The overall performance of the population was better at Maruteru than Hyderabad except for number of productive tillers, yield per plant and harvest index and no significant difference between the two levels of nitrogen could be observed. Strong positive correlations were observed between the grain yield and many of the component traits like panicle length, number of filled grains per panicle, spikelets per panicle, 1000-grain weight as expected. A total of 99 QTL were identified (fig. 2) of which, 44 QTL at Hyderabad for eight yield related traits *viz.*, four QTL for number of productive tillers/plant, 8 for panicle length, 2 for filled grains per panicle, 5 for spikelets per panicle, 10 for percentage spikelet fertility, 10 for test grain weight, one for biomass and 3 for yield per plant. At Maruteru, 55 QTLs were identified for nine yield related traits *viz.*, seven QTL for number of productive tillers/plant, 8 for test grain weight, two for spikelets per panicle, one QTL each for panicle length, filled grains per panicle, percentage spikelet fertility and biomass. Maximum number of QTL were identified for yield per plant (20) followed by harvest index (14). Nine QTL were found to be common and stable at both the locations. Analysis of QTLs detected for yield related traits revealed that 27 marker intervals on 12 chromosomes were influencing more than one trait. Of these, seven had QTL for 4 traits, nine for 3 traits, nine for 2 traits and one each for five and six traits respectively. Major effect QTL explaining phenotypic variance exceeding 15% were identified for all the yield related traits.

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Twenty seven QTLs at Hyderabad and 48 at Maruteru were detected under both the nitrogen levels. Out of the 99 QTL identified, 41 QTL are reported for the first time (table 1) Maximum number of novel QTLs were observed for harvest index (12) followed by yield per plant (8), spikelets per panicle and number of productive tillers (5), spikelet fertility (4), 1000-grain weight (3), panicle length (2) and filled grains per panicle and biomass (1). INRC10066 allele has contributed an increased effect at 72 QTL positions.

Conclusion: The normal distribution of the mapping population (RIL) for all the traits studied indicated the absence of selection pressure in the development of it. The low polymorphism observed between the parents may be because both the parents belong to the same species. More number of QTL identified at Maruteru may be due to the positive interaction between the genotypes and environment as indicated by the mean performance also. The common QTLs identified across locations and growing environments provide an excellent opportunity for selecting chromosomal regions relating to yield and yield components and develop QTL introgressed lines using them in breeding for yield enhancement. The result was in accordance with the finding of Septiningsih *et al.* (2003). Analysis of QTLs detected for yield related traits revealed that 27 marker intervals on 12 chromosomes were influencing more than one trait indicating that the underlying gene(s) influencing these traits are either closely linked or pleiotropic as shown by the strong positive correlations. Sequencing and functional analysis of such loci would alone reveal the genetic architecture of these QTL. Out of the 99 QTLs identified, 41 QTL were reported for the first time uncovering the existence of potentially novel alleles. Dissection and functional analysis of all the major yield influencing QTL would help identify the gene(s) involved in the yield relevant pathways and clone them for selective and collective improvement of grain yield through gene transfer technology. INRC 10066 allele has contributed an increased effect at 72 QTL positions indicating potential of these QTL in improving the yield related traits by using marker assisted selection/ breeding.

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Table 1: The QTL identified in the RIL population of Jaya/INRC 10066

S.No	Trait	No. of QTL	Name of the QTL
1	NPT	5	<i>qNPT1.1, qNPT 3.1, qNPT 6.1, qNPT 7.1, qNPT 12.1</i>
2	PH	2	<i>qPL1.1, qPL11.1</i>
3	FGP	1	<i>qFGP4.1</i>
4	SPP	5	<i>qSPP1.1, qSPP1.2, qSPP 2.1, qSPP 9.1, qSPP11.1</i>
5	SF	4	<i>qSF7.1, qSF 8.1, qSF 9.1, qSF12.1</i>
6	TGW	3	<i>qTGW 7.1, qTGW 10.1, qTGW 10.2</i>
7	BM	1	<i>qBM 10.1</i>
8	YPP	8	<i>qYPP1.2, qYPP2.1, qYPP4.1, qYPP 5.1, qYPP6.1, q YPP7.1, qYPP 11.1, qYPP11.2</i>
9	HI	12	<i>qHI 1.1, qHI 1.2, qHI2.1, qHI3.1, qHI 5.1, qHI 6.1, qHi 8.1, qHI10.1, q HI 10.2, qHI 11.1, qHI 11.2, q HI12.1</i>

An interpretation of corollary of different spacings and nitrogen levels on yield and yield attributes of Red cabbage (*Brassica oleracea* var. *Capitata* f. *Rubra*)

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Introduction

Red cabbage (*Brassica oleracea* var. *capitata* f. *rubra*) is a highly fancied exotic crop and is one of the important vegetable in terms of nutrition. Red cabbage is distinguished by exceptional health-enhancing properties and many beneficial sensory traits and has become more and more popular in recent years (Wojciechowska *et al.*, 2007). A foremost advantage of red cabbage is the fact that it is generally consumed raw, which permits the preservation of vitamins sensitive to thermal processing and some polyphenolic compounds (Ismail *et al.*, 2004). In India, its cultivation was negligible but is now gaining popularity with the growers from the past few years due to its high nutritive value and increased tourist influx. The study of package of practices is a pre-requisite for any new crop assessment with respect to optimum plant density and nitrogen levels to achieve more returns per unit area. Since this crop has been introduced recently in Andhra Pradesh, there is a dire need to standardize the plant densities and nitrogen levels to suit the local conditions. Although total market returns are determined primarily by crop yield, head quality is also an important factor as it determines the marketability of the crop.

Among various factors that contribute towards the attainment of potential yield in red cabbage, spacing is of prime consideration. Maintenance of optimum plant population per unit area influences yield. Red cabbage is a heavy feeder of mineral elements and it removes large amount of macro- nutrients from the soil. Thus, a major constraint in increasing crop yields is the supply of nutrients. Among the plant nutrients, nitrogen is one of the most important elements for higher yield and good quality heads. Lack of nitrogen causes slow spindly growth and poor foliage resulting in limited production. Hence adequate application of nitrogen is extremely important to maintain optimum growth and yield.

In spite of its greater importance in terms of bringing good returns to farmers, no systematic research work has been carried out in standardizing its agro-techniques in Andhra Pradesh. Therefore, the present investigation to study the effect of plant spacing and nitrogen levels on yield of red cabbage (*Brassica oleracea* var. *capitata* f. *rubra*) was under taken with the following objectives.

Objectives:

- i. To study the effect of different plant spacing on yield and yield attributes of red cabbage.
- ii. To study the effect of different levels of nitrogen on yield and yield attributes of red cabbage.
- iii. To study the interaction effect of plant spacing and nitrogen levels on yield and yield attributes of red cabbage.

Methods: The study included 9 treatment combinations each replicated thrice in Factorial Randomized Block Design. The treatment combinations included were three plant spacings *viz.*, 45 x 45 cm (S₁), 60 x 45 cm (S₂) and 60 x 60 cm (S₃) and three nitrogen levels *viz.*, 200 Kg N/ha (N₁), 250 Kg N/ha (N₂) and 300 Kg N/ha (N₃). The data was analyzed statistically and the results are summarized below.

Results: Significant variations were observed among plant densities with respect to yield and yield attributes. Closely spaced plants (S₁) took minimum number of days for both head initiation and days to harvest. Highest head circumference (46.72 cm), head volume (1308.70 cc), fresh weight (1.15 kg), number of heading leaves (19.57) and dry matter production (10.57%) were observed at wider spacing (S₃). But, maximum yield per plot (23.80 kg), marketable yield (183.69 q/ha) and highly compact heads were recorded at closer spacing (45 x 45 cm). However, low percentage of abnormal heads was recorded at wider spacing (60 x 60cm). Yield parameters were also significantly influenced by different doses of nitrogen application. Yield and yield contributing characters *viz.*, head circumference, volume, and fresh weight, heading leaves, yield per plot, marketable yield and dry matter production were found to be superior at higher dose of nitrogen (N₃). Highest head circumference (42.03 cm), head volume (1345.26 cc), fresh weight (1.16 kg), number of heading leaves (20.14), yield per plot (23 kg), marketable yield (177.57 q/ha) and dry matter production (11.18 %) were obtained with the application of 300 kg N/ha. Higher doses of nitrogen showed higher yield. However, minimum percentage of abnormal heads

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and highly compact heads were recorded with low N (200 kg/ha). Yield attributes like fresh weight (1.43 kg), head circumference (51.33 cm), head volume (1672 cc), dry matter production (12.38 %), number of heading leaves (22.33) were found to be maximum at final harvest with the interaction of S₃N₃. But in terms of total yield, the highest total yield per plot (27.73 kg) [fig.1], marketable yield (214.48 q/ha) and less percentage of abnormal heads were recorded with the interaction effect of S₁N₃.

Illustration:

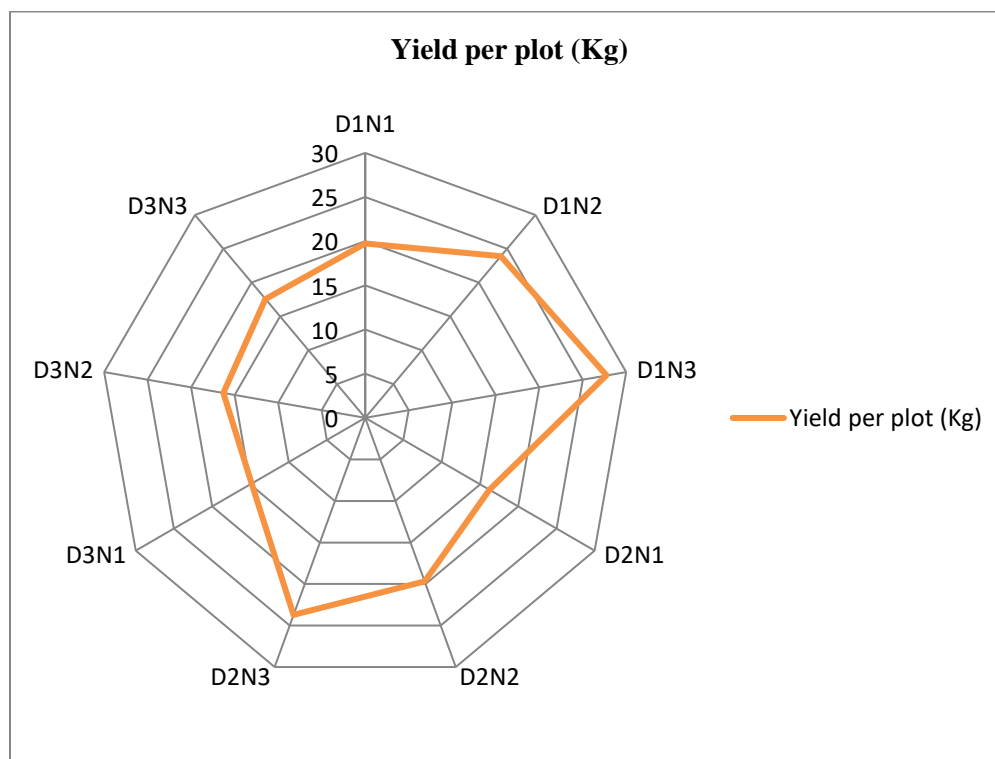


Fig. 1. Interaction effect of different plant densities and nitrogen levels on yield per plot in red cabbage

Conclusion: The experiment results revealed that closer spacing (S₁) and higher dose of nitrogen (N₃) produced higher head yield/ha. So it was suggested that, a spacing level of S₁ (45 x 45 cm) and a nitrogen level of N₃ (300 kg/ha) is most profitable for the cultivation of red cabbage in Rayalaseema region of Andhra Pradesh.

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Value Chain Analysis of Prominent Vegetables in Nadia District of West Bengal

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ABSTRACT

Purpose: Vegetables are the essential parts of the human diet due to their high vitamin and fibre content. India ranks second in the production of fruits and vegetables in the World but a considerable amount of vegetables get wasted because of their high perishability. So, the production must require proper value chain management practices to minimize the losses at the time of transportation and marketing.

Methods: The present study was conducted in different villages under the Santipur Block and Krishanagar I Block of Nadia district in West Bengal. Data has been collected from the randomly selected twenty primary wholesalers, twelve secondary wholesalers, twenty-five retailers, and twenty consumers of Fulia, Majhdia, and Kolkata market through a structured interview schedule.

Results: The study reveals that marketing efficiency and producer share in consumers' rupees are lower in the local marketing channels than the Kolkata marketing channels due to the presence of several middlemen. Though local markets are more profitable but because of the smallholding capacity of the local market and lack of storage facilities producers are bound to sell their products in the Kolkata market.

Conclusions: There is no doubt that farmers are the most deprived section among all stakeholders are engaged in the supply chain. Only proper value chain management practices can able to distribute value eventually and make the channel efficient without minimizing the number of stakeholders.

Keywords: Value Chain, Marketing efficiency, Producer share in Consumers' Rupees, Stakeholders, Perishability.

Development of diversified jute products for upsurge in farmers' income

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ABSTRACT

Purpose: Jute is one of the cheapest natural fibres and is second most important after cotton. It has several beneficial properties such as high tensile strength and modulus with good dimensional stability, moisture absorption, heat and sound insulation. Besides its beneficial properties, it has a few drawbacks such as a harsh rough feel, meshy structure, poor wrinkle recovery and high fibre shedding. Thus, jute finds its application in secondary uses only and is mainly employed to create a number of fabrics such as hessian cloth, sacking, carpet backing cloth and canvas. The aim of the study was to soften jute fabric by employing enzymes & develop diversified products in order to bring the jute fibre to mainstream primary applications. Mainstreaming of jute will increase its consumption which will bring on increment in the income of farmers.

Methods: Jute fabric was softened by enzyme combination. An extensive list of commonly used textile articles under three categories of home furnishing articles, utility articles and apparel & accessories was prepared for selection of articles to be developed from enzymatically softened jute fabric. Preferential choice index was developed to inquire the preferences of experts regarding textile articles for development of products from enzymatically softened jute fabric. The selected textile articles i.e. table runner and table mats (set of six) under home furnishing category, wall pocket and handbag under the category of utility articles & ladies jacket and cap from the category of apparel and accessories were developed. The developed products were assessed by randomly selected fifty consumers who visited the exhibition.

Results: The developed products were evaluated by consumers for various suitability parameters. On the basis of overall weighted mean scores, the handbag with 2.85 WMS got I rank, followed by wall pocket with 2.70 WMS which ranked II, ladies jacket with 2.54 WMS got III rank, table runner with 2.42 WMS got rank IV. Rank V was assigned to table mats (2.38) followed by cap with 2.32 WMS got VI rank. It is thus concluded that all the developed products except cap were rated as highly acceptable whereas cap was rated as acceptable. The opinion of consumers was assessed for the different products. The collected data related to opinion of consumers regarding developed products in terms of creative use of jute fabric, usability in day to day life, suitability of softening treatment, quality of workmanship, market potential and overall appearance.

Conclusions: Thus, it can be concluded that softening of jute and development of diversified products will lead to an increase in its demand by modern consumers. The findings will also increase the income of farmers engaged in production of jute, processing units in business and in trade of jute as well.

Key words: Jute, products, mainstream, farmer, income

Pesticide’s usage and health risks among farmers

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ABSTRACT

Purpose: India since earlier times has been the land of organic farming. But the green revolution in India introduced chemical fertilizer and pesticides and after the green revolution use of fertilizers and pesticides has increased several times. Pesticide covers a wide range of compounds including fungicides, insecticides, rodenticides, herbicides, nematocides, molluscicides, plant growth regulators and others. On one hand, it is helpful in increasing the yield but on other side, the consequences are such which cannot be ignored and resulted in severe health implications to human and his environment. A study was planned to assess the impact of pesticides on farmers’ health after using the pesticides and knowledge of farmers regarding pest controlling methods.

Methods: A total of 200 farmers were selected purposively from two districts of Haryana state. Interview schedule was used to collect the data on knowledge of farmers about pest controlling methods and health hazards faced by the farmers after applying pesticides used at their farm. Data were analyzed by calculating percentage, mean and standard deviation.

Results: Research found that near about fifty per cent (46%) farmers mentioned the dangerous effect of pesticides on health of Jind district. Almost equal number of farmers (41%) of the Ambala reported the dangerous and very harmful effect on their health because of pesticides usage. Headache and difficulty in breathing were found the main problems with equal mean score i.e. $\bar{x} = 2.9 \pm 1.0$ faced by farmers after use of pesticides. It was also found that 33 per cent farmers knew about organic farming and 16 per cent farmers who had knowledge of integrated pest management as an alternative method of pest control.

Conclusion: It is concluded that out of 43 per cent farmers, 17 per cent were found to be suffering from skin problems followed by eyes (13%), suffocation problems (9%) and asthmatic issues (4%). So, application of pesticides and using extremely toxic pesticides that endanger farm workers was unacceptable.

Keywords: Pesticides, knowledge, biopesticides, agriculture, farmers.

Phenotypic study in Pearl millet [*Pennisetum glaucum* (L.) R.Br.] germplasm lines using yield and yield related component traits

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ABSTRACT

Purpose: Pearl millet is one of the most important dual-purpose crops which is mainly grown for grain and fodder. Pearl millet (*Pennisetum glaucum*) is the most widely grown type of millet. As it is tolerant to difficult growing conditions such as drought, low soil fertility and high temperature, it can be grown in areas where other cereal crops would not survive Pearl millet contains enormous phenotypic diversity, that's why it is an ideal crop to study diversity. It is necessary to find the association of component characters with yield and their exact contribution through direct and indirect effect in order to have appropriate choice of characters for selection of desirable genotypes. The aim of present investigation is to know the correlation between yield and yield related traits.

Methods: A field experiment was conducted using 60 genotypes of pearl millet during *Kharif*, 2017 (in one environment) and *Kharif*, 2018 (in two environments, irrigated and unirrigated) to find out the correlation between yield related traits and yield in different environments.

Results: The traits, *i.e.* panicle length, panicle girth, number of productive tillers/plant, 1000 grain weight, dry fodder yield were found to be significantly correlated with grain yield/plant in all environments.

Yield is prime objective for a breeder. With higher yield, one can feed the increasing population

In this study, research papers have been used

Only few traits, *i.e.* panicle length, number of productive tillers/plant *etc.* are related to yield and by improving them, yield can be increased

By studying component traits related to yield, yield can be increased easily

Conclusion: These traits can be considered as an important yield determining traits can be given due attention during population and hybrid development.

Keywords: pearl millet, correlation, yield, yield contributing traits

Changes in eating behaviour of people who recovered from Covid-19

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ABSTRACT

Purpose: COVID-19 epidemic had a profound impact on individuals' daily lives. Compulsory quarantines and restrictions to protect public health were in place for a lengthy period. It has changed my dietary pattern and food behavior. It resulted in psychiatric illnesses, a decrease in physical activity, sleep issues, and changes in eating habits. Emotional eating can contribute to short-and long-term health concerns such as obesity, diabetes, hypertension, and coronary artery disease.

Methods: The study was conducted online between August 25th and September 25th, 2021 with approximately 60 participants. Participants were sent a link to an electronic questionnaire created in Google Doc format. No personal information was collected.

Results: Respondents from Uttar Pradesh, Uttarakhand, and Rajasthan participated in the survey. Food habits and patterns were examined, including meal patterns and frequency of consumption. 71.7 percent completed 30 minutes of indoor games before the 19th pandemic, while 18.3 percent completed an hour. 70% spent 30 minutes or more on outdoor games after the pandemic. 11% were stressed, 2 (3.3%) said they were sad, 7 (11.7%) were angry, 15 (25%) were bored, and 4 (6.7) were bored. Fresh fruits 46 (76.7%), green vegetables 45 (75%), dry fruits 38 (63.3%), super foods 8 (13.3%). Water intake before COVID 19: "2-4 litres 60%, 1-2 liters 26.7%, more than 4 liters 13.4%".

Conclusion: Do not use any herbal supplement without first consulting an expert, and consider the amount to be taken because failure to do so can result in a variety of physical complications such as kidney disease, ulceration, and so on. We emphasize the importance of adopting a healthy lifestyle, as the COVID-19 pandemic nowadays is ongoing.

Key words: covid-19, food intake, lifestyle; dietary pattern, food behaviours, emotional eating

Emotional Intelligence and Self Esteem among Residential Hearing Impaired Children

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ABSTRACT

Purpose: Hearing is one of the most important sensory ability that increases the adaptation of human with their environment (Demehriet *al*, 2015). The hearing impairment: it is the functional definition which relies on the extent to which the degree of hearing loss affects realization and understanding the verbal language. Based on this definition, Soliman (2007) believes that the hearing impairment means a deviation in hearing that reduces the ability of oral and verbal communication. The emotional intelligence is a good predictor of the person's success in his practical life rather than the whole intelligence which is only a good predictor for the individual's academic success. The people who are highly emotional intelligent are too close to achieve success in their life. Based on Goleman's theory (1995) emotional intelligence includes knowing and managing of personal emotions, sympathizing with others and manipulation of communications in order to be satisfied with them.

There are many factors which may exert an enhancing or detrimental influence in the ability of a child to achieve success in the world. One such factor is self-esteem. A child's self-esteem is formed on the basis of how others respond to the child, what the child thinks of himself, and what the child would ideally like to be. Other studies comparing the self-concept / Self esteem of DHH children and their hearing peers have shown inconsistent results. Some studies have established a higher incidence of low self-concept in DHH individuals than in hearing individuals (Schlesinger, 2000).

Methods: A correlation research design was used to know the influence of selected variables on emotional intelligence and self-esteem among residential hearing impaired children. The population for the study comprised of hearing impaired children in the age group of 13 - 17 years. Samples were selected from Deaf and dumb schools of Belagavi and Dharwad taluks of UAS jurisdiction. Thus, total sample comprised of 84 hearing impaired children. The hearing impaired children were assessed on emotional intelligence, self-esteem and SES condition by using Bar-on-emotional Intelligence scale by Baron and Parker (2000), Self-esteem scale by Heatherton and Aggarwal *et. al*, SES scales (2005). The collected data was analyzed using SPSS software. The statistical test used for analysis was frequency and percentage distribution, chi square, t-test, F-test and correlation analysis.

Results: Hearing impaired children had profound (63.10%) hearing loss and use sign language as mode of communication and all the children are availing, disability pension, free education and poor and accommodation facility by Government. Majority of hearing impaired children showed low (58.33%) level of emotional

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intelligence and moderate level of self esteem (72.60%). Hearing impaired children were low on performance and social dimensions of self esteem. There was significant influence of age, ordinal position and SES on emotional intelligence, where as self esteem did not differ on age , gender and ordinal position among hearing impaired children.

Conclusions: Majority of hearing impaired children belong to low level of emotional intelligence and moderate level of self esteem as they are unable to hear and communicate well. So there is a need of early detection and intervention is crucial to minimising the impact of hearing loss on child development of self esteem.

Key words: Emotional Intelligence, Self esteem, Hearing impairment.

Effect of polythene mulching on moisture conservation, weed control, yield and economics of tomato

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ABSTRACT

Purpose: Tomato (*Lycopersicon esculentum*) is the most consumed vegetable in the world. Water is being a limited resource, its efficient and effective utilization through viable irrigation management is essential for tomato crop to attain sustainable yields. Weeds are one of the constraints that competes for space, light, water and nutrients with tomato crop and causes yield reduction. Polythene mulching has been emerged as potential management approach to maintain favorable soil moisture and to control or suppress weeds in tomato crop.

Methods: Rashtriya Seva Samithi (RASS) – Krishi Vigyan Kendra (KVK) has conducted thirty three demonstrations on ‘Moisture conservation and weed control in tomato using polythene mulching’ in Chittecherla and Deendarlapalli villages of Chinnagottigallu mandal, Chittoor district, Andhra Pradesh under National Innovations on Climate Resilient Agriculture (NICRA) project from 2015-16 to 2019-20 with an objective of soil moisture conservation and weed control during crop growing period thereby to improve productivity.

Results: The five years data revealed that 26.2 irrigations were given to farmers practice (without polythene mulch), whereas it was only 17.6 in the demonstration (with polythene mulch). Weed density was low under polythene mulch condition (37.94 per m²) in tomato than without mulch (59.52 per m²). Polythene mulching with drip irrigation in tomato significantly increased the number of fruits per plant (32.9) and individual fruit weight (72.83gm) there by higher fruit yield (65676kg/ha) as compared to the farmers practice (53324 kg/ha). The gross returns (Rs.387736/- per ha), net returns (Rs.222169/- per ha) and BC ratio (2.45) were more in the case of polythene mulched tomato when compared to without polythene mulch.

Conclusion: It can be concluded that the use of polythene mulch along with drip irrigation was significantly increased the growth, yield and economic parameters in tomato by conserving soil moisture, effective nutrient uptake and suppressed weed growth.

Key words: Tomato, Polythene mulch, Weed, Drip irrigation, NICRA, Gross returns, BC Ratio

Information communication technology: - Enable Services in Agriculture sector

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3rd International Conference on “Global Initiative in Agricultural, Forestry and Applied Sciences for Food Security, Environmental Safety and Sustainable Development (GIAFAS-2021)”

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Introduction

In India, agriculture is the most important sector for food security, nutritional security, long-term development, and poverty reduction. It accounts for roughly 16 percent of GDP. The Green Revolution, Evergreen Revolution, Blue Revolution, White Revolution, Yellow Revolution, Biotechnology Revolution, and the most recent Information and Communication Technology Revolution are all milestones in India's agricultural progress. It has changed the way information is communicated, and the ability to use that information to enhance the agriculture industry has a huge beneficial impact that benefits everyone. IT has become a global link for people from all walks of life. Information and Communication Technology (ICT) is an umbrella word that encompasses all forms of transmission, such as electronic devices, networks, mobile phones, services, and apps that employ technology to assist spread information. In recent years, information and communication technology (ICT) has shown to be tremendously beneficial for farmers, particularly small landholders, marginalized farmers, and disadvantaged farmers, assisting them with marketing, precision farming, and increased profits. Farmers have been given the ability to share their thoughts, experiences, and ideas through the use of information and communication technology (ICT). It has provided farmers with more exposure and enabled them to employ research that considers agriculture as a whole.

Information and Communication Technology (ICT) is an umbrella word that encompasses all forms of transmission, such as electronic devices, networks, mobile phones, services, and apps that employ technology to assist spread information. In recent years, information and communication technology (ICT) has shown to be tremendously beneficial for farmers, particularly small landholders, marginalized farmers, and disadvantaged farmers, assisting them with marketing, precision farming, and increased profits. Smallholders are economic agents that make decisions based on all available information when farming their parcels of land. They pick what to plant, which inputs to use and how, when to plough, sow, and harvest; how much to keep for household consumption and how much to sell to make cash, or how much to store, based on this information. They frequently make decisions in an unfavorable economic climate, with poorly functioning markets and insufficient information accessible to enlighten them in time for their decisions. As a result, their decisions are frequently less than ideal. ICTs can help close this vital information and knowledge divide.

1.1 ICT in agriculture: deveping countries.

High transaction and operating expenses also stymie services provided by governments in poor countries. In a developing country where agriculture accounts for a significant portion of the economy, a large number of extension agents are required to reach geographically dispersed and remote farmers, interact with them, and advise them on innovative productive technologies that can be critical to their livelihoods.

ICTs have the ability to lower these expenses — digital technology has the power to change the world. DrumNet, for example, used a cashless microcredit scheme to connect financial institutions, smallholder farmers, retail suppliers, and agricultural product customers in Kenya. Some services are

Improving market access

Agricultural extension and advisory services

Climate change adoption and early warning

Food safety, traceability and certification

Financial inclusion

Insurance and risk management

1.2 ICT in agriculture: developed countries

Agriculture is one of the most visible examples of the digital gap between industrialized and underdeveloped countries. This is due to differences in farm architecture as well as the extent to which digital technology have infiltrated rural areas in developed and emerging economies. ICTs are used by farmers, their cooperatives, large,

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medium, and small input suppliers, merchants, processors, and retailers along the agricultural value chain, from soil testing through food processing with 3D printers.

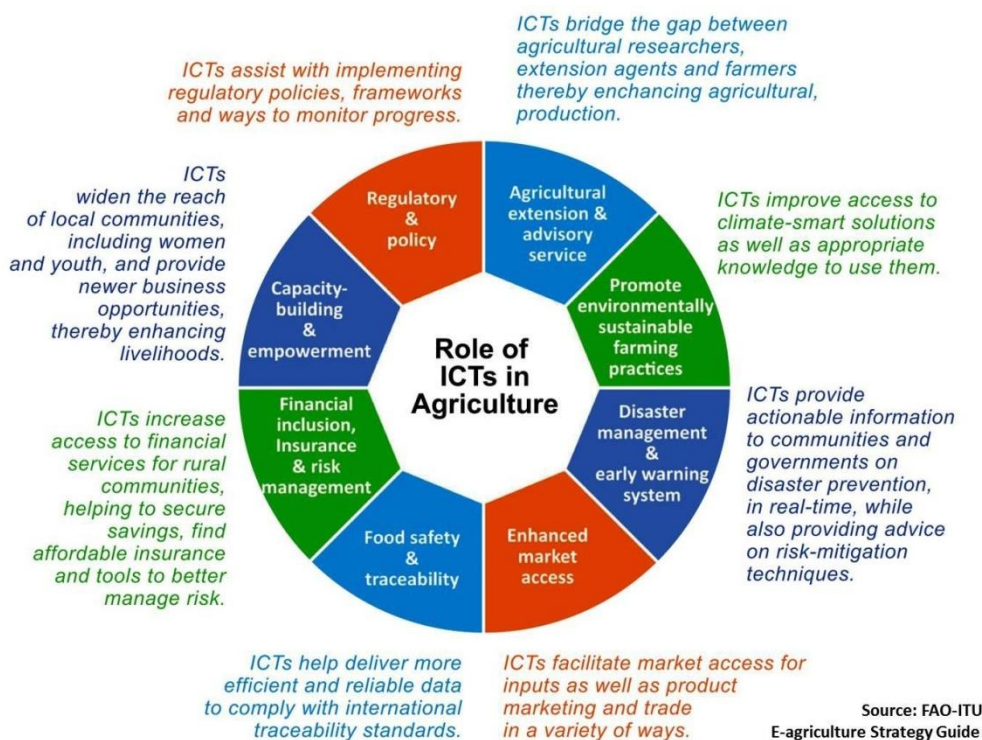
Precision in agriculture

While the primary motivation for using Precision Agriculture (PA) technologies is to increase profits, it may also be used to address health and safety concerns as well as lessen the environmental impact of farming operations. Large arable farms in Central and Northern Europe, the United States, and Australia are currently using the method. Controlled Traffic Farming, which uses GNSS technology and decision support systems to constrain field vehicles to the smallest area of permanent traffic lanes, lowers crop damage and soil compaction while reducing crop damage and soil compaction. Farmers in Australia and the United Kingdom have been able to save money on machinery and inputs while increasing crop yields.

Serious gaming

Games on the internet aren't just for fun. Serious games are interactive digital worlds that teach players how to solve problems. They are becoming increasingly popular in a variety of fields, including public policy, defence, corporate management, education, and training. They are simulation platforms that allow learners to interact with a variety of scenarios and events while providing answers, improving analytical skills, learning and remembrance abilities, problem recognition, and problem solving.

2. Role of ICT in Agriculture



3. application of information and communication technology in agriculture

3.1 Land Records Digitization

One of the most pressing concerns facing governance today is the preservation of land records and the availability of easily available property information. The term "land records" is a broad term that encompasses documents

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such as the land registry, Records of Rights (RoRs), tenancy and crop inspection registers, mutation registers, contested cases registers, and so on. It can also include geological information about the land's shape, size, and soil type, as well as economic data about irrigation and crops.

3.2 Commodity Trading in Agriculture

In 2003-04, the Government of India took significant steps toward the introduction of commodity futures trading, including the removal of the prohibition on futures trading in all commodities by issuing a notification and the establishment of National Level Commodity Exchanges, such as the National Commodity & Derivatives Exchange Limited (NCDEX), Multi Commodity Exchange of India Limited, and National Agricultural Futures Exchange of India Limited (NMCE).

3.3 Information dissemination

Kisan – SMS Based Farm: m – Kisan – SMS Based Farm: A farmer can get a preferred advisory on his cell phone through SMS using m – Kisan. At www.mkisan.gov.in, experts can register and provide advice messages to farmers. The messages are delivered in the native tongue.

3.4 Kisan call centers (KCC)

3.5 Farm advisory through mobile

3.6 Face book for farmers and extension workers

4. ICT Initiatives

- a) Digital green
- b) e-Arik
- c) e-Chaupal
- d) Honey Bee Network
- e) ICICI Knowledge Park (IKP) center for advancement in agricultural practices
- f) IFFCO Kisan Sanchar Limited
- g) Intelligent advisory system for farmers
- h) Life line india
- i) a-AQUA
- j) iKisan
- k) e-sagu
- l)

Table 1: Sources of agricultural information used by farmers

Source	Per cent of households
Other progressive farmers	16.7
Input dealers	13.1
Radio	13.0
Television	9.3
Newspaper	7.0
Extension worker	5.7

Source: Mittal and Tripathi (2009)

5. Advantages of ICT in agriculture

The following are some of the benefits of information and communication technologies in agriculture:

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- i. It will launch new agricultural and rural businesses such as e-commerce, real estate for satellite offices, rural business, and small-scale farm virtual corporations.
- ii. It will support political and analytical work on optimal farm production, disaster management, and agro-environmental resource management, among other things, as well as exploitation tools such as geographic information systems (GIS).
- iii. It will improve farm management and farming technologies by achieving competitive and property farming with safe products through cost-efficient farm management, risk management, and effective data or data transfer, among other things. For instance, a farmer has the authority to make crucial decisions such as what to sow. When is the best time to plant? Is there a way to control pests? Off-farm considerations such as environmental consequences, market access, and trade norms are taken into account. Their options will undoubtedly be aided by an IT-based call web.
- iv. It would provide methods and instruments to ensure food traceability and reliability, which has become a major concern for farm products after significant contamination such as chicken infectious disease was discovered.
- v. It will facilitate rural activities and provide a softer and safer rural living by providing services comparable to those found in metropolitan regions, such as distant education, telemedicine, remote public services, and remote diversion, among other things.
- vi. Stakeholder empowerment (government officials, researchers, educators, and extension specialists, farmers, and various service providers such as community data centres).
- vii. Extension services will be strengthened by the development of information management, phone support, and consolation systems, which will also be used for the Farmers Redressal System.

6. Opportunities

Information and communication technology (ICT) has the potential to transform the Indian agricultural sector, benefiting all farmers, especially small-scale, marginalised, and poor farmers. To reduce losses and boost rural livelihood and food security, strategies should be developed through provide farmers with all types of information from seed sowing to harvesting and marketing their agricultural goods on a regular basis. Despite the availability of farming resources in the surrounding areas, there is always a paucity of agricultural information, including seeds, farming practises, climate, diseases and pests, harvesting processes, farm machinery application, and post-harvest management.

7. Challenges associated with application of ICT in Agriculture growth

In developing countries accessing adequate and functional internet services and other ICT facilities are among the major concerns to farmers both in the rural and urban areas. These challenges are discussed as follows

7.1 Inadequate ICT Facilities and Personnel

In some existing issues to include inadequate accessibility of ICT services to rural farmers, lack of basic skills of using ICT facilities in agriculture, inability of government to deliver adequate ICT knowledge to farmers.

7.2 Infrastructure

Inadequate, and unstable power supply, cost of hardware and software are high with respect of average rural dwellers (Kale *et al.*, 2015). Similarly, Taragona and Gelb (2005) maintains that awareness, time, cost of technology, system integration, and software availability are the main constraints of ICT adoption in agriculture.

7.3 Power Supply and Farmers Perception of ICT Skills

The use of specialized ICT devices has not been adequately recognized in agricultural activities due to low investment of ICTs that can be used for teaching and learning modern production techniques in research institutes.

7.4 Harmonization of Knowledge and Language

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the role of ICT in Agricultural Knowledge Management (AKM) by assessing prospects and challenges for adoption of ICTs in India. Authors urge the harmonization of the basic and scientific research knowledge database and farmers’ knowledge database adopted biologically and socially over a period of time.

8. Recommendation

- These ICT projects are targeting a specific segment of the population, and they need to be popularized to reach a larger audience.
- Farmers' use of mobile applications is extremely restricted. This has to be researched and widely promoted among farmers. For this reason, e-literacy schools must be formed.
- Given the cost issue, the quantity of messages sent is quite limited. As a result, actions must be done to boost the amount of messages transmitted.
- In places where power and internet connectivity are unavailable, alternative forms of communication must be established.

9. Summary

With the usage of diverse ICT equipment, ICT has had a significant impact in sustaining agricultural development in developing countries. Nonetheless, there are a slew of obstacles and roadblocks that stand in the way of reaping the benefits of ICT use in agricultural activities. ICT can play critical role in strengthening the capacities of not only farmers but also for the field level functionaries and intermediaries. Developing the right or relevant content at the appropriate level has always been a challenge and more efforts are needed in this direction. However, lack of basic ICT skills, absence of political will, inadequate and fluctuation of power supply, poor internet infrastructure, and insufficient personnel to handle ICT infrastructure, language and harmonization of knowledge continued to impede ICT implementation in agricultural growth.

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Effect of different drying techniques on flower dehydration

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ABSTRACT

Dried and preserved ornamental products offer a wide range of qualities like novelty, longevity, aesthetic properties, flexibility and year round availability (Joyce 1998). Dry flowers are essential export items both in Indian and International markets and Indian export basket composed of 71% dry flowers which are exported to mainly USA, Japan, Australia, Russia and Europe. The demand for dry flowers is increasing at an impressive rate of 8-10 per cent annually thus offering a lot of opportunities for the Indian entrepreneurs to enter in the global floricultural trade (Singh 2009).

Methods: The range of dried flowers and other attractive plant parts is quite extensive, namely stems, roots, shoots, buds, flowers, inflorescences, fruits, fruiting shoots, cones, seeds, foliage, bracts, thorns, barks, lichens, fleshy fungi, mosses etc (Desh Raj 2001). In addition to native and naturalized- plants number of cultivated plants especially flowering annuals Viz., Amaranthus, button daisy, celosia, dahlia, gomphrena, marigold, pansy, paper flower, salvia, straw flower, statice, bells of Ireland, etc. and other leading flowers like carnation, chrysanthemum, rose and lotus can be grown for dehydration (Radha Rani and Reddy 2015). Potpourri is a major segment of dry flower industry valued at Rs. 55crores in India alone.

Results: The beauty and fresh look of flowers can be retained only for a few days even when some flower preservatives or chemicals are used to prolong the shelf life. However, techniques like flower dehydration can preserve certain flowers and foliage in such a way that their fresh look is maintained for several months or even years. These dried flowers are handy and available throughout the year and score over the cut flowers. A number of drying techniques such as air drying, sun drying, press drying, embedded drying, microwave drying, freeze drying, molecular sieve drying and cryo-drying, preservation techniques and value addition of dry flowers discussed in details.

Conclusion: Dehydrated flowers have long lasting. Beauty and charm of fresh flowers can be retained only for a few days even by using some preservatives where dehydration of flower may play significant role. Export demand of some flowers like gerbera, carnation, and rose when decreases, at this time dehydration of flowers can be provide alternative for business.

Key words: Cryo-Preservation, Gerbera, Microwave, Silica gel, Rose, Embedded

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Effect of foliar application of micronutrients on morpho-physiological parameters for enhancing the productivity in bt. Cotton

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ABSTRACT

Purpose: Cotton (*Gossypium* spp.) popularly known as “the white gold” is an important commercial fiber crop grown under diverse agro-climatic conditions around the world. It provides fiber and raw material for textile industry along with cotton seed and plays a vital role in economy of the country. India contributes about 25 % of the world’s cotton production. In India, the area about 13.4 million hectares with the production of 360 lakh bales and having productivity of 455 kg ha⁻¹, among the cotton producing major states are Gujarat, Maharashtra, Andrapradesh and Karnataka. In Karnataka, cotton is cultivated under area of 8.17 lakh hectare with production of 23 lakh bales and productivity of 522 kg ha⁻¹.

Methods: A field experiment was conducted during kharif season of 2019-20 at Agricultural Research Station, University of Agricultural Sciences, Dharwad, Karnataka. The experiment was laid out in Randomized Block Design with three replications in 5.4 x 4.5 m plot size with spacing of 90 cm x 60 cm. The trial comprised of nine treatments viz., FeSO₄, ZnSO₄, MgSO₄, MnSO₄, Boron and combination of MnSO₄ + ZnSO₄, MgSO₄+ ZnSO₄ and FeSO₄+ ZnSO₄ foliar spray of all these at 70 and 90 DAS.

Results: The data showed that the foliar application of MgSO₄ 1 % + ZnSO₄ 0.5% at 70 and 90 DAS (T₇) recorded significantly highest plant height (130.4 cm), monopodial and sympodial branches per plant (4.3 and 20.3, respectively), total dry matter production (224.5 g plant⁻¹), leaf area index (2.75 dm² plant⁻¹), photosynthetic rate (27.5 μmol CO₂ m⁻² sec⁻¹), chlorophyll content (3.60 mg/g/fr./wt.), cotton yield (2393 kg ha⁻¹), higher number of bolls per plant, (46.0) and single boll weight (6.35 g boll⁻¹) as compared to other treatments.

Conclusion: Based on the experimental results, it could be concluded that, foliar application of MgSO₄ 1% + ZnSO₄ 0.5 % significantly increased the plant, number of sympodial and monopodial branches per plant, total dry matter production, photosynthetic rate, chlorophyll content, number of bolls per plant, boll weight and cotton yield.

Key words: Cotton, Foliar spray, Micro-nutrient, Yield.

Effect of azolla and flaxseed supplemented poultry excreta on fish and pond water qualities

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Introduction

The feed given to poultry is voided as excretory waste which has undigested feed, metabolic excretory products and residues resulting from microbial synthesis that contains considerable amount of nutrients for fish production (Fashakin *et al.*, 2002). Poultry manure can be used after processing or fresh directly from the site, through sitting of poultry houses over ponds or after collection, storage and transport to the site for fish culture to enhance natural food production in ponds. Available literature clearly indicates that work on Azolla and flaxseed supplementation in poultry and other livestock is sufficiently available. However, no study is available on the use of Azolla and flaxseed supplementation in poultry feed under poultry-fish integrated farming and use of its excreta as fish feed supplementation. Therefore, the present study was made to find out the use of flaxseed and Azolla supplemented poultry excreta as fish feed and its impacts on water quality and fish.

Material and methods

The test was carried out to evaluate the effect of poultry excreta as fish feed supplemented from chicks fed with 2% and 4% of Azolla & flaxseed respectively on fish and physicochemical quality of water. 110 live specimens of the fish Common Carp *Cyprinus carpio* (ranging between 44-57 g in weight and 144-166 mm in length) acclimatized in 1000 litre capacity tank were transferred to the test tubs of 100 litre capacity. The study was conducted for 30 days in ten plastic tubs of 100 litre capacity divided into 5 groups having two replicates in each group with 10 specimens in each tub. Feeding of fish was started next day with 50% basal diet and 50% sun-dried poultry excreta. Feeding was done twice daily.

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Experimental design	Completely Randomized Design (CRD)
Experimental fishes	Common Carp (<i>Cyprinus carpio</i>)
Number of treatments	5
Control (PC)	100% Basal diet
*PTA1	50% Basal diet+50% excreta from 2% Azolla meal supplemented poultry
PTA2	50% Basal diet+50% excreta from 4% Azolla meal supplemented poultry
**PTF1	50% Basal diet+50% excreta from 2% Flaxseed meal supplemented poultry
PTF2	50% Basal diet+50% excreta from 4% Flaxseed meal supplemented poultry
Number of replicates per treatment	2
Number of fishes per replicate	10
Total number of fishes	100
Duration of experiment	4 weeks

*PTA Azolla supplemented poultry

**PTF Flaxseed supplemented poultry

Water from each tub was tested daily for temperature and pH, bi-weekly for dissolved oxygen (DO) free CO₂ and total solids. All determinations were carried out according to the Standard Methods of American Public Health Association (APHA, 1998). Fish weight and length were recorded initially and at the end of the experiment. Data were tested by using one way ANOVA (analysis of variance). Significance was tested at 5% level. All the data was statistically analysed using statistical methods described by Snedcor and Cochran (1989) using SPSS (Statistical Package for Social Sciences) software [version 16.0-SPSS Inc.]

Results: The mean values of water temperature ranged from 21.18 to 25.6, 21.50 to 25.14, 21.86 to 25.75, 21.71 to 25.50 and 21.43 to 25.50 in PC, PTA1, PTA2, PTF1 and PTF2, respectively. The overall mean temperature in different treatment groups during the experiment period was 22.78 in PC, 22.84 in PTA1, 23.35 in PTA2, 23.20 in PTF1 and 23.24 in PTF2.

The mean values of pH ranged from 9.45 to 9.58, 9.45 to 9.53, 9.47 to 9.52, 9.50 to 9.52 and 9.48 to 9.52 in PC, PTA1, PTA2, PTF1 and PTF2 respectively. The overall mean values of pH in different treatment groups during the complete experiment period were 9.49 in PC and 9.5 in PTA1, PTA2, PTF1 and PTF2.

The mean values of DO range from 6.22 to 6.35, 6.22 to 6.32, 6.22 to 6.29 and 6.22 to 6.31 and 6.23 to 6.28 in PC, PTA1, PTA2, PTF1 and PTF2, respectively. Over all the mean value of DO in different treatment groups during the total experimental period was 6.23 in PC, 6.24 in PTA1, 6.23 in PTA2, 6.25 in PTF1 and 6.23 in PTF2. The mean value of free CO₂ ranged from 10.51 to 10.57, 10.48 to 10.56, 10.51 to 10.55, 10.45 to 10.55 and 10.50 to 10.55 in PC, PTA1, PTA2, PTF1 and PTF2, respectively. Over all mean value of free CO₂ in different treatments throughout experiment period was recorded as 10.53 in PC, 10.53 in PTA1, 10.53 in PTA2, 10.51 in PTF1 and 10.52 in PTF2.

The mean value of total solids ranged from 61.32 to 64.77, 61.28 to 65.00, 61.58 to 64.22, 61.13 to 64.59 and 61.22 to 65.00 in PC, PTA1, PTA2, PTF1 and PTF2, respectively. Over all mean of total solids were non-significant among all treatments throughout the experimental period with the value 63.00 in PC, 63.17 in PTA1, 63.16 in PTA2, 62.99 in PTF1 and 63.34 in PTF2.

There are no significant changes ($P > 0.05$) in the Initial-final length and Initial-final weight of fishes in all the treatments during the short period of 28 days in both experiments.

Conclusion: There was no adverse impact of the use of either source of poultry excreta on fish and water quality in this feeding trial. Hence, it is suggested that formulated feed for carps may be replaced up to 50% with dried poultry excreta, the level that gave an optimal fish performance and conducive water quality. The use of chicken excreta to make the fish feed pellets can reduce the feeding cost also and form a good ecological cycle between chicken and fish farming.

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Antidiabetic effect of hydroalcoholic extract of *Ajuga bracteosa* leaves in alloxan induced diabetic chick model

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ABSTRACT

Objective: To investigate the antidiabetic effect of hydroalcoholic extract of *Ajuga bracteosa* leaves in alloxan induced diabetic chick model.

Hypothesis: *Ajuga bracteosa* has been reported for its antioxidant and antidiabetic property clinically or preclinically. However, more scientific research is yet to be done on *Ajuga bracteosa*.

Methods: Alloxan (12 mg/ 100 gm body weight, i.p.) was used to induce diabetes in chicks and the blood glucose level was estimated by using commercial kit (Span Biotech, Surat, India). After the confirmation of diabetes in chicks, hydroalcoholic extract of leaves of *Ajuga bracteosa* (10 mg/ 100gm body weight, orally) was administered to the diabetic chicks for 30 days daily. The study was carried out on three group including normal control group, diabetic control group and diabetic treated group; by assessing blood glucose level at the end of the study period.

Results: The administration of hydroalcoholic extract of *Ajuga bracteosa* in diabetic chicks showed a marked improvement in the blood glucose level as compared to the diabetic control chicks ($p < 0.05$) and is almost or near to the values in normal control chicks ($p < 0.05$).

Conclusion: These results suggest the potent antidiabetic effect of hydroalcoholic extract of *Ajuga bracteosa* leaves in the alloxan induced diabetic chick model.

Keywords: Alloxan, diabetes, *Ajuga bracteosa*, antidiabetic, hydroalcoholic

Severe infestation of root-knot nematode on tuberous *Vigna vexillata* (L.)

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Introduction

Vigna vexillata (L.) A. Rich) an underutilized legume species belongs to the family Fabaceae. Two types of *V. vexillata* have been reported i.e., seed type and tuber (storage root) type. The tuber type is reported as resistant to several biotic and abiotic stresses. It is a pantropical herbaceous legume occurring in Africa, Asia, Australia and America. Its fusiform roots are eaten raw or boiled in tribal pockets of Indian hills and are considered superior to sweet potato in flavour and nutrition. Among various domesticated species of *Vigna*, tuber cowpea is one of the least researched crops. Among several factors for the poor and unstable yield of food legume crops, biotic and abiotic stresses appeared to be the most important. Although several plant-parasitic nematodes are infesting legume crops but root-knot nematodes (RKNs), *Meloidogyne* spp. are considered an important constraint in production of leguminous crops in tropical and subtropical regions. RKNs are one of the most damaging groups of plant-parasitic nematodes capable of attacking a wide range of crop plants and many weed species. Infestation of *M. incognita* in tubers of *V. vexillata* is reported here for the first time. Further research is required to work out on damage potential of *M. incognita* on *V. vexillata* tubers as well as its sustainable management.

Materials and Methods: During a routine survey for nematode diseases, severe infestation of *M. incognita* was noticed in *V. vexillata*, in October 2020, which was grown at ICAR-National Bureau of Plant Genetic Resources, New Delhi, India. Stunted, chlorotic and wilted plants were observed in *V. vexillata* growing plot. The soil samples along with roots were randomly collected from around the rhizosphere of infested plants. A total of 20 composite soil and root samples were collected from a depth of up to 20-cm from diseased plants. The second stage juveniles (J2) of the RKN were isolated from 200-cc of each sample using standard methods. The J2s were counted under the stereoscopic microscope at 40X magnification and severity of root galling on infested plants was assessed on a 0–5 rating scale according to the percentage of galled tissue, in which 0 = 0–10% of galled roots; 1 = 11–20%; 2 = 21–50%; 3 = 51–80%; 4 = 81–90%; and 5 = 91–100%. For identification of RKN species perineal pattern characteristics of mature females and morphological analysis of other stages, i.e., J2 and males were used. Nematode J2s were also used for molecular characterization of RKN species.

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Results: Based on perineal pattern morphology and nucleotide sequences of ITS region, the population was identified as *M. incognita*. In soil analysis, all the soil samples yielded J2 of *M. incognita* in variable numbers. The average population density was 687.5 ± 123.72 J2/200cc soil ($=3.44$ J2/cc soil), The entire roots of the infected plants were heavily galled in a unique pattern with gall index (GI) of 3-5 (4.3 ± 0.79) encompassing 70-100% root systems. It was noticed that the infested *V. vexillata* growing bed had a history of cucumber cultivation for the last three consecutive years (2017-2019). This suggests that RKN may be derived from the previous crops known as RKN susceptible. This might have led to the buildup of the high population density of *M. incognita*.

Conclusion: It is concluded that *M. incognita* can be a damaging pest of *V. vexillata* and can serve as a source of infestation to other host crops. Therefore, proper management strategies should be taken to minimize nematode damage in *V. vexillata* cultivation. Therefore, growers are advised to have the soil from the proposed area tested for nematodes before planting. For that, take soil samples with a hand shovel in a zigzag pattern across the selected plots from the top 15-30-cm of soil. Mix samples thoroughly and send to the nearest Nematology laboratory for nematode analysis.

Key words: Cowpea, infestation, root-knot nematode, tuberous root

Optimizing Tillage and Residue Retention Practices for Improving Soil Quality in Maize Wheat Cropping System of Lower Shivalik

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ABSTRACT

Purpose: The study aimed to optimize the tillage and residue retention practices for improving soil quality in degraded Shivalik.

Methods: A field experiment was conducted from 2009-10 to 2016-17, in maize (*Zea mays* L.) - wheat (*Triticum aestivum* L.) cropping sequence. Six treatments were laid out in the field in randomized block design, which comprised of (T1) Conventional tillage; (T2) Deep tillage once in three years; (T3) Conventional tillage with integrated nutrient management; (T4) Conventional tillage with brown manuring in maize + cowpea (1:2) and wheat+ pea (4:1) ratio ; (T5) Conservation tillage; and (T6) Conservation tillage with brown manuring. The treatments comprising varied combination of tillage and residue retention practices were compared with control.

Results: It was found that, 70 to 80% reduction in soil loss, 18 to 22% increase in soil organic carbon, 28% increase in soil available nitrogen can be achieved by optimum combination of tillage and residue management, as compared to control. The macro aggregate % varied from 28 to 46.5%. The highest percentage of macroaggregate was recorded under CST-BM system, followed by CT, CT- BM and lowest in DT. Mean soil available nitrogen varied from 180 to 330 Kg/ha, and the brown manuring systems significantly increased soil available nitrogen due to incorporation of leguminous plant residues. Soil moisture varied from 2.2 to 7.5%, highest being under treatments with residue addition *i.e* T4, T5 and T6. The treatment T6 (Conservation tillage with brown manuring) have been found to be the best in terms of resource conservation and sustainable crop production.

Conclusions: Thus, the study suggests that Conservation Tillage in conjunction with brown manuring could be a promising practice for improving soil quality in light textured soil of Shivalik region.

Key words: Tillage, Residue, Shivalik, Soil quality

***Punica granatum* peel as a sustainable source for the prevention hypertension**

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ABSTRACT

Punica granatum is commonly known as pomegranate is widely cultivated in India that generates million tons of fruit waste mainly peel and seed every year. Pomegranate peel is a rich source of phytochemicals which contains high quantities of antioxidant and polyphenolic compounds as compared to other part of the fruit. Major bioactive compounds present in the peels are ellagic acid, gallic acid, punicalagin, tannins and flavonoids which mainly provides pharmacological properties *i.e.* antihypertensive, anti-aging, anti-cancer, anti-inflammatory etc. Hypertension is associated with many diseases such as cardiovascular disease, type 2- diabetes, anti-inflammatory, end stage renal disease, cerebrovascular disease and metabolic syndrome. Finding from several studies showed that presence of some antioxidant in the peels of pomegranate prove to reduce the risk of hypertension by inhibiting the activity of serum angiotensin converting enzyme which eventually decreased the systolic blood pressure. Pomegranate fruit as whole is also known as heart healthy fruit, due to its anti-hypertensive activity which ultimately improves the heart health. Overall this review explores the antihypertensive activity of *P. granatum* peel.

Introduction

High blood pressure or hypertension is one of the major consequences of cardiovascular diseases which include stroke, myocardial infraction and heart failure; cerebrovascular diseases, type 2 diabetes, end stage renal disease and metabolic syndrome, these diseases are the major cause of death and infirmity around the globe. Prevalence of hypertension is about 15% throughout the world which is expected to increase up to 30% by 2025. To avoid the occurrence of these diseases it is necessary to control the blood pressure of the patient either by lifestyle modification, medication or both. Several controlled study indicated that 5 mmHg decline in diastolic blood pressure, reduce the risk of cardiovascular diseases up to 15 to 40% respectively. According to seventh report of Joint National committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC-7), initiation of cardiovascular disease is due to the double increment of blood pressure of 20/10 mmHg. JNC-7 also defined prehypertension at 120 mmHg \leq systolic blood pressure (SBP) < 140 mmHg 12 and/or 80 mmHg \leq DBP < 90 mmHg. Prehypertension is a medical condition in which development of hypertension in future is 2 fold higher that can be a risk factor for the progression of several other diseases. It is a major public health issue as many people are unaware because it is mostly asymptomatic at initial stage. Finding suggested that through the intervention, progression of prehypertension can be reduced. Several anti-hypertensive drugs has been introduced still hypertension remains the major medical problem. This is why the focus has been lies on products from natural sources to treat the high blood pressure (Asgary *et al.*, 2013; Stowe, 2011).

Pomegranate is one the famous edible fruit deliberated as ornamental fruit for Mediterranean people which provide broad application in traditional medicine since ancient times. It is enduring and drought-lenient plant, growing in arid and semiarid regions. They are extensively cultivated in Iran, India and the Mediterranean countries like Turkey, Spain, Morocco, Egypt and Tunisia. Pomegranate is considered as berry but belonging to its own botanical family *Punicaceae*, containing single genus *Punica*, with one main species known as *P. granatum* (Zarfeshany *et al.*, 2014). All the parts of pomegranate plant like peel, juice, seed, flower, bark, leaf and root contains ample amount of phytochemical compounds including flavonoids (e.g. anthocyanins, catechins, quercetin, and rutin), other types of polyphenols, ellagitannins, antioxidants, water soluble vitamins and minerals which provides many therapeutic activities against different types of disorders. Pomegranate contains a juicy volume but the major portion of the fruit is peel, around 50% of fruit weight, 40% arils and 10% seeds. The peel consists of two parts; outer hard structure is called pericarp and the inside soft structure is mesocarp in which the arils are attached (Ranjha *et al.*, 2021; Asgary *et al.*, 2013; Viuda-Martos *et al.*, 2010). Peel of the pomegranate is deliberated as agro-industrial waste but it is a good source of bioactive compounds such as tannins (punicalin, punicalagin, pedunculagin, gallic acid and casuarinin), alkaloids, flavonoids (catechin, epicatechin,

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epigallocatechin-3-gallate, flavan-3-ol, kaempferol, kaempferol-3-O-glucoside, kaempferol-3-O-rhamnoglucoside, luteolin, luteolin 7-O-glucoside, Naringin, pelargonidin, prodelphinidin, quercetin and rutin) and organic acids which possesses many health benefits. Several studies also indicated that pomegranate peel comprises greater antioxidant activity as compared with flower leaf, seed and juice (Malviya et al., 2014).

Bioactive compounds present in different parts of pomegranate

Bioactive compounds is also called as phytochemical compounds which are particularly found in variety of foods and have the ability to regulate the metabolic processes, consequence in better health advancement. These compounds are mostly found in plant sources such as whole grains, fruits and vegetables, which is when included in the diet in considerable amount provides health benefits beyond the elementary nutrition. Bioactive compounds present in different part of pomegranate are listed below in Table. 1.

Table 1. Principal bioactive compounds present in different parts of the pomegranate fruit

Fruit components	Bioactive compounds	References
Peel	Anthocyanin, Ellagic acid, Gallic acid, Catechin, Quercetin, Rutin, Punicalin, Delphinidin, Punicalagin, Linoleic acid, Caffeic acid, Chlorogenic acid, Coumaric acid Tannin, Luteolin, Pelletierine alkaloids, Quinic acid, Epicatechin, Epigallocatechin-3-gallate, Kaempferol, Kaempferol-3-O-glycoside, Kaempferol-3-O-rhamnoglucoside, Naringin, Cyanidin, Pelarginidin, Delphinidin, Corilagin, Casuarinin, Gallagylidilacton, Pedunculagin, Tellimagrandin, Granatin A, Granatin B.	Prakash <i>et al.</i> , (2011); Jacinto (2018);
Seed	Anthocyanin, Ellagic acid, Gallic acid, Catechin, Quercetin, Rutin, Punicalin, Punicalagin, Coniferyl, Sinapyl, Cinnamic acid, Genistein, Linoleic acid, Caffeic acid, Tannin, Luteolin, Pelletierine alkaloids, Ellagic acid, 3,3'-Di-O-methylellagic acid, 3,3'.4'-Tri-O-methylellagic acid, Punicic acid, Stigmasterol, β -Sitosterol, Daucosterol, Camesterol, 17- α -Estradiol, Estrone, Testosterone, Estriol, γ -tocopherol, Ursolic acid, Oleanolic acid, Genistein, Daidzein	
Juice	Anthocyanin, Ellagic acid, Gallic acid, Catechin, Quercetin, Rutin, Kaempferol, Punicalin, Cinnamic acid, Delphinidin, Punicalagin, Linoleic acid, Caffeic acid, Tannin, Luteolin, Pelletierine alkaloids, Quinic acid, Caffeic acid, Chlorogenic acid, <i>p</i> - Coumaric acid, Catechin, Epicatechin, Epigallocatechin-3-gallate, Cyanidin-3-O-glucoside, Cyanidine-3,5-di-Oglucoside, Delphinidin-3-O-glucoside, Delphinidin-3,5-di-Oglucoside, Pelargonidin-3-O-glucoside, Pelargonidin-3,5-di-Oglucoside, α -tocopherol, Corilagin, Casuarinin, Gallagylidilacton	

Anti-hypertensive activity of pomegranate

Anti-hypertensive activity of pomegranate is very effective which acts in various mechanical due to the presence of polyphenols. In a dose dependent manner it was observed that polyphenols from juice of pomegranate reduce the risk of hypertension through the reduction of serum angiotensin-converting enzyme (ACE) up to 36% which in turns decrease the systolic blood pressure by 5%. It was detected that juice provides protection against vascular diseases which might correlated with the inhibition of oxidant stress and serum ACE activity (Wang et al 2010). A study conducted on small randomized human trials indicated that 50 ml consumption of pomegranate juice provides 1.5 mM of total polyphenols to the patient having severe carotid artery stenosis encouraged the reduction of carotid intermediate thickness (IMT) and also decrease the systolic blood pressure (Aviram et al. 2004). Several polyphenols like punicalagin, which is the main compound of the peel increase the synthesis of endothelial nitric oxide (NO) that provides relaxing sensation in the endothelium through the stimulation of endothelial NO synthase (eNOS) that acts as vasodilator which ultimately reduce the blood pressure (Nigris *et al.*, 2007). In a study consumption of pomegranate juice by hypertensive patient for two weeks, showed the significant reduction by 36% of ACE activity due to the antioxidant property of the juice. It was observed that antioxidant therapy use used to control the blood pressure in hypertensive patient is because of the oxygen species that contributes to the contraction of endothelium and increase the vascular resistance which in turns decrease the blood pressure. Additional possibility of the reduction of serum ACE activity by pomegranate juice is related to the effect of cytochrome P-450 enzymes which breakdowns the ACE inhibitory drugs and lowers the activity of serum ACE, thus regulate the blood pressure (Aviram and Dornfeld, 2001). Figure 1 illustrated the effect of pomegranate on cardiovascular disease.

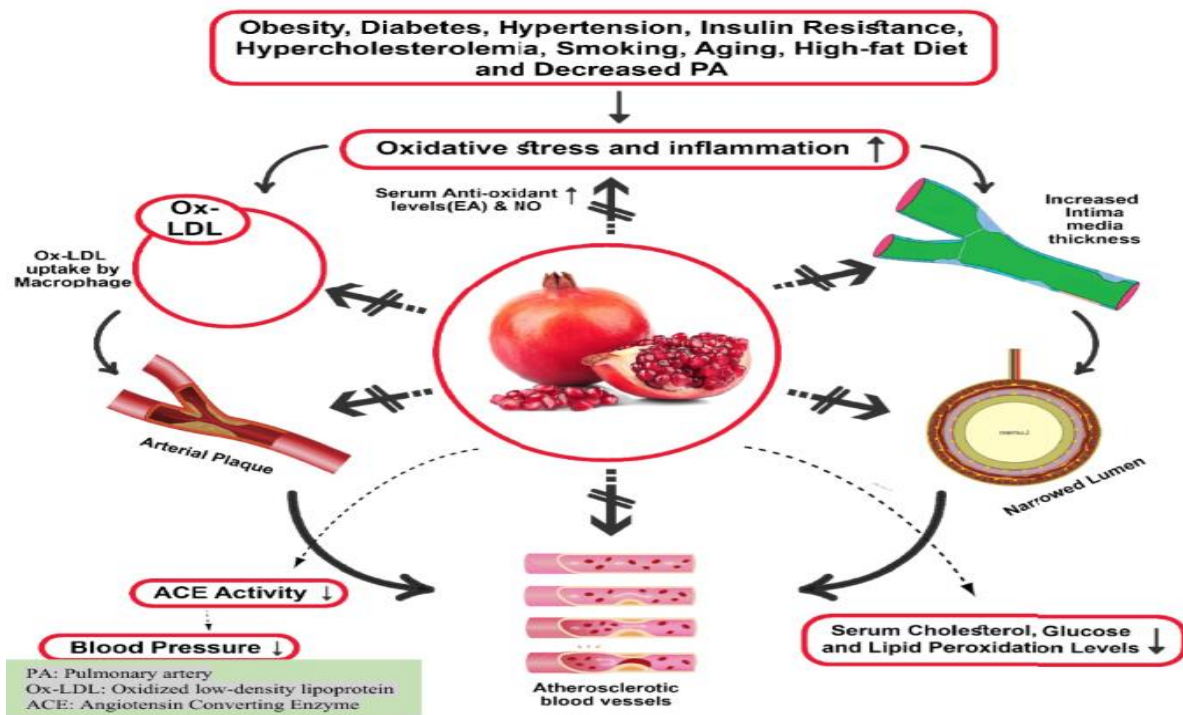


Fig.1. Effect of pomegranate on CVDs (Ranjha *et al.*, 2020)

Several studies indicated that highest polyphenols was found in peel as compared to juice and seed, but there is no study reported on anti-hypertensive activity of pomegranate peel, only the consumption of juice was detected which prevent the hypertension in some extent. Main focus of this review is to detect the anti-hypertensive activity of peel in future researches.

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Conclusion: This review concluded that different parts of pomegranate contain various bioactive compounds that have many beneficial health effects. It was also observed that highest polyphenolic content was found in the peel which is considered as waste and discarded. Anti-hypertensive activity of pomegranate juice was detected in several studies, all the antioxidants and phenolic compounds present in juice are present in the peel in greater extent so the anti-hypertensive activity of peel may also be obtained in future research.

Conflict of interest statement

All the authors declare no conflict of interest. There is no financial interest to report and all co-authors have seen and agree with the contents of the manuscript.

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Comparison of Physico-Chemical properties of soils under different forest types in dry tropical forest ecosystem in Achanakmar-Amarkantak Biosphere Reserve, India

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ABSTRACT

The present study was conducted to assess the variations in physico-chemical properties of soils under four forest types viz. Mixed Forest, Mixed Sal Forest, Mixed Teak Forest, and Teak Mixed Forests in a typical dry tropical ecosystem of Achanakmar-Amarkantak Biosphere Reserve (AABR), Central India. Soil samples were collected from four types of forest and analyzed for the soil samples were taken at three soil depths i.e. at 0-20 cm, 20-40cm and 40-60 cm and analysed for pH, EC, Organic C, soil moisture, bulk density, nitrogen (N), phosphorous (P) and potassium (K). The pH of soil was lower (5.43) under Mixed Forest and higher (6.13) in Teak Mixed Forest, while EC in soil was lower (0.04 dS m⁻¹) in Mixed Sal Forest and higher (0.32 dS m⁻¹) under Teak Mixed Forest. Organic C varied from 11.5 Mg ha⁻¹ to 17.8 Mg ha⁻¹ at 0-20 cm soil depth which was highest in soil under Mixed Sal Forest and lowest in Teak Mixed Forest. The Organic C and EC values were decreased with an increase in soil depth, while the bulk density showed reverse trend. Soil nutrients in different depths varied between 160.2-196.9 kg ha⁻¹, 10.4-17.7 kg ha⁻¹ and 266.4-439.1 kg ha⁻¹ for N, P and K, respectively. The nutrient quantities in soil were higher in Mixed Sal Forest and lower under Teak Mixed Forest, which decreased with soil depth. The paper discusses the possible variations in soil properties in relation to structure and composition of forest type and suggests appropriate management practices for the sustainable development of forest soils in dry tropical ecosystem.

Key words: Biosphere Reserve, Litter, Nutrients, Soil health, Structure, Tropical Forest

Introduction

Soils provide nutrients, water and space for vegetation, thus play an important role in bio-geochemical cycling of forest ecosystem (Goebes *et al.*, 2019). The morphological, physical, chemical and biological properties of soils are generally influenced by structure and composition of forest vegetation. Tropical forests are more dynamic as population of one species get replaced by another species in succession will significantly alter the properties of surface and subsurface soils such as pH, organic matter and exchangeable bases and nutrients at varying spatial and temporal scales (Poudel *et al.*, 2003). Biogeochemical cycling is regulated by vegetation through litter production and decomposition. The bio elements affect composition and processes at all levels of biological organization. The accessibility of bio elements not only influences plant growth but also biodiversity but also ecosystem processes, which are intricately linked to C assimilation and its storage in soil and vegetation. Therefore, understanding physico-chemical properties of soils become imperative for improving the productivity and C stocking in tropical forests.

As tropical forests play an important role in global carbon cycle and levels of soil organic carbon (SOC) might determine ecosystem functions and influence soil characteristics. Hence, the management of SOC levels is crucial in mitigation of atmospheric levels of greenhouse gases and also the supporting diversity of life forms (IPCC, 2018). The soil properties in tropical forests and other vegetation need to be understood for maintaining long term health of soil and vegetation development. Only few studies have been conducted by earlier workers and a relatively very little attention given on tropical forests of Chhattisgarh (Thakur *et al.*, 2007; Jhariya *et al.*, 2012). Therefore, the present study was conducted to assess the variations in physico-chemical properties of soils under different vegetation types of tropical forest of AABR.

Materials and methods

The study was conducted in Achanakmar Amarkantak Biosphere Reserve situated in parts of Bilaspur, Annupur and Dindori districts of Chhattisgarh and Madhya Pradesh, Central India (Fig. 1). It lies between 21° 48'35" to 22° 40'30" North latitudes and 81° 29'45" to 82° 02' 10" East longitudes. The area adjoining Achanakmar forest village has a number of hillocks scattered all over the area. Dry deciduous forest, grasslands, agriculture lands

and human habitations surrounds the study area. The climate of study area is dry humid tropical. The mean annual rainfall varies from 1200 to 1400 mm. It gradually decreases from southeast direction to northwest direction. About more than 90% of annual rainfall received in monsoon season from June to October. The peak rainfall occurs in July-August months. Number of rainy days varies from 71-118 days. It gradually decreases from south east direction to North West direction. May and June are the hottest months, whereas December and January are the coldest months of the year with minimum temperature reaches to 3-50° C. The mean temperature in January is about 21° C and in May temperature rises between 31° C and 41° C. Soils of Achanakmar area are grouped in to three classes viz., *Inceptisols*, *Alfisols* and *Vertisols*. Different types of forest vegetation occur in the study area. The natural vegetation in the Achanakmar-Amarkantak Biosphere Reserve varies across the reserve. The forest area of the reserve has tropical deciduous vegetation harboring 1500 plant species represented by 151 plant families.

The survey has been conducted in biosphere and identified four types of forests viz., Mixed Forest, Mixed Sal Forest, Mixed Teak Forest and Teak Mixed Forest. Soil samples were randomly collected from ten different sampling quadrates in these forest types. The soil samples were taken at three soil depths i.e. at 0-20 cm, 20-40 cm and 40-60 cm from different sampling quadrates with the help of auger. In all 120 soil samples (4 types x 10 quadrates x three depths) was collected during growing season and subjected to physico-chemical analysis. Bulk density was calculated by soil core method. The soil core was drawn from each sampling plot at different soil depths. The following expressions were used for the estimation of soil moisture and bulk density.

$$\text{Soil moisture (\%)} = \frac{\text{Dry weight of soil (g)}}{\text{wet weight of soil (g)}} \times 100$$

$$\text{Bulk density (gcm}^{-3}\text{)} = \frac{\text{Weight of oven dried soil (g)}}{\text{Volume of soil core (cm}^{-3}\text{)}}$$

The collected soil samples were analyzed in triplicate for pH, EC, organic C, available N, P and K. Soil pH and EC values were measured using pH and EC meters, respectively. Nitrogen was estimated by Micro- Kjeldahl method (Jackson, 1958) the total phosphorus following spectrophotometer and vando–molybdate yellow reagent procedure. Potassium was determined by flame-photometric method (Jackson, 1958). The organic carbon in soil was determined by Walkley and Black (1934) method. The amount of nutrients and carbon in soil was determined by multiplying soil volume, bulk density and respective concentration of carbon and nutrient values for given soil depth corresponding to each vegetation type and extrapolated on Mg ha⁻¹.

Results & Discussion: Results on physical properties of soil in different forest types are summarized in Table 1 and depicted in Figs. 2-5. The pH values of soils are found to be slightly acidic in nature, which varied from 5.43 to 6.13. It increased with soil depth. Soil pH was highest under Teak Mixed Forest and lowest under Mixed Forest in comparison to other vegetation types. It increased with an increase in soil depth (Fig. 2). Electrical Conductivity (EC) of soil varied significantly, which was highest (0.32) under Teak Mixed Forest and lowest (0.06) in Mixed Sal Forest. It also gradually decreased with an increase in soil depth (Fig. 3).

Bulk density is an important soil physical property, which varied from 1.38 to 1.51 Mg m⁻³ at 0-20 cm soil depth under different vegetation types (Table 1). It was highest under Teak Mixed Forest and lowest under Mixed Sal Forest. The bulk density increased with an increase in soil depth (Fig. 4). Soil moisture (%) content varied from 78.24% to 89.09% at 0-20 cm soil depth under different vegetation types (Table 1). It was highest under Mixed Sal Forest and lowest under Teak Forest. The soil moisture (%) was almost 12% higher in Mixed Sal Forest compared to Teak Mixed Forest. The soil moisture (%) increased with soil depth (Fig. 5).

Results on chemical properties of soil in different forest types are summarized in Table 2 and depicted in Figs. 6- 9. Soil C varied across vegetation types and also at varying soil depths (Table 2). It ranged from 7.5 to 17.8 Mg ha⁻¹. Soil organic C was highest under Mixed Sal Forest followed by Mixed Forest and Mixed Teak Forest. It was lowest in Teak Mixed Forest. The organic C levels decreased with an increase in soil depth (Fig. 6). Available N in soil ranged from 160.7 kg ha⁻¹ to 196.9 kg ha⁻¹ under different vegetation types. It decreased with an increase in soil depth (Table 2). It was highest in Mixed Sal Forest and lowest in Teak Mixed Forest. The

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available N levels were statistically at par in Mixed Sal, Mixed Teak and Mixed Forest at different depths (Fig. 7). The available P values in soil under different vegetation types ranged from 12.1 to 17.7 kg ha⁻¹, 11.6 kg ha⁻¹ to 16.6 kg ha⁻¹ and 10.4 kg ha⁻¹ to 13.3 kg ha⁻¹ at 0-20 cm, 20-40 cm and 40-60 cm depths, It was highest in Mixed Sal Forests followed by Mixed Teak Forest and Mixed Forest and lowest under Teak Mixed Forest (Table 2). The P values were statistically at par in Mixed Sal Forest and Mixed Forests. Similarly, it was also statistically at par in Mixed Teak Forest and Teak Mixed Forests (Fig. 8). K in the soil under different forest types ranged from 314.4 kg ha⁻¹ to 439.1 kg ha⁻¹, 280.7 kg ha⁻¹ to 423.8 kg ha⁻¹ and 266.4 kg ha⁻¹ to 411.2 kg ha⁻¹ at 0-20 cm, 20-40 cm and 40-60 cm depths, respectively (Table 2). It was highest in Mixed Sal Forests and lowest in Teak forest. The available K content decreased with an increase in soil depth (Fig. 9)

The structure and composition of forest vegetation strongly influence the soil pH, organic matter and exchangeable bases and nutrients (Poudel *et al.*, 2003). The results on physical properties of soil revealed that pH, EC, moisture % and bulk densities varied significantly across vegetation types and also along soil depth. The soil properties of this study were comparable to soil characteristics of tropical forest reported by Huston, (1980), Singh and Singh, (1991), Thakur *et al.* (2007). The soil bulk density and pH levels were higher under Mixed Sal forest and lower under Teak forest. This might be due to higher organic matter as a consequence of more litter deposition which decreased bulk density and increased the humid acid content at the time of decomposition of litter into humus result in a stronger acidic reaction. The supply of nutrients for vegetation also significantly influences the soil pH as it indicates the soil fertility (Zhao *et al.* 2012). This could be due to slow transformation of organic acids to humid substances in Mixed Sal Forests compared to other forest types. The moisture (%) is also higher in Mixed Sal Forest, which might attributed to better soil texture and structure, which corroborated with findings of earlier workers (Bhuyan and Sharma, 2015; Salve *et al.* 2018). They opined that higher amount of litter crop might act as mulch which could increase infiltration rate and preventing the moisture loss by reducing the levels of evaporation from soil surface. The study also showed soil moisture levels increased with an increase in soil depth, which was not an extraordinary phenomenon as the evaporation losses decrease with soil depth. The moisture losses are usually higher in soil surface and lower in sub surface layers and our values were comparable with other studies (Paudel and Sah, 2003).

The results revealed that organic C content, available N, P and K were higher under Mixed Sal Forest, which might be attributed higher amount of nutrient return to soil by vegetation via litter crop. Such affects were also reported by previous workers (Bijalwan *et al.* 2010; Thakur, 2014; Behera *et al.* 2017). Both standing litter and litter crop were higher under Mixed Sal Forest, which were lower under Teak forest resulted in low nutrient status in soil (Darro and Swamy, 2020). Different vegetation components contain different amounts of nutrients and accordingly build up the soil organic matter. The amount of nutrients added through litter crop varies with structure and composition of vegetation and environmental conditions. The decrease in nutrients and organic C in soil with increase in depth is not uncommon as several workers also observed similar trend (Poudel and Sah, 2003; Gariola *et al.*, 2012; Abdalmoula *et al.*, 2019). The management of litter crop is very essential as most of the dry tropical forests are subjected to forest fires in summer. Besides, the illegal grazing and harvesting of firewood and small timber from Teak Mixed Forest and Mixed Teak Forests should be regulated. The involvement of local people and community based management approach needs to be invigorated for the addressing the problems of societies, improving status of vegetation and also soil health for sustainable development of tropical forests of AABR.

Conclusion: The study clearly demonstrated that quite useful for characterization of physio-chemical properties of soils under different forest types in dry tropical ecosystem. The classification accuracy was found significantly higher for soils use and vegetation classes, which facilitated the qualitative and quantitative analysis of soils. The nutrient quantities in soil were higher in Mixed Sal Forest and lower under Teak Mixed Forest, which decreased with soil depth. The spatial data analysis helped in discriminating four vegetation types. Each vegetation type was unique, showed marked soils depth in different layers. The anthropogenic pressure was high in Teak Forests. The encroachment in Teak Mixed and Mixed Teak forests are also reduced the soils quality and diversity levels. Therefore, there is need of closure and protection of these vulnerable types for conservation biodiversity. Will not only affect the well being of large population of indigenous whose livelihoods and economy is intricately linked with the forest wealth. There is need to implement suitable policies and involve local people for community

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based approach and sharing the benefits to sustainable management of forests to secure the interests of both local and global communities.

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Table 1. Variation in physical properties of soil at different depths (cm) under vegetation types in Khudiya Forest Range of Mungeli Forest Division Chhattisgarh, India

Vegetation Types	pH			EC (dS m ⁻¹)			Bulk Density (Mg m ⁻³)			Moisture (%)		
	0-20	20-40	40-60	0-20	20-40	40-60	0-20	20-40	40-60	0-20	20-40	40-60
Mixed Forest	5.43	5.72	5.95	0.15	0.11	0.09	1.44	1.47	1.49	88.3	88.6	90.0
Mixed Sal Forest	5.87	5.86	5.85	0.06	0.05	0.04	1.38	1.41	1.46	89.1	92.7	93.9
Mixed Teak Forest	5.8	5.8	5.79	0.18	0.08	0.07	1.47	1.5	1.51	88.1	91.8	94.2
Teak Mixed Forest	6.13	6.01	5.99	0.32	0.32	0.29	1.51	1.52	1.54	78.2	85.9	88.6
CD at 5%	0.22	0.26	0.29	0.12	0.11	0.11						

Table 2. Variation in available organic C, N, P and K (Kg ha⁻¹) of soil at different depths (cm) under vegetation types in Khudiya Forest Range of Mungeli Forest Division Chhattisgarh, India

Vegetation Types	Organic C (Mg ha ⁻¹)			N (kg ha ⁻¹)			P (kg ha ⁻¹)			K (kg ha ⁻¹)		
	0-20	20-40	40-60	0-20	20-40	40-60	0-20	20-40	40-60	0-20	20-40	40-60
Mixed Forest	17.1	16.9	14.5	183.6	178.1	160.2	17.2	15.5	14.7	409.7	383.5	296.4
Mixed Sal Forest	17.8	17.3	15.2	196.9	184.4	170.6	17.7	16.6	13.3	439.1	423.8	411.2
Mixed Teak Forest	16.6	15.3	11.1	184.7	179.4	161.2	16.9	14.4	11.5	395.8	372.1	284.4
Teak Mixed Forest	11.5	9.2	7.5	174.2	164.2	160.7	12.1	11.6	10.4	314.4	280.7	266.4
CD at 5%	1.2	2.6	3.2	11.7	11.5	6.7	2.7	1.6	1.6	18.2	14.2	16.8

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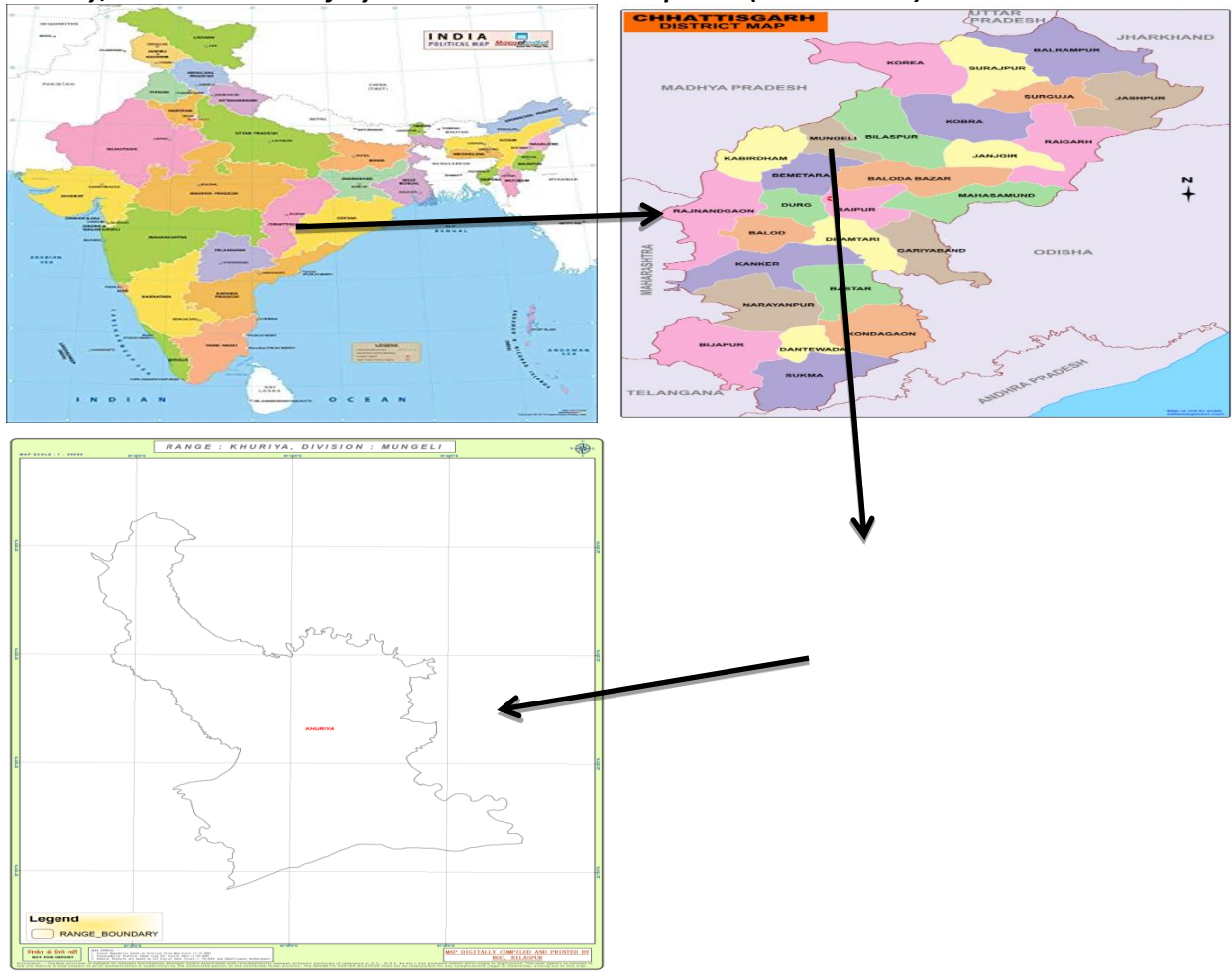


Fig. 1. Study area of Khuriya Forest Range, Mungeli Forest Division Chhattisgarh, India

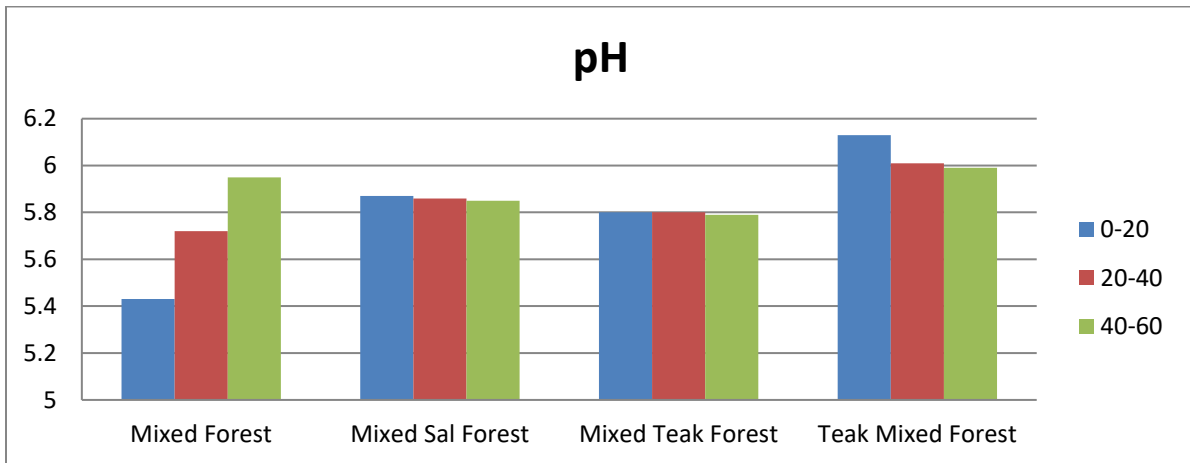


Fig. 2. Contribution of pH value in different vegetation types

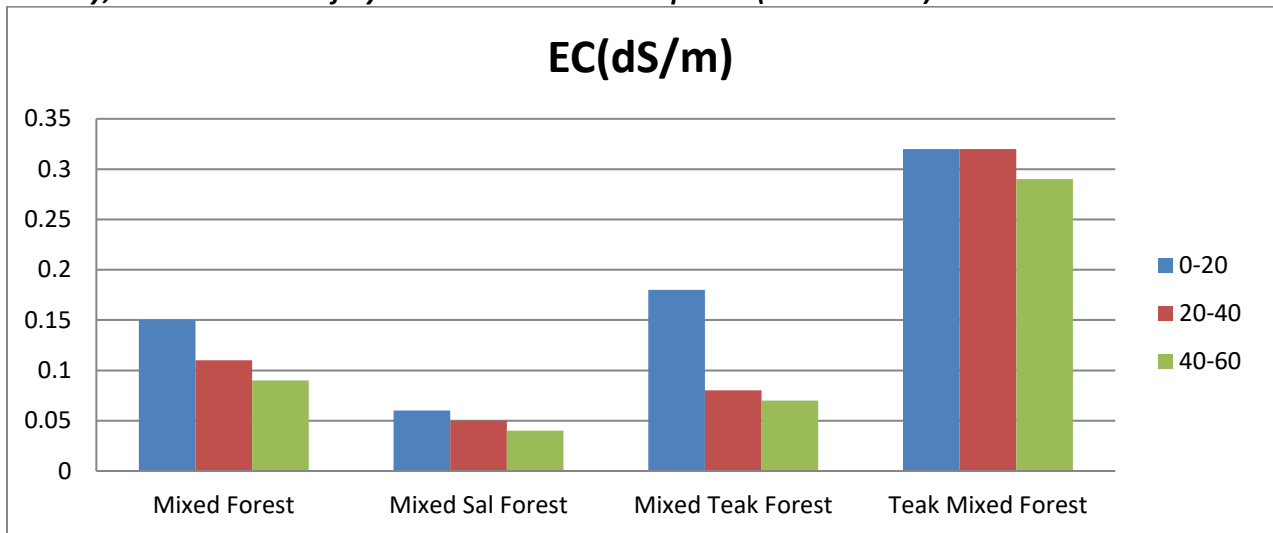


Fig. 3. Contribution of EC value in different vegetation types

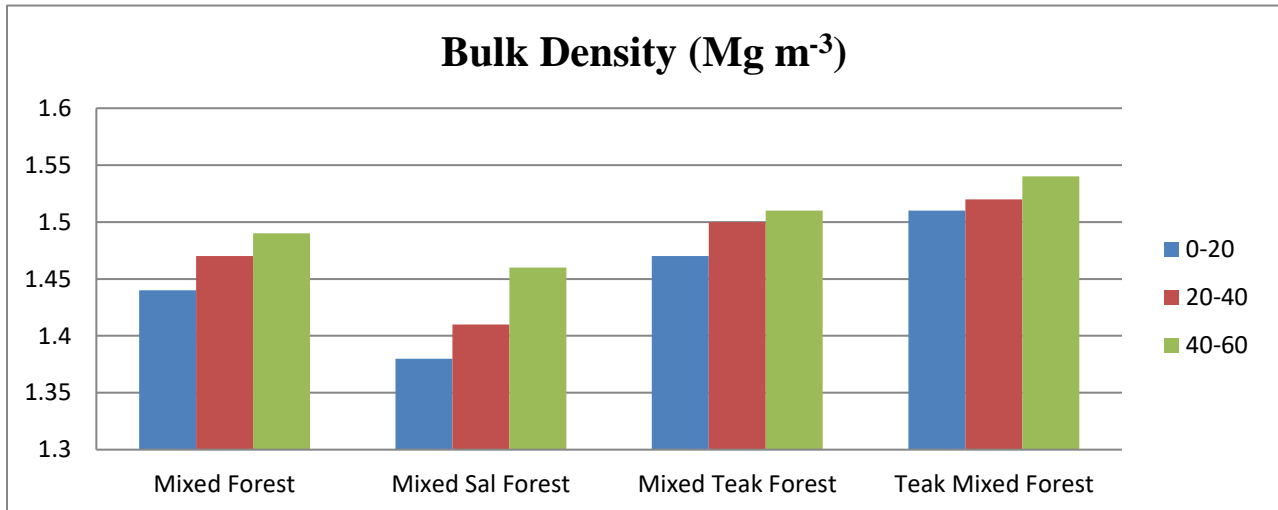


Fig. 4. Contribution of bulk density value in different vegetation types

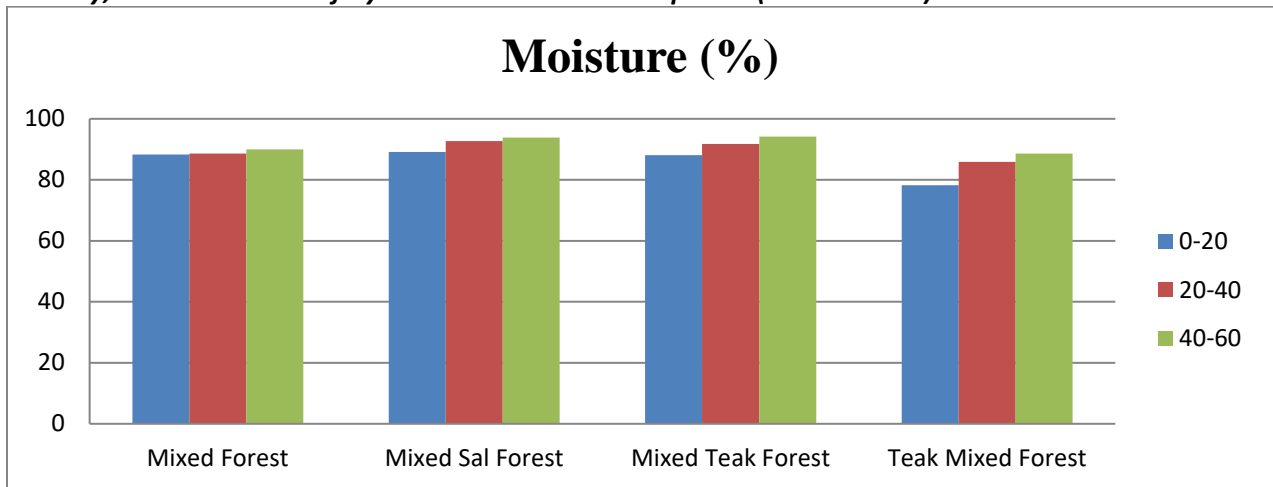


Fig. 5. Contribution of moisture (%) value in different vegetation types

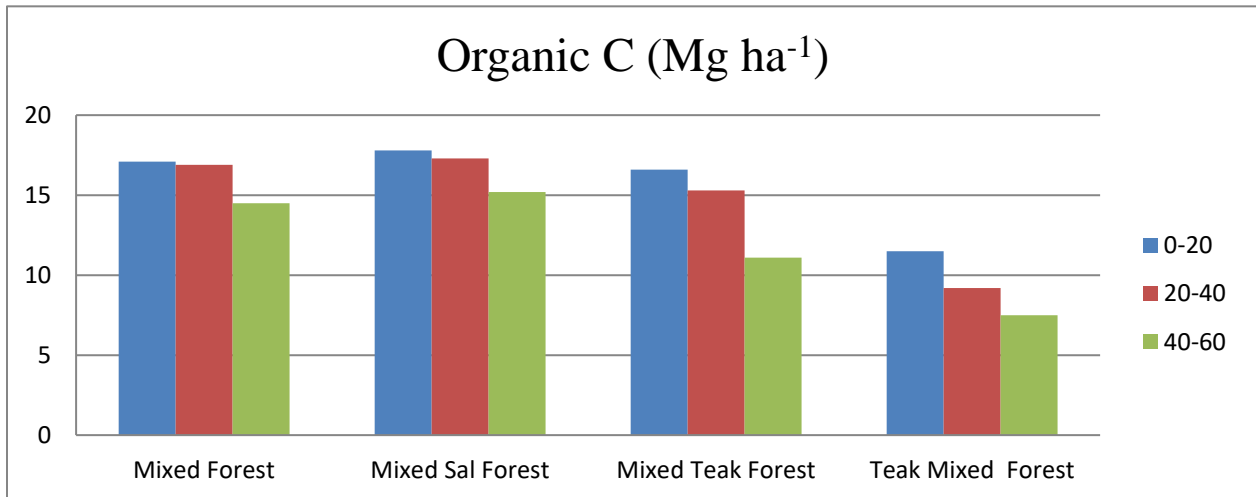


Fig. 6. Contribution of organic C value in different vegetation types

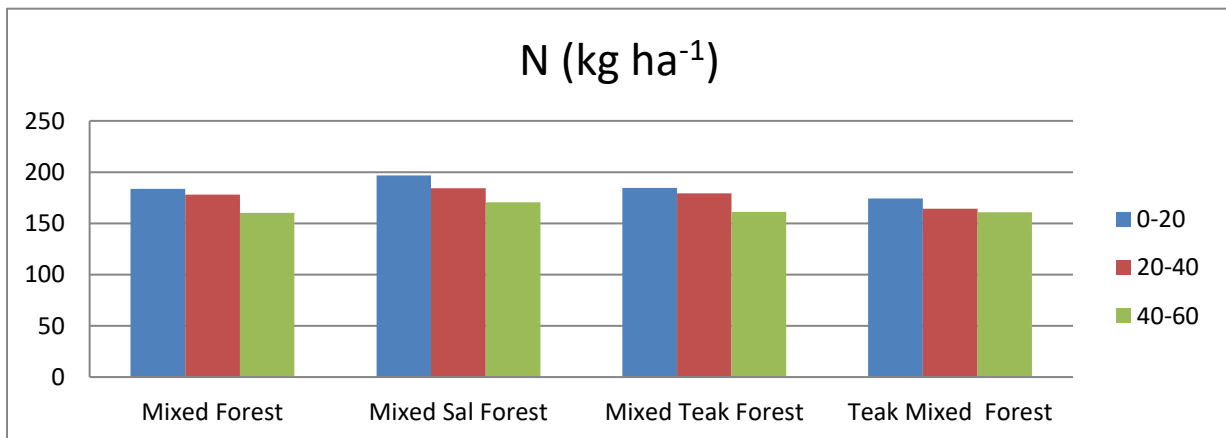


Fig. 7. Contribution of N value in different vegetation types

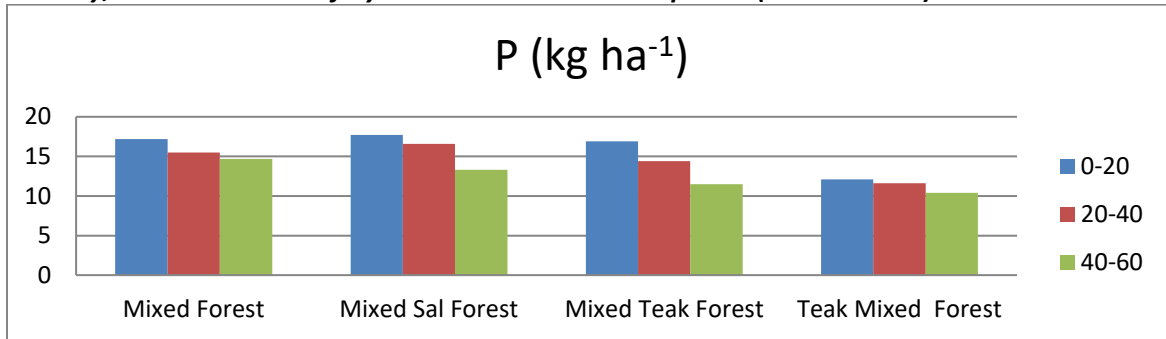


Fig. 8. Contribution of P value in different vegetation types

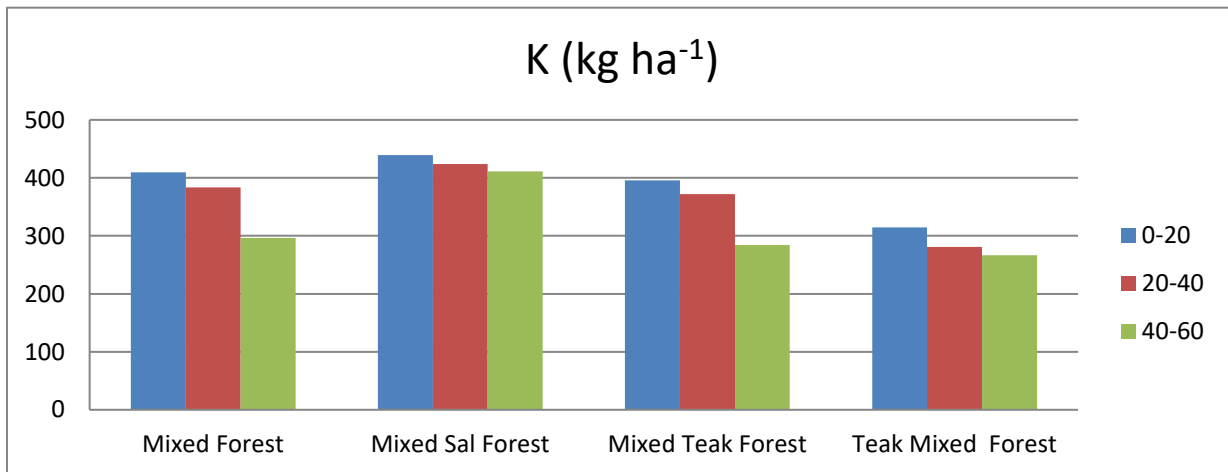


Fig. 9. Contribution of K value in different vegetation types

Study on population dynamic of fruit fly, *Bactrocera* spp. (Tephritidae: Diptera) and species diversity

Amit Kumar Patel, Arvind Parmar, Vishal Sarsaiya, Sundar Pal Panwar, Pradeep Kumar

ABSTRACT

Purpose

Fruit fly belongs to family Tephritidae found all over the world. Nearly 5000 described spp. of tephritid fruit fly have been categorized in almost 500 genera. Fruit flies are the most important limiting factor due to economic importance and direct damage to the fruit crops. We aim to study and define fruit fly species diversity and population dynamics of fruit flies trapping in pheromone baited traps, economic trap for fruit flies trapping, correlate the Fruit fly population with abiotic factors and species diversity of FruitFlies.

Methods

The Bottle Fruit Fly Traps used in present study and fruit flies trapped in each trap were collected into plastic vials measuring 6.5 x 2.5 cm² separately and brought to the laboratory at weekly interval, starting from 41st SW from 2019 to 22nd SW 2020. Sufficient number of transparent, white mineral water bottles of one litre capacity measuring 276 mm long, 76.4 mm wide at base and 27.4 mm at neck were purchased from market. A total of four entry holes of 22.5 mm² size were made at equal distance just below the curve of the shoulders with the help of a blade. Different treatments were studied viz., Bottle fruit fly baited with Methyl eugenol, Bottle fruit fly baited with Cuelure, McPhail fruit fly trap baited with Methyl eugenol, McPhail fruit fly trap baited with Cuelure, Param fruit fly trap baited with Methyl eugenol and Param fruit fly trap baited with Cuelure.

Results

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Population dynamics of fruit flies trapped in ME and CL baited traps was recorded on adult population of fruit fly, *Bactrocera* spp. from 45th standard week (SW) of 2019 to 11th SW of 2020. The population range was 88.9-334.6 FFs/trap/week. The Bottle fruit fly trap baited with cue lure was most effective and economically because it has trapped a total of 5948 adult fruit flies (FFs) and it was 23.58 per cent of totaled trapped flies in both the lures. The cost benefit was highest with trapped 10.5 fruit flies after per rupee investment followed by McPhail Fruit fly traps (5.4 FFs/rupee) and Param fruit fly traps (5.0 FFs/rupee) with cue lure. The correlation was recorded as significant between population of *Bactrocera cucurbitae* and maximum & minimum temperature ($^{\circ}$ C) and relative humidity (RH%) but it was non-significant with %, rain fall (mm) and wind velocity (km/hr). Three species of fruit fly viz, *Bactrocera affinis*, *B. dorsalis* and *B. zonata* were trapped in methyl eugenol baited traps and one species viz., *Bactrocera cucurbitae* was trapped in cue lure baited traps.

Conclusions

Among all the species of fruit fly species were attracted in methyl eugenol baited traps, the *Bactrocera affinis* population was lower than the *Bactrocera zonata* population, but it was seen to be higher than the *Bactrocera dorsata* population. Bottle fruit fly trap baited with methyl eugenol was most economic comparison to other traps and trapped 8.4 fruit flies after one rupee investment. Cue lure para-pheromon was most effective with good performance and trapped a total of 17422 fruit flies. *Bactrocera affinis*, *B. dorsalis* and *B. zonata* population trapped in methyl eugenol bait traps was significant with minimum temperature but it was non-significant with maximum temperature, relative humidity, rainfall and wind velocity while it was non-significant with rainfall and wind velocity.

Characterization of Morphological, Physio-Chemical and Fertility Properties of Pear Growing Orchards under Temperate Conditions of Jammu & Kashmir, India

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ABSTRACT

Soils are vital natural resources and information on their characterization, classification, location, extent and distribution, potential and problems is imperative for any developmental planning in a particular area (Sidhu *et al.*, 2014). Genesis, morphology and taxonomy of soils on scientific lines is the major source of information for precision agriculture, land-use planning and management (Mustafa *et al.*, 2011 and Mahapatra *et al.*, 2019). The prevailing climatic condition of Jammu and Kashmir offers favourable agro-ecological potential for fruit production (Dar *et al.*, 2012). The growth and yield of fruit trees are influenced by several factors including climate, soil, irrigation, pruning, plant protection and nutrition. Amongst the various soil factors required for sustainable pear production of better quality fruit, the soil medium and site-characteristics influence to a large extent the tree health and production (Najar *et al.*, 2009). Therefore it is imperative to characterize and classify the soils as well as evaluate their fertility index dedicated to the cultivation of pear

Methodology

A general reconnaissance survey was undertaken using the soil map of J & K state prepared by NBSS and LUP (Sehgal, 2014) during the course of traversing. Six representative soil profiles in pear orchards located in major pear growing areas selected from three different physiographic altitudes of district Pulwama. The selected sampling sites were geo-referenced using Global Positioning System (GPS) to establish pedon site features. The morphological properties were studied in detail according to Field Guide for Soil Survey Manual (Natarajan and Sarkar, 2009) during in-situ description of the exposed profile. The composite soil samples were collected and subjected to laboratory processing before analytical characterization of physico-chemical properties as per the prescribed standard procedures. The fruit and leaf samples collected from the same pear orchards during the same year after due processing were analyzed for nutrient and quality parameters as per the prescribed standard analytical procedures (Jackson, 1973). For statistical analysis of the data generated, significant ($p < 0.05$) differences of mean and standard error (mean \pm SE) were determined by one way ANOVA and Pearson's correlation analysis was done to study relationship pattern.

Results

The selected locations under study observed heterogeneity in site characteristic features such as altitude, topography, aspect, natural vegetation etc. The pedon locations varied in altitude ranging from 1591 to 1836 mts. amsl. The topography ranged from nearly level to gentle slope with slope gradient varying from 0 to 1 percent in inland valley of mid and low altitude pedons (P₃, P₄ and P₆) and 1 to 3 percent of high hill plateaus (P₁, P₂ and P₅). Located between geo-coordinates of 33^o51.233'N latitude and 74^o88.283'E longitude, the pedons have mostly northern aspect except P₂ and P₅ with southern aspect. Pedons P₁ and P₂ located in high altitude are developed on hill slope whereas pedons of mid and low altitude (P₃, P₄ and P₅, P₆) are developed on inland valley slope. Pedons P₅ and P₆ are very deep to moderately deep, and P₁ & P₂ on high hill plateaus are

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moderately deep. Pedons P₁ and P₂ have structurally differentiated B (Cambic) horizon, while as P₃ and P₄ have structural B (Cambic) and C horizons. All the pedons studied have a hue of 10YR, value ranging from 3 to 5 and chroma from 2 to 6. For surface pedogenic horizons of P₁ and P₂, the colour (moist) value and chroma varied from dark greyish brown (10YR4/2) to brown (10YR5/3) while as P₃, P₄, P₅ and P₆, the colour ranged from dark yellowish brown to brown. In general the texture varied from silt loam to clay loam throughout depth. The structure varied from fine weak granular and medium moderate / angular blocky to sub-angular blocky throughout the pedons. Lose to slightly hard / very hard when dry, friable to slightly firm / firm when moist, slightly sticky / plastic to non-sticky when wet slightly sticky / plastic to non-sticky and plastic consistency was observed. For most of the profiles, clear and gradual to smooth, wavy or irregular boundary was observed between the pedogenic horizons. A slight effervescence with dil. 10% HCl observed for lower horizons of high and mid altitude pedons. Bulk density (BD), particle density (PD) observed significant ($p < 0.05$) decrease with altitude but irregular trend with depth but significantly ($p < 0.05$) greater porosity in high and mid altitudes pedons. In general, the soils are slightly acidic to slightly alkaline in pH and significantly ($p < 0.05$) decreasing tendency with increase in altitude ($6.56 < 6.90 < 7.15$). Although EC observed non-significant declining trend with altitude and depth but was below unity. In general the status of OC was low to high and varied significantly ($p < 0.05$) with altitude and soil depths, with the values ranging from 0.30 to 1.35%. Significantly ($p < 0.05$) lower CEC was observed in higher altitude pedons than mid and low altitude pedons ranging from 13.16 to 15.20, 14.32 to 16.50 and 16.20 to 17.85 Cmol (p+) kg⁻¹ respectively. The analytical results of exch. bases reveal that Ca⁺⁺ was dominant exch. cation accounting for more than 74% of exch. bases followed by Mg⁺⁺, K⁺ and Na⁺. However, the exch. cations except Na⁺ recorded significant ($p < 0.05$) difference between altitudes but non-significant variation between pedogenic horizons. For the values of base saturation (BS), non-significant difference between depths but significantly ($p < 0.05$) higher BS (%) in higher physiographic position than mid and low altitudes was recorded. Based on the field description of soil morphological and laboratory analytical data the soils under study were classified in two orders viz: Inceptisols and Entisols according to Soil Taxonomy.

Status and Variability of Available Soil and Leaf Nutrients By considering the critical limits, the soils are rated high in available N and P (mean value of 372.80 and 15.03), medium in available K, Ca and Mg (264.30, 2205.83 and 252.14 kg ha⁻¹) status. However, S and B are found to be low in amounts. Most of the pear orchards are rated high in Zn, Cu, Mn and Fe (1.30, 2.16, 46.75 and 52.09 ppm). An appraisal of leaf nutrients reveal that for macronutrients, marginal to adequate N content with average value of 2.46% while adequate content of P, K, Ca, Mg and S was recorded. Furthermore, for mineral micronutrients such as Zn, Cu, Mn, Fe and B (46.62, 14.18, 101.11, 121.38, 40.1 and 0.54 ppm), adequate status was observed. Available macronutrients such as N, P, K and Ca exhibited positive and significant ($p = 0.01$ & $p = 0.05$) relationship with their corresponding values in leaves with correlation coefficients ($r = 0.638^*$, $r = 0.812^*$, $r = 0.708^*$ and $r = 0.665^*$). Micronutrients like Cu, Mn and Fe showed significant and positive relationship ($r = 0.632^*$, $r = 584^*$ and $r = 0.715^{**}$) with their corresponding leaf values. Available N, P and Cu detected positive and significant relationship with fruit yield with correlation coefficient values ($r = 0.859^{**}$, $r = 0.590^*$ and $r = 0.714^{**}$). The linear regression analysis showed much better and significantly strong relationship of fruit yield with soil pH and OC ($R^2 = 0.7634$ and 0.4369).

The present study indicates two soil orders Inceptisols and Entisols. Most of the important soil quality indicators such as texture, structure, OC, pH, CEC and nutrients are influenced by different landscape positions. The prevailing relatively lesser amounts of clay at the surface permitting good porosity in combination with adequate organic matter, better soil fertility attributes as indicated from evaluation pattern and relationship studies demonstrate the zones in good coordination with sustainable production.

Key words: diversity, dynamic, *Bactrocera* spp, incidence, population, species, seasonal

Anti-AGE properties of Acesulfame potassium and its interaction with BSA

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ABSTARCT

Background and aims: The noncovalent interaction of amino groups of proteins and carbonyl group of sugars lead to formation of advanced glycation end products (AGEs). The rate of formation of AGEs increases during the hyperglycaemic conditions. These products are involved in many metabolic and neurodegenerative disorders. In last few decades there has been a several fold increase in the usage of artificial sweeteners in various food products because of their less caloric value and less dependence on sugars to prevent Diabetes. However, there are very few reports on the implications of these sweeteners in the process of Glycation.

Materials and Methods: In the present study, the acesulfame potassium (Ace-K), an FDA-approved artificial sweetener, was investigated for its involvement in glycation and aggregation process on the protein (BSA). The glucose-mediated glycation was analysed spectroscopically with fructosamine content by NBT method and carbonyl content by DNPH method.

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The AGEs and aggregation (Th T) of glycated products were assayed fluorometrically. Glycation-induced-secondary structure alteration of BSA was analysed with Circular Dichroism. Further, DLS, TEM, and SDS-PAGE analysis were performed to analyse the aggregation of proteins.

Results: Ace-K decreased the Amadori products and carbonyl content by 65.33% and 63.38% at 28 days incubation in comparison to glucose-mediated glycation of BSA. The presence of Ace-K also caused only 41.27% AGEs and 42.87% cross β -amyloid structures formation. TEM analysis indicated the size range of 50-300 nm of glycated BSA in presence of Ace-K. The secondary structure of BSA shown to be like native protein in the presence of Ace-K in the glycation system. Similarly, migration patterns of glycated BSA in the presence and absence of Ace-K indicted the antiglycating role of this sweetener.

Conclusion: The decrease in the amount of Amadori products, carbonyl content, and total AGEs, inhibition of glycation-induced aggregation and maintenance of secondary structure of glycated proteins in the presence of Acesulfame potassium indicate the potential antiglycating property of this artificial sweetener.

Keywords: Acesulfame potassium, Aggregation, AGEs, BSA, Glycation, Thioflavin T

PROGRESSIVE DEVELOPMENT OF IRRIGATION POTENTIAL IN INDIA

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ABSTRACT

Efficient utilization of available water resources is crucial for a country like India which shares 17% of the global population with only 2.4% of land and 4% of the water resources. Annual per capita water availability which was 5247 m³ in 1951 (presently 1453 m³) is expected to go down to 1170 m³ by 2050 (CWC, 2015). The country is witnessing drought/ flood situations that impacted crop productivity. Agricultural sector alone consumes 80% of the ground water (Harsha, 2017). The declining trend of groundwater level in all parts of the country also indicates that the assured supply of good quality water will become a concern for country's development (Manivannan *et al.*, 2017).

Utilizable water in the country

The rainfall in large parts of the cropped area is insufficient and uncertain which caters need for irrigation. In India, only 48.8 percent from 140 million hectare (mha) of agricultural land could come under irrigation and remaining 51.2 per cent is rainfed. The mean productivity of rainfed area is about 1.1 tonne per hectare as compared to 2.8 tonne per hectare of irrigated area. 76 percent of rainfall in India occurs between June and September due to southwest monsoon in most of the states and more than 50 percent of precipitation takes place in about 15 rainy days in less than 100 hours. India receives an average annual precipitation of about 4,000 Billion Cubic Meters (BCM) out of which 3,000 BCM occurs during monsoon months. Average annual flow available in rivers is around 1953 BCM during June to September but due to topographical, hydrological and other constraints, only about 690 BCM of the available surface water can be utilized and ground water recharge of 432 BCM thus total utilizable water in the country is assessed as 1122 BCM. The annual potential evapo-transpiration in the country is 1775 mm.

Advancement of Cumulative Irrigation Potential during Five Year Plans:

In India, irrigation has a crucial role in agricultural and rural development (Vaidyanathan *et al.*, 1994). Due to yield oriented impact of irrigation, it has received high priority in the successive Five Years Plans (FYP). Ultimate irrigation potential of India has been estimated to be 139.89 million hectare (mha), comprising 58.89 mha from major and medium schemes, 15 mha from minor irrigation schemes and 66 mha from groundwater exploitation. India's irrigation potential has increased from 22.6 mha in pre Plan period to 102.8 mha during 10th Plan. Under the Five Year Plans, the cumulative irrigation potential has achieved a considerable progress. Table 1 shows the progress of cumulative potential and its utilization during different plan periods. It is obvious from Table1 that the cumulative irrigation potential has increased from 22.6 mha during the pre-plan period to 26.3 mha during the 1st Five Year Plan and the cumulative utilization of such potential was 25.1 mha. During 5th Plan irrigation potential has reached at 52.1 mha and then to 89.5 million hectares (mha) during the 8th Plan out of which the cumulative utilization was 80.7 million hectares. The target for the cumulative irrigation potential during the 9th Plan was fixed at 106.4 million hectares and that of cumulative utilization fixed at 94.4 million hectares and the actual realization was 94.0 million hectares and 84.7 million hectares, respectively at the end of 9th Plan. Again at the end of the 10th Plan, total irrigation potential in the country has increased to 102.8 million hectares and the cumulative utilization of this potential was only 87.2 million hectares. The potential created so far has been estimated to be 73.5 percent of the ultimate irrigation potential of the country. The utilization of already created irrigation potential witnessed a declining trend over the successive Five Year Plan, raising several efficiency issues in the execution of irrigation projects.

Table 1: Plan-wise position of Irrigation Potential Created and Utilized

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Again in 1950-51, out of total irrigation potential of about 23 million hectare, 10 million hectare was under major and medium irrigation and 13 million hectare under minor irrigation. By the end of 2006, the total irrigation potential reached 102.80 million hectare having 42.80 million hectare under the major and medium project and 60 million hectare under the minor project.

The average annual rate of utilization remained lower than the average annual addition to the irrigation potential resulting in the cumulative utilization rate witnessing a continuous reduction that results to inefficient use of funds and also causes reduced income from irrigated lands.

Decade wise development of irrigation

The ultimate irrigation potential of India is 139.80 million hectares but due to lack of technology, this could not be achieved so far. It is estimated that even after achieving the full irrigation potential, nearly 50 percent of the total cultivated area will

Period	Cumulative Irrigation Potential (Million hectares)	Cumulative utilization (Million hectares)
Pre Plan	22.6	22.6
1 st Plan	26.3	25.1
2 nd Plan	29.0	27.7
3 rd Plan	33.6	42.2
4 th Plan	44.2	48.5
5 th Plan	52.1	62.2
6 th Plan	67.9	68.6
7 th Plan	76.5	68.6
8 th Plan	89.5	80.7
9 th Plan	94.0	84.7
10 th Plan	102.8	87.2
Ultimate Potential	139.89	

remain rain fed. Decadal trend of the net irrigated area (Table2) indicate that there is a considerable growth in net irrigated area from 1950-2011. There was constant increase in net irrigated area from 1951 (20.85 million hectare) and rapid increase from 1970-71 to 1995-2000. During year 1950-65, increase in net irrigated area was very slow with an increase of only 9 million hectares within 15 years. 1960 was the decade of the introduction of the green revolution in India aiming increase in net food production by boosting agriculture production with advancement in technology. Net irrigated area reached 68.383 million hectare in 2014-15. Despite a few ups and downs, there is a noticeable increase in the irrigated area and also in irrigation potential.

Table 2: Decade wise irrigated area of India under different sources (in million hectares)

Decade	Government Canals	Private Canals	Canals	Tanks	Tube wells	Other Wells	Other Sources	Total net irrigated area
1950-51	7.158	1.137	8.295	3.613	NA	5.978	2.967	20.85
1960-61	9.17	1.2	10.37	4.561	0.135	7.155	2.44	24.66
1970-71	11.972	0.866	12.838	4.112	4.461	7.426	2.2661	31.1
1980-81	14.45	0.842	15.292	3.182	9.531	8.164	2.551	38.72
1990-91	16.972	0.480	17.453	2.944	14.257	10.437	2.932	48.02
2000-01	15.762	0.203	15.965	2.455	22.569	11.26	2.885	55.13
2010-11	15.496	0.171	15.667	2.004	28.552	10.509	6.867	63.598
2011-12	15.846	0.172	16.017	1.937	29.48	10.779	7.123	65.263
2012-13	15.506	0.165	15.672	1.753	30.543	10.763	7.536	66.266
2013-14	16.115	0.163	16.278	1.842	31.126	11.312	7.542	68.100
2014-15	16.020	0.163	16.182	1.723	31.606	11.354	7.519	68.383

Sources: Directorate of Economics and Statistics, Ministry of Agriculture (2015)

Utilized and ultimate irrigation potential under major, medium and minor projects

Table 3 shows created and utilized irrigation potential under major & medium and minor scheme since the time of independence to year 2007-12. Created potential increased from 22.6 mha at the time of independence to 113.53 million hectare during 2007-12 while utilized irrigation potential (both surface and ground water) increased to 87.86 million hectare.

Table 3: Source wise created, utilized and ultimate irrigation potential

Source	Irrigation potential (million hectares)
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	At the time of Independence	Up to 2007-12		Ultimate
	Created and utilized	Created	Utilized	
Major & medium (Surface water)	9.7	47.97	34.95	58.5
Minor (Surface water)	6.4	-	-	17.3
Minor (Surface & ground water)	12.9	56.56	52.5	81.4
Total (Major, medium and minor)	22.6	113.53	87.86	139.9

Source: CWC (2015); DES, GoI (2017)

Net Irrigated Area under various sources of irrigation

Since 1950-51, the government had given much importance to the development of command area under canals and India has gross irrigated area of 96.46 mha, net irrigated area 68.38 mha in 2014-15. In 1950-51, the canal irrigated area was 8.295 mha (Table 2) and in 2014-15 it stands at 16.18 mha (Table 4).

Table 4: Net Irrigated area from various sources and their relative contribution

Sources	Year 2009-10		Year 2014-15	
	Net Irrigated Area	% Contribution	Net Irrigated Area	% Contribution
Canal	16.697	26.40	16.18	23.66
Tanks	1.638	2.59	1.72	2.52
Wells	39.042	61.72	42.96	62.82
Others	5.880	9.30	7.52	11.00
Total	63.257	100	68.38	100

Source: DES, MoA&FW, GoI (2018)

On the other hand, the well and tube well accounted for 28.7 % of total irrigated area in 1950-51 and in 2014-15 it's share increased to 62.82 % of the total net irrigated area. However, the relative importance of canals has come down from 39.78 % in 1950-51 to 23.66 % in 2014-15. Contribution of irrigated area under canals and tank declined since 2009-10 but area under ground sources are on rise, which is a matter of concern. This is due to improved irrigation infrastructure that resulted into increase in the net irrigated area (NIA). However, a structural shift has been observed in the relative contribution of different sources of irrigation in NIA over the years. It was due to significantly higher annual growth of groundwater irrigated area than canal irrigated area during 1950-2007. Significant growth in the groundwater irrigated area indicated the growing importance of groundwater because of its reliability and higher irrigation efficiency of 70-80 per cent compared to 25-45 per cent of the canal irrigation (Sharma, 2009).

CONCLUSIONS

The area under irrigation has increased substantially during the post independence period and construction of a large number of major, medium and minor irrigation projects have been done. Irrigation has received massive government support in the successive Five year Plans and has witnessed significant growth during the past more than fifty years. Improved irrigation infrastructure has resulted into increase in the net irrigated area. The potential of irrigation development varies across geographical regions due to topographical, hydrological and other constraints. Further, the increasing gap between irrigation potential created and its utilization over the years has raised efficiency issues in the execution of irrigation projects. This is main challenge of irrigation sector in our country. Another challenge is uneven distribution of water over the length of the canal system. Irrigation efficiency of the major and medium irrigation projects is around 38 per cent which should be improved to around 50-60 per cent and that of groundwater from about 65-70 per cent to 72-75 per cent. Minor irrigation projects have both surface and ground water source, while major and medium projects mostly exploit surface water resources. There is need to develop and implement cost effective technological innovations for improvement of efficiency of surface irrigation system and groundwater irrigation system. As about 88 per cent of ultimate irrigation potential has already been developed, irrigation infrastructure can be improved further by bridging the gap to increase cropping intensity and crop diversification of high-value crops. Water productivity can be improved further by increasing irrigation efficiency, developing sustainable water supply system and emphasizing on completion of the on-going irrigation projects efficiently rather starting new ones. To reduce the consumption of water and maximize agricultural productivity, there is need to introduce advanced technologies in crop production like crop diversification, efficient water management methods and equipments, use of treated waste water for agriculture, use of improved irrigation infrastructure etc.

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Under Long-Term Experiment, Response of Increasing Doses Phosphorus Application on Wheat and Soil Carbon and Nitrogen Content

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ABSTRACT

Purpose

Soil organic carbon (specifically organic matter) is used as an essential indicator of soil health. Soil organic carbon is related to plant growth and the availability of mineral nutrients such as nitrogen (N) and phosphorus (P). However, still there is limited literature about relationship between soil organic carbon and P nutrition. The aim of study is to investigate effects of different P doses application on soil and plant C and N concentrations. In this respect since phosphorus, increase plant biomass the hypothesis to be tested is; increasing P application contribute plant and soil C and N pool.

Methods

A Long-term field experiment was established at University of Çukurova, Research and Application field on Arıklı soil series at 1998. Four P doses such as; 0 kg P₂O₅ ha⁻¹ (P0), 50 kg P₂O₅ ha⁻¹ (P50), 100 kg P₂O₅ ha⁻¹ (P100) and 200 kg P₂O₅ ha⁻¹ (P200) with tree replications was applied. Adana-99 species wheat (*Triticum aestivum L.*) seeds were sown in November 2018 and harvested at May 2019. After harvesting, plant sample and soil samples under different depth (0-15 and 15-30 cm in rhizosphere and non-rhizosphere soil) were taken. Root, shoot and seed part of wheat and soil C and N sample analyzed by Fisher 2000 model CN analyzer. The Organic Carbon (OC) and Total N (TN) pools were calculated by Ortas and Lal, 2012. Obtained data statistically analyzed and LSD test were realize by JMP 8 computer package program.

Results

There was statistically significant different as N% and C% concentration under P200 doses application. The heights C% and N% concentration was determined with P200 treatment. Also, there was statistically significant different as soil OC amount in rhizosphere 0-15 soil depth in P 200 doses treatment in which the highest carbon content 46.1 Mg ha⁻¹ was determined. In addition soil total nitrogen was determined and the highest N was measured in 0-15 cm soil depth. Soil C:N ratio changing from 6.1 to 10.3 and the highest C:N ratio was determined in non-rhizosphere 15-30 cm soil depth.

Conclusions

Under long-term field conditions, depend on increasing doses P fertilizer wheat plant growth and increased plant N and C concentration. Also soil OC and TN amount were increased. It seems that addition P dose application increased biomass and consequently plant and soil C content. This founding is supporting our hypothesis.

Key words: Long-term experiment, Phosphorus, Wheat, Soil Organic Carbon and Nitrogen.

IDENTIFICATION OF TERMINAL HIGH-TEMPERATURE TOLERANT CHICKPEA (*Cicer arietinum L.*) GENOTYPES THROUGH YIELD-BASED SELECTION INDICES

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ABSTRACT

Purposes

Chickpea (*Cicer arietinum L.*) is a third most important cool season grain legume crop cultivated in arid and semi arid region of the world. Under rainfed cultivation chickpea crop faces heat stress during flowering and grain development. Terminal heat stress during reproductive phase cause negative impact on several physiological processes results reduction of productivity. Therefore, prime objective of this study to identify terminal heat tolerant genotypes under changing global climate scenario.

Methods

The experiment were conducted at research farm of Banda University of Agriculture and Technology, Banda (25° 29' N latitude; 80° 20' E longitude, 123 m above mean sea level and soil pH 7.3) during growing season 2019-20 under two environments, near optimal (10, November) and delayed sown (14, January) under irrigated environments. Ninety genotypes were planted in augmented block design with four checks in plot size of two rows of 2 m length with row to row spacing of 30 cm. One irrigation was applied in timely sown and two irrigation were applied in late sown experiment to rescue crop from drought stress. Fifteen quantitative traits were recorded in normal and stress environment. The recorded traits were

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subjected to statistical analysis using for yield-based selection indices viz., Yield reduction% (YR%), Capacity for seed filling under heat stress (KWR%), Heat susceptibility index (HSI), Yield stability index (YSI) and Stress tolerance index (STI), were used to identify the tolerant genotypes and/or best performing genotypes under normal and late sown conditions in chickpea. The adjusted mean values of traits were used for estimation of selection indices.

Results

The analysis of variance showed highly significant differences among the germplasm lines for studied traits in normal and heat stress environments. The crop start flowering after 55 days of sowing where as in late sown conditions flowering start in 40 days of sowing. Crop life cycle was reduced 41 to 65 days under terminal heat stress and plants force to mature in 84 to 95 days under late sown condition. The determinant effects of terminal heat stress were observed on each studied trait. The mean seed yield of five plants normal environment is 88.31gm, whereas more than 39% decline (50 gm) observed is under late sown crop. The reduction in all traits under stress environment indicates the sensitivity of the chickpea to heat stress. The stress indices comparing of normal and late sowing have been estimated. The maximum YR% was observed in JG 322 and C-1762(56%) followed by PUSA-1053(55%) however, lowest yield was reduced in C-1791 (19%), GNG 1854 (20%) and Vijay (25%). The lowest KWR% was recorded in C-1779 (1%), EC-556270 (2%) and ICVT-181114 (3%). Based on selection indices contrasting heat tolerant and susceptible genotypes were identified. The genotype C1791 had minimum YR% (19%) followed by GNG 1854 (20%), Vijay (25%), GNG 2127 (26%) and ICVT 181102 (27%). These genotypes also show lowest HSI thereby these genotypes considered as heat tolerant material. The genotype JG-312 and C1762 has maximum YR% (56%), followed by PUSA 1053 (55%), ICVT 181116 and ICCV 2055 (54%) under heat stress environment. These genotypes show highest HSI thereby considered as heat susceptible genotypes. The C 1791, GNG 1854, Vijay, GNG 2127 and ICVT 181102 show stable performance (YSI) under two diverse growing environments. The genotype GPF 2, ICVT 181116, and IC 244263 shows high HTI 1.56, 1.51 and 1.39, respectively.

Conclusions

Among abiotic stress terminal high-temperature is main cause of significant yield loss in chickpea crop. The genetic resource which showed tolerance to terminal heat stress can be utilised in breeding programme. In the presented study, C1791, GNG 1854, Vijay, GNG 2127 and ICVT 181102 are identified terminal heat tolerant genotypes. The genotype JG 322, C-1762, PUSA-1053, ICVT-181116 and ICCV-205 are identified as heat susceptible genotypes. The C 1791, GNG 1854, Vijay, GNG 2127 and ICVT 181102 show stable performance. Based on the performance of germplasm lines under both conditions, identified genotype which have ability to withstand in heat stress situation would be useful in chickpea breeding programme.

Keywords: Chickpea, Terminal heat stress, Selection indices, Heat susceptible index

Evaluation of some beetroot cultivars for their response of resistance and/or susceptibility to root-knot nematode, *Meloidogyne javanica*

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ABSTRACT

Purpose: The objective of this study is to find out the resistance and/or susceptibility response of beetroot cultivars against root-knot nematode, *Meloidogyne javanica*.

Methods: In the current study, seven cultivars of beetroot (*Beta vulgaris* L.) were evaluated for their reactions to *Meloidogyne javanica* by inoculating with 1500 second stage juveniles per pot. The pots were arranged in a completely randomized design (CRD) with four replication of each cultivar under greenhouse conditions. The data were subjected to one-way analysis of variance (ANOVA) using SPSS-17 statistical software (SPSS Inc., Chicago, IL, USA). Mean values of each cultivar were statistically compared and separated by Duncan's Multiple Range Test (DMRT) at $P \leq 0.05$.

Results: The data revealed that all examined beetroot cultivars displayed varying degrees of resistance and/or susceptibility to *M. javanica*. Based on the number of galls, none of the cultivars was found highly resistant or immune. Among all cultivars, the cultivars namely, CG, DDR and Red Ace, were recorded moderately resistant as they showed the minimum number of galls (4.0, 8.0 and 7.0). In comparison, the cultivar Red Express was observed as highly susceptible showed a maximum number of galls (126). Similarly, the cultivars Atlas and Red Queen were found moderately susceptible followed by the cultivar Red Ruby which was recorded susceptible. A significant negative correlation was recorded between root-knot nematode infestation and plant growth parameters.

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Conclusion: All examined cultivars displayed a significant decline in plant growth due to infection caused by *M. javanica* when compared with their controls. The highest reduction in growth parameters was recorded in cultivar Red Express while the least reduction was observed in CG, DDR and Red Ace. A positive and significant correlation was found between the number of galls and per cent reduction in plant growth parameters. From the study, it can be recommended that the cultivation of resistant cultivars is an eco-friendly tactic that can be used to manage the nematode density below the economic threshold level.

Keywords: Beetroot, Cultivars, *Meloidogyne javanica*, Resistance, Screening

Under Long-Term Field Conditions, the Application of Organic and Inorganic Fertilizers on Soil and Plant Nitrogen and Carbon Contents.

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ABSTRACT

Purpose

Increased human population have a negative impact on soil to provide sufficient and safe food production. In order to ensure food safety regularly, different agricultural production and operating methods are being implemented. . Soil and crop managements such as chemical fertilizer applications have a negative impact on the soil biological quality and productivity. Especially under long term fertilizers conditions organic carbon poor soil are being exhausted. Instead of using such as exhaustible artificial mineral fertilization resource, organic fertilizers and mycorrhizal fungi can be used. The most well-known organic fertilizer such as animal manure, compost and mycorrhizae fungi are significantly contributing soil organic carbon sink and consequently, organic fertilizers have a positive effect on the soil biological diversity and productivity. In order to increase soil carbon content, long-term organic fertilizer applications increase soil carbon budget hypothesis was tested under field conditions.

Purpose of the study; to investigate the effects of different organic and inorganic fertilizer applications on the soil and wheat plant carbon and nitrogen content and carbon sinks

Methods

A long-term field experiment was established in 1996 until present time. Before each production season, without fertilizer (control), Mineral fertilizer (NPK), Animal manure (25 ton ha⁻¹), Compost (25 ton ha⁻¹) and Compost+Mycorrhiza (10 ton ha⁻¹) were applied regularly. Adana-99 varieties wheat (*Triticum aestivum L.*) seeds were sown in October 2018 and harvested in May 2019. After harvest, soil and plant samples were taken and soil-plant carbon nitrogen analyses were made. Measured data were statistical were analyzed by JMP 8 computer package program.

Results

Results shown that; when the C % and N % contents of the plant seed, shoot and root were examined, especially organic fertilization applied treatments have higher concentration than that of the control treatment. When the TC %, OC % and N % contents of the soil at different depths (0-15 cm and 15-30 cm) and in rhizosphere (R) and no rhizosphere (NR) area was examined, compost and animal manure treatments have higher content than that of control parcels. At the rhizosphere area 0-15 cm depth the soil % OC, and % IC contents were statistically significant (P<0.05). The highest values of soil OC %, C/N and IC % contents at Rhizosphere 0-15 cm depth were obtained in animal manure with 2.94 %, 10.06 and 3.90 % respectively. Total soil carbon and nitrogen content were examined and it was found that animal manure have the highest content in both soil depths, while the lowest values were obtained in the control application.

Conclusions

It has been concluded under long-term organic fertilizer application increased soil the %TC %OC, %N content as well as contribute to the carbon and nitrogen budget. The results found support our hypothesis. Animal Manure, compost and Compost+Mycorrhiza inoculation can be used as an eco-friendly and agro ecological fertilizer for sustainable agriculture and safe food security.

Key words: Wheat, Carbon, Organic Carbon Nitrogen, organic mineral and fertilizer

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Efficacy of some biopesticides and synthetic insecticides against banana leaf and fruit scarring beetle, *Basilepta subcostatum* Jacoby (Coleoptera: Chrysomelidae)

Sh. Biraj Kalita and Dr. Inee Gogoi

ABSTRACT

Purpose

Banana is a wholesome fruit and is also known as “poor man’s apple”. It is the fifth most traded agricultural commodity in the world and second most important fruit crop in India. It got introduced and infested with an insect pest called leaf and fruit scarring beetle (*Basilepta subcostatum*), which has now become a key pest in the whole North-Eastern region of India. It has also paved its way to places like Bihar and Odisha and is now a national concern and threat to the banana export industry. We aim to decipher the best management practice, like the banana bud injection, foliar application and central whorl application of insecticides and bio-pesticides at the critical stages of the crop to curb the beetle infestation at initial stages so that the farmers can get a better price by increasing the fruit cosmetic value.

Methods

Increase and decrease in beetle population were recorded at all the critical stages of the crop before and after spraying. Bud injection was applied at shooting stage of the crop. Leaf scars were recorded from the photo synthetically important leaf along with the records of fruit parameters. Randomized Block Design was used to carry out the research in field.

Results

Among all the treatments, chlorpyrifos was the best treatment in field in reducing the beetle population and imidacloprid was at par with the standard check chlorpyrifos. Among the biopesticides used, *Metarhizium anisopliae* proved to be best out of all three. Meteorological data showed their highest incidence during monsoon. The bud injection method proved to be safer and competent preventive technique for reducing the percentage of blemished fruits.

Conclusions

The present study may help in rational selection of novel insecticide molecules, microbial and botanical insecticides, which can be taken advantage for developing integrated pest management (IPM) program for banana. To get solace from this pest and restrain its cryptic behavior, proper study of the beetle biology is necessary.

Key words: banana leaf and fruit scarring beetle, field bio-efficacy, bud injection, bio-pesticides.

MICRONUTRIENT MALNUTRITION IN INDIA: MAGNITUDE AND CONSEQUENCES

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ABSTRACT

Micronutrients are used to signify essential vitamins and minerals required from the diet, needed in very small quantity to maintain virtually all cellular and molecular functions of the body for attaining optimal growth, development and physiological functions. The impact of the insufficiency of these micronutrients on human health are critical, and, deficiency in any of them contributing to the low productivity and a vicious cycle of malnutrition and other nutritional deficiencies which may lead severe and even life-threatening conditions of the person. It is also referred as 'Hidden Hunger' that affects the health, learning ability as well as productivity owing to high rates of illness and disability. In the current scenario, micronutrient deficiency is a global public health issue that affects more than one-fourth of the world's population. Several programmes have been instigated in India over the years for improving the nutritional and health status of the population, however, a large section of the population is still affected by micronutrient deficiency. It is estimated that around two billion people in the world are deficient in one or more micronutrients.

In India, various surveys have been carried out at district and national level such as - District Level Household Survey (DLHS), Annual Health Survey (AHS), National Family Health Survey (NFHS), and, National Nutrition Monitoring Bureau (NNMB) for assessing the health and nutritional status of the population in the country. The objective of this study focussed on the current situation of micronutrient status in the country, based on national surveys and recent studies.

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Micronutrient malnutrition

Micronutrient malnutrition is a term used to refer to diseases, caused by a dietary deficiency of vitamins or minerals. More than 2 billion people in the world today affected by micronutrient malnutrition. In India 44% of children under the age of 5 are underweight, 72% of infants, and, 52% of married women have anaemia. Research has conclusively shown that malnutrition during pregnancy causes the child to have increased risk of future diseases, physical and mental retardation and reduced cognitive abilities. The major micronutrient malnutrition issues affecting populations in developed and developing countries addressed in the WHO Guidelines are shown in Table 1.

Table 1: Micronutrients Deficiency Conditions and Their Worldwide Prevalence

Micronutrient	Deficiency Prevalence	Major Deficiency Disorders
Iodine	2 billion at risk	Goiter, hypothyroidism, iodine deficiency disorders, increased risk of stillbirth, birth defects infant mortality, cognitive impairment
Iron	2 billion	Iron deficiency, anemia, reduced learning and work capacity, increased maternal and infant mortality, low birth weight
Zinc	Estimated high in developing countries	Poor pregnancy outcome, impaired growth (stunting), genetic disorders, decreased resistance to infectious diseases
Vitamin A	254 million preschool children	Night blindness, xerophthalmia, increased risk of mortality in children and pregnant women
Folate (Vitamin B6)	Insufficient data	Megaloblastic anemia, neural tube and other birth defects, heart disease, stroke, impaired cognitive function, depression
Cobolamine (Vitamin B12)	Insufficient data	Megaloblastic anemia (associated with Helicobacter pylori induced gastric atrophy)
Thiamine (Vitamin B1)	Insufficient data, estimated as common in developing countries and in famines, displaced persons	Beriberi (cardiac and neurologic), Wernicke and Korsakov syndromes (alcoholic confusion and paralysis)
Riboflavin (Vitamin B2)	Insufficient data, est. to be common in developing countries	Non specific – fatigue, eye changes, dermatitis, brain dysfunction, impaired iron absorption
Niacin (Vitamins B3)	Insufficient data, estimated as common in developing countries and in famines, displaced persons	Pellagra(dermatitis, diarrhea, dementia, death)
Vitamin B6	Insufficient data, estimated as common in developing countries and in famines, displaced persons	Dermatitis, neurological disorders, convulsions, anemia, elevated plasma homocysteine
Vitamin C	Common in famines, displaced persons	Scurvy (fatigue, hemorrhages, low resistance to infection, anemia)
Vitamin D	Widespread in all age groups, low exposure to UV rays of sun	Rickets, osteomalacia, osteoporosis, colorectal cancer

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Calcium	Insufficient data, estimated to be widespread	Decreased bone mineralization, rickets, osteoporosis
Selenium	Insufficient data, common in Asia, Scandinavia, Siberia	Cardiomyopathy, increased cancer and cardiovascular risk
Fluoride	Widespread	Increased dental decay, affects bone health

Source: Adapted from Allen L et al.: Table 1.2 pp 6-10.2

The reasons for nutritional micronutrient deficiencies in India may range from an improper diet to an unhealthy lifestyle. There are many micronutrient deficiency problems exist which affect vast segments of our population. Iron deficiency anaemia, Vitamin A deficiency, and iodine deficiency disorders are the most widespread forms of micronutrient malnutrition which are common contributors to poor growth, intellectual impairments, perinatal complications, and increased risk of morbidity and mortality..

IRON DEFICIENCY ANEMIA (IDA)

Anemia is a global public health problem which affects 1.62 billion (24.8%) people worldwide. It is the most common form of micronutrient deficiency which affects infants, preschool children, adolescent girls, pregnant women and lactating mothers. It can be caused due to deficiencies of micronutrients such as iron, folic acid and vitamin B₁₂, with iron deficiency being the most common cause of anaemia. The latest National Family Health Survey (NFHS4) carried out by the Ministry of Health and Family Welfare in 2015 - 16, reported the prevalence of anaemia as 58.6, 53.1, 50.4 and 22.7 percent, among children aged 6-59 months, women aged 15-49 yr, pregnant women aged 15-49 yr and men aged 15-49 yr, respectively. The deficiency of iron in the body occurs when iron intake is inadequate, absorption of iron is insufficient, bio-availability of dietary iron is reduced, need of iron is increased or there is chronic blood loss. Blood loss in childbirth is very dangerous for anaemic women and is the main cause of about 20 percent of maternal deaths. Maternal anaemia also leads to foetal growth retardation, low infant birth weight and increased perinatal mortality. Anaemia in infants and children is associated with retarded physical growth, reduced resistance to infections and slow development of learning abilities. In adults it causes fatigue and reduced work capacity and may cause reproductive impairment. Since, nutritional anemia is a serious problem, the Government of India launched National Nutritional Anaemia Prophylaxis Programme (NNAPP) in 1970, as a part of Family Planning Programme to prevent nutritional anaemia among children, expectant and nursing mother. The programme was later renamed in 1991 as National Nutritional Anaemia Control Programme, targeting women in reproductive age group, especially pregnant and lactating women and preschool children, because if untreated, these can affect next generation child resulting in increased morbidity and mortality and decreased productivity.

VITAMIN A DEFICIENCY (VAD)

Vitamin A deficiency is highly prevalent health concern, associated with substantial morbidity and mortality, mostly affecting young children in impoverished regions throughout the world. Insufficient intake of absorption leads to deficiency and compromise of essential physiologic processes. VAD primarily affects children, worldwide. It causes night blindness, delayed dark adaptation, lowers resistance to infections and, eventually, produce blindness as a permanent disability (xerophthalmia). Young children below the age of 3 years and pregnant and lactating women are most vulnerable to VAD. It also contributes to retarded physical growth and impaired resistance to infections, resulting in high rates of sickness and death among young children. Regular consumption of vitamin A-rich foods such as animal products, orange and yellow fruits and vegetables, dark green edible leaves, could prevent VAD.

The Government of India launched the National Prophylaxis Programme in 1970 against Nutritional Blindness caused due to VAD, targeting the children in the age group of 1-6 yr with the specific aim of preventing nutritional blindness occurred due to keratomalacia. The programme was modified in 1994, under the National Child Survival and Safe Motherhood Programme, where, the target group was restricted to 9-36 months children. The age of the target group was later modified in 2006 as 6 to 59 months.

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IODINE DEFICIENCY DISORDERS (IDD)

Iodine deficiency disorders constitute the single largest cause of preventable brain damage, affects about 2 billion people, worldwide. Majority of consequences of IDD are invisible and irreversible but at the same time these are preventable. It is most common in developing countries where people may lack access to enough healthy food. But it can also affect people in developed countries who lack an adequate diet or whose bodies don't correctly process iodine. In India, the entire population is prone to IDD due to deficiency of iodine in the soil of the subcontinent, and, consequently the food derived from it. In pregnancy, iodine deficiency either causes spontaneous abortions, stillbirths and infant mortality or may interfere with the brain development of the foetus, result in birth of iodine deficient babies who may be cretins; characterized by mental disorder, hearing defects, squint and stunted growth. So, they require more iodine than any other group of people, because they may experience a deficiency if they don't make a conscious effort to consume high-iodine foods. Realizing the magnitude of the problem, the Government of India launched National Goitre Control Programme, which was later renamed as National Iodine Deficiency Disorders Control Programme (NIDDCP).

CONCLUSION

Micronutrient insufficiency is a serious public health concern across the world, with anaemia impacting almost half of the population, although vitamin A deficiency and IDD have improved over time. The population's micronutrient status is projected to improve in the future years as a result of recent government measures and the improvement of current health and agriculture systems.

Key words: micronutrient, anemia, vitamin, mineral, iodine

Natural resource management for retaining diversity on EARTH

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Biodiversity:

Biodiversity refers to every living thing, including plants, bacteria, animals, and humans on Earth. It not only includes rare, threatened or endangered species but also every living thing for which we are less aware of. Human and human cultural diversity is also included in bio diversity which is also called bio culture.

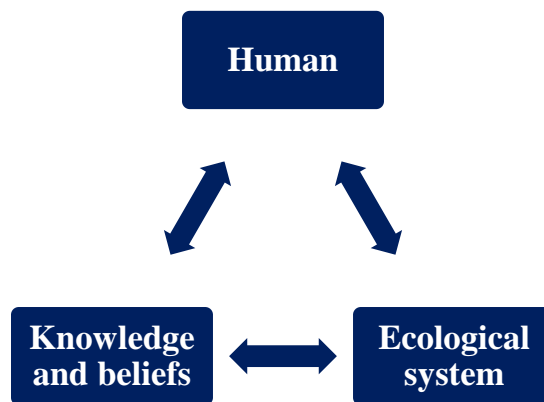


Fig 1. Concept of bio culture

The above relationship makes all the diversity be right which is very important to our wellbeing¹.

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The unlimited use of natural resources has caused disturbance in the ecosystem and massive loss of biodiversity. The major problems thus caused include habitat loss, unsustainable resources, pollution and global climate change. Conservation challenges are not impossible. It can be managed by understanding threats to biodiversity and how they play out in context².

India is one of the 17 mega-biodiversity countries of the world. Although India has only 2.5% of land area, total plants and microbes here accounts for 7.8% of recorded species in the world which is quite a big number.

Natural Resource Management (NRM)

A “natural” resource is one that is produced by nature without human intervention. The 20th century saw the importance of optimise utilisation and was projected at a supranational level.

First major internationalization of the natural resource management was observed during World War II, when countries came together to address the issues of damaged capacities and insufficient use of available resources. That context yielded to tackle problems of agricultural production in developing countries.

1. Food and Agricultural Organization (FAO) in 1945,
2. The International Whaling Commission in 1946, and,
3. The International Fund for Agricultural Development, in 1977

Second change was shift at a global level to Earth’s resources as a whole :- the seas, the air, and biodiversity. Following were the outcomes:

1. At international level the United Nations Environment Programme (UNEP) was established in 1972
2. The national level environmental ministries (in Europe) or agencies (in the United States) flourished in developed countries in the early 1970s.

Methods for natural resource management

According to Cooney, there are 4 methods to manage the precaution of biodiversity in natural resources management;

1. "Ecosystem-based management"
2. "Adaptive management"
3. "Environmental impact assessment"
4. "Protectionist approaches"³.

Approaches for natural resource management include ⁴:

- Top-down (command and control)
- Community-based natural resource management
- Adaptive management
- Precautionary approach
- Integrated natural resource management
- Ecosystem management

In India, Natural Resource Management Division of ICAR is conducting basic and strategic researches to develop technologies for conservation, management and sustainable utilization of the natural resources ensuring food, nutritional and environmental security in the country through 15 research institutes. The outcome of NRM research has been promoted through various developmental Plan schemes of the Government and contributing towards increase in agricultural productivity in the country.⁵

What Can Be Done to Strengthen India’s Natural Resource Management?

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India’s government has started to shift its priorities in terms of how it manages the country’s economy and natural resources. Among new Prime Minister Narendra Modi’s first national initiatives was changing the name of the Ministry of Environment and Forests to the Ministry of Environment, Forests, and Climate Change. This sends a strong signal that the government is serious in addressing climate change. Meanwhile, his Swachh Bharat Abhiyan, or “Clean India,” campaign to scrub India’s streets and countryside has the potential to evolve into a national air and water clean-up program.

The promising shift in resource management comes amid an assessment of the administration of environmental laws in India’s economic development. The active steps proposed by the commission are two-fold⁶:

1. The first is to exempt some big project proposals from the citizen involvement and public hearing process required by India’s environmental impact assessment rules.
2. The second is to replace the politically appointed and frequently corrupt national and state pollution control boards, which review and issue permits, with professionally staffed national and state environmental management agencies.

It has been observed that the agricultural sector has the greatest potential for energy savings. Not only this, the agro waste has the potential for revenue generation if explored properly.

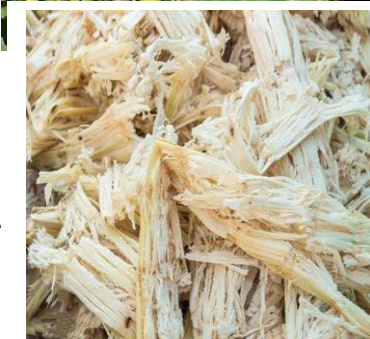
Development of innovative fabrics from agro waste

From agro waste, fibres can be explored which after modification can be used for different textile end uses ranging from house hold articles to technical textiles.

1. Fibres from Lotus stem



stem (https://www.google.com/search?q=okra+stem&client=firefox-b-L_4JfYd0gk4nmg):



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Exploration of the above agro waste yielded the results that fiber for the specific use in textiles can be explored. These fibers had utility in the technical textiles and with the modification it can be used for Apparels also. Okra fibres were suitable for house hold items because of it coarseness. Lotus fibers were as good as silk and pineapple fibres were also suitable for textiles. Sugarcane bagasse with its inherent adsorption property was suitable for technical textiles.

The production of fibres on large scale at the site only can help in achieving the sustainable development goals.

Dyes from agro waste:

1. From flowers: Marigold, Rose, Sunflower



2. F



3. From roots: Turmeric, Madder



- 4.



- 5.



October :

1 marine life.
minimising the

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carcinogenic impact of the synthetic dyes, it will help in reducing tons of the waste created from the after use of the flowers.

SUSTAINABLE DEVELOPMENT GOALS



Fig 2. List of sustainable development goals (source:https://en.wikipedia.org/wiki/Sustainable_Development_Goals)

Of the above, with the proper and scientific utilisation of agro waste, we will be able to attain following SDG to some extent

1. SDG 1 No poverty
2. SDG 8 Decent work and economic growth
3. SDG 9 Industry innovation and infrastructure
4. SDG 11 Sustainable cities and communities
5. SDG 12 Responsible consumption and production
6. SDG 17 Partnership for the goals.

With the exploration for fibres and dyes from agro waste above SDG can be achieved.

Lets take oath to make a lovely place to live in and leaving better place for the future generation.

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Comparative evaluation on the intercropping and monocropping system on the vegetative growth performance of pineapple

Raimi M. Redwan*, Nik Nur Anis Ayunee Nik Zakaria, Fatimah Kayat

ABSTRACT

Purpose

Demand for pineapple especially for fresh consumption has been increasing worldwide. In Malaysia, even though the current production has surpassed the SSL of 100%, the country aims to increase the production to fulfil the global demands especially for export to China. Pineapple has potential to be intercropped with various crops due to its small shrub nature and intercropping provides various benefits both to increase diversity of area and to improve the income of farmers.

Methods

In this research, the vegetative growth stage of pineapple grown in monoculture and intercropped in between banana were evaluated for 18 weeks. The parameter used to assess the growth were the number of leaves, length of leaves, width of leaves and height of plant. The experiment was performed in two treatments and 15 replicates for each treatment. Data were then analysed using Independent Variable T Test.

Results

The result indicated that there are no significant differences showed in all the parameters for both treatments except for parameter height of plant. Moreover, from the agronomic aspects evaluation of the planting bed during the experiment, the planting bed for pineapple intercropped in banana farm was less affected by weed in comparison to pineapple planted in monocrop system.

Conclusions

The study highlights the potential of pineapple to be intercropped with banana to bring benefits to the crop ecosystem without affecting its growth performance. The study can be used to advocate farmers to practice intercropping to maximise their farm income.

Key words: Pineapple, MD2, monocropping, intercropping, banana

Influence of Different growing media and Bio-enhancer on seed germination and seedling growth after transplanting of papaya (*Carica papaya* L.) cv. Pusa Nanha

* Ravi Shankar Singh, A.K.Dwivedi, Akash Shukla, Manoj Kumar and Jitendra Shukla

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ABSTRACT

Purpose

Papaya (*Carica papaya* L.) is an important tropical commercial fruit crop of India. Belong to the family caricaceae and genus carica. It is native to the tropical of the America. It is very rich source of vitamin A and good source of vitamin C. It is also fairly rich in calcium, iron, vitamin B 2, nicotinic acid, protein, fat, carbohydrates and other minerals. So it's a good choice for cultivation for grower and consumer. The increasing germination per cent and producing more number of healthy seedlings is a challenge for papaya growers because it have high seedling-mortality due to damping-off disease at the nursery stage. Growing media composition influences seed germination and quality of the seedlings.

Methods

The experiment was conducted to improving the germination and seedling growth of papaya influence by media (Soil, Sand, FYM) and bioenhancer (Cow pat pits, Jiva-amrit, Amritpani, Vermivash) at Experiment Station, Department of Horticulture, Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya with five treatment and replicate four in R.B.D. in papaya after transplanting stage. **Results**

The present study showed that the maximum value of plant height was found with the treatment of (Amritpani) stem diameter (vermivash), leaf width and length (jeeva amrit). Whereas the minimum was found in control. Whereas after transplanting all the bio-enhancer which was found at par in all the influence of observation.

Conclusion

Therefore, It may be concluded from the results obtained in present investigation for the growth of papaya any bio-enhancer can be utilized as per the availability in indo-gangetic plains of eastern Uttar Pradesh due to less economy.

Keyword: Papaya, Media, Bio-enhancer, Germination, Seedling growth.

Impact of foliar application of Nutrients and PGR's on Physico- Chemical Property of Guava (*Psidium guajava*) fruit cv. Lalit

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ABSTRACT

Purpose

The Guava is fourth most important fruit after mango, banana and citrus fruit in India it's also known as 'Poor man's Apple'. It is a rich source of vitamins especially vitamin-C (300 mg/100g) and minerals like calcium, phosphorus, Iron etc. and anti-oxidant. In guava different fruiting seasons commonly known as bahar. Among all the bahars, higher economic yield are obtained from mrigbahar. However, mrigbahar faces different abiotic stresses due to poor nutritional condition. So, foliar application of nutrients and plant growth regulators reduce the poor nutritional factor and improved physico-chemical property of guava fruits.

Methods

The experiment was conducted to improve the physico-chemical property through foliar application of nutrients and PGR's on eleven year old guava plants in the month of first week of August and second week of September during 2017-18 at Horticulture Research Farm, BBAU, Lucknow. The experiment was laid out in R.B.D. with three replication and ten treatments single or in combination of T₀(control), T₁(Urea 1%), T₂(Potassium sulphate 1%), T₃(Zinc sulphate 1%), T₄(GA₃ 50ppm), T₅(NAA

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50ppm), T₆(Urea 1%+ NAA 50ppm), T₇(Urea 1%+ GA₃ 50ppm), T₈(Urea 1%+ Zinc sulphate 1%), T₉(Urea 1%+ Potassium sulphate 1%).

Results

Results showed that the foliar application of Urea 1% + NAA50ppm was the best treatment combination among the all treatment for improving physico-chemical property of guava fruits (viz, T.S.S 7.66 -12.09 °Brix, total sugar 5.87 - 7.20%, ascorbic acid 158.45 - 172.07 mg/100g and reduce the acidity 0.68 -0.51 %), where as the minimum result was found in control.

Conclusion

Therefore, combined spray of Urea 1% + NAA 50ppm can be advocated to guava growers for the better quality of guava fruits.

Keyword: Guava, Plant Growth Regulator, Nutrients and Physio- Chemical Property.

Effect of organic manures on quality and physico-chemical characteristics of winter season guava (Psidium guajava L.) in cv. L-49

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ABSTRACT

Purpose

Guava (*Psidium guajava* L.), is one of the most important tropical and sub-tropical fruit crops of India, which belongs to the family Myrtaceae. Integration of organic substrates can have significant effect on the physical, microbiological and chemical properties of soil, which are indirectly responsible for supporting plant growth and fruit quality. We aim to identify, the best sources of organic manure for the production of improved quality of guava.

Methods

The experiment was conducted in Simple Random Block Design with three replications in guava cv. L-49. The experiment was laid out in open field condition with seven treatments viz. T1 (control), T2 (FYM), T3 (vermicompost), T4 (poultry manure), T5 (FYM + vermicompost), T6 (vermicompost + poultry manure) and T7 (FYM + poultry manure). The different levels of organic manures were applied in soil at a distance of 1-2 ft. away from the tree trunk.

Results

The observations revealed that the use of organic manures improved the physical and chemical characteristics as well as yield attributes in the guava plant. Among the different organic manures evaluated in the present study, vermicompost + poultry manure combination emerged as the best choice of organic manures, closely followed by FYM + poultry manure in improving the fruiting characteristics and fruit quality.

Conclusions

The organic manures can be implemented for organic guava production, and due to the application of vermicompost + poultry manure combination to guava field, potentially contribute to improved quality guava fruits.

Key words: Organic farming, FYM, vermicompost, poultry manure, healthy fruits.

Study the nutrition level on sesamum varieties under rainfed condition

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ABSTRACT

Purpose

Sesame (*Sesamum indicum* L.) is the oldest indigenous oilseed crop, with longest history of cultivation in India. Sesame or gingelly is commonly known as til (Hindi, Punjabi, Assamese, Bengali, Marathi), tal (Gujarati), nuvvulu, manchi nuvvulu (Telugu), ellu (Tamil, Malayalam, Kannada), tila/pitratarpa (Sanskrit) and rasi (Odia) in different parts of India.

Methods

The experiment was carried out in the Department of Crop Physiology, C.S. Azad University of Agriculture and Technology, Kanpur during the year 2016-2018. Complete Randomized Block Design was used in trial.

Results

Aimed with to study the effect of Nitrogen, Phosphorus, Potassium Sulphur, and Farm Yard Manure used in the experiment were 40:20:20:20 and 2.5 t/ha. Significantly increased growth yield and quality of Sesamum varieties Shekhar (V₁), Pragati (V₂), and Tarun (V₃) and treatment as control(NPK) T₁, NPK+S (T₂), NPK+FYM(T₃) and NPK+S+FYM@ 40:20:20:20kg /ha and 2.5 t/ha. (T₄). Result revealed that the application of T₄(Nitrogen, Phosphorus, Potassium, Sulphur and Farm Yard Manure) and variety Tarun over all best response in all observation like as used in the experiment were Significantly increased seed yield (q/ha.), Chlorophyll intensity (%), RWC (%), plant height (cm), Branches/plant were significantly enhanced in comparison to control (NPK).

Conclusion

Result revealed that the application of T₄(Nitrogen, Phosphorus, Potassium, Sulphur and Farm Yard Manure) and variety Tarun over all best response in all observation like as used in the experiment were Significantly increased seed yield (q/ha.), Chlorophyll intensity (%), RWC (%), plant height (cm), Branches/plant were significantly enhanced in comparison to control (NPK).

Key words: Sesamum, Farm Yard Manure, Chlorophyll intensity, Nitrogen, Phosphorus, Potassium, Sulphur.

Impact of alternative cheap gelling agents for shoot multiplication and rooting of strawberry (*Fragaria × ananassa* Duch.) under *in vitro* condition

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ABSTRACT

Purpose

Strawberry is one of the most important fruits which contain vitamin B complex, vitamin C, lots of antioxidant and mineral matters. So its cultivation in this region will be helpful for growers as well as consumers for energy as well as better health benefits. The conventional propagation method is vegetative means but commercial and large scale production of plantlets has been not possible and the chance of yield reduction due to the infestation of biotic stresses. Therefore, the availability of quality planting material is of urgent need. Recently, tissue culture has been a promising approach for strawberry multiplication at large scales. In the tissue culture techniques, gelling agent agar is costly compound so there is need of search out cheap compound as gelling agent for large scale production of plantlets through tissue culture to meet out the demand of needy growers.

Methods

The experiment was carried out in the Tissue Culture Laboratory, Department of Horticulture, SVPUA&T, Meerut under *in vitro* condition during the year 2017-2019. The experiment was laid out in C.R.D with three replication (10 containers or pots/treatment).

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Results

Result showed that the earliest shoot initiation (14.21 days) was noted under BAP 4.00 mg l⁻¹ + Sago@20 g l⁻¹. The minimum days taken for shoot development (24.28 days) was noted under Half MS Media +Tapioca (sago) 10 g l⁻¹ +BAP@2.0 mg l⁻¹. After, 40 and 60 days Maximum number of shoots obtained (5.78) were noted under the same treatment of Half MS medium +BAP 4.00 mg l⁻¹ + Sago@20 g l⁻¹. Maximum percentage of developed shoots obtained (83.16%) was noted under the same treatment of BAP and Sago. Maximum shoot length obtained (2.86 cm) under the treatment of Half MS medium + BAP 4.00 mg l⁻¹ + Sago@ 20 mg l⁻¹.where as the maximum day taken for shoot development maximum (34.58 days) was noted under the treatment combination of Half MS Medium with Corn flour@ 30 g l⁻¹+BAP @ 2.0 mg l⁻¹. Highest proliferated rooting was reported in strawberry shoots on Half MS media supplemented with Sago@ 20 g l⁻¹+ IBA 2.50 mg l⁻¹. The minimum days taken for root initiation (12.67 days) were found under Half MS Media +Tapioca (sago) 20 g l⁻¹ +IBA @2.0 mg l⁻¹. The maximum number of roots per plantlet was recorded (4.22) under the same treatment of IBA and Sago@20 g l⁻¹. Where as the maximum (15.00 days) for root initiation was noted under treatment combination MS Media + Corn flour 30 g l⁻¹ +IBA @3.0mg l⁻¹.

Conclusion

In this way sago@ 20 g l⁻¹ + BAP@ 2 mg/l for shoot development and sago@ 20 g l⁻¹ + IBA @2.5 mg l⁻¹ for root development. So it's proved that sago starch could be used as a substitute to agar in culture medium to substantially reduce the medium cost.

Key words: Explant (runner), strawberry, Micropropagation, Sterilization, gelling agent (sago, corn flour, agar), Callus.

Genetic diversity study in species of three important genera- *Arachis*, *Cicer* and *Oryza* using seed storage proteins

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ABSTRACT

Purpose

Seeds are reservoirs of nutrients which are utilized by the developing seedlings and humans for dietary intake and food security. A seed storage protein defines the nutritional value of the grains. In our study, we aim to highlight the importance of seed storage proteins in diversity analysis and phylogeny in three plant systems *Arachis*, *Cicer* and *Oryza*, which can be further utilized in determining and improving the nutritional quality of seeds.

Methods

Seed storage proteins are extracted for the isolation of total soluble proteins by using extraction buffer under controlled conditions and the extracted total protein sample is subjected to SDS-PAGE for the analysis of banding pattern obtained. The banding profiles are then analyzed with the help of bioinformatics tools.

Results

Intraspecific variation seen among different varieties of plant systems. The cluster analysis studies and polymorphism in the banding pattern of seed protein profiles among varieties of *Arachis*, *Cicer* and *Oryza* helps in studying genetic diversity intraspecifically.

Conclusion

Seed storage protein analysis is molecular biology tool for determining genetic diversity, nutritional value, genetic relatedness among species or varieties which might be helpful in developing high yield and nutritious varieties (nutritional improvement/biofortification).

Key words: seed storage proteins, diversity, intraspecific variation, nutritional improvement/biofortification.

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Influence of liquid and carrier based biofertilizers on quality of guava (*Psidium guajava* L.) cv. Taiwan White

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ABSTARCT

Purpose

In the present scenario, farmers are opting fertigation which ensures precise timing and uniform distribution of nutrients and is an efficient and agronomically sound method of providing soluble plant nutrients directly to the active plant root zone. Biofertilization with liquid biofertilizers is the efficient and precise use of beneficial microorganisms through a microirrigation system over carrier based biofertilizers. However, limited attempts have been made to study the influence of liquid formulations on the growth, yield and quality of fruits in India and there is need to validate the relative advantage of liquid formulations over carrier based biofertilizers.

Methods

The present investigation “-Influence of liquid and carrier based biofertilizers on quality of guava (*Psidium guajava* L.) cv.Taiwan White” was carried out for two fruiting years (Mrig Bahar) viz., 2019-2020 and 2020-2021 at College of Horticulture, Venkataramannagudem, Dr.YSRHU. The experiment was laid out in Factorial RBD with two factors and three replications. The first factor consisted of three levels of RDF (100 %, 80 % and 60 % of RDF) and the second factor with three levels of different combinations of biofertilizers (NFB + PSB + KSB liquid biofertilizers, NFB + PSB + KSB carrier based biofertilizers and without biofertilizers) comprising nine treatment combinations.

Results

Guava trees applied with 100% RDF + liquid biofertilizers was found significantly superior over other treatments in respect of TSS (9.47 °Brix), total sugars (8.19%), reducing sugars (4.76%), ascorbic acid content (233.52 mg/100 g pulp), pectin content (1.16%), calcium content (23.67 mg/100 g pulp) and phosphorous content (36.33 mg/100 g pulp) in fruits. Application of 100 % RDF + liquid biofertilizers was on par with 80 % RDF + liquid biofertilizers for TSS (9.38 °Brix) and total sugars (8.19%).

Conclusions

The conjoint use of 100% RDF with liquid biofertilizers (NFB + PSB + KSB) recorded maximum increase in quality parameters in guava cv. Taiwan White besides maintaining the soil fertility.

Key words: Guava, liquid biofertilizers, inorganic fertilizers, quality parameters

Eco friendly dyeing with extracts of henna on cotton

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ABSTRACT

Purpose

Growing consciousness about organic value of ecofriendly products has generated renewed interest of consumers towards use of textiles dyed with ecofriendly natural dyes. Henna (*Lawsonia inermis*) extract is harmless dye extensively used in natural healing science. Colouring content gradually percolates into the substrate. We aimed to standardize natural dyeing conditions, optimize the mordanting methods, evaluate the colour strength value and fastness properties.

Methods

Optimization of pre-treatment with Myrobolan, mordanting and dyeing concentration for 2/64s cotton yarn experimented. Assessment of quality parameters for colour fastness using standard test procedures and colour strength using spectrophotometer with interface Colour Premiere Software for change in colour.

Results

The colour strength of samples mordanted with ferrous sulphate was the maximum followed by potassium dichromate and copper sulphate. The samples mordanted with potassium dichromate, potash alum, copper sulphate and aluminum acetate were towards the greener tinge. Light fastness of the samples mordanted with stannous chloride and Aluminum acetate was moderate. Perspiration fastness for acidic media of the samples mordanted with salts was good. Change in colour of the samples mordanted with Aluminum acetate and zinc chloride for wash fastness was good to excellent.

Conclusions

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Standardized protocol for dyeing and the types of mordant used, a variety of colours can be produced for cotton for better performance. So, extraction and purification of natural dyes and their application can be of great significance in the future.

Key words: Henna, Mordants and Cotton Yarn

IDENTIFICATION OF TERMINAL HIGH-TEMPERATURE TOLERANT CHICKPEA (*Cicer arietinum* L.) GENOTYPES THROUGH YIELD-BASED SELECTION INDICES

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ABSTRACT

Purposes

Chickpea (*Cicer arietinum* L.) is a third most important cool season grain legume crop cultivated in arid and semi arid region of the world. Under rainfed cultivation chickpea crop faces heat stress during flowering and grain development. Terminal heat stress during reproductive phase cause negative impact on several physiological processes results reduction of productivity. Therefore, prime objective of this study to identify terminal heat tolerant genotypes under changing global climate scenario.

Methods

The experiment were conducted at research farm of Banda University of Agriculture and Technology, Banda (25° 29' N latitude; 80° 20' E longitude, 123 m above mean sea level and soil pH 7.3) during growing season 2019-20 under two environments, near optimal (10, November) and delayed sown (14, January) under irrigated environments. Ninety genotypes were planted in augmented block design with four checks in plot size of two rows of 2 m length with row to row spacing of 30 cm. One irrigation was applied in timely sown and two irrigation were applied in late sown experiment to rescue crop from drought stress. Fifteen quantitative traits were recorded in normal and stress environment. The recorded traits were subjected to statistical analysis using for yield-based selection indices viz., Yield reduction% (YR%), Capacity for seed filling under heat stress (KWR%), Heat susceptibility index (HSI), Yield stability index (YSI) and Stress tolerance index (STI), were used to identify the tolerant genotypes and/or best performing genotypes under normal and late sown conditions in chickpea. The adjusted mean values of traits were used for estimation of selection indices.

Results

The analysis of variance showed highly significant differences among the germplasm lines for studied traits in normal and heat stress environments. The crop start flowering after 55 days of sowing where as in late sown conditions flowering start in 40 days of sowing. Crop life cycle was reduced 41 to 65 days under terminal heat stress and plants force to mature in 84 to 95 days under late sown condition. The determinant effects of terminal heat stress were observed on each studied trait. The mean seed yield of five plants normal environment is 88.31gm, whereas more than 39% decline (50 gm) observed is under late sown crop. The reduction in all traits under stress environment indicates the sensitivity of the chickpea to heat stress. The stress indices comparing of normal and late sowing have been estimated. The maximum YR% was observed in JG 322 and C-1762(56%) followed by PUSA-1053(55%) however, lowest yield was reduced in C-1791 (19%), GNG 1854 (20%) and Vijay (25%). The lowest KWR% was recorded in C-1779 (1%), EC-556270 (2%) and ICVT-181114 (3%). Based on selection indices contrasting heat tolerant and susceptible genotypes were identified. The genotype C1791 had minimum YR% (19%) followed by GNG 1854 (20%), Vijay (25%), GNG 2127 (26%) and ICVT 181102 (27%). These genotypes also show lowest HSI thereby these genotypes considered as heat tolerant material. The genotype JG-312 and C1762 has maximum YR% (56%), followed by PUSA 1053 (55%), ICVT 181116 and ICCV 2055 (54%) under heat stress environment. These genotypes show highest HSI thereby considered as heat susceptible genotypes. The C 1791, GNG 1854, Vijay, GNG 2127 and ICVT 181102 show stable performance (YSI) under two diverse growing environments. The genotype GPF 2, ICVT 181116, and IC 244263 shows high HTI 1.56, 1.51 and 1.39, respectively.

Conclusions

Among abiotic stress terminal high-temperature is main cause of significant yield loss in chickpea crop. The genetic resource which showed tolerance to terminal heat stress can be utilised in breeding programme. In the presented study, C1791, GNG 1854, Vijay, GNG 2127 and ICVT 181102 are identified terminal heat tolerant genotypes. The genotype JG 322, C-1762, PUSA-1053, ICVT-181116 and ICCV-205 are identified as heat susceptible genotypes. The C 1791, GNG 1854, Vijay, GNG 2127 and ICVT 181102 show stable performance. Based on the performance of germplasm lines under both conditions, identified genotype which have ability to withstand in heat stress situation would be useful in chickpea breeding programme.

Keywords: Chickpea, Terminal heat stress, Selection indices, Heat susceptible index

ECONOMIC CONTRIBUTION OF POPLAR FARMING TO RURAL LIVELIHOODS IN KASHMIR HIMALAYA, INDIA

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ABSTRACT

Poplar farming constitutes a major source of livelihood among rural people in Kashmir playing a vital role in economy, rural development, employment and occupation, forest-industries, growth and survival, social, economic and cultural conditions and poverty alleviation (Islam et al., 2016). The poplars resources are used by the rural communities to meet their daily livelihood needs besides satisfying their social, economic, cultural, religious, ethical, traditional, spiritual, ecological and political aspirations (Islam et al., 2012). The study investigated the tree resource production, subsistence consumption, economic contribution and socioeconomic determinants of poplar farming in Ganderbal district of Kashmir.

Methodology

Multistage random sampling technique was employed to select the 191 households from the 10 sample villages. Secondary data were collected from all possible sources and primary data were gathered through field survey administering structured interviews, non-participant observations and focus group discussions. The data were analyzed using descriptive statistics and analytical regression model.

Results

Results revealed that total production (p) and consumption (c) of poplar resources were; fuel wood (p=105.58 t/year, c=105.58 t/year), tree browse (p=74.90 t/year, c=74.90 t/year), timber (p=2730.54 m³/year, c=223.08 m³/year) and leaf litter (p=49.93 t/year, c=49.93 t/year). Poplar resources generated total income of ₹ 2207903.72/year (subsistence=₹ 1250180.18/year, cash=₹ 1880589.10/year) @ ₹ 16391.45/household/year. Timber contributed largest share (65.41%) to the total poplar income followed by fuel wood (20.23%), tree browse (14.36%) and leaf litter (0.00%). The average gross annual income was ₹111256.17/household which is differentiated as agriculture (35.68%), business (20.06%), livestock (18.24%), poplar farming (8.85%), willow farming (7.20%), service (6.94%) and wage labour (3.03%). Nonetheless, the poplar farming is the 4th major contributor of household economy. Regression analysis showed that the socioeconomic factors namely, family size, family labour, land holding, herd size, main occupation, annual income, proximity to forest and forest visits are the key determinants influencing significantly the poplar resources based income.

Conclusion

The findings suggested that the poplar farming is the key alternative for poverty alleviation, socioeconomic development and livelihood security; hence, policy must be implicated towards the livelihood diversification through sustainable production, value addition and commercialization of poplar resources.

Keywords: Poplar farming, tree resource, socioeconomic factors, livelihoods, income, Kashmir, Himalaya.

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Assessing the impact and management of parthenium weed (*Parthenium hysterophorus*) and a look to the future in Bangladesh

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ABSTRACT

Purpose

A field survey study was carried out to assess the socio-economic effects of a highly invasive plant species, parthenium weed (*Parthenium hysterophorus* L.) during 2020-21 across the Jashore Hub and Greater Rajshahi regions of Bangladesh. We also investigated the performance of the chemical control of *P. hysterophorus* using four herbicides under field conditions.

Methods

Primary data were collected using semi-structured interview questions and through direct observation on the field. Butachlor (25.00 kg ha⁻¹), Bispyribac Sodium (150 L ha⁻¹), Quizalofop-p-Ethyl (2.5 L ha⁻¹), and Carfentrazone Ethyl (5%) + Glyphosate (36%) (2.00 L ha⁻¹) were used for the chemical control of *P. hysterophorus*.

Results

Farmers were well aware of parthenium weed presence, its biology, habitat, and mode of dispersal across the landscape. Vehicles and flood water are the major agents, which proliferate the seeds of the weed. Most of the respondents (76%) indicated that the weed first appeared on the roadside and spread to other habitats. Summer is the most favorable growing season and April is the most dominant month of infestation. All the major crops cultivated were infested by varying degrees of weed densities. Farmers (52%) found they have 10 to 20% crop yield reduction due to the parthenium infestation. Serious impacts upon the health of livestock in parthenium-infested areas have been reported from respondents (47%), found to cause clinical signs in animals. Farmers reported parthenium weed as a very difficult-to-manage weed and unsurprisingly, manual weeding or herbicides were the major weed control methods across the regions which is consistent with the overall management practices in the country. Carfentrazone Ethyl (5%) + Glyphosate (36%) and Quizalofop-p-Ethyl resulted in a 100% and 90% mortality rate on 21 DAS in the field study. No mortality was seen in another two herbicides.

Conclusions

The agricultural communities described significant effects of parthenium weed on their crop and livestock production and social well-being. Therefore, a comprehensive management strategy is urgently needed to address the looming crisis of parthenium weed invasion across the regions and a similar approach must be implemented at the national and international levels.

Key words: Parthenium weed; Socio-economic impacts; Weed management; Animal health; Herbicide; Bangladesh

“TEFF- A SUPER MILLET CROP”

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ABSTRACT

Major cereals viz., rice, maize, wheat, etc., though capable of meeting food demands, require major concern in their production with high demand for external inputs. Continuous consumption of these crops is inviting many health issues as they are capable of supplying limited nutrition. Though, minor millets are being cultivated since ages in India as integral part of sustainable farming for their high nutritiousness, yet the value they fetch in the market is too low for a grower to lead a comfortable life. This is creating a wider socio-economic gap between the poor farmers and commercial farmers. Hence, there is an urgent need for a crop that not only suffice the hunger with high nutritional quality but, must have a higher demand in the market. Teff is one such minor millet native of Ethiopia where it is cultivated and consumed as staple food for about 50 percent population of the country. It is an intriguing grain, rich in nutrition compared to other cereals and is free of gluten and capable of yielding potentially even on marginal soils. Teff was introduced to India by CFTRI, Mysore. The promotion and cultivation of Teff in India is still in infant stage as less is known about the crop and lack of any standard/improved practices available for its cultivation. The present article is a brief review of the importance and agronomic practices of teff crop in a view to promote the cultivation and consumption of teff in India.

Key words: Teff, tiny seeds, nutrition, agrotechniques, lodging

INTRODUCTION

Teff (*Eragrostis tef* [Zucc.] Trotter), commonly known as “Williams love grass, teffa and annual bunch grass” in different parts of the world is originated and diversified from Ethiopia (Vavilov, 1951). Being minor millet, it belongs to the Poaceae family, sub-family Eragrostoidae, tribe Eragrostae and genus *Eragrostis*. The word “teff” is derived from the Amharic word “teffa” which means "lost", due to small size of the grain and how easily it is lost if dropped (Ketema, 1991), while some say it was derived from Arabic word “tahf” a name given to similar wild plant (Constanza, 1974; Tadesse, 1975; Endeshaw, 1978). Domestication of teff started at the time of food scarcity due to famines (Tadesse, 1975; Endeshaw, 1978) and now is the major indigenous cereal cultivated and consumed as a staple food for more than 85 per cent of the 85 million people of Ethiopia (Lee, 2018). In Ethiopia, teff ranks first in acreage (cultivated on 7.85 lakh hectares of land out of 1.12 m hectares of total land size) and second in production (1,117.24 m tonnes) next to maize among the cereals (Tamirat and Tilahum, 2020). Simultaneously, benefits of teff cultivation are dispersing to various parts of the world viz., Australia, Canada, Cameroon, China, India, South Africa, The Netherlands, UK, Uganda and USA. However, complete statistics with respect to teff production, consumption and trade are least accessible from those countries.

PLANT BIOLOGY

Teff is a sexually propagated, self-pollinating annual grass species (Dejene and Lemlem, 2012). It is tetraploid with a chromosome number of $2n = 40$ (Tareke, 1975; Endeshaw, 1978) and an allopolyploid (Tareke, 1981). Teff is a warm seasonal annual grass in which all the plant biomass below the ground is called root and all that is seen above is called shoot. It has thin, slender stem made of longer internodes at the base and shorter at the apex, which opens into succulent and very thin leaves. On an average a teff plant produces ten panicles (inflorescence), each panicle consisting around 1000 seeds. The plant phenology in detail is presented below in Table 1.

Table 1. Phenological characters of teff

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Source: Assefa *et al.*, 2016

Phenological trait	Min.	Max.
Days to panicle emergence	25	81
Days to mature	60	140
Plant height (cm)	20	156
Culm length (cm)	11	82
First culm internode length (cm)	2.68	8.05
Second culm internode length (cm)	4.15	11.45
First and second culm internode diameter (cm)	1.2	4.5
Panicle length (cm)	10	65
Peduncle length (cm)	5.85	42.3
Number of primary panicle branches	10	40
Number of spikelets per panicle	30	1070
Number of florets per spikelet	3	17
Grain yield per panicle (g)	0.11	2.5
Number of tillers plant ⁻¹ (total)	4	22
Number of tillers plant ⁻¹ (fertile)	1	17
Grain yield per plant (g)	0.54	21.9
Total phytomass per plant (g)	4	105

Teff seeds are the smallest seeds in the world, varying in 1-1.7 mm long and 0.6-1 mm diameter and 1000 seed weight measuring around 0.3-0.4 grams (weight of 150 teff grains = 1 wheat grain) (Miller, 2007). The seeds are mucilaginous with various seed coat colour *viz.*, ivory, light tan to deep brown or dark reddish-brown purple, depending on the variety (upper class consumed the lighter grains while, the dark grain was the food of soldiers and servants). Majorly three types of seeds are available *viz.*,

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White teff: Grows only in highlands, when used increases shelf life of injera, chestnut-like flavor and mostly preferred by the higher-class people.

Red/Brown teff: More adoptability, earthier and taste more like hazelnuts and mostly preferred by poor and working community.

Mixed: Has intermediate traits of white and brown type.



NUTRITIONAL COMPOSITION OF TEFF

Teff is an intriguing grain, ancient and minute in size packed with nutrition. In spite of its tiny size, it holds enormous nutritional factors in its seeds. Even teff straw got higher palatability due to its high nutrient composition and high succulent nature of the stem which makes teff straw much preferred by the cattle than any other cereal straw.

Nutritional composition of teff grain and straw

Table 2: Teff grains composition		Table 3: Teff hay composition	
Component	100 g ⁻¹	Quality Parameters	Composition (%)
Water (g)	10.0	Crude Protein	9-14
Energy (kJ)	1468	Acid Detergent Fiber (ADF)	32 – 38
Protein (g)	12.3	Neutral Detergent Fiber (NDF)	53 – 65
Fat (g)	2.1	Total Digestible Nutrients (TDN)	55 - 64
Starch (g)	59.8	Relative Feed Value (RFV)	80-120
Fibers (g)	7.9	Source: Table 2: Akanksha <i>et al.</i> , 2018 Table 3: Miller, 2007	
Calcium (mg)	167		
Iron (mg)	5.7		
Magnesium (mg)	194		
Potassium (mg)	477		

Table 4: Comparison between types of teff grains

Minerals (mg/100 g)	White teff	Red teff	Mixed teff
Iron	9.5-37.7	11.6 – 150	11.5 - 150
Zinc	2.4-6.8	2.3-6.7	3.8-3.9
Calcium	17-124	18-178	78.8-147
Copper	2.5-5.3	1.1-3.6	1.6

Source: Akanksha *et al.*, 2018

USES OF TEFF:

- Teff flour is primarily used to make a fermented, sourdough type, flat bread called *Injera*.

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- Teff is also eaten as porridge and also used for making traditional alcoholic drinks like *tella* (local opaque beer) and *katikalla* (local spirit), *kitta* (sweet dry unleavened bread) and *muk* (gruel) (Gebremariamet *al.*, 2012).
- Cooked teff can be mixed with herbs, seeds, beans or tofu, garlic, and onions to make grain burgers.
- The seeds can also be sprouted and the sprouts used in salads and on sandwiches.
- Good thickener for soups, stews, gravies, and puddings and can also be used in stir-fry dishes, and casserole dishes.
- Best forage crop that is capable of yielding higher biomass coupled with high quality fodder for cattle (Miller, 2008).
- Straw incorporated with mud to reinforce it and used in plastering the house walls.

Teff products: Teff flour can be used as a substitute for part of the flour in baked goods, or the grains added uncooked or substituted for part of the seeds. Appetizers Baked goods, Biscuits and scones Breads, Breakfast and desserts bars, Breakfast dishes (to be eaten with fruits and milk, hot or cold), Brownies, Cakes and cupcakes Casserole dishes Cookies, Crackers Desserts, Dips, sauces and gravy Granolas (muesli) Muffins, Pancakes & waffles Pastas, Pie crusts Pizza crusts Rolls & buns Soups & stews, Tortillas and flat breads and Weaning food.

SOIL AND CLIMATE

Teff is a tropical low risk cereal that grows in a wider ecology and can tolerate harsh environmental conditions where most other cereals are less viable (Gebremariamet *al.*, 2012). Teff is a warm season annual grass that requires a frost-free growing season. It is cultivated from sea level up to 2800 m on soils with varying physical and chemical properties, in waterlogged and in well drained soils, in moisture stress areas having less than 300 mm of rainfall as well as in areas having 1000 mm seasonal rainfall. This gives an idea of the tremendous ecological diversity under which the crop can be grown (Ketema, 1991). Soil temperatures at planting should be at least 65° F. Teff comes up well in light sandy loam to medium deep black soils. Teff seeds sown in clay loam soil recorded significantly higher plant height (8.7 cm) than sown in sandy loam soil (7.6 cm) due to finer clay particles with higher surface area can easily come in contact with small seeds and supports early and better establishment of the seedlings than sandy loam soils (Debelo, 1992).

SEED BED PREPARATION

Teff requires a firm and compact seedbed (Miller, 2007). Two ploughings prior to sowing were optimum to attain significantly higher grain yield (816 kg ha⁻¹), while no ploughing and more than two number of ploughing resulted in lower yields (Debelo, 1992). This is due to better contact between the seeds and soil under ploughed land than unploughed land, that resulted in better establishment of the crop. As the number of ploughings increased, the soil became more porous and seeds were placed at greater depth resulting in poor germination and crop density, resulting in lower yields. Results also revealed that sub-soiling practice as water conservation technique on *vertisol* ensured more porosity of the soil that enhanced infiltration rate and available soil moisture which was sufficient to meet the water requirement of the crop ultimately resulting in higher yield levels as compared to teff grown under conventional and minimum tillage systems (Melesse, 2007).

SEED SELECTION (Variety, seed treatment, seed rate)

Teff seeds are the smallest seeds in the world. Though there is much lack of genetic improvement in teff varieties, few local varieties are promising yielders to the farmer. Seed variety chosen should be well adopted to the prevailing, soil and climatic conditions in order to achieve the higher yields. Between the machere and quncho varieties, machere produced significantly higher number of tillers m⁻² (165.9), effective tillers m⁻¹ (128.9) and grain yield (2344 kg ha⁻¹), while, higher plant height (124.6 cm) and shoot biomass (7467 kg ha⁻¹) were noticed in quncho variety (Aleminew and Legas, 2015). This is mainly attributed to genetic potentiality of the varieties. Similarly, Cross 387 gave higher grain yield than Cross 37 (Anon, 2008). Since, seeds are tiny the rate of planting is very less. Broadcasting the teff seeds at the rate of 25 kg ha⁻¹ is the most common practice in Ethiopia (Aleminew and Legas, 2015). Aleminew and Legas (2015) reported that seed rate of 5 kg ha⁻¹ recorded significantly higher plant height (126.9 cm), number of tillers m⁻² (201.8) effective tillers m⁻² (160.5) and grain yield (2527 kg ha⁻¹) compared to higher seed rates (10, 15, 20, 25 and 30 kgs ha⁻¹). Similarly, Tesfay and Gebresamuel (2016) noted 74.19 to 78.54 per cent higher yield can be achieved with 5 kg ha⁻¹ under line sowing than broadcasting 25 kg ha⁻¹ of seeds. Results also revealed that grain yield increases with increasing seed rate from 2.5 to 10 kg ha⁻¹ and then declined with further increase in seedrate (Fekremariam *et al.*, 2020). Arefaine *et al.* (2020) and Biya (2020) concluded that 10 kg ha⁻¹ seeds were sufficient to attain significantly higher magnitudes of growth parameters, yield attributes and yield of teff. This is due to lack of inter and intra-competition between the plants that resulted in better growth and development of the crop. Seeds sown at lower densities results in higher yield levels than compared to higher seed rates. An average of 1.5 kg raw or 3.0 kg coated seeds per acre are sufficient to attain optimum forage yield in summer (Miller, 2007).

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Seed treatment had least effect on enhanced germination of the seeds. Seeds treated with water (0.0 MPa) showed 99.0 per cent germination within two days which was on par with 0.3 MPa NaCl treatment (Debelo, 1992). This is due to increased water potential of solutions at higher concentrations caused exo-osmosis that badly affected physiological processes of seed germination.

PLANTING (time, method, spacing and depth)

Teff can be grown as both *Kharif* (June-July) and *Rabi* (October-November) for grain purpose or as summer forage (Miller, 2007). Sowing on 2nd week of July recorded significantly higher plant height (74.55 cm), panicle length (32.00 cm) and grain yield (2876.4 kg ha⁻¹) than delayed sowing (i.e., on 3rd and 4th week of July). The reductions in teff yield due to delay in sowing by 7 and 15 days was very high about 60 and 68 per cent, respectively. This is mainly attributed to the inter-specific competition by weeds that was severe under late sown crop (Juraimiet al., 2009). Method of planting has greater effect on growth and development of the crop (Ariogluet al., 2004). Broadcasting method was commonly practiced by the farmers producing minor millets. Row planting with seed drills has become popular for its own advantages, while, transplanting under limited water supply condition is gaining higher importance for its ease in better establishment and management of the crop (Abraham et al., 2014). Tesfay and Gabresamuel (2016) reported that higher plant height (144.93 cm), panicle length (55.57 cm), tillers per plant (13.83), grain (3.66 t ha⁻¹) and straw yield (9.5 t ha⁻¹) were obtained under row planting of teff crop over broadcasting method. Similar results were also concluded by Arefaine et al. (2020). Row planting of teff lead to 38.20 to 90.67 per cent higher net returns than under broadcasting method (Tefay and Gebresamuel, 2016). Oumer (2017) concluded that mean technical efficiency of row planting in teff was 90.93 per cent and efficient utilization of the available resources and inputs can increase this technical efficiency by 9.07 per cent. Results of system of teff intensification revealed that, a four-fold increase in yield was obtained under transplanting (5109 and 4385 kg ha⁻¹) over broadcasting (1014 and 1181 kg ha⁻¹) in two varieties (Cross 37 and Cross 387, respectively) of teff crop (Anon, 2008). Similarly, an increase of about 17.47 and 24.33 per cent of grain and straw yields, respectively, were attained under transplanting over line sowing method (Mahantesh, 2020). Transplanting gave 34 and 75 per cent higher grain yield over line sowing and broadcasting methods, respectively (Fekremariam et al., 2020). The variation in yield levels under different planting methods is mainly because of early establishment of the seedlings coupled with greater availability of all the resources viz., space, light, nutrients and moisture that lead to enhanced physiological processes reflected in higher growth and development of the crop. Transplanting or sowing in rows gave three-to-four-fold higher grain yield coupled with reduced lodging and ease in weed management than broadcasting method (Behreet al., 2011 and Fufaet al., 2011, Alematet al., 2016).

Solid lines with closer spacing in between the rows are recommended for the teff. Row spacing of 15-30 cm and intra row spacing upto 15 cm gave higher grain yield levels than increased inter and intra-row spacing under line sowing method (Amare and Legas, 2015; Fekremariam et al., 2020). Though narrow planting enhanced the competitive ability of teff grain yields were lower due to more lodging of the crop while, lower yield under wider spacing was mainly due to lesser plant population. Hence, 20 cm inter row spacing is optimum to attain maximum grain yield levels (Ali et al., 2011; Tamirat, 2019; Wubante et al., 2017; Biya, 2020). However, studies showed that spacing had least significant effect on biological yield (Fikere Mariam et al., 2014). Significantly higher grain yield was obtained by transplanting the teff seedlings at 15 cm between the rows. Shorter crop duration (early panicle emergence and physiological maturity) under narrow spacing was because of severe intra-specific competition between the neighboring plants for the available resources (Bekalu and Tenaw, 2015). Jebesa and Abraham (2016) noted that higher grain yield and net returns can be achieved even with inter-row spacing of 10 cm provided with higher fertilizer supply. However, some improved varieties of teff showed wider elasticity to yield optimally over a range of plant densities (Daniel et al., 2016).

Depth of planting matters much in teff cultivation due to tiny size of the seeds. Debelo (1992) observed that 5 mm depth was optimum and recorded significantly highest per cent germination (about 79-86 % on 4th day after sowing) in both Dabbi and DZ-01-354 cultivars of teff. Seed placement should not exceed 1/4 inch in depth (Miller, 2007). Seeds placed at lesser depth/near surface were subjected to desiccation of seeds exposed to sunlight. At higher depths of sowing delayed the germination hindering the plant emergence, this is due to insufficient energy in the smaller seeds to emerge vigorously through the soil surface. Similarly, the plant height at 14 DAS was maximum (9.5-9.6 cm), when seeds placed at a depth between 5-10 mm than placed at greater depths.

NUTRIENT MANAGEMENT

Teff respond well to applied fertilizers. Increased application of nutrients higher grain yield levels (Temesegen Kebede, 2012; Mahantesh, 2020). Application of 150 kg NPS (63:25:10.5) + 34.5 kg N ha⁻¹ recorded significantly higher grain yield (1946.3 kg ha⁻¹), which was on par with supply of 150 kg NPKSB (64:18:18:7.1:0.75) + 43.24kg N ha⁻¹ (1542.5 kg ha⁻¹) which indicates that teff is a nitro positive crop and responds much to increased nitrogen levels than supply of multinutrients and was economically feasible with B:C ratio of 12.4 (Habte and Boke, 2017). Jebesa and Abraham (2016)

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noted that supply of 80:80 kg N:P₂O₅ ha⁻¹ recorded significantly higher number of effective tillers, grain yield and harvest index than lower rates. The lower yield level with supply of multinutrients is mainly because of increased concentration of one element had antagonistically affected the availability of another nutrient ultimately reflecting lower physiological activity associated with the deficient element. Tamirat (2019) also noted that increased supply of sole nitrogen recorded higher grain and biomass yield. Application of zinc at 8 kg Zn ha⁻¹ found to enhance grain and straw yields to the tune of 14 and 15 per cent on *Vertisols* (Haileselassie *et al.*, 2011). However, Ayalew and Habte (2017) noted that balanced nutrient supply (64 kg N + 30 kg P + 25 kg K + 13 kg S + 2.4 kg Zn + 1 kg B ha⁻¹) recorded 20.92 and 35.90 per cent higher grain yield (1502 kg ha⁻¹) and net returns (20958.7 Birr ha⁻¹) over supply of only recommended dose of N and P (64 kg N + 30 Kg P ha⁻¹). These were supported by the findings of (Asefa *et al.*, 2014).

Weeredeet *et al.* (2018) found that 67 per cent recommended N and P in inorganic fertilizer and 33 per cent recommended N in organic fertilizer was optimum proportion and recorded significantly higher plant height (68 cm), grain yield (900 kg ha⁻¹) gross returns (US \$ 650 ha⁻¹) and net returns (US \$ 540 ha⁻¹) than other proportions of organic and inorganic fertilizers. This is mainly because of supply of organic and inorganic fertilizers in appropriate proportions ensures availability of all the essential nutrients coupled with improved soil properties sustains soil productivity in turn stabilizing yield levels.

Regardless of the fertilizer type, the time, rate and method of fertilizer application greatly determines plant growth and development. Though, fertilizers are applied at the time of sowing in cereals recent studies showed that split application of fertilizers gave significant results. Nitrogen applied prior to onset of stem elongation stimulated enhanced leaf area in turn resulting in higher photosynthetic and assimilation rates (Kebedew *et al.*, 2013). Band application of fertilizers (placing along the teff rows) gave 78.54 per cent higher grain yield besides saving loss of fertilizer and helps in controlling weed growth than simply broadcasting throughout the field (Tsfay and Gebresamuel, 2016).

LODGING IN TEFF

Lodging is the bending over or displacement of the stem and roots of grain crops from their proper and vertical placement (Seema *et al.*, 2018). It causes difficulty in harvesting and results in reduced grain yield. The causes for lodging of plants are legion viz., seed type, stem nature, over population, sowing date, disease, soil density, high nitrogen levels, storm damage, etc., which weakens the supportive system of the plant to upright (Rawson and Macpherson, 2000). Lodging is referred as ‘an abundance disease’ that is restricting the exploitation of yield promoting factor in major and nutri-cereals. Lodging is of much significance in cultivation of teff crop, because of its very thin nature of the stem that is incapable of supporting higher shoot biomass above the ground. Lodging in teff ranges between 20-100 per cent (Assefa *et al.*, 2013) and on an average 11-12 per cent yield loss in teff is attributed to lodging (Vandelden *et al.*, 2010). Lodging increased with increased application of fertilizers to the tune of 20 to 90 per cent (Assefa *et al.*, 2016 and Mahantesh, 2020). Among the supplied fertilizers, nitrogen has profound influence on lodging as it stimulated the higher shoot biomass and making stem more succulent that is incapable of supporting the greater biomass (Habtegebrail and Singh, 2006, Tamirat, 2019). However, lodging was less under row planting than broadcasting method and under wider spacing than narrow planting (Tamirat, 2019).

IRRIGATION MANAGEMENT

Teff can grow well under extreme moisture regimes of both drought and waterlogged conditions (Teklu and Tefera 2005; Roseberg *et al.*, 2006; Mintenet *et al.*, 2013). The crop coefficient (K_c) values for teff at initial, vegetative, mid and late stages are 0.8-1.0, 0.95-1.0, 0.95-1.1 and 0.4-0.5, respectively (Araya *et al.*, 2010). Deficit of moisture by 75 per cent (supplying only 25 % of FC) throughout the crop growth period recorded significantly lowest grain yield (0.66 t ha⁻¹) with relative yield reduction of about 80.0 per cent than supplying optimum water (Yihun *et al.*, 2013). However, among the different crop stages, 75 per cent deficit in water supply during mid stage recorded 30 per cent reduction in grain yield with lowest crop water productivity (0.73 kg m⁻³). Severe stress (supply of 25 % of field capacity) at grain filling stage caused 69.89, 93.90 and 96.79 per cent reduction in CO₂ assimilation rate, transpiration rate and stomatal conductance coupled with higher leaf rolling index (80 %) over severe stress (supply of 25 % of field capacity) at establishment stage (Mengistu, 2009). Hence, teff is much sensitive to water stress during mid stage and any stress during this stage causes drastic yield reduction. Reducing 50 % of the irrigation water caused 36 and 69 % decreased biomass and grain yield (Hilemical and Alamirew, 2017). However significantly highest water productivity (2.0 kg m⁻³) and harvest index (25 %) were observed in teff when irrigated at 0.5 ET_c over 1.25 ET_c (Hilemical and Alamirew, 2017).

WEED MANAGEMENT

Weeds greatly suppress teff growth at initial stages and requires several weeding (Assefa *et al.*, 2014). Teff showed allelopathic effect on many weeds coupled with early emergence and crop biomass production making it a much competitive against weeds during later stages of the crop growth (Haftamu *et al.*, 2020). This was much observed in local landraces than

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the improved varieties. Weed control either through hand weeding as and when required or through herbicide application at tillering stage gave on par grain yield levels, yet 24.92 to 34.85 per cent higher than no weeding (Debelo,1992). Similarly, weeding once recorded 18.31, 24.33 and 37.21 per cent higher panicle length, grain yield and biomass in teff than no weeding in local variety sown after single ploughing (Dawit *et al.*, 2020). This mainly owes to the reduced inter-specific competition between the weed and the crop led to luxury availability of the resources. Herbicides recommended for other minor millets can be freely used in teff at any stage of the crop growth as it found to be tolerant to herbicide application. Application of premix of 2.5 g ai ha⁻¹florasulam+ 99 g ai ha⁻¹fluroxypyr + 15 g ai ha⁻¹pyroxsulam gave acceptable control of barnyard grass and resulted in significantly higher straw yield (7200 kg ha⁻¹) while application of either of the herbicides (*viz.*, carfentrazone, dicamba, florasulam, fluroxypyr, pyroxsulam or 2,4-D amine) gave more than 91 per cent control of broadleaved weeds when applied at four-leaf stage of teff (Norberg and Felix, 2014). However, some level of injury was observed when herbicides (2,4-D amine) applied at tillering stage (Hinds-Cook *et al.*, 2015). Herbicides for broad leaved weeds must be applied at least at 5-7 leaves stage of teff (Miller, 2008).

PESTS AND DISEASES

Teff is least vulnerable to attacked by the pests and diseases making it a low-risk crop for the marginal farmers (Fufaet *al.*, 2011 and Mintenet *al.*, 2013). However, at high humidity areas head smuts and rusts are observed (Stallknecht *et al.*, 1993).

TEFF BASED CROPPING SYSTEMS

Teff is a short duration crop hence, fit well as component crop into multiple cropping systems as intercrop with *B. Carinata*, safflower and sunflower and as relay crop in maize and sorghum (Ketema, 1991). Mixed cropping of teff + faba bean (at the proportion of 100:62.5 % seeds) recorded significantly higher teff equivalent yield (1697 kg ha⁻¹) and total land equivalent ratio(LER=1.32) than sole cropping of teff and faba bean separately (Aegehuet *et al.*, 2011). Mixed cropping of teff + 50 % seed rate of sunflower recorded significantly higher LER (1.39), net income (Rs. 17,588 ha⁻¹) and net benefit (Rs. 7,777 ha⁻¹) over sole cropping of teff alone (Bayuet *et al.*, 2007). This is due to increased total grain yield per unit land and high market price of sunflower.

Teff sown in maize (as relay crop) recorded higher teff yield ranging from 0.91 to 1.06 t ha⁻¹ and land equivalent ratio ranging from 1.29 to 1.45 (pooled data of two years) under different planting patterns and spacing (Worku, 2004).

HARVESTING, THRESHING, YIELD AND STORAGE

Manual harvesting with the help of sickle is the usual practice since ages and is predominately practiced till today. Because of higher feed value the crop is harvested very close to ground (TamiratWato and TilahunNegash, 2020). Threshing is done by beating the plants against hard surface or trampling by the cattle. Utmost care should be taken to avoid loss of seeds as the seeds are minute in nature and this necessitates that threshing yard should be clean and free of mud and any other smaller particles to get pure teff seeds. Grain and biomass yield ranges between 1058-4599 and 6355-19630 kg ha⁻¹ in Ethiopia (Assefa *et al.*, 2013). In India, 159 to 294 kg ha⁻¹ grain yield and 249-474 kg ha⁻¹ straw yield is achieved (Mahantesh, 2020). Storage of seeds doesn't require any special maintenance as it attracts no weevils and other storage pests, hence, reduced postharvest loss (Abel, 2005; Yihun, 2015). Care should be taken to restrict the movement of rodents. Teff seeds have longer shelf durability and can be stored upto two years without loss of viability.

TEFF IN INDIA

The Central Food and Technological Research Institute (CFTRI), Mysore introduced teff crop to India- an effort to promote it as a “super food” as well as a means of easy earnings for farmers and make it more accessible and less expensive to the consumers. Presently teff is cultivated on a few hundred hectares in Karnataka around Mysore, Sirsi (Uttar Kannada), Haveri, Gadag and Raichur districts. CFTRI, Mysore and Kadamba Foundation, Sirsi are the premier organizations for promotion and cultivation of teff in South and North Karnataka, respectively.

SCOPE FOR TEFF IN INDIA...!

- 52 % area under cultivation in India is dryland and yield levels of major crops are sub-optimal, yet teff can yield better even in such harsh conditions.
- In India, 1/3rd of children are malnourished and 72 % infants and 52 % of married woman have anemia. Teff promotion and cultivation helps in overcoming these issues as it is nutria-packed.
- Teff is an export oriented crop hence, fetches high market value than other minor millets
- A reliable and low-risk crop with least or no pest and diseases which requires minimum costs for production

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- A new opportunity crop for innovative farmers in dryland agriculture in India

Limitations in teff cultivation:

Lack of awareness, availability of quality seeds, standard agrotechniques coupled with labour scarcity and market facilities are major setback to teff cultivation. Tiny seeds coupled with lodging (thin and weak stem) causes severe losses during harvesting and threshing.

CONCLUSION

Teff (*Eragrostis tef*) is a warm season annual grass native to Ethiopia. Teff is an intriguing grain, ancient, minute in size and packed with nutrition. It requires warm climate and comes up well on sandy to medium deep black soils with fine seedbed. Line sowing with 5-10 kg seeds ha⁻¹ at shallow depth (<5mm) is better over broadcasting. Though, it comes up well throughout the year, summer crop gives pure seeds and fetches higher price. Responds well to fertilizers on areas of poor fertility, however, nitrogen should be cautiously applied to reduce extent of lodging as it is inevitable in teff. Irrigation at critical stage (mid stage) during drought periods results in maximum grain yield. Teff is much competitive than weeds because of its rapid growth and hardy nature, yet during severe weed menace few weedicides can be freely used before crop starts tillering. Few or no pests are observed in teff crop during on and off the field. Teff fits well as component crop in multiple cropping systems as intercrop/mixed and sequence crop because of its short duration and lesser competition for growth resources. Harvesting is of great concern in teff as the seeds are tiny and are much prone to losses. Manual harvesting at 85-90 DAS ensures least grain loss.

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Predicting tuber yield losses of exportable potato varieties under saline condition in Bangladesh

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ABSTRACT

Purpose

Presently in Bangladesh we producing potato in some selected areas but, southern belt is the most important areas of agricultural production. So, the potato production is facing great hindrance from salinity intrusion in crop field of southern region which may create an export market in Bangladesh with superior quality along with better yield. From these perspectives, the study was conducted to evaluate the effect of applied salt on the performance of tuber where the people want to grow potato in their field.

Key words: Yield reduction, salt application, potato.

Methods

The experiment consisted four salt application doses (N_0 = non-saline, N_1 = 5, N_2 = 15 and N_3 = 25 g NaCl pot⁻¹, respectively) and three varieties (V_1 = Granula, V_2 = Lady Rosetta and V_3 = Asterix). The pot was arranged following completely randomized design (CRD) with 3 times repetition of treatment. Data on yield was collected and analysed using WASP statistical program following AVONA techniques. The means were adjusted with least significant difference (LSD) test at 5% level of significance.

Results

Result revealed that salinity has much impact on different exportable traits of potato (data not shown). The tuber yield was also significantly influenced by salt treatment. For getting the maximum return from this study, the results demonstrated that non-saline (control) condition of pot soil is most favourable for tuber yield. Granula exhibited the highest yield (428.04 g/plant) which was statistically similar to Lady Rosetta (416.11 g/plant) under non-saline condition. Thereafter with the increasing of salinity levels the yield has been decreased and so, a yield reduction trend was found. The yield reduction was (0.21%, 1.87% and 14.21%, respectively; 11.48%, 11.73% and 20.41%, respectively; 18.14%, 19.14% and 25.66%, respectively) found in Granula, Lady Rosetta and Asterix, respectively with N_1 , N_2 and N_3 , respectively.

Conclusions

In conclusion, it may be said that potato has sensitivity to salinity for its performances. So, the salt tolerance/salt avoidance varieties should be introduced/developed in our country and the further research should be carried out with how much amount of EC of salinity can be tolerated by exportable potato varieties in field condition.

ABSTRACT

Purpose

Mungbean contributes 10-12% total pulse production in Bangladesh. This means the shortage is almost 80% of the total requirement. The balance use of organic and inorganic fertilizer increases the growth and yield of mungbean. Proper management of cowdung may reduce the need for chemical fertilizer, allowing the small farmers to reduce cost of the production. On the other hand foliar application of B at vegetative stage may important role in mungbean growth, flowering and pod filling. Considering the above facts we aim to evaluate the organic and inorganic fertilizer with boron splitting on the yield of mungbean.

Key words: Foliar application, Splitting, Boron, Fertilizer, mungbean.

Methods

The experiment consisted of three level of fertilizer viz., F₁ : Recommended dose (RD) of NPK fertilizer, F₂ : RD of Cowdung, F₃ : 1/2 RD of NPK and cowdung and Boron was applied by four levels viz., B₁ : 100% RD as basal, B₂ : 80% RD as basal +20% as foliar spray (FS) at pre flowering, B₃ : 60% RD as basal + rest 40 % as FS at pre flowering, B₄ : 40% RD as basal + 60 % as FS at pre flowering stage. The experiment was set up in a split-plot design with three replications. The mean values of all the characters were calculated and analysis of variance (ANOVA) was performed with the help of a computer package program MSTAT –C and the mean differences were adjusted by Least Significance Difference (LSD) test at 5% level of probability.

Results

Different fertilizer management and Boron application showed significant effect on seed yield (kg ha⁻¹) of mungbean. From the experiment result exhibited that the maximum seed yield (1177.80 kg ha⁻¹) was observed from F₁ treatment whereas minimum seed yield (861.70 kg ha⁻¹) was observed from F₂ treatment. In case of Boron, the seed yield (1125.60 kg ha⁻¹) was observed from B₃ which was statistically similar (1103.30 kg ha⁻¹) with B₄ treatment. On the other hand result showed that the maximum seed yield (1356.70 kg ha⁻¹) was observed from F₁B₃ treatment which was statistically similar (1310.00 kg ha⁻¹) with F₁B₄ treatment combination whereas minimum seed yield weight (756.70 kg ha⁻¹) was observed from F₂B₁ treatment combination.

Conclusions

Foliar application of boron combines with chemical fertilizer gave the best performance. It can be concluded from the discussion that the effect of organic and inorganic fertilizer and boron levels had greatly influenced the yield of mungbean.

Modified single cross for developing high yielding field corn hybrids

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Introduction

Hybrid development program of maize involves identification of outstanding cross combination having high heterotic effect. Among the hybrid development techniques, modified single cross (MSC) method is a special technique where a single cross(SC) between closely related lines is used as female parent instead of a inbred line to develop MSC hybrid in maize (Lee et al., 2006). The main usefulness of this hybrid is the benefits from seed production. Cost of hybrid seed production from single cross is high and risky. Because, in single cross hybrid only two inbred lines are involved. The female parent here is a inbred line and yield ability of inbred line is always lower. On the other hand, female parent of modified single cross is a single cross and seed production ability from this type of single cross female parent is higher than inbred line. Moreover, adaptability of modified single cross hybrid is much higher than single cross hybrid. Therefore, the experiment was conducted for developing high yielding good quality field corn hybrids. costs.

Materials and Methods

Twenty-two locally developed modified single cross hybrids of field corn and one check BHM 9 were evaluated at Bangladesh Agricultural Research Institute field, Gazipur during rabi 2014-15. Seeds were sown on 10 November, 2014. The experimental design was Randomized complete block design with three replications. Spacing was 60 x 20 cm between rows and hills, respectively. After seedling emergence one healthy plant per hill was kept. Fertilizers were applied @ 250, 55, 110, 40, 5 and 1.5 kg/ha of N, P, K, S, Zn and B respectively. All intercultural operations were done according to the necessity. Data on yield, days to tasseling and silking were recorded on whole plot basis. For convenience, plot yield was converted to ton/ha. Data on plant and ear height (cm), ear length (cm), ear diameter (cm), kernel/ear and 1000-seed weight (g) were recorded from ten plants randomly. After harvesting, shelling and drying data was recorded for yield and 1000 seed weight and was subjected to analyze. Analysis was performed through PBtools software.

Results and Discussion

Mean performance of all the crosses along with checks are presented in the Table 1. Only four characters; plant height, ear length, ear diameter and yield showed significant variations among the entries where maximum variation was observed in number of cob per row. The cross MSC-1 was found as significant short statured (161 cm) but was lower yielder, where plant height ranged from 161 to 200 cm. Ear diameter ranged from 53 to 82 cm. The cross MSC-7 exhibited highest ear diameter and the check variety has the lowest following MSC-22 (69 cm). All most all the entries showed significantly higher ear diameter over the check. None of the yield contributing traits such as; number of kernel/ear and 1000 seed weight showed significant variations. Though kernel per ear and 1000 seed weight were not significant but seven crosses demonstrated higher number kernel per row and all the crosses resulted higher 1000 seed weight than the check. Yield showed significant variations among the entries, which was ranged from 2.26 to 10.29 t/ha. None of the entries showed significantly higher yield over the check. Among the crosses, the highest (10.29 t/ha) yielder entry was MSC-3 followed by MSC-13 (9.84 t/ha) which was also a dwarf type genotype (table 1). Considering the yield advantage over the check MSC-2 (5%), MSC-3(13%), MSC-6 (2%), and MSC-13 (8%), were found promising (Fig.1).

Conclusion

From the overall performance the hybrid MSC-3 and MSC-13 were found promising for grain yield as well as medium tall lines.

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Table 1. Performance of modified single cross field corn hybrids evaluated at Gazipur, Bangladesh during rabi 2014-2015

Modified single cross hybrids	DT	DP S	D S	PH (cm)	EH (cm)	NC/R	EL (cm)	ED (cm)	NK/E	TS W (g)	Y (t/ha)
MSC1	81	88	86	161	74	16	15	14	437	525	6.78
MSC2	87	90	94	183	90	22	16	15	455	500	9.57
MSC3	85	87	89	188	74	17	17	15	496	460	10.29
MSC4	88	90	95	185	94	13	15	14	458	500	6.56
MSC5	87	90	93	178	73	18	16	15	491	450	6.86
MSC6	85	89	93	191	79	17	16	16	521	510	9.29
MSC7	87	90	93	186	90	15	16	16	470	500	8.86
MSC8	89	92	95	184	89	16	16	15	500	480	7.92
MSC9	87	90	92	188	78	18	16	15	502	480	8.58
MSC10	84	87	89	198	84	16	15	15	449	525	9
MSC11	86	89	92	195	94	16	16	16	427	450	8.19
MSC12	86	88	92	190	93	17	16	15	483	480	7.37
MSC13	84	87	89	175	97	18	16	16	515	470	9.84
MSC14	87	90	93	183	86	18	16	16	506	425	8.65
MSC15	85	88	90	162	81	15	16	15	458	540	7.25
MSC16	73	76	78	191	82	15	16	15	445	490	7.75
MSC17	72	75	78	194	83	19	16	16	496	440	9.72
MSC18	73	76	79	181	83	18	17	14	448	510	8.09
MSC19	72	75	77	185	81	18	15	14	430	485	5.53
MSC20	75	78	81	184	86	8	14	15	457	490	2.26
MSC21	74	76	80	182	85	12	15	14	490	425	3.3
MSC22	73	77	79	184	90	10	15	14	471	415	3.24
BHM 9 (Check)	86	101	91	200	88	12	19	11	478	385	9.1

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Modified single cross hybrids	DT	DP S	D S	PH (cm)	EH (cm)	NC/ R	EL (cm)	ED (cm)	NK/E	TS W (g)	Y (t/ha)
Grand Mean	82	85	87	185	85	16	16	15	473	475	8
Range	17	27	18	39	24	14	4	6	94	155	9
Sd	8.8	9.4 9	8. 9	13.1 4	8.11	3.96	1.00	1.62	46.4	47.4	2.47
F-test				*			**	**			**
LSD _(0.05)	14.4	14. 28	13 .8	18.7 3	15.36	7.38	1.45	1.54	79.6	81.1 5	2.60

*, ** indicate significant at 5% and 1% respectively; DT= Days to 50% Tasseling, DPS= Days to Pollen Shedding, DS= Days to 50% Silking, PH=Plant Height, EH= Ear Height, EL= Ear Length, ED= Ear Diameter, NC/R= Number of Cob per Row, NK/E=Kernel Number per Ear, TSW= Thousand Seed Weight, Y= Yield

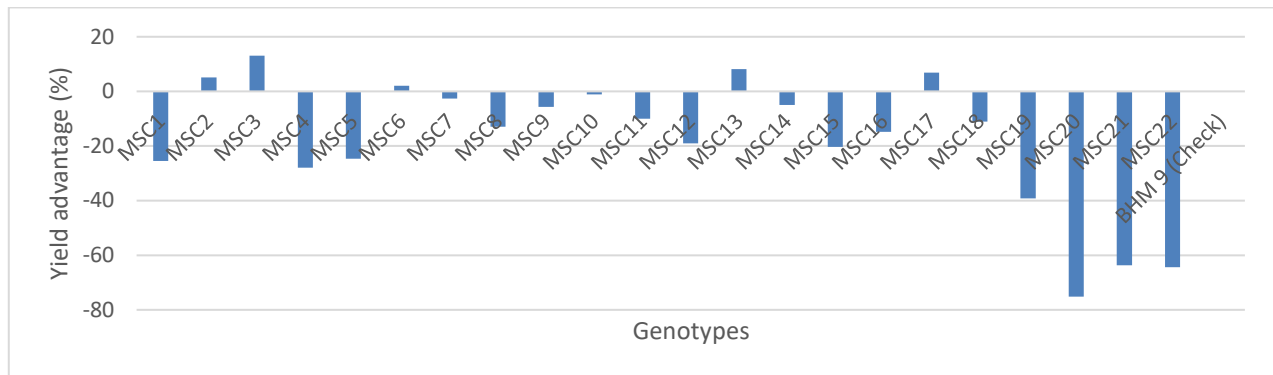


Fig.

1. Yield advantage than check(%)

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Role of Self-Help Groups (SHGs) for all round development of farm women

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Women are an integral part of society. All-round development and harmonious growth of a nation would be possible only when women are given their desired place and position in the society and are treated as equal partners of progress with men. However, in most of the regions, women have a low social and economic status. In such areas, effective empowerment of women is essential to harness the women in the main stream of economic development.

The role of women and the need to empower them are central to human development programmes, including poverty alleviation programmes. In spite of safeguards provided in many of the poverty alleviation programmes, it has been observed that women in rural areas, especially from poor families, are not benefited.

Women are a vital parts of the Indian economy, constituting one-third of the national labor force. In Agriculture and allied sector too, women play a major role. Emancipation of farm women is a pre-requisite for nation's economic development and social upliftment..

"Empowerment of women" is the central issue that has been pervading the development debate after the 80s. Women empowerment is always considered as the key aspect of social development throughout the world. In India more attractive schemes have been introduced, to eradicate women unemployment, one of which with less effort is **Self Help Group (SHG)**. Self Help Group is one of the most important approaches for socio-economic transformation of rural women in India.

SHG is a group of rural poor females who have volunteered to organize themselves into a group for eradication of poverty of the members. They agree to save regularly and convert their savings into a Common Fund known as the Group corpus. The members of the group agree to use this common fund as a group through a common management. The members of an SHG face similar problems. They **help** each other, to solve their problems. SHGs promote small savings among their members. The savings are kept with the bank. The SHG collects the minimum voluntary saving amount from all the members. The group devises a code of conduct to bind itself. This is in the form of regular meetings (weekly or fortnightly), functioning in a democratic manner, allowing free exchange of views, participation by the members in the decision making process. The SHG corpus fund is used to give advance to the members in the form of loans. The group develops the financial management norms covering the loan sanction procedure, repayment schedule and interest rates.

The **Self Help Group** (SHG) is a viable organized setup to disburse micro credit to the rural women for the purpose of making them enterprising and encouraging them to enter into entrepreneurial activities. The formation of SHG is not solely a micro-credit project but it aims to empower women.

SHG addresses various dimensions of empowerment – political, material, cognitive, perceptual and relational

The origin of **self-help group** can be traced from Grameen bank of Bangladesh, which was **founded** by Mohamed Yunus. SGHs were **started** and formed in 1975. In India NABARD **initiated** in 1986-1987. The absence of institutional credits available in the rural area has led to the establishment of SHGs. Formation and functioning of SHGs is based upon the concept of group approach to decision making and programme implementation. Most of the successful functioning organisations be it at micro level (a single firm) or at macro level (parliament, as for instance) reinforce the significance of group approach to problem solving.. Access to credit can help in expansion of material base of women by enabling them to start and expand small businesses, often accompanied by market access.

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Many governmental and non-governmental organizations have been trying to organize women into groups integrate them into the development process by actively involving them in Group Farming, transfer of technology, production and marketing, agriculture and allied sector development, natural resource management, etc.

The women members feel empowered as a result of the following characteristics of self-help groups.

REGULAR ATTENDANCE INCREASES SELF-EFFICACY

Self-efficacy is the belief that people have in their own ability to achieve goals. The higher this level is, the more confident a person is that he or she will be able to succeed at something

PROVIDES PARTICIPANTS WITH SOCIAL CONTACT

Spending time in a room with people who are going through similar issues helps participants to feel as though they are not alone. They can also see that others understand exactly what they’re going through. This is a much healthier form of social contact.

DECREASES THE ODDS OF A RELAPSE

Attending group meetings, getting support from other members, and seeing for themselves that a sober lifestyle can be achieved over a long-term in spite of life stresses is inspiring to members. They know exactly what it feels like to commit to the lifestyle change involved in getting help and keep following through even when life throws a curve ball at them.

OPEN TO EVERYONE

No special preparation or knowledge is required to attend a self-help group. They welcome anyone who is suffering and is in need of help. It doesn’t matter if a participant in the group has had a setback or relapse. Group members can come back and start again.

SELF – HELP GROUPS IN INDIAN MOVEMENT

India has adopted the Bangladesh’s model in a modified form. To alleviate the poverty and to empower the women, the micro-finance has emerged as a powerful instrument in the new economy. With availability of micro-finance, self-help groups (SHGs) and credit management groups have also started in India. And thus the movement of SHG has spread out in India.

Impact of Self-Help Groups on Women Empowerment

1) Micro- Financing benefit for rural poor households

Self-help has aimed at enhancing profitability for rural people. The low economic growth of this country was perceived to be due to lack of capital resources, especially in rural areas. A vicious cycle of low capital, low productivity, low incomes, low savings and weak capital base was perceived to be operating perpetuating a permanent poverty syndrome. Therefore, cheap rural credit policies like micro financing SHGs were designed to provide rural poor with access to adequate capital. Microfinance through SHG has become a ladder for the poor to bring them up not only economically but also socially, mentally and attitudinally and above all help them break through the stronghold of exploitative money lenders.

2) Bank – SHG linkage

In this type of linkage banks provided financial support to SHGs which had grown almost spontaneously without any intervention of any SHPI. The SHGs were initially on the basis of a common activity, Problem and took up

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thrift and credit activities. The case of such linkages is not very common. In this model, the SHPI have taken the role of a financial intermediary between the banks and a number of SHGs.

3) Economic empowerment

According to the report by National Commission for Women (NCW) - (Status of women 2011), in India, women work for longer hours than men do. The proportion of unpaid activities to the total activities is 51% for females as compared to only 33% for males. Over and above this unpaid work, they have the responsibilities of caring for household which involves cooking, cleaning, fetching water and fuel, collecting fodder for the cattle, protecting the environment and providing voluntary assistance to vulnerable and disadvantaged individuals in the family. This shows that though there is still a long journey ahead towards women empowerment. Women's can save small amount of money regularly and mutually agree to contribute a common fund.

4) Social empowerment

The social empowerment means that the woman should get an important place in her family and society, and should have a right to enable her to make use of available resources. It has resulted in developing self-confidence, self-esteem and self-respect also.. As the woman has now increased presence in banks, Gram Panchayats, various Government committees etc., her social status is seen somewhat elevated. The social impact of the SHG program increased involvement in Decision-making, awareness about various programs and organizations, increased access to such organizations, increased expenditure on Health and Marriage events, there is a Change in the attitude of male members of the families, now they are convinced about the concept of SHG and encourage women to participate in the meetings and women reported that they have savings in their name and it gives them confidence and increased self-respect.

5) Saving and Financial Decision Making

One of the primary benefits of participation in a SHG is the opportunity to save regularly, access formal savings institutions and participate in the management of these savings. They save regularly, have their own bank accounts and make deposits into these accounts. SHG is having a good impact on members, in their ability to save their hard earned money.

6) Access to credit

SHGs results into an improvement in woman's access to credit. The financial mobility due to participation in the SHG leads to an improvement in the quality of life, according to some of the successful groups. Overall, many families were able to address their basic needs better than before. Some of NGOs reports have shown that the record on the repayment of loans by women was often better than that of men, and that women were also more likely to spend the income earned, on their families, leading to improved health and nutrition of the poor population and for improving the quality of their lives.

7) Employment

The implementation of SHG has generated Self-employment opportunities for the rural poor. This has been shown by many SHGs formed by JEEVIKA in Bihar.

In a case study on impact of SHG on women empowerment in Patna district ,Kumar Amresh (2018) concluded that 25 per cent of the respondents) had no occupation in the pre-SHG stage whereas cent per cent is occupied at the post-SHG stage. The occupation chosen by the SHG members depends on the availability of skill and resources. He also observed that the income of the members of the SHG had increased substantially

Further, Kumar Amresh revealed that SHGs have the power to create a socio-economic revolution in the rural areas of our country. SHGs have not only produced tangible assets and improved living conditions of the

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members, but also helped in changing much of their social outlook and attitudes. In the study area SHGs have served the cause of women empowerment, social solidarity and socio-economic betterment of the poor.

According to Bihar State Women Development Corporation (BSWDC) managing director N Vijaya Lakshmi “Bihar has the potential to get about a million self-help groups (SHGs) engaged in real productive activities in the next few years” as reported in newspaper TNN Times of India on 18-07-2009. The objective can be achieved by maintaining a synergy between state-level working group and action plan,” she added. According to her, three agencies Rural development department, JEEVIKA Project and Women Development Corporation (WDC) are engaged in SHG formation in Bihar under their separate book keeping method, processes and action plan. Lakshmi said the new approach would require one process, similar bookkeeping method and a common action plan so that the SHGs of the three agencies are able to work together in tandem with banks, which give loans to the SHGs to make their activities a massive social movement.

CONCLUSION:

SHG is an important approach focusing the empowerment of individual woman as well as of the groups themselves for becoming self-reliant not only by farming but by opting some economic activities in allied sectors also. But, to be more effective, the groups need some technological support.

SHGs of all types have an important role in development. They provide space for participation, which contributes to group member's ownership of the issue at hand as well as any solutions. This in turn builds group cohesiveness, solidarity and promotes mutual support. They can be the platform for building a sense of community a social support system, increasing self-confidence, learning together and providing a sense of equality.

SHGs will however become sustainable, only if they have backward linkages with technology, credit and forward linkages with processing and marketing organization. Steps will have to be taken to convert micro-finance into livelihood finance through appropriate support system.

There is also need for establishing SHG Capacity Building and Mentoring Centers. Further, scaling up of bank linkages and increased SHG activities would require a large force of trainers. Besides, there has to be common training approach, common book keeping approach, and common rating system. It will be useful to promote SHGs at the production end of the farming enterprise involving men. This will be particularly helpful in the case of integrated pest management, integrated nutrient supply, scientific water management and improved post-harvest technology, marketing etc.

Mop Fan in controlled environment greenhouse

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ABSTRACT

A greenhouse is essentially an enclosed structure, which traps the short wavelength solar radiation and stores the long wavelength thermal radiation to create a favourable microclimate for higher productivity. The sun's radiation incident on the greenhouse has two parts: direct radiation and an associated diffuse sky radiation. The diffuse part is not focused by the lenses and goes right through Fresnel lenses onto the surface of the absorbers. This energy is absorbed and transformed into heat, which is then transported via the liquid medium in copper pipes to the water (heat) storage tanks or, if used, open fish tanks. In this way, an optimal temperature for both plant cultivation and fish production can be maintained. Stable plant growth conditions are light, temperature and air humidity. Light for the photosynthesis of plants comes from the diffuse radiation, which is without substantial fluctuations and variation throughout most of the day. The air temperature inside the greenhouse is one of the factors that have an influence on the precocity of production. The selective collector acts in a more perceptible way on extreme air temperatures inside the greenhouse. Hence, the system makes it possible to avoid the excessive deviation of the temperature inside the greenhouse and provides a favourable microclimate for the precocity of the culture. Sediment and some associated water from the sediment traps are used as organic fertiliser for the plant cultivation. The present trend in greenhouse cultivation is to extend the crop production season in order to maximise use of the equipment

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and increase annual productivity and profitability. However, in many Mediterranean greenhouses, such practices are limited because the improper cooling methods (mainly natural or forced ventilation) used do not provide the desired micro-climatic condition during the summer of a composite climate. Also, some of these greenhouses have been built where the meteorological conditions require some heating during the winter, particularly at night. The worst scenario is during the winter months when relatively large difference in temperature between day and night occurs. However, overheating of the greenhouse during the day is common, even in winter, requiring ventilation of the structure. Hence, several techniques have been proposed for the storage of the solar energy received by the greenhouse during the day and its use to heat the structure at night. Reviews of such techniques are presented in this chapter. Air or water can be used for heat transport. The circulating water is heated during the day via two processes. The water absorbs part of the infrared radiation of the solar spectrum. Since the water is transparent in the visible region, they do not compete with the plants that need it. Alternatively, the water exchanges heat with the greenhouse air through the walls. At night, if the greenhouse temperature goes down below a specified value, the water begins to circulate acting as heat transfer surfaces heating the air in the greenhouse. This chapter describes various designs of low energy greenhouses. It also, outlines the effect of dense urban building nature on energy consumption, and its contribution to climate change. Measures, which would help to save energy in greenhouses, are also presented. It also enabled the minimisation of temperature variation and, hence avoided the hazard of any sudden climatic change inside the greenhouse.

Keywords: Greenhouse environment; energy efficient comfort; ventilation; humidity; sustainable environmental impact.

1. Introduction

Globally, buildings are responsible for approximately 40% of the total world annual energy consumption [1]. Most of this energy is for the provision of lighting, heating, cooling, and air conditioning. Increasing awareness of the environmental impact of CO₂ and NO_x emissions and CFCs triggered a renewed interest in environmentally friendly cooling, and heating technologies. Under the 1997 Montreal Protocol, governments agreed to phase out chemicals used as refrigerants that have the potential to destroy stratospheric ozone. It was therefore considered desirable to reduce energy consumption and decrease the rate of depletion of world energy reserves and pollution of the environment.

One way of reducing building energy consumption is to design building, which is more economical in their use of energy for heating, lighting, cooling, ventilation and hot water supply. Passive measures, particularly natural or hybrid ventilation rather than air-conditioning, can dramatically reduce primary energy consumption [2]. However, exploitation of renewable energy in buildings and agricultural greenhouses can, also, significantly contribute towards reducing dependency on fossil fuels. Therefore, promoting innovative renewable applications and reinforcing the renewable energy market will contribute to preservation of the ecosystem by reducing emissions at local and global levels. This will also contribute to the amelioration of environmental conditions by replacing conventional fuels with renewable energies that produce no air pollution or greenhouse gases.

The provision of good indoor environmental quality while achieving energy and cost efficient operation of the heating, ventilating and air-conditioning (HVAC) plants in buildings represents a multi variant problem. The comfort of building occupants is dependent on many environmental parameters including air speed, temperature, relative humidity and quality in addition to lighting and noise. The overall objective is to provide a high level of building performance (BP), which can be defined as indoor environmental quality (IEQ), energy efficiency (EE) and cost efficiency (CE).

- Indoor environmental quality is the perceived condition of comfort that building occupants experience due to the physical and psychological conditions to which they are exposed by their surroundings. The main physical parameters affecting IEQ are air speed, temperature, relative humidity and quality.
- Energy efficiency is related to the provision of the desired environmental conditions while consuming the minimal quantity of energy.
- Cost efficiency is the financial expenditure on energy relative to the level of environmental comfort and productivity that the building occupants attained. The overall cost efficiency can be improved by improving the indoor environmental quality and the energy efficiency of a building.

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An approach is needed to integrate renewable energies in a way to meet high building performance. However, because renewable energy sources are stochastic and geographically diffuse, their ability to match demand is determined by adoption of one of the following two approaches [2]: the utilisation of a capture area greater than that occupied by the community to be supplied, or the reduction of the community’s energy demands to a level commensurate with the locally available renewable resources.

For a northern European climate, which is characterised by an average annual solar irradiance of 150 Wm^{-2} , the mean power production from a photovoltaic component of 13% conversion efficiency is approximately 20 Wm^{-2} . For an average wind speed of 5 ms^{-1} , the power produced by a micro wind turbine will be of a similar order of magnitude, though with a different profile shape. In the UK, for example, a typical office building will have a demand in the order of $300 \text{ kWhm}^{-2}\text{yr}^{-1}$. This translates into approximately 50 Wm^{-2} of façade, which is twice as much as the available renewable energies [3]. Thus, the aim is to utilise energy efficiency measures in order to reduce the overall energy consumption and adjust the demand profiles to be met by renewable energies. For instance, this approach can be applied to greenhouses, which use solar energy to provide indoor environmental quality. The greenhouse effect is one result of the differing properties of heat radiation when it is generated at different temperatures. Objects inside the greenhouse, or any other building, such as plants, re-radiate the heat or absorb it. Because the objects inside the greenhouse are at a lower temperature than the sun, the re-radiated heat is of longer wavelengths, and cannot penetrate the glass. This re-radiated heat is trapped and causes the temperature inside the greenhouse to rise. Note that the atmosphere surrounding the earth, also, behaves as a large greenhouse around the world. Changes to the gases in the atmosphere, such as increased carbon dioxide content from the burning of fossil fuels, can act like a layer of glass and reduce the quantity of heat that the planet earth would otherwise radiate back into space. This particular greenhouse effect, therefore, contributes to global warming. The application of greenhouses for plants growth can be considered one of the measures in the success of solving this problem. Maximising the efficiency gained from a greenhouse can be achieved using various approaches, employing different techniques that could be applied at the design, construction and operational stages. The development of greenhouses could be a solution to farming industry and food security.

The move towards a de-carbonised world, driven partly by climate science and partly by the business opportunities it offers, will need the promotion of environmentally friendly alternatives, if an acceptable stabilisation level of atmospheric carbon dioxide is to be achieved. This requires the harnessing and use of natural resources that produce no air pollution or greenhouse gases and provides comfortable coexistence of human, livestock, and plants. This study reviews the energy-using technologies based on natural resources, which are available to and applicable in the farming industry. Integral concept for buildings with both excellent indoor environment control and sustainable environmental impact are reported in the present communication. Techniques considered are hybrid (controlled natural and mechanical) ventilation including night ventilation, thermo-active building mass systems with free cooling in a cooling tower, and air intake via ground heat exchangers. Special emphasis is put on ventilation concepts utilising ambient energy from air ground and other renewable energy sources, and on the interaction with heating and cooling. It has been observed that for both residential and office buildings, the electricity demand of ventilation systems is related to the overall demand of the building and the potential of photovoltaic systems and advanced co-generation units. The focus of the world’s attention on environmental issues in recent years has stimulated response in many countries, which have led to a closer examination of energy conservation strategies for conventional fossil fuels. One way of reducing building energy consumption is to design buildings, which are more economical in their use of energy for heating, lighting, cooling, ventilation and hot water supply. Passive measures, particularly natural or hybrid ventilation rather than air-conditioning, can dramatically reduce primary energy consumption. However, exploitation of renewable energy in buildings and agricultural greenhouses can, also, significantly contribute towards reducing dependency on fossil fuels.

The main advantages of solar greenhouse are summarised as follows:

- In the climatic conditions of Europe, the collector system equipped with linear raster lenses is able to absorb, on average, 12% of the total incoming global solar energy on the collector and convert this energy into heat at a

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temperature of between 30 to 50°C. The system, therefore, consumes approximately 50% less energy for heating purposes than would a traditional normal greenhouse.

- The system provides suitable, perhaps ideal, conditions for the cultivation of high quality vegetables, and even during periods of maximum solar energy absorption on the collectors, there still remains sufficient light for good vegetable growth under the area of the collectors.
- Due to the almost continuous high humidity levels and to the applied nutrient solution being rich in organic matter and microorganisms, organic matter is hardly mineralising in the soil, hence, does not degrade in patches. On the contrary, organic matter content in the soil increased during cultivation.
- In comparison with a traditional greenhouse, the system does not overheat inside. Therefore, less ventilation is necessary, which brings the benefits of smaller losses of water. Furthermore, the system saves energy, allows the efficient recycling of water and nutrients, and provides suitable growth conditions with a smaller range of extreme humidity, temperature and light allowing the cultivated plants to face less stress and have a higher quality.
- Due to the relatively low temperature in the greenhouse, additional heating might be required. Therefore, vegetables will adapt to low radiation levels, and low temperatures and, consequently, quality is preserved even during failure of control system.

This study describes various designs of low energy buildings. It also, outline the effect of dense urban building nature on energy consumption, the problems related to inadequate ventilation in buildings, and its contribution to climate change. Measures, which would help to save energy in buildings, are also presented.

2. Air Pollutants and Transmutation

Controlling the pollution of the present civilisation is an increasing concern. More importance is given to control global carbon dioxide, which is considered to be the main factor of green house effect. Though the complete experimental result on the fact is yet to be debated, the immense heat, temperature and turbulence of nuclear explosion oxidising the atmospheric nitrogen into nitric oxide, are considered to be similarly responsible for depletion of ozone layer [4]. At present, more importance is given for plantation to reduce the level of global carbon dioxide. The plantation over the whole earth surface may control only 50% of carbon dioxide disposed to atmosphere and its greenhouse effect. There are, also, explosions in the ozone layer time to time to add to the problem. Irrespective of the relative importance of each factor, the ozone layer protects us from harmful cosmic radiations and it is believed that the depletion of ozone layer increases the threat of outer radiations to human habitation if environmental pollution is not controlled or there is no possibility of self-sustainable stability in nature [5].

The presence of ionosphere in the outer-sphere is most probably for ionic dissociation of the gases of the outer-sphere in the presence of low pressure and cosmic radiation [6]. Moreover the ionosphere contains charged helium ions (alpha particle). Therefore, it may be concluded that the explosion in the ozone and transmission of radiations through it are the possible effects of transmutation of pollutants with exothermic reaction (emission of radiations) [7]. The existence of a black hole in the space, which is found in the photo camera of astrologist, is still unexplored. This black hole may be an effect of transmutation process with absorption of heat energy (endothermic reaction). The idea of transmutation of pollutants has been proposed for one or more of the following reasons:

- The experimental results support the transmutation of materials.
- To search the sinks of the remaining carbon dioxide not absorbed by plants or seawater.
- To find out the possible causes of explosion in the ozone layer other than the depletion of ozone layer.
- To investigate the possibilities of the self-sustaining stability of global environment.

To prove the portable of transmutation of pollutants, experimental investigations may be conducted to bombard C or CO₂ or CH₄ or other air pollutants by accelerated alpha particles in a low-pressure vacuum tube in a similar condition of ionosphere. Heating them with gamma radiation can accelerate the alpha particles. The results of such experimental investigation may prove the probable transmutation of pollutants and self-sustaining equilibrium of the global environment.

3. Greenhouses

Population growth and less availability of food material have become global concerns. The world population increases exponentially whereas food production has increased only arithmetically, meaning that the availability of food per capita has decreased. This is more pronounced in the cases of oils, vegetables, fruits and milk, whereas it is marginal, rather than minimum, in cereals. The increase in population has also resulted in the use of more urban areas for habitation, less land available for cultivation and, hence, more food requirements. The resultant need is, therefore, to increase productivity and year round cultivation. To maximise production and meet the global demand on food, vegetables, flowers and horticultural crops, it is necessary to increase the effective production span of crops. The sun is the source of energy for plants and animals. This energy is converted into food (i.e., carbohydrates) by plants through a process called photosynthesis. This process is accomplished at suitable atmospheric conditions. These conditions are provided by nature in different seasons and artificially by a greenhouse. The primary objective of greenhouses is to produce agricultural products outside the cultivation season. They offer a suitable microclimate for plants and make possible growth and fruiting, where it is not possible in open fields. This is why a greenhouse is also known as a “controlled environment greenhouse”. Through a controlled environment, greenhouse production is advanced and can be continued for longer duration, and finally, production is increased [8]. The off-season production of flowers and vegetables is the unique feature of the controlled environment greenhouse. Hence, greenhouse technology has evolved to create the favourable environment, or maintaining the climate, in order to cultivate the desirable crop the year round. The use of “maintaining the climate” concept may be extended for crop drying, distillation, biogas plant heating and space conditioning. The use of greenhouses is widespread. During the last 10 years, the amount of greenhouses has increased considerably to cover up to several hundred hectares at present. Most of the production is commercialised locally or exported. In India, about 300 ha of land are under greenhouse cultivation. On the higher side, however, it is 98600 ha in Netherlands, 48000 ha in China and 40000 ha in Japan [9]. This shows that there is a large scope to extend greenhouse technology for various climates.

However, the effective utilisation of greenhouses has to deal with some specific climate problems like frost, during winter and overheating in summer days. These problems show the necessity of having a tool capable of predicting the thermal behaviour of a greenhouse under specific exterior conditions. Also, greenhouse industry has to deal with some problems related to a poor design of a great number of greenhouses. Such problems are mostly related to, on the one hand, its incapacity to deal with the problem of frost, which in the cold clear sky days of winter can destroy the whole work of a season, and, on the other hand, the question of overheating in the summer days.

4. Greenhouse Environment

The comfort in a greenhouse depends on many environmental parameters. These include temperature, relative humidity, air quality and lighting. Although greenhouse and conservatory originally both meant a place to house or conserve greens (variegated hollies, cirsium, myrtles and oleanders), a greenhouse today implies a place in which plants are raised while conservatory usually describes a glazed room where plants may or may not play a significant role. Indeed, a greenhouse can be used for so many different purposes. It is, therefore, difficult to decide how to group the information about the plants that can be grown inside it. Whereas heat loss in winter a problem, it can be a positive advantage when greenhouse temperatures soar considerably above outside temperatures in summer. Indoor relative humidity control is one of the most effective long-term mite control measures. There are many ways in which the internal relative humidity can be controlled including the use of appropriate ventilation, the reduction of internal moisture production and maintenance of adequate internal temperatures through the use of efficient heating and insulation.

The introduction of a reflecting wall at the back of a greenhouse considerably enhances the solar radiation that reaches the ground level at any particular time of the day. The energy yield of the greenhouse with any type of reflecting wall was also significantly increased. The increase in energy efficiency was obtained by calculating the ratio between the total energy received during the day in greenhouse with a reflecting wall, compared to that in a classical greenhouse. Hence, the energy balance was significantly shifted towards conservation of classical energy for heating or lighting. The four-fold greater amount of energy that can be captured by virtue of using a reflecting

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wall with an adjustable inclination and louvers during winter attracts special attention. When sky (diffuse) radiation that was received by the ground in amounts shown in Figure 1, were taken into account, the values of the enhancement coefficients were reduced to some extent: this was due to the fact that they added up to the direct radiation from the sun in both new and classical greenhouses. However, this is a useful effect as further increases overall energy gain. There is also an ironing out effect expressed in terms of the ratios between peak and average insulations [10].

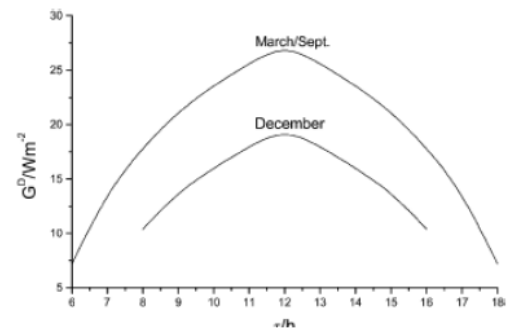
Finally, the presented theory can be used to calculate the expected effects of the reflecting wall at any particular latitude, under different weather conditions, and when the average numbers of clear days are taken into account. Thereby an assessment of the cost of a particular setup can be obtained. Under circumstances of a few clear days, it may still be worthwhile from a financial point of view to turn a classical greenhouse into one with a reflecting wall by simply covering the glass wall on the north-facing side with aluminum foil with virtually negligible expenditure.

4.1. Relative Humidity

Air humidity is measured as a percentage of water vapour in the air on a scale from 0% to 100%, where 0% being dry and 100% being full saturation level. The main environmental control factor for dust mites is relative humidity. The followings are the practical methods of controlling measures available for reducing dust mite populations:

- Chemical control.
- Cleaning and vacuuming.
- Use of electric blankets, and
- Indoor humidity.

Figure 1. Ground irradiance from diffuse (sky) radiation from a clear sky at the shortest winter day and at equinox.



5. Conclusions

Thermal comfort is an important aspect of human life. Buildings where people work require more light than buildings where people live. In buildings where people live the energy is used for maintaining both the temperature and lighting. Hence, natural ventilation is rapidly becoming a significant part in the design strategy for non-domestic buildings because of its potential to reduce the environmental impact of building operation, due to lower energy demand for cooling. A traditional, naturally ventilated building can readily provide a high ventilation rate. On the other hand, the mechanical ventilation systems are very expensive. However, a comprehensive ecological concept can be developed to achieve a reduction of electrical and heating energy consumption, optimise natural air condition and ventilation, improve the use of daylight and choose environmentally adequate building materials. Plants, like human beings, need tender loving care in the form of optimum settings of light, sunshine, nourishment, and water. Hence, the control of sunlight, air humidity and temperatures in greenhouses are the key to successful greenhouse gardening. The mop fan is a simple and novel air humidifier; which is capable of removing particulate and gaseous pollutants while providing ventilation. It is a device ideally suited to greenhouse applications, which require robustness, low cost, minimum maintenance and high efficiency. A device meeting these requirements is not yet available to the farming community. Hence, implementing mop fans aids sustainable development through using a clean, environmentally friendly device that decreases load in the greenhouse and reduces energy consumption.

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ECONOMIC CONTRIBUTION OF POPLAR FARMING TO RURAL LIVELIHOODS IN KASHMIR HIMALAYA, INDIA

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ABSTRACT

Poplar farming constitutes a major source of livelihood among rural people in Kashmir playing a vital role in economy, rural development, employment and occupation, forest-industries, growth and survival, social, economic and cultural conditions and poverty alleviation (Islam et al., 2016). The poplars resources are used by the rural communities to meet their daily livelihood needs besides satisfying their social, economic, cultural, religious, ethical, traditional, spiritual, ecological and political aspirations (Islam et al., 2012). The study investigated the tree resource production, subsistence consumption, economic contribution and socioeconomic determinants of poplar farming in Ganderbal district of Kashmir.

Methodology

Multistage random sampling technique was employed to select the 191 households from the 10 sample villages. Secondary data were collected from all possible sources and primary data were gathered through field survey administering structured interviews, non-participant observations and focus group discussions. The data were analyzed using descriptive statistics and analytical regression model.

Results

Results revealed that total production (p) and consumption (c) of poplar resources were; fuel wood (p=105.58 t/year, c=105.58 t/year), tree browse (p=74.90 t/year, c=74.90 t/year), timber (p=2730.54 m³/year, c=223.08 m³/year) and leaf litter (p=49.93 t/year, c=49.93 t/year). Poplar resources generated total income of ₹ 2207903.72/year (subsistence=₹ 1250180.18/year, cash=₹ 1880589.10/year) @ ₹ 16391.45/household/year. Timber contributed largest share (65.41%) to the total poplar income followed by fuel wood (20.23%), tree browse (14.36%) and leaf litter (0.00%). The average gross annual income was ₹111256.17/household which is differentiated as agriculture (35.68%), business (20.06%), livestock (18.24%), poplar farming (8.85%), willow farming (7.20%), service (6.94%) and wage labour (3.03%). Nonetheless, the poplar farming is the 4th major contributor of household economy. Regression analysis showed that the socioeconomic factors namely, family size, family labour, land holding, herd size, main occupation, annual income, proximity to forest and forest visits are the key determinants influencing significantly the poplar resources based income.

Conclusion

The findings suggested that the poplar farming is the key alternative for poverty alleviation, socioeconomic development and livelihood security; hence, policy must be implicated towards the livelihood diversification through sustainable production, value addition and commercialization of poplar resources.

Keywords: Poplar farming, tree resource, socioeconomic factors, livelihoods, income, Kashmir, Himalaya.

Assessing the impact and management of parthenium weed (*Parthenium hysterophorus*) and a look to the future in Bangladesh

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ABSTRACT

Purpose

A field survey study was carried out to assess the socio-economic effects of a highly invasive plant species, parthenium weed (*Parthenium hysterophorus* L.) during 2020-21 across the Jashore Hub and Greater Rajshahi regions of Bangladesh. We also investigated the performance of the chemical control of *P. hysterophorus* using four herbicides under field conditions.

Methods

Primary data were collected using semi-structured interview questions and through direct observation on the field. Butachlor (25.00 kg ha⁻¹), Bispyribac Sodium (150 L ha⁻¹), Quizalofop-p-Ethyl (2.5 L ha⁻¹), and Carfentrazone Ethyl (5%) + Glyphosate (36%) (2.00 L ha⁻¹) were used for the chemical control of *P. hysterophorus*.

Results

Farmers were well aware of parthenium weed presence, its biology, habitat, and mode of dispersal across the landscape. Vehicles and flood water are the major agents, which proliferate the seeds of the weed. Most of the respondents (76%) indicated that the weed first appeared on the roadside and spread to other habitats. Summer is the most favorable growing season and April is the most dominant month of infestation. All the major crops cultivated were infested by varying degrees of weed densities. Farmers (52%) found they have 10 to 20% crop yield reduction due to the parthenium infestation. Serious impacts upon the health of livestock in parthenium-infested areas have been reported from respondents (47%), found to cause clinical signs in animals. Farmers reported parthenium weed as a very difficult-to-manage weed and unsurprisingly, manual weeding or herbicides were the major weed control methods across the regions which is consistent with the overall management practices in the country. Carfentrazone Ethyl (5%) + Glyphosate (36%) and Quizalofop-p-Ethyl resulted in a 100% and 90% mortality rate on 21 DAS in the field study. No mortality was seen in another two herbicides.

Conclusions

The agricultural communities described significant effects of parthenium weed on their crop and livestock production and social well-being. Therefore, a comprehensive management strategy is urgently needed to address the looming crisis of parthenium weed invasion across the regions and a similar approach must be implemented at the national and international levels.

Key words: Parthenium weed; Socio-economic impacts; Weed management; Animal health; Herbicide; Bangladesh

Predicting tuber yield losses of exportable potato varieties under saline condition in Bangladesh

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ABSTRACT

Purpose

Presently in Bangladesh we producing potato in some selected areas but, southern belt is the most important areas of agricultural production. So, the potato production is facing great hindrance from salinity intrusion in crop field of southern region which may create an export market in Bangladesh with superior quality along with better yield. From these perspectives, the study was conducted to evaluate the effect of applied salt on the performance of tuber where the people want to grow potato in their field.

Key words: Yield reduction, salt application, potato.

Methods

The experiment consisted four salt application doses (N_0 = non-saline, N_1 = 5, N_2 = 15 and N_3 = 25 g NaCl pot⁻¹, respectively) and three varieties (V_1 = Granula, V_2 = Lady Rosetta and V_3 = Asterix). The pot was arranged following completely randomized design (CRD) with 3 times repetition of treatment. Data on yield was collected and analysed using WASP statistical program following AVONA techniques. The means were adjusted with least significant difference (LSD) test at 5% level of significance.

Results

Result revealed that salinity has much impact on different exportable traits of potato (data not shown). The tuber yield was also significantly influenced by salt treatment. For getting the maximum return from this study, the results demonstrated that non-saline (control) condition of pot soil is most favourable for tuber yield. Granula exhibited the highest yield (428.04 g/plant) which was statistically similar to Lady Rosetta (416.11 g/plant) under non-saline condition. Thereafter with the increasing of salinity levels the yield has been decreased and so, a yield reduction trend was found. The yield reduction was (0.21%, 1.87% and 14.21%, respectively; 11.48%, 11.73% and 20.41%, respectively; 18.14%, 19.14% and 25.66%, respectively) found in Granula, Lady Rosetta and Asterix, respectively with N_1 , N_2 and N_3 , respectively.

Conclusions

In conclusion, it may be said that potato has sensitivity to salinity for its performances. So, the salt tolerance/salt avoidance varieties should be introduced/developed in our country and the further research should be carried out with how much amount of EC of salinity can be tolerated by exportable potato varieties in field condition.

Yield of mungbean as influenced by boron with other source of fertilizers

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ABSTRACT

Purpose

Mungbean contributes 10-12% total pulse production in Bangladesh. This means the shortage is almost 80% of the total requirement. The balance use of organic and inorganic fertilizer increases the growth and yield of mungbean. Proper management of cowdung may reduce the need for chemical fertilizer, allowing the small farmers to reduce cost of the production. On the other hand foliar application of B at vegetative stage may important role in mungbean growth, flowering and pod filling. Considering the above facts we aim to evaluate the organic and inorganic fertilizer with boron splitting on the yield of mungbean.

Methods

The experiment consisted of three level of fertilizer *viz.*, F₁ : Recommended dose (RD) of NPK fertilizer, F₂ : RD of Cowdung, F₃: 1/2 RD of NPK and cowdung and Boron was applied by four levels *viz.*, B₁: 100% RD as basal, B₂: 80% RD as basal +20% as foliar spray (FS) at pre flowering, B₃: 60% RD as basal + rest 40 % as FS at pre flowering, B₄:40% RD as basal + 60 % as FS at pre flowering stage. The experiment was set up in a split-plot design with three replications. The mean values of all the characters were calculated and analysis of variance (ANOVA) was performed with the help of a computer package program MSTAT –C and the mean differences were adjusted by Least Significance Difference (LSD) test at 5% level of probability.

Results

Different fertilizer management and Boron application showed significant effect on seed yield (kg ha⁻¹) of mungbean. From the experiment result exhibited that the maximum seed yield (1177.80 kg ha⁻¹) was observed from F₁ treatment whereas minimum seed yield (861.70 kg ha⁻¹) was observed from F₂ treatment. In case of Boron, the seed yield (1125.60 kg ha⁻¹) was observed from B₃ which was statistically similar (1103.30 kg ha⁻¹) with B₄ treatment. On the other hand result showed that the maximum seed yield (1356.70 kg ha⁻¹) was observed from F₁B₃ treatment which was statistically similar (1310.00 kg ha⁻¹) with F₁B₄ treatment combination whereas minimum seed yield weight (756.70 kg ha⁻¹) was observed from F₂B₁ treatment combination.

Conclusions

Foliar application of boron combines with chemical fertilizer gave the best performance. It can be concluded from the discussion that the effect of organic and inorganic fertilizer and boron levels had greatly influenced the yield of mungbean.

Key words: Foliar application, Splitting, Boron, Fertilizer, mungbean.

ABSTRACT

Purpose: The present study was conducted to examine the costs and returns in production, price spread in different marketing channels of Bangalore red rose onion.

Methods: The study was conducted by using a random sample of sixty cultivators and twenty market intermediaries from Chikkaballapura and Chennai export markets. The primary data was collected by personal interview method with help of pretested and structured schedule during 2019-20 crop season.

Results: The major findings of the study revealed that About 78.40 per cent of the farmers sold through Channel-I (Producer → Village level trader → Commission agent → Exporter → Foreign importer → Consumers), about 15.00 per cent in channel-II (Producer → Contract trader → Exporter → Foreign importer → Consumers) and about 6.60 per cent in channel-III (Producer → Trader in APMC → Exporter → Foreign importer → Consumers). The price spread was higher in Channel-I (Rs. 9,600) compared to Channel-II (Rs. 8,800) and channel-III (Rs. 9,150) due to a greater number of intermediaries.

Conclusion: With a marketing efficiency index of 3.15, channel-II was the most efficient channel followed by channel-III (2.78) and channel-I (2.59) according to Shepherd’s method.

Influence of soil oil and foliar application of zinc sulphate and ferrous sulphate on growth and yield of sunflower (*Helianthus annus L.*)

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ABSTRACT

Sunflower (*Helianthus annus L.*) is an important oilseed and an ornamental crop largely cultivated in India. It is one of the most popular oilseed crop of Asteraceae family and important source of vegetable oil. It is photo and thermo-insensitive crop, short duration and wide range adaptability to different cropping patterns and also for soil and climatic condition, drought tolerance, lower seed rate, higher seed multiplication ratio and good quality of edible oil (45-50 %). Micronutrients are of large important in crop nutrition for obtaining higher yield. The foliar application of fertilizer is an effective and economic practices. The purpose behind that is not to replace soil fertilizer application, but to supply plant nutrient need in critical growth stage of the plant. Zinc, iron as well as sulphur plays an important role in obtaining high quality seed and oil yield. For wide spread adoption and exploitation of high yield of the sunflower crop, the experiment entitled “Influence of soil oil and foliar application of zinc sulphate and ferrous sulphate on growth and yield of sunflower (*Helianthus annus L.*)” was carried out.

METHODOLOGY

A field experiment was conducted during *rabi* season, 2020-2021 at Experimental Farm, Department of Agronomy, College of Agriculture, Latur, to study the “Influence of soil and foliar application of zinc sulphate and ferrous sulphate on growth and yield of sunflower (*Helianthus annus L.*)”. The soil of experimental plot was clayey in texture, low in available nitrogen (231.00 kg ha⁻¹), medium in available phosphorous (15.90 kg ha⁻¹) and very high in available potassium (475.27 kg ha⁻¹). Available Zn and Fe in soil was 0.53 ppm and 3.94 ppm respectively. The soil was slightly alkaline in reaction having pH (7.45). A field experiment was laid out in a Randomized Block Design (RBD) with ten treatments replicated three times. The treatments were T₁ -RDF, T₂ -RDF + FYM @ 5 t ha⁻¹, T₃ -T₂ + ZnSO₄ @ 20 kg ha⁻¹ soil application, T₄ -T₂ + FeSO₄ @ 20 kg ha⁻¹ soil application, T₅ -T₂ + ZnSO₄ @ 0.5% foliar spray, T₆ -T₂ + FeSO₄ @ 0.5% foliar spray, T₇ -T₂ + FeSO₄ @ 20 kg ha⁻¹ + ZnSO₄ @ 20 kg ha⁻¹ soil application, T₈ -T₂ + FeSO₄ + ZnSO₄ @ 0.5% foliar spray, T₉ -T₂ + ZnSO₄ @ 20 kg ha⁻¹ soil application + FeSO₄ @ 0.5% foliar spray and T₁₀ -T₂ + FeSO₄ @ 20 kg ha⁻¹ soil application + ZnSO₄ @ 0.5% foliar spray. The gross plot size of each experimental unit was 5.4 m x 4.5 m and net plot size was 4.2 m x 3.9 m. The recommended dose of fertilizer (RDF) was 90:45:45 NPK kg ha⁻¹ given as per treatment.

RESULTS

Growth attributing characters viz., plant height (cm), dry matter accumulation plant⁻¹ (g), stem girth (cm) and head diameter (cm) as well as yield attributes viz., number of filled seeds head⁻¹, test weight (g), seed yield (kg ha⁻¹) and stalk yield (kg ha⁻¹) were significantly higher with application of T₂ + ZnSO₄ @ 20 kg ha⁻¹ soil application + FeSO₄ @ 0.5% foliar spray (T₉) recorded significantly higher plant height at all growth stages of crop which was at par with application of T₂ + FeSO₄ @ 20 kg ha⁻¹ + ZnSO₄ @ 20 kg ha⁻¹ soil application (T₇) and T₂ + ZnSO₄ @ 20 kg ha⁻¹ soil application + FeSO₄ @ 0.5 % foliar spray (T₁₀) and also found significantly superior over rest of the treatments. Zinc and iron fertilization increased the synthesis of enzyme like auxin biosynthesis, IAA production and protein synthesis which helped in promoting vegetative growth of sunflower crop. These results are in accordance with those obtained by Raghavendra *et al.*, (2020) and Torabian *et al.*, (2017).

Conclusion

The application of RDF + FYM @ 5 t ha⁻¹ + ZnSO₄ @ 20 kg ha⁻¹ soil application and of FeSO₄ @ 0.5 % foliar spray (T₉) was found beneficial in recording higher seed yield (1768 kg ha⁻¹) and stalk yield (3499 kg ha⁻¹) of sunflower.

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INTANGIBLE BENEFITS OF AGROFORESTRY SYSTEM- AN ANALYSIS ON WILLINGNESS TO PAY BY FARMERS IN THE AGRO CLIMATIC ZONE OF TAMIL NADU **P. Naveen Kumar², R. Minithra³, K. Thomas Felix⁴**

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ABSTRACT

Agricultural pollution consists a serious concern for environmental protection managers. Among the pollutants, nitrates, phosphoric compounds and organic pesticides from agricultural activities are the most common and hazardous to the environment and human health. The World Health Organisation (WHO) has defined the maximum nitrate level of a contaminant in drinking water as 50 mg/L. Nitrate is one of the dangerous for human health as well as plant. Nitrate contamination in groundwater is due to overuse of nitrogenous fertilizer that lead to accumulation of nitrates in the soil. Leaching of nitrates into the soil will directly affect the purity of groundwater. Groundwater is one of the source of irrigation and drinking purpose. In order to reduce the nitrate contamination in groundwater some mitigation techniques have been proposed to control these pollutants. Agroforestry is vital technique which provides numerous ecosystem services. Agroforestry, the intentional integration of trees and shrubs into crop and animal production systems, is being deployed to enhance productivity, profitability, and environmental stewardship of agricultural operations and lands. National Forest policy (NFP) states that each state in India has to achieve the target of 33 percentage of green cover by promoting tress outside forest. Tamil Nadu has achieved the green cover of about 20.27 percentage remaining 12.63 percent need to cover as forest cover through the adoption of various agroforestry systems by the farmers. Agroforestry not only has potential to increase the net income of the farmers but also for upliftment of environmental stability. Different types of agroforestry systems such as agrisilviculture, agrihorticulture, silvipasture, hortisilviculture and boundary plantations are commonly practised in Tamil Nadu.

METHODOLOGY

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Study area:

Multistage random sampling method was adopted for the study. From Central ground water board (2018-2019) data was collected for Tamil Nadu. According to Bureau of Indian Standards (BIS) nitrate <45g/l there is no effect on groundwater but more than 45 mg/l there is more negative effect on groundwater. For Tamil Nadu, the nitrate content is less than 45mg/l in about 51 per cent of the sample analysed and nearly 49 % of sample gives more than 45 mg/l spread all over the state. District wise data were collected and each districts were pooled based on seven agro climatic zones. Based on nitrate level, the western zone was found to high. Hence western zone was selected for the study. In western zone, Coimbatore district was randomly selected. Under this district, two blocks and in each block three villages were selected. In each village 25 farmers were randomly selected. Finally 150 sample farmers were selected for the study. With this background the present study attempts to estimate the level of willingness to pay by farmers to intangible benefits offered by agroforestry system in order to reduce nitrogenous pollutants.

Data were collected from 150 randomly selected farmers through a contingent valuation survey. Contingent Valuation Method (CVM) was applied to assess farmers willingness to pay (WTP) for raising plantations and its maintenance for mitigating the impact of nitrate contaminations.

CVM: Contingent valuation method is based on interviewing of WTP (Willingness to Pay) by the demanders, who reveal their preferences based on their income and other considerations. Contingent valuation method is applied essentially asking people what they are WTP for the benefit. Regression model in which the dependent variable or regress and evokes ‘Yes’ or ‘No’ or present or absent response are known as dichotomous or dummy dependent variable regression models. Among the methods that are used to estimate such models, four methods considered are LPM (Linear Probability Model), Logit, Probit and Tobit regression. If the dependent variable takes two values i.e., zero or one, then we can use either Logit or Probit regression. But in the Tobit model the dependent variable also takes two values i.e., zero and some value greater than zero. In Tobit model we can measure both intensity and amount spent to tackle externalities.

RESULTS

Among the sample respondents, majority of the farmers (55 per cent) were willing to pay for agroforestry system. Remaining 45 per cent of farmers were not willing to pay for agroforestry system. Socioeconomic variable like age of the respondents, Household heads education, household income, depth of the well, land holding size index were positively related to the willingness to pay (WTP).

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Genetic Variability Study in Radish (*Raphanus sativus* L.) For Root Yield under Mid-Hills of Uttarakhand

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ABSTRACT

Purpose

Radish (*Raphanus sativus* L.) which belongs to the family Brassicaceae is a prominent vegetable crop grown worldwide. It is commonly known as Muli or Mula which grows in every part of India. The genetic parameters such as heritability, genetic advance, genotypic and phenotypic coefficients of variability are effective for the breeders to select a genotype having the most desirable traits for yield. The study was undertaken to study the relative magnitude of genetic variability, heritability and genetic advance for root yield and quality traits of horticultural importance in radish.

Methods

The study was conducted during rabi season at College of Horticulture, VCSG, UUHF, Bharsar. The experiment was laid out in RCBD method with three replications at spacing of 45 cm × 20 cm. The observations were recorded on five random competitive plants per replication for each genotype of twelve important characters.

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Results

The analysis of variance indicated that differences among the genotypes were highly significant for all the twelve characters studied. The magnitude of phenotypic coefficient of variation (PCV) was significantly higher than the corresponding genotypic coefficient of variation (GCV) for all the characters under the study, indicating a considerable influence of environment on their expression. The phenotypic coefficients of variation (PCV) were found high gain for root weight without leaves (g), leaves weight (g), root weight with leaves (g), root yield per plot (kg) and root diameter (cm).

Conclusion

It is concluded that four genotypes viz Gol Mooli, Mino Early White, Hill Queen and Radish Roshni recorded higher root yield and also performed better than all other genotypes

Key words: Genetic variability, root yield, quality traits, raddish

Analysis of Secretion system in *Bacillus subtilis* RC 25

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ABSTARCT

Purpose

Bacterial secretion systems are sophisticated molecular machines that fulfil a wide range of important functions, which reach from export/secretion of essential proteins or virulence factors to the implication in conjugation processes. There are two major pathways exist to secrete proteins across the cytoplasmic membrane. The general Secretion route, termed Sec-pathway, catalyzes the transmembrane translocation of proteins in their unfolded conformation, whereupon they fold into their native structure at the trans-side of the membrane. The Twin-arginine translocation pathway, termed Tat-pathway, catalyses the translocation of secretory proteins in their folded state. In this study we analyzed the bacterial secretory system of potential *Bacillus subtilis* RC25.

Methods

Functional annotation of potential *Bacillus subtilis* RC25 genome for analysis of their secretory system was performed by using RAST and BlastKoala server.

Results

Bacillus subtilis RC25 has various plant growth promoting activities such as synthesis of IAA, ACC-deaminase, siderophores and HCN and the capacity of solubilizing phosphate, in addition to strong hydrolytic activity in vitro by production of extracellular enzymes like protease, amylase, cellulase lipase and gelatinase. Genome annotation was performed using Rapid Annotation using Subsystems Technology (RAST) v.2.0 and BlastKoala. The 3.9 Mb genome of *Bacillus subtilis* RC25 has 4115 genes and 1082 genes participated in different pathways. Sec and Tat (Twin arginine targeting) secretion system were predicted in the genome, total 11 genes were identified secretion among them 9 viz *SecD/F*, *SecE*, *SecG*, *SecY*, *YajC*, *YidC*, *SecA*, *FtsY* and *ffh* were participated in sec system and 2 viz *TatA* and *TatC* in Tat system.

Conclusions

Nine important genes contributing to Secretary System and two genes to Twin arginine targeting system were deciphered in *B. subtilis* RC 25.

Keywords: *Bacillus subtilis*, BlastKoala, RAST and Twin-arginine

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Phytochemical screening of medicinal plants against *Streptococcus mutans* targeting Putative deoxycytidylate deaminase

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ABSTARCT

Purpose

Oral hygiene plays a consequential role in maintaining the overall health of a human being. *Streptococcus mutans* is well-recognized as the main causative factor of dental caries. Chlorhexidine (CHX) is one of the most common antimicrobial agents. Besides, CHX can cause taste confusions, tooth staining, and drug resistance. In this regard, the phytochemicals of medicinal plants could be explored to prevent this disease.

Methods

Therefore, we constructed a library of 1399 phytochemicals from 23 medicinal plants and filtered it through the SwissADME web tool. Screening of 357 phytochemicals by Virtual Screening and Molecular dynamics Simulation and MMPBSA resulted in four potential phytochemicals. Further, molecular docking studies of filtered phytochemicals were performed with Putative deoxycytidylate deaminase(dCD) enzyme to investigate the binding interactions.

Results

Based on the binding energy score of the top 4 phytochemicals, the results indicate that Cyclocurcumin, Androsta-1,4,6-triene-3,17-dione, Sesamin and 3,4-Dichloroatropine has the highest and equal binding affinity (-7.5 kcal mol⁻¹, -7.5 kcal mol⁻¹, -7.9 kcal mol⁻¹, -8.3 kcal mol⁻¹) as compared to the reference molecule (-7.5 kcal mol⁻¹). Further, 100 ns molecular dynamics simulation of the top four phytochemicals showed that Cyclocurcumin, Androsta-1,4,6-triene-3,17-dione, Sesamin and 3,4-Dichloroatropine have good stability with dCD. These four phytochemicals were then subjected for MMPBSA (last 10 ns) calculation to analyze the protein-ligand stability and dynamic behavior. Promising outcomes from MD simulations evidence the worth of these phytochemicals for future drug development to combat tooth disease.

Conclusions

Thereby, alternative antibacterial agents are still needed for the control of dental plaque and caries. Small molecules have shown inhibitory effect on bacterial biofilms due to its good antimicrobial activity, good stability, and low toxicity. These compounds may be investigated in vitro to evaluate the efficacy against *S.mutans*.

Keyword –Tooth disease; *Streptococcus mutans*; Molecular Docking; Phytochemicals; MD simulation; MMPBSA

PERFORMANCE OF CHICKPEA (RVG 202) UNDER RAISED BED PLANTING IN NARSIHPUR DISTRICT

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ABSTARCT

Protein malnutrition is a major problem in India. Enhancing the productivity of pulse crops has therefore become a major concern. Chickpea (*Cicer arietenum*) is one of the potential pulse crops in the country. It is grown in 8.3 million ha area with an annual production of 7.7 million tonnes and an average productivity of 928 kg/ha (MOA 2013). Major area of chickpea is found in Madhya Pradesh, Rajasthan, Maharashtra, Karnataka, Andhra Pradesh and Uttar Pradesh. In most of the states the crop productivity is low as the traditional practices of cultivation are followed. Narsinghpur is a major pulse. growing district in Madhya Pradesh. On an average about 89000 ha area is covered under chickpea in Narsinghpur during rabi season.

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There is immense scope in the district for increasing the productivity of chickpea. Present investigation was undertaken for observing the role of planting method on chickpea in vertisols. Raised bed system of planting was compared with the flat bed method of planting prevalent in the district.

KEY WORDS

Chickpea, Raised bed planter and RVG 202

METHOD AND MATERIALS

The trial was conducted in Rabi season during the year 2020-21 in farmers fields in village Seoni bandha Narsinghpur district of Madhya Pradesh. One year the raised bed planting was done at ten fields of size one acre each. A tractor drawn bed planter was utilized for raised bed planting of chickpea. Chickpea variety RVG 202 was considered for the study. Ordinary seed cum fertilizer drill was utilized for the flat bed planting of chickpea. The seed rate under the raised bed planting was 50kg/hectare. Under the raised bed method sowing was done in two rows spaced at nine inch on each bed of fourteen inch width. Each bed was separated by a furrow. Under the flat bed planting the farmers stuck to their usual seed rate of 75 kg/ha. Irrigation was given through sprinklers at flowering and at pod formation stage. Data on crop yield was taken on actual yield per acre basis. Cost of cultivation and gross return were computed on prevalent market rates basis.

RESULT

During the year 2020-21 the crop yield under raised bed planting was 14.5 q/ha. This was higher by 3.5 q over the flat bed planting. Thus the crop yield under the flat bed planting was obtained as 11.0 q/ha. The average cost of cultivation was computed on the basis of prevalent market rates. It was observed that the cost of cultivation under the raised bed planting was computed to be Rs. 23450/- per ha which was slightly higher than that computed under the flat bed planting. The gross return under the flat bed planting was computed to be Rs. 53760/- per ha which increased to Rs. 69600/- per ha under the raised bed planting. The net return was higher in case of raised bed planting. The average net return under raised bed planting was found to be Rs. 46150/- per ha. An additional amount of Rs. 11310/- per ha was fetched as net return under the raised bed planting against the flat bed planting. The B: C ratio in case of raised bed planting was 2.96 as compared to 2.34 computed under the flat bed planting. Thus the results of raised bed planting were encouraging.

CONCLUSION

The raised bed planting of chickpea provided an environment much suitable for the crop growth. Eventually the crop yield under the raised bed planting was higher than that under the flat bed planting. This is well evident from the results of the two years study. Moreover lesser amount of seed was required under the raised bed planting. Thus it can be concluded that the raised bed planting is a good option for increasing crop growth in the vertisol regions of central India. Pramanik et al., (2009) in their study of raised bed planting with chickpea have also reported that raised bed planting gave higher grain yield than the flat bed planting. Thus here also the raised bed sowing outperformed the conventional of sowing of chickpea in vertisols. Hence it can be concluded that the raised bed method of planting is a more suitable option for cultivation of chickpea in vertisols.

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Molecular characterization, development of functional markers and their utilization in molecular breeding for *sugary1* gene governing kernel sweetness in maize

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ABSTRACT

Purpose

Sweet corn has become a popular choice, both as a fresh and processed vegetable worldwide. Two recessive mutant genes affecting the starch metabolism, *sugary1* (*su1*) and *shrunken2* (*sh2*) have been extensively used for development of sweet corn cultivars. Of these, *su1* gene encoding starch de-branching enzyme has been in much use for sweet corn cultivar development in United States and European nations. *Su1*-based sweet corn kernels possess three-times more sugar than ordinary maize, and kernels appear attractive due to the presence of higher accumulation of water soluble phytyglycans (WSP). The demand of sweet corn in India has increased tremendously in the last few years due to increased urbanization. Despite, its abundant usage, *su1* gene has not been characterized comprehensively at the molecular level, and limited information on allelic diversity of *su1* gene among diverse inbreds exists. Further, development of sweet corn hybrids using conventional breeding methods takes 8-10 years. Molecular breeding accelerates the breeding cycle by taking less than half of the time. Functional marker is ideal for marker-assisted selection (MAS). However, no functional marker for *su1* gene has been reported. Thus, molecular characterization of *su1* gene and development of suitable functional markers would pave the way for early selection of suitable plants in the segregating generation, leading to saving of considerable time and resources.

Methods

11.7 kb region of *su1* gene was sequenced among 5 wild type and 6 *su1* mutants of maize. 27 overlapping primers amplifying small contigs of 300-400 bp length were used for sequencing. The *su1* gene was characterized at molecular level among diverse genotypes of maize and 23 orthologues. On the basis of identified variations among 11 maize inbreds, SNP and InDel based markers were developed and validated in five F₂ populations and in a set of 230 diverse inbreds having both mutant and wild-type alleles of *su1*. The functional markers were used in marker-assisted introgression of *su1* gene into the four *sh2*-based parental inbreds (PMI-SWT-16, PMI-SWT-17, PMI-SWT-19 and PMI-SWT-20) of two popular sweet corn hybrids (PSSC-1 and PSSC-2).

Results

A total of 12 InDels and 96 SNPs were identified that clearly differentiated the dominant and recessive allele of *su1*. Besides, 15 InDels of 2-45 bp were selected to develop markers for studying allelic diversity in *su1* gene among 19 mutant- (*su1*) and 29 wild-type (*Su1*) inbreds. Analysis showed major allele frequency ranged from 0.52 to 0.90, while PIC and gene diversity varied from 0.15 to 0.37 and 0.16 to 0.49, respectively. Two major clusters each for wild- type (*Su1*) and mutant (*su1*) types were observed in phylogenetic tree. A total of 44 haplotypes of *su1* were identified, with three haplotypes (Hap6, Hap22 and Hap29) sharing more than one genotype. Introns in orthologues (77-2206 bp) were longer than maize (859-1718 bp). Conserved α -amylase and CBM_48 domains SU1 protein were predicted in SU1 protein of maize and orthologues. Phylogenetic analysis showed closer relationship of maize SU1 protein with *P. hallii*, *S. bicolor* and *E. tef* than *Triticum sp.* and *Oryza sp.* Four variations including InDels of 6 bp and 36 bp in intron-10 and promoter region, respectively, and one SNP in exon-2 were selected to develop breeder-friendly codominant functional markers (SuDel6-FR, SuDel36-FR and SNP2703-CG-85/89). These three functional markers were validated among F₂ populations and the panel of diverse inbreds. Of these, SuDel36-FR was successfully used in molecular breeding for introgression of *su1* gene in *sh2* genetic background. BC₁F₁, BC₂F₁ and BC₂F₂ populations were successfully genotyped. Use of >100 SSRs led to the recovery of >90% of the recurrent parent genome. This has led to the development of MAS-derived inbreds with both *su1* and *sh2* genes in homozygous conditions. The newly derived inbreds (*su1su1/sh2sh2*) possesses higher kernel sweetness than the individual mutants.

Conclusions

This is the first comprehensive characterization of *su1* gene and its allelic forms in diverse maize and related orthologues. The study also represents the development and validation of first universal functional markers for *su1* gene. The information generated here assumes great significance in molecular breeding of sweet corn.

Key words: sweet corn, functional marker, SNP, InDel, allelic variation, haplotype, orthologue, *Zea mays*

STATUS OF FARM PRODUCE AND FOOD GRAIN AVAILABILITY IN THE WESTERN HIMALAYA: A CASE STUDY OF THE UTTARAKHAND HIMALAYA

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ABSTRACT

More than 70% population in the hills of Uttarakhand generates their livelihood from agriculture based activities. People maintain their traditional agroforestry system in the study area. Technological uses in agriculture in the hilly regions has been done but production is still low, not enough to meet out the demand of the population. Keeping this in view this study aims to assess the status of agriculture production and the availability of food grains for the cultivators in the study area.

METHODOLOGY:

Analysis of primary and secondary data set has been done. Collection of primary data has been through the extensive survey of villages in the study area. Secondary data has been collected from available published material like Census, reports, research articles etc.

RESULTS AND DISCUSSION:

Advancement in technology helping to increase the yield of crops but still the overall production of main agricultural crops has been decreasing. Positive and negative growth has been found in production of different crops in different altitudinal zones. Rise in temperature is showing some positive indication for cultivation for few crops as well negative for the established apple orchards. Farmers are facing wild animals attack and climatic uncertainty on crops, resultant it impacts farm production and the interest of cultivators.

CONCLUSION:

Hilly terrain creates many challenges to implantation of technological advances in agriculture. Increase in scattered and small landholdings causing operational costs of agriculture increasing with the time. Natural disasters like hail storm, odd precipitation and the wild animals like monkeys and wild boar etc. are destroying the crops such a level that production of crops in few areas are negligible and the cultivators are hopeless. Some bigger steps need to be taken for these issues.

KEY WORDS: Agriculture, Food grain, Farmers, Landholdings, Uttarakhand Himalaya

Genetic assessment of newly developed maize inbreds for yield and its attributes in different agro-climatic conditions

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ABSTRACT

Purpose

Maize is a strategically important crop for the millions of resource-poor farmers because of its multiple uses as food, feed and raw material for industry. The detailed genetic assessment of germplasm derived new elite lines is pre-requisite for future breeding programmes. So, present study was undertaken to develop new crosses and determine the combining ability over the environments.

Methods

Twenty eight crosses developed by crossing eight inbred lines in half diallel mating design, were evaluated in RBD at two environments representing different agroclimatic and ecological conditions of North-Western Himalayas (SAREC, Kangra and HAREC, Bajaura). Data was recorded for various agro-morphological traits during *Kharif*, 2019.

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Results

Analysis of variance indicated sufficient amount of genetic variability in material. Bartlett’s test revealed that error variance was homogeneous only for six traits out of total twelve traits. Estimates of σ^2 SCA were higher as compared to σ^2 GCA in both the environments and in pooled over environment as well, except for the days to 75% brown husk in Kangra which indicated preponderance of non-additive gene action. The inbred line B73 in Bajaura, pooled over environment and LM14 in Kangra were found good general combiner for most of the traits. The crosses B73 × BAJIM-1811 and BAJIM-1522 × BAJIM-1811 in Kangra, Bajaura as well as in pooled over environment identified as the potential hybrids.

Conclusion

The inbred lines with good GCA may be utilized as potential parents for development of high yielding single cross maize hybrids. The crosses identified as potential hybrids may be commercially exploited after critical evaluation for its superiority in performance and with stability across the locations over years.

Key words:

Maize, General Combining Ability, Specific Combining Ability, Genetic Variance

EFFECT OF SEED PRIMING WITH CHITOSAN BIONANOCONJUGATE IN WHEAT CULTIVARS

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ABSTARCT

INTRODUCTION

Numerous biopolymers such as starch, cellulose, alginate, chitin, and chitosan have been used to develop new materials with environmental sustainability and desirable functionality. Due to their abundance, biocompatibility, biodegradability, hydrophilicity, and safe and non-toxic properties, chitosan-based nanomaterials are largely being explored for defence and as growth promoter in plants (Saharan *et al.*, 2016). It is because nano-chitosan, compared to bulk chitosan, has superior physico-chemical characteristics that provide enhanced biological activities and improved nutrient use efficiency in plants. Being an advance and better approach, slow-release nanofertilizers have been targeted for their effective and long-term effects in crops. In the present investigation, Zinc (Zn, an essential micronutrient utilized in several metabolic reactions) was encapsulated in bionanoconjugate (BNC) along with salicylic acid (SA, a phenolic compound with growth regulatory and signalling properties) (Khan *et al.*, 2015). We aimed to improve their availability and efficacy in wheat cultivars. BNC obtained from ionic gelation method were stable, mono-dispersed, and extensively characterized for various physico-chemical properties. Priming with this BNC was performed on seeds of two wheat varieties, WH-1124 and WH-542, which showed a significant increase in root-shoot length, germination rate, coefficient of germination, and seed vigour index (SVI) as compared to bulk treatments. Our results demonstrated that developed BNC is more effective than bulk chitosan, zinc, salicylic acid, and their combination in seed germination and plant establishment.

METHODS

Synthesis of BNC was done by ionic gelation technique, and the mono-disperse and stable nanomaterial was obtained, which was used in further studies. It was extensively characterized (DLS, FTIR, etc.) for various physico-chemical properties (Kumaraswamy *et al.*, 2019). Two wheat varieties, WH-1124 and WH-542, were selected to study the effect of priming with BNC at different concentrations ranging from 100 to 1600 ppm. Ten primed seeds were placed in the Petri plates and germination paper each to evaluate various attributes (germination %, shoot-root length, seedling length, growth rate, coefficient of germination, and SVI) during germination (ISTA, 1999).

RESULTS

The post-priming effect of BNC was evaluated for its impact on plant and seedling growth of the wheat crop. Synthesized mono-disperse BNC has a mean size of 353.2 nm, a PDI value of 0.28, and a zeta-potential of +38.1mV. X-ray diffraction and FTIR study revealed the pendant and bridge pattern interactions in BNC. Seedling growth was monitored for up to 10

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days in all the treatments. At 0-3 days, negligible germination was observed in all treatments except a few in WH-542. Higher germination was found in BNC treated seeds than control. There was a significant difference in germination rate and coefficient of germination with a negligible difference in germination percent on the 10th day after priming (Table 1). Shoot-root and seedling lengths were higher in the BNC-primed (mainly 400ppm) seeds. Treatment with BNC (100-1600ppm) significantly ($p = 0.05$) improved SVI as compared with control, bulk chitosan (no germination), zinc, and SA treatments. Also comparing the varieties: Variety B (WH-542) was more responsive than Variety A (WH-1124).

CONCLUSIONS

Chitosan is a well-recognized biomaterial in agriculture and have successfully been utilized in many crops for enhancing seed germination, decreasing abiotic stress, increasing nutrient uptake and boosting the defence response in plants. Our results demonstrated that BNC is more effective as compared to bulk chitosan, zinc, salicylic acid, and their combination in seed germination percentage, shoot-root length, root number, and SVI of wheat. The BNC clearly showed growth-promoting effect on wheat seedling and further work on stress mitigation activity is under progress.

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Transforming farm lands into small tea gardens: socio-economic impact on participation of farm women

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ABSTRACT

Purpose

Any transformation or change in the ecosystem has got both rippling and spill-over effects. It invites reciprocal and seamless changes in the landscape, life, and livelihood of hundreds and more hundreds for the visible and invisible biota. The transformation of farmlands into tea gardens, the shift of a crop-based ecosystem into a perennial plantation, has got both bio-physical and socio-economic implications. The drivers of the transformation are economic benefits, ease of farm management, and availability of technology from the surrounding tea gardens. The empirical inquiries have been whether these changes are ephemeral have got a long-term ecological impact in terms of loss of traditional gene pools, settlement pattern, soil and water characteristics, and livelihood at large.

Methods

The present study has been conducted on sixty respondents, those who have already transformed their crop field into tea gardens, by taking farm women engagement (y) as the dependent variable and the score of twelve independent variables. The respondents were taken from three blocks of Alipurduar district of the northern part of West Bengal of India namely Falakata Block, Madarihat Block, and Alipurduar-1, and interviewed through the structured schedule.

Results

The results show that the variables such as mean change in land under cultivation, mean change in average garden size, mean change in total income, the ratio of pesticides use have been found to significantly impacting on the socio-economic factors of the farm women who are engaged in the transformed small tea gardens.

Conclusions

The study had revealed the emergence of small tea gardens helps in the empowerment of women as well as increasing the demand for women participation in the transformed farming sector, which improves the overall status of the Women farmers.

Keywords: Agricultural transformation, small tea gardens, women farmers, women engagement.

Land demand for food and cooking fuel-wood in India

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INTRODUCTION: Land is limited in supply and it is inevitable resource for human existence. Especially, land supplies food and energy to the people. On the one hand, as the population increases, the demand for food increases. On the other hand, due inelastic in land supply and compulsion to increase the food production, people are shifting the forest area into agricultural land. The intensity of global agricultural land use is increasing and gradually the forest area is decreasing. In near future, the demand for food and cooking fuel will increase as farmers will tend to encroach on forests to expand agricultural land (Charoenratana and Shinohara, 2017). Alexander et al., (2016) stated that to satisfy the food consumption need of an individual who lives in rural India requires about 2000 m² of agricultural land. If the trend continues, it will lead to increased competition over land for food and fuel.

OBJECTIVES: With the above background, the present study aims to determine the food intake and per capita demand for cooking fuel; and to assess the land requirement for food and for cooking fuel and compare the results

METHODOLOGY: The land requirement for food-and-cooking fuel were calculated using the methodology developed by Kastner and Nonhebel.

Land Requirement for Food: per-capita food consumption multiplied with the per hectare yield

Consumption data were collected from NSSO 68th Round (Consumption); Crop yield and Cropping intensity data were collected from GoI

$$\text{Land Requirement for Consumption} = \frac{\text{Fuelwood use (t/cap/year)}}{\text{Biomass yield (t/ha/year)}}$$

Land Required for Cooking Fuel: per-capita firewood consumption multiplied with the per hectare fuelwood production.

Fuelwood demand data was collected from NSSO 68th Round (Consumption)

Biomass yield was calculated using the below formula

$$\text{Biomass yield} = \text{Mean Annual Increment} \times \text{Wood Density} \times \text{Biomass Expansion Factor}$$

RESULTS: The average land requirement for food is about 1000 m²/cap/yr, varies with a range between 800-1300m²/cap/yr. It is evident that the average land requirement for fuelwood is about 7 times larger than the area required to produce food.

CONCLUSION: Results are evident that, there is a wide disparity in land demand between all the states of India. Dietary change is not an option for the rural people. Hence, changes to cooking fuels could be another option. This study recommends the policy makers to make policies which reduce the fuelwood consumption and shift the people to adopt a more efficient cooking fuel.

Table 1: Effect of different treatments on growth and yield attributing characters of sunflower.

Treatments	Plant height (cm) at harvest	Dry matter (g) at harvest	Stem girth (cm) at 75 DAS	Head diameter (cm) at harvest	No of filled seeds head ⁻¹	Test weight (g)	Seed yield (kg ha ⁻¹)	Stalk yield (kg ha ⁻¹)
T ₁ – RDF	154.37	87.58	6.07	12.71	646	44.72	1037	2646
T ₂ - RDF + FYM @ 5 t ha ⁻¹	155.48	88.58	6.82	13.38	657	45.51	1301	2896
T ₃ . T ₂ + ZnSO ₄ @ 20 kg ha ⁻¹ soil application	176.03	99.77	7.63	15.93	701	51.27	1462	3094

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T ₄ - T ₂ + FeSO ₄ @ 20 kg ha ⁻¹ soil application	175.43	98.66	7.50	14.99	689	49.67	1360	3018
T ₅ -T ₂ + ZnSO ₄ @ 0.5% foliar spray	169.54	91.95	7.26	13.22	664	46.90	1302	2898
T ₆ - T ₂ + FeSO ₄ @ 0.5% foliar spray	170.74	94.59	7.35	14.32	681	47.69	1345	2992
T ₇ - T ₂ + FeSO ₄ @ 20 kg ha ⁻¹ + ZnSO ₄ @ 20 kg ha ⁻¹ soil application	193.13	109.81	8.23	17.64	760	55.87	1587	3330
T ₈ - T ₂ + FeSO ₄ + ZnSO ₄ @ 0.5% foliar spray	172.45	96.35	7.47	15.11	683	48.30	1352	3007
T ₉ - T ₂ + ZnSO ₄ @ 20 kg ha ⁻¹ soil application + FeSO ₄ @ 0.5% foliar spray	199.80	112.91	9.09	18.92	804	58.87	1768	3499
T ₁₀ -T ₂ + FeSO ₄ @ 20 kg ha ⁻¹ soil application + ZnSO ₄ @ 0.5% foliar spray	184.71	100.49	7.99	16.34	732	53.60	1491	3109
SE ±	7.41	4.25	0.38	0.95	31	2.96	93	135
CD at 5%	20.03	12.64	1.13	2.84	93	NS	277	402

Response of soybean (*Glycine max* (L.) Merrill) varieties to different moisture conservation practices under rainfed condition

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ABSTRACT

Purpose

During last three-four year, it was notice that, in Maharashtra there was continuous dry spell of 15-35 days during kharif season, which seriously affects the growth and yield of soybean. It is evident from the literature that the different land configuration such as broad bed and furrow (BBF) are helpful in moisture conservation in soil and also lessen the loss of water through evaporation from the soil.

In attendance study, the crop was subjected to different land layouts by opening of furrows at different interval of rows. The advantageous effect of land layouts will certainly accelerate the process of growth and development of soybean resulting in better yield. Similarly, the surplus water during rainy days will be drained out from the field through this furrow and thereby saving the crop from water logged conditions. We aim to identify, the effect of moisture conservation practices on growth and yield of soybean

Method

The experiment was conducted during kharif season of the year 2019 at Experimental Farm of Agronomy section. College of Agriculture, Latur, to study the Assessment of land configuration and varieties of soybean. The experiment was laid out in a factorial Randomized Block Design with 12 treatments combinations, consisting three varieties *viz*, V₁-MAUS-71, V₂- MAUS-162 and V₃. DS-228 and four land configurations *viz*, flatbed (45 cm x 5 cm) (L₁), ridges and furrows (L₂), Opening of furrows after every two rows (L₃) and L₁ + Mulching. Sowing was done by dibbling method on 2nd August 2019. The RDF was applied before sowing. The recommended cultural practices and plant protection measures were undertaken as per recommendation.

Result

Soybean varieties DS-228 was found to be beneficial in improving growth characters, yield attributes and yield in soybean over MAUS -162 and MAUS- 71. Among different land configuration sowing with ridges and furrows was found to be beneficial in improving growth characters, yield attributes and yield in soybean over flatbed opening of furrows after every two rows and L₁+ mulching (L₄) and flatbed (L₁).

Conclusion

The variety DS-228 (V₃) and the land configuration of ridges and furrows (L₂) was found to be most productive for getting elevated growth, yield attributes and yield of Soybean.

Keywords: Soybean, Moisture conservation, layout, ridges and furrows, yield

Linkage disequilibrium analysis study reveals the genetic architecture of flowering time Indian mustard (*Brassica juncea* L.)

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ABSTARCT

Purpose: Flowering Plants are evolved to have sophisticated systems to acclimatise to local conditions, domestication and natural or artificial selection. The selective pressures of these different growing conditions have caused significant genomic divergence within species. This crucial factor plays major role to maintain the sustainable development. Triggering the flowering at appropriate times can also prevent plants from suffering from adverse growth conditions, such as disease escape, drought, and winter hardness. Hence, discovering the genome-wide genetic mechanisms that influence flowering time variations and understanding their contributions to adaptation at this vital phenological stage is important topic of interest.

Method: In present study a core collection with 64 *Brassica juncea* lines was first planted in two year trials independent environments, and their flowering time traits were phenotyped. A genome-wide association mapping of flowering times with 82 SSRs for core set was done.. The information of population structure matrix and trait phenotypic data on flowering time were together used in software TASSEL and significant MTAs were identified.

Results: In total, showed marker-trait associations two year trial. On the whole 26 QTLs were identified, only 1 QTL showed significant association with flowering time variations. To explore flowering time QTLs and genes related to growth habits in Indian mustard, selection signals related to divergent habits were screened at the genome-wide level.

Conclusion: Based on this study, a number of marker-trait associations and candidate genes for flowering time variations in Indian mustard were revealed. These results will be applied to brassica breeding programs to assist in selection of best lines for their use in molecular breeding.

Keywords: Growth habits, flowering time, GWAS, *Brassica juncea*

Identification of promising rice crop establishment methods in Rice – Linseed cropping system under conservation agriculture

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ABSTARCT

Rice – Fallow area is more in India to catch this area with appropriate rabi crop it is necessary to modify rice crop establishment method. Direct Seeded Rice (DSR) can save the time and cost for the farmers. After harvest of DSR linseed could also be gives better results on various Conservation Agricultural practices. Therefore to identify promising rice crop establishment method in rice linseed cropping system this study was carried out.

METHODOLOGY

A field experiment was conducted at AICRP on Linseed and Mustard College of Agriculture, Nagpur during *kharif* and *rabi* season of 2020-21 in Split-Split Plot design with three replications. Main Plot treatments are crop establishment methods for Rice i.e. T₁ – Transplanting Rice, T₂ – Direct Seeded Rice, Sub Plot Treatments includes conservation tillage practices for Linseed L₁ - Conventional tillage (Line sowing), L₂ - Zero tillage (Broadcasting) and L₃ - Zero tillage (Line sowing), Sub sub plot treatments: Nutrient management for linseed includes N₁ - 75 % RDF, N₂ - 100 % RDF (60:30:00) and N₃ - 125 % RDF. The soil was clayey in nature with pH 7.2 indicating slightly alkaline in reaction, low in available nitrogen; medium in available phosphorus and very high in available potassium.

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RESULTS

The higher growth and yield attributing characters viz., plant height (cm), no. of tillers (m⁻²), dry matter accumulation (m⁻²), panicle length (cm), effective tillers (m⁻²), No. of filled and unfilled grains, panicle weight (g), grain yield (q ha⁻¹), straw yield (q ha⁻¹) was recorded when rice was sown by transplanting method as compare to direct seeded rice method.

In case of linseed growth and yield attributing characters viz., plant height, number of branches plant⁻¹, dry matter accumulation plant⁻¹, grain yield and straw yield plant⁻¹, seed and straw yield (q ha⁻¹), was found higher when linseed was sown after direct seeded rice by treatment zero tillage (Line sowing), as compare to Conventional tillage (Line sowing) and zero tillage (Relay cropping broadcasting). In nutrient management for linseed the maximum growth and yield attributing characters viz., plant height, number of branches plant⁻¹, dry matter accumulation plant⁻¹, grain yield and straw yield plant⁻¹, seed and straw yield (q ha⁻¹), was found when linseed was supplied with 125 % RDF but it was found at par with 100 % RDF (60:30:00).

CONCLUSIONS

Amongst sowing methods for rice treatment T₂ Direct seeded rice was found more economical through it was less productive as compare to treatment T₁ Transplanting rice. Linseed sown after direct seeded rice WITH 100 % RDF by zero tillage (Line sowing) 30 cm apart was found most productive and economic method for sowing of linseed

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Integrated weed management in irrigated linseed

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ABSTARCT

Linseed, *Linum usitatissimum* L., the important *rabi* oil seed crop faces the weed problem in irrigated condition which reflected in yield loss to the tune of 50%. The linseed plant having small leaves and short, upright growth habit and never forms canopy make linseed a poor competitor with weeds throughout its life. Because of slow initial growth and small sized leaves, an initial growth period of 20-45 days is very critical and season long weed competition has been found to reduce linseed yield to the extent of 30-40% (Mahere *et al.*, 2000). Weed competition leads to higher dockage in the grain due to high amounts of weed seed, therefore it should be controlled when the crop height is between 5 and 10 cm i.e. at early stage of plant growth. Therefore an integrated approach for controlling the weeds is indispensable in irrigated linseed.

METHODOLOGY

An experiment was conducted at AICRP on Linseed and Mustard College of Agriculture, Nagpur during *rabi* season of 2020-21 in randomized block design with three replications on medium black soil. The treatment details are Weedy check (T₁), HW Twice at 20-25 and 40-45 DAS (T₂), Metribuzin @ 250 g.a.i/ha + Qxyflourfen @125 g.a.i./ha (Pre emergence) (T₃), Pendimethalin @ 1 kg a.i./ha (Pre emergence) fb. Metsulfuron methyl @ 4 g.a.i./ha at 25 DAS (T₄), Imazethapur 10 EC 75 g.a.i./ha at 2-3 leaf stage of weed (T₅), Oxyflourfen @ 125 g.a.i./ha (Pre) (T₆), Metsulfuron methyl @ 4 g.a.i./ha at 2-3 leaf stage of weed (T₇), Clodinafop @ 60 g a.i./ha at 2-3 leaf stage of weed (T₈) Clodinafop @ 60 g a.i./ha + Metsulfuron methyl @ 4 g.a.i./ha at 2-3 leaf stage of weed (T₉) and Oxadiargyl @ 80 g/ha (pre) (T₁₀).

RESULTS

The weed control treatments significantly reduced the weed population and weed biomass when compared with unweeded control (Table 1 and 2). Weed count and weed dry weights at 20, 40 and 80 DAS were recorded prior to execution of different treatments scheduled at the respective stage. The treatment Clodinafop @ 60 g a.i./ha + Metsulfuron methyl @ 4 g.a.i./ha at 2-3 leaf stage of weed showed superiority in minimizing the weed count upto 80DAS.

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Among the different herbicide tested in linseed, weed control efficiency was found maximum in treatment having post emergence application of Clodinafop @ 60 g a.i./ha + Metsulfuron methyl @ 4 g.a.i./ha at 2-3 leaf stage of weed followed by treatment having application of Clodinafop @ 60 g a.i./ha at 2-3 leaf stage of weed. The low weed control efficiency was recorded in treatment having application of Oxyflourfen @ 125 g.a.i./ha as Pre-emergence herbicide, followed by application of Oxadiargyl @ 80 g/ha (Pre-emergence) and treatment having application of Metribuzin @ 250 g.a.i./ha + Qxyflourfen @ 125 g.a.i./ha (Pre emergence). Lowest weed index was recorded in treatment having application of Clodinafop @ 60 g a.i./ha + Metsulfuron methyl @ 4 g.a.i./ha at 2-3 leaf stage of weed. Growth and yield attributes in linseed was found maximum in the weed free treatment i.e. Hand weeding twice at 20-25 and 40-45 DAS but found at par with treatment having application of Clodinafop @ 60 g a.i./ha + Metsulfuron methyl @ 4 g.a.i./ha at 2-3 leaf stage of weed. This might be due to the effect of post emergence application of herbicides controls the weed during the crucial growth period of linseed. Hand weeding twice at 20-25 and 40-45 DAS recorded significantly higher seed yield which was at par with treatment having post emergence application of Clodinafop @ 60 g a.i./ha + Metsulfuron methyl @ 4 g.a.i./ha at 2-3 leaf stage of weed. The gross monetary return was recorded maximum in weed free treatment i.e. Hand weeding twice at 20-25 and 40-45 DAS, whereas, net monetary return was recorded highest in treatment having application of Clodinafop @ 60 g a.i./ha + Metsulfuron methyl @ 4 g.a.i./ha at 2-3 leaf stage of weed this might be due to the more cost of cultivation in weed free treatment. The B:C ratio (2.61) was also found more in treatment having application of Clodinafop @ 60 g a.i./ha + Metsulfuron methyl @ 4 g.a.i./ha at 2-3 leaf stage of weed.

CONCLUSIONS

Application of weedicide Clodinafop @ 60 g a.i./ha + Metsulfuron methyl @ 4 g.a.i./ha at 2-3 leaf stage of weed (20-25 DAS) found better in control of weeds in linseed and recorded higher seed yield with highest B:C ratio of linseed.

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Phylogeny of *Oscheius myriophilus* isolated from *laevicaulis alte*, inferred from rDNA and morphometrical basis

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ABSTRACT

Purpose

The purpose of the study is to isolate, identify and document the MPNs of the studied area and use of highly pathogenic identified species against the major pest problem *i.e.*, slugs in respect to Indian environmental conditions. Despite the agriculture best, Western Uttar Pradesh is being neglected by the scientists with reference to MPN research. There are possibilities of finding the new nemic species which might be highly lethal to slug infection in the agriculture fields of this area.

Methods

Survey was conducted in agricultural fields of District Baghat, UP, India for the presence of Mollusks parasitic nematodes (MPN). During survey nematode was isolated through the soil baiting technique using Slugs (Gastropod), and was identified on the morphological, morphometrical and molecular basis.

Results

Based on the morphological and molecular parameters the nematode was identified of the genus *Oscheius* isolate OCS2, molecular evidence indicate the closeness of the species with already described *Oscheius myriophilus*. Molecular analysis of nearly full length small subunit of rDNA gene, D2D3 expansion of segment of the large subunit rDNA gene revealed it as a new species of genus *Oscheius*. The result of BLAST search using the newly obtained partial sequences also revealed it as a new species from Indian subcontinent. Distance matrix analyses and phylogenetic studies also provide better evidence to establish nematode as a species of *O. myriophilus*. The morphometric characteristic of new species are: male body “J” shaped on fixation, a short part of tail protruding beyond the bursa, spicule paired, symmetrical, nine pairs of genital papillae is

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present; females are almost straight upon fixation, vulva is covered with double flapped epipygium tail is long with pointed tips, juvenile body cylindrical, mouth smooth, tail long pointed as a part of hyaline.

Conclusions

Enormous molluscicides are being used by the farmers which increase the crop productivity and their residual effects are directly or indirectly harmful not only to non-targeted soil fauna but animals and humans too. Documentation of the nemic fauna of slugs will also help to the academia for progression of the work in searching the bio-control agent and formulation development against slug pests.

Keywords: Mollusks parasitic nematodes, Slugs, *Osccheius myriophilus*, BLAST and phylogenetic.

EFFECT OF SILICEA, ARSENICUM ALBUM AND VERMIWASH ON GROWTH, YIELD AND NUTRITIVE VALUE OF PEA (*Pisum sativum* L.)

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ABSTRACT

Experiment was conducted at Regional Agricultural Research Station, Ambalavayal, Wayndad district during *Rabi* 2019. Field study was conducted with an objective to assess the effect of various potencies of human homoeopathic medicine (Silicea 30 C, 200 C, Arsenicum album 30 C, 200 C) and vermi wash on the growth, yield and nutritive value of Peas (*Pisum sativum* L.). The experiment consists of 12 treatments with 3 replications. Foliar application of vermiwash and Arsenicum album 200C at vegetative stage and flowering stage had significant influence in enhancing growth, yield attributing characters and grain yield in Pea. Higher protein content was observed with foliar application of Silicea 30C at vegetative stage and flowering stage.

(Key words: Arsenicum album, growth & yield, *Pisum sativum*, Silicea, vermi wash)

INTRODUCTION Pea (*Pisum sativum* L.) is one of the important vegetables in the world and ranks among the top 10 vegetable crops. Pea is commonly used in human diet throughout the world and it is rich in protein (21-25 %), carbohydrates, vitamin A and C, Calcium, Phosphorous and has high levels of amino acids ie., lysin and tryptophan.

MATERIALS AND METHODS

Experiment was conducted at Regional Agricultural Research Station, Ambalavayal, Wayndad district, part of Western Ghat in Kerala during *Rabi* 2019. Soil type was forest loam soil with pH 5.62, Organic carbon 1.6 %, available phosphorus 10.14 kg ha⁻¹, and available potassium 333 kg ha⁻¹. The experiment consists of 12 treatments (foliar application of Silicea 30C at vegetative stage, foliar application of Silicea 30 C at vegetative stage and flowering stage, foliar application of Silicea 200C at vegetative stage, foliar application of Silicea 200C at vegetative stage and flowering stage, foliar application of Arsenicum album 30C at vegetative stage, foliar application of Arsenicum album 30C at vegetative stage and flowering stage, foliar application of Arsenicum album 200C at vegetative stage, foliar application of Arsenicum album 200C at vegetative stage and flowering stage, foliar application of vermiwash at vegetative stage, foliar application of vermi wash at vegetative stage and flowering stage, foliar application of water spray at vegetative stage and foliar application of water spray at vegetative stage and flowering stage) with 3 replications.

RESULTS

The results showed that the plant height at 10 days after flowering stage was significantly affected by the treatments. Foliar application of vermiwash at vegetative stage and flowering stage recorded significantly higher plant height (50.17 cm) and similar results were observed with foliar application of vermiwash at vegetative stage, foliar application of Arsenicum album 200C at vegetative stage and flowering stage, foliar application of Arsenicum album 200C at vegetative stage and foliar application of Arsenicum album 30C at vegetative stage and flowering stage. The yield attributes like number of pods per plant, number of seeds per pod and resulted grain yield were also significantly affected by the treatments.

Foliar application of vermiwash at vegetative stage and flowering stage registered significantly higher number of pods (6.2). The treatments like foliar application of vermiwash at vegetative stage, foliar application of Arsenicum album 200C at vegetative stage and flowering stage, foliar application of Arsenicum album 200C at vegetative stage tillage, foliar application of Arsenicum album 30C at vegetative stage and flowering stage and foliar application of Arsenicum album 30C at vegetative stage were also found significant. Number of seeds per plant of Pea was significantly affected by the

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treatments. Foliar application of vermiwash at vegetative stage and flowering stage observed significantly higher number of seeds per plant (17.8) and similar results were registered with foliar application of vermiwash at vegetative stage, foliar application of Arsenicum album 200C at vegetative stage and flowering stage, foliar application of Arsenicum album 200C at vegetative stage tillage and foliar application of Arsenicum album 30C at vegetative stage and flowering stage.

Foliar application of vermiwash at vegetative stage and flowering stage registered significantly higher grain yield (814.1 Kg ha⁻¹). Foliar application of Arsenicum album 200C at vegetative stage and flowering stage (788.3 Kg ha⁻¹) and foliar application of Arsenicum album 200C at vegetative stage (782.2 Kg ha⁻¹) were showed statistically similar result for enhancing grain yield than other treatments and control. While comparing with water spray (control) all the treatments except foliar application of Silicea 30C at vegetative stage recorded statistically enhanced grain yield. The significant increase in the growth and enhancement of grain yield of Pea due to high level of macro and micronutrients available in the vermiwash. The experiment with *Vigna mungo* and *Vigna radiata* Hatti, *et al.* (2010) recorded the significant improvement of growth and yield of respective crops. The experiment with solutions of potentised homeopathic medicine Arsenicum album demonstrated a biological response in their effects on germinating seeds, seedlings development and photosynthetic activity of pea (Panda *et al.*, 2013). They also proved that photosynthetic pigments like chlorophyll –a, chlorophyll –b, total chlorophyll, carotenoid and phaeophytin showed a positive effect when treated with higher potency homeopathic medicines. Enhancement in growth, yield attributes and grain yield may be due to the stimulatory effect of potentised homeopathic medicine. The present field experiment also in conformity with above studies.

The quality and nutritive parameters had a positive relation with treatments. Vermiwash foliar spray at vegetative stage registered higher moisture content in grain (9.74 %) while foliar application of Arsenicum album 200C at vegetative stage recorded the lower moisture content of 5.33%. Higher protein content was observed with foliar application of Silicea 30C at vegetative stage and flowering stage registered (23.80 %). Foliar application of Arsenicum album 200C at vegetative stage and flowering stage registered higher crude fibre content in grain (3.96 %) while foliar application of Silicea 30c at vegetative stage T₁ recorded the lower fibre content of 1.31%.Foliar application of vermiwash at vegetative stage recorded higher Calcium content in grain (1.44 %) while foliar application of Arsenicum album 200C at vegetative stage and flowering stage and foliar application of vermiwash at vegetative stage and flowering stage recorded the lower crude protein content of 1.17% .Foliar application of Silicea 30c at vegetative stage recorded higher Phosphorus content in grain (0.40 %) while foliar application of Arsenicum album 200c at vegetative stage and flowering stage registered the lower value of 0.15% .

CONCLUSION

Foliar application of vermiwash and Arsenicum album 200C at vegetative stage and flowering stage had significant influence in enhancing growth, yield attributing characters and grain yield in Pea. Higher protein content was observed with foliar application of Silicea 30C at vegetative stage and flowering stage.

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Effect of Gibberellic Acid and Naphthalene Acetic Acid on Seed Germination of *Rubus species* Manju, Nikesh Chandra and Gopalmani,

ABSTARCT

Pupose

Rubus belongs to family Rosaceae, which encloses a large number of highly variable and heterogeneous species, which occur in all parts of the world except dessert regions. The genus has been divided into 12 subgenera of which only a few species have been domesticated. Rubus species have been known since ancient times for their curative properties, and have been used for the treatment of various ailments, such as wounds, diarrhea, colic pain, diabetes, inflammatory disorders, and as antimicrobial agents. Rubus spp have been eradicated from the Himalayan region in order to reclaim the hill slopes for agriculture and for the development of arban areas. The present investigation was therefore carried out at College of Horticulture VCSGUUHF Bharsar during the year 2020, to evaluate the effect of GA₃ and NAA concentrations on seed germination and seedling growth of Rubus species found in Himalayan region, which would be useful in the management strategies for protecting its endangered population.

Methods

The present investigation was carried out to evaluate the effect of GA₃ and NAA different concentration on seed germination and seedling growth of three species of Raspberry namely Rubus niveus, Rubus paniculatas and Rubus ellipticus. The experiment was laid out in Randomized Block Design with seven treatments (GA₃ 50, 75,100 ppm NAA 50, 75, 100 ppm and water soaking as control) and three replications.

Results

The result revealed that the Among the Rubus sp. under study best result showed in Rubus niveus and Rubus ellipticus showed the minimum responses to the growth regulators for seed germination and seedling growth. All the treatments show the significant effect on seed germination and seedling growth in all the species. While GA₃ was found the most effective treatment to enhance seed germination, height of plant and number of leaves per plant as compared to NAA.

Conclusion

For the improvement of seed germination and seedling growth of Rubus species GA₃ can be used.

Key words: Rubus, Raspberry, Germination, Seedling.

INCORPORATION OF CONTINUOUS AND INTERMITTENCE MICROWAVE APPLICATION ON CONVECTIVE DRYING OF GRATED BEETROOT

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ABSTRACT

Purpose

Microwave and hot air drying have several limitations which may result in substantial degradation in quality attributes, such as color, nutrients, and flavor. However, recent studies involving their combination system has helped in keeping the limitations in check.

Methods

Grated beetroot was subjected to convective drying employing continuous and intermittent microwave application. Microwave power levels used varied from 60-80%, while the inlet air temperature kept between 40°C - 60°C. The intermittence time of microwave application ranged from 30s ON – 30s OFF to 30s ON – 60s OFF. The corresponding pulse ratios for these ON–OFF timings were 2.0 and 3.0 respectively. Rehydration and drying characteristics of the dried samples were analysed. The samples were also subjected to color analysis using Hunter Lab color system.

Results

The drying time during continuous and intermittent microwave-convective drying ranged between 25 to 60 min and the final moisture ranged between 0.0483 and 0.0753 g of water/ g of dry matter. Color kinetics indicated that L*, a* and b* values followed exponential degradation models. Total color change (ΔE) followed exponential growth model and was significantly

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affected only by inlet air temperature. The hue angle for all the dried samples ranged between 8.283° and 28.405° indicating that the color of the dried beetroot samples were reddish. Rehydration ratio was found to increase when microwave input power was increased at given drying air temperature and vice-versa.

Conclusions

Distinct differences were observed in drying times according to the various conditions applied, with shortest time for sample dried under continuous drying system. Samples subjected to higher microwave power exhibited highest rehydration value due to increased porosity of dried product at higher microwave power resulting in increased absorption of water during rehydration. However, intermittence resulted in reduced color loss and better redness value of dried product despite having longer drying periods. Thereby, suggesting that intermittent microwave–convective drying conducted at lower drying air temperature and microwave power level resulted in better quality, such as color preservation, and less destruction of the dried products.

Keywords: microwave-convective drying, rehydration ratio, color change, redness value

Adaptation of water conservation technique mulching to mitigate water crisis due to river Sand mining in state Bihar, India

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ABSTARCT

Purpose

The purpose of this study to popularize the water conservation techniques among farmers specially in river sand mining areas. In state Bihar most of the districts are facing water crises during summer and winter season, ground water goes down. So that water conservation practice like mulching can be played a major role to minimize the water loss, improvement in soil health, increase in production, enhance the production and productivity of vegetable crops, minimization of manpower in agriculture. In Bihar agricultural laboures in also a big issue because most of the farmers migrated of the employment to other states. Therefore use of mulching in different crops, types of mulches and its adoption among the farmers has taken in the study.

Methods

The present study was attempted to documents all types of mulches, which is easily available to the vegetable farmers over time for confronting the water crisis in the district –Banka, Begusarai –Bihar state, India. Across-sectional and questionnaire-based survey was conducted to collect primary data. The pre-test interviewing questionnaire consisted of 8 sections with 49 questions. A total of 94 vegetable growers of the district Banka Begusarai and Vashali selected as respondent for the study.

Results

All colored plastic mulch significantly had higher marketable yield compared to bare soil. Marketable yield increased by 65% in silver/black followed black (50%), blue (40%), red (26%) and clear plastic mulch (24%). The increase in yield of mulched plot was probably associated with the conservation of moisture and improved microclimate both beneath and above the soil surface and great weed control, spacially in silver/black and black plastic mulch. Reference [25] found that use of black polyethylene mulch plus drip irrigation further raised the tomato yield by 57.87 t/ha. The lowest marketable yield was also obtained in weedy plots, due to severe competition of weeds with tomato plants.

Conclusion

In this study, plants grown on plastic mulches produced more number of branches and leaves than those in bare soil. The use of plastic mulch increased soil temperature 3.3 to 6.6°C compared to without mulch. The silver/black and Black plastic mulch controlled weeds by 95 to 98%. The light transmitter plastics advanced earliness and the highest early yield was obtained in clear plastic mulch. This can be attributed to increase soil temperature under plastic, when air temperature was low at early spring. The marketable yield was greater with the use of plastic mulches (up to 24 to 65%) compared to bare soil. The increase in yield of mulched plots was probably associated with the conservation of moisture,

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improved microclimate both beneath and above the soil surface, light reflection and great weed control, specially in silver/black plastic mulch.

ECONOMIC VALUATION OF NON-TIMBER FOREST RESOURCES (NTFRs) FLOWS IN THE GUREZ VALLEY OF KASHMIR

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ABSTRACT

Background

The non-timber forest resources (NTFRs) play an important role in livelihood security, poverty alleviation, economic well-being, rural enterprises and socio-economic development of rural people (Islam et al., 2015). More than two billion people around the world depend on non-timber forest resources (NTFRs) for food, fodder, fuel, shelter, medicine, cash income and employment (Ahenkan and Boon, 2011). Over the past years, the recognition of the widespread dependence of rural people on NTFRs and the poverty-NTFRs use relationships have spawned a growing scientific interest in demonstrating the economic dependence on NTFRs and understanding its determinants (Islam and Quli, 2017). The study investigated the household collection, subsistence consumption, economic contribution and socioeconomic determinants of NTFRs in Gurez valley of Kashmir.

Methodology

Multi-stage random sampling was employed to select villages (18) and households (337) in the valley. Data were collected using both secondary sources and primary field survey. Secondary data were collected from all the possible sources. The primary data were collected by structured interviews, non-participant observation, focus group discussions and rapid market assessments. Descriptive statistics and multiple linear regression models were used to analyze the data.

Results

The study finds that 176 NTFRs were collected, consumed for subsistence and marketed for cash income by the *Shina* tribe. NTFRs contributed a total income of ₹ 10357156/year @ ₹ 30733.40/household/year. NTFRs accounted for the 3rd key contributor (20.41%) to economic wellbeing after agriculture (30.62%) and livestock (22.68%) in the surveyed people. Of the total NTFRs income, herbal medicines contributed largest share (45.32%) followed by cottage industry materials (23.04%), spices (12.74%), wild vegetables (8.22%), fuel wood (3.59%), edible nuts (2.39%), *shilajeet* (1.80%), fodder (1.40%), edible fruits (0.74%), beverages (0.49%) and incense (0.27%). Among plant parts used, whole plants, roots rhizome, tubers, leaves, flowers, fruits, seeds, stems, and barks were used by the forest fringe dwellers. The extent and pattern of household dependence on NTFRs for subsistence and income differ widely across different socioeconomic profiles. Regression analysis showed that herd size, main occupation, gross annual income, proximity to forests, frequency of forest visits and forest resource possession influenced significantly the intensity of household NTFRs income.

Conclusion

The findings suggest that NTFRs play an important role in securing rural livelihoods in terms of subsistence consumption, cash income and safety net for households. Hence, policy implications are needed towards the livelihood diversification through sustainable collection, value addition and commercialization of NTFRs. Further, attempts to promote sustainable forest management and biodiversity conservation should recognize these determinant factors that influence NTFRs flows and forest income levels to ensure equitable responsibility and benefit sharing systems for better livelihoods.

Keywords: Economic valuation, NTFRs flows, socioeconomic factors, livelihoods, income, Gurez valley, Kashmir.

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IMPACT OF VARIOUS SOURCES OF SEED PRIMING ON GROWTH YIELD AND QUALITY OF SPINACH LOCAL (*Spinacia olearacea*) in-vitro AND in-vivo CONDITION

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ABSTRACT

Purpose

Spinach (*Spinacia olearacea*) is one the nutritious green leafy vegetable which usually encounters with poor germination which results in late germination, reduces uniformity, resulted in poor quality and low yield. Proper and healthy seed germination is one the basic step towards a good crop yield which can be done by seed priming. This experiment was conducted to study, how different priming treatments work on spinach on the basis of different quality parameters observed under lab(in-vitro) and field (in-vivo) conditions.

Methods

The experiment was conducted in Vegetable Science Department under the Defence Institute of Bio-Energy and Research (DIBER), (DRDO), Pithoragarh, Uttarakhand in the year 2020-2021 to standardize the best treatment of seed priming specific to Spinach (*Spinacia olearacea*). An investigation was conducted both in a laboratory and on the field with the same treatment that was: (T1) Distilled water, (T2) 1%NaCl, (T3) 1%H₂O₂, (T4) 1%Na₂CO₃, (T5) Tap water, (T6) 1%DAP (T7) Control. Seeds were soaked for 16 hrs and then dried to original moisture content for 2 days.

Results and conclusion

All the treatments showed a significant difference with control. Highest germination percent (71%) was recorded in seeds treated with 1% DAP in lab (in-vitro) while seeds treated with 1%Na₂CO₃ showed good response in field condition (in-vivo). The conclusion came through this experiment is, both 1% DAP and 1% Na₂CO₃ gave good response while 1%Na₂CO₃ proved to be more effective in field

Keywords: seed, germination, priming treatments, uniformity.

Wild apricot (*Prunus armeniaca*) and mung bean-garlic based agroforestry system affects growth and yield parameters

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ABSTRACT

Purpose

The present investigation was carried out at Faculty of Veterinary sciences Shuhama, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, during the year 2017 and 2018. The main aim behind this research was to work out the economic importance of mung bean-garlic based agroforestry system and effective land use system.

Methods

The experiment was laid out in a randomized block design with three replications comprising eight treatments. Two crops mung bean and garlic were intercropped with 11 year old orchard of apricot planted at spacing of 3m x 2m. The influence of different treatments on growth and yield parameters of mung bean and garlic was studied. The seeds of mung bean were sown in the month of June and garlic cloves were sown in the month of November respectively.

Results

Growth and yield parameters like plant height , number of pods per plant, pod yield, number of seeds per pod, and total biomass in mung bean and plant height, bulb yield, no. of cloves per bulb, diameter of bulb and total biomass in garlic were less when these crops were grown in combination with apricot trees in comparison to sole cropping. Results revealed that maximum values for plant height (39.13 cm), number of pods (23.83), no. of seed per pod (13.17), pod yield (1002.40 kg/ha),

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grain yield (506.20kg/ha), straw yield (1936.67 kg/ha), (above ground biomass (1471.04 kg/ha), below ground biomass (196.40 kg/ha) and total biomass (1667.44 kg/ha) were recorded under sole cropping in mung bean, whereas plant height (56.13 cm), no. of cloves per bulb (12.36), diameter of bulb (3.74cm), bulb yield (8.93 t/ha) and total biomass (2472.23kg/ha) were recorded under sole cropping in garlic while as lowest values for aforementioned parameters were observed under agroforestry system.

Conclusion

The better growth and yield parameters of apricot were observed in agroforestry system than in control (only apricot). It is suggested that the cultivation of mung bean & garlic in apricot based agroforestry system may be recommended for better yield and economic returns.

Key words: Agroforestry, Mung bean, Garlic, Apricot, yield

Effect of growing media with GA₃ on seedling and physiological growth of Acid lime (*Citrus aurantifolia* Swingle) Cv. Vikram

Mohni Parmar, Amit Kumar,

ABSTRACT

Purpose

Citrus fruits are one of the most delicious fruits belonging to the family Rutaceae. India is the largest producer of acid lime in the world. Lime or acid lime is also commercially known as ‘Pati lime’ or ‘Kagzi lime’. Growing media play an important role in germination of seeds and for further growth and development of seedling. The Acid lime seeds are recalcitrant in nature therefore, nursery men faces the problem of poor germination of acid lime seed which having very short storage period. For overcoming such type of problems at nursery stage, investigation is important to find out the influence of storage period by using storage media on seed germination and growth of acid lime seedlings

Methods

The experiment consist of six growing media viz. (M1) soil (M2) soil + sand (1:1), (M3) soil + sand + vermicompost (1:1:1), (M4) soil + vermicompost (1:1), (M5) soil + sand + *azotobacter* (1:1+5g/ kg AZO), (M6) soil + sand + vermicompost + *azotobacter* (1:1:1+5g/kg AZO) and three concentration of gibberellic acid i.e. (G1) water soaking, (G2) GA₃ 50 ppm, (G3) GA₃ 100ppm having 18 treatment combinations The experiment was laid out in poly bags in factorial randomized block design with three replications. Observations were recorded using standard procedure and statistically analysed.

Results

The experiment was carried out at Fruit Research Station, Imalia, Department of Horticulture, College of Agriculture, JNKVV, Jabalpur (M.P.) during September 2018 to January 2019. Among all the growing media, soil + sand + *azotobacter* (1:1+5g/ kg AZO) and among all the seed treatment, GA₃ (50ppm) were proved most promising as compare to others. Among the various treatment combinations, the M5G1 treatment combination (soil + sand + *azotobacter*; 1:1+5g/ kg AZO + 50ppm GA₃) was proved most superior over rest of the treatment combinations with respect to fresh and dry weight of shoots (2.29, 1.91, 2.45 and 0.90, 0.57, 0.94 respectively). Fresh and dry weight of roots (1.48, 1.28, 1.73 and 0.53, 0.30, 0.62 respectively). Seedling vigour index I (cm) and II (g) (2340.11, 2145.20, 2455.03 and 103.88, 55.04, 119.59). Leaf area index (2.65, 2.07, 2.89). Leaf area Duration (4425.89, 4141.16, 4560.90).

Conclusion

1. Seedling growth parameters like fresh & dry weight of shoots and fresh & dry weight of root were significant by various treatments. Among the treatment M5G2 (soil + sand + *azotobacter*; 1:1+5g/ kg+ AZO & GA₃ 50ppm) was found to be significantly superior to rest of the treatments under study.
2. Physiological growth parameters like Seedling vigour index I (cm) & II (g), Leaf area index and Leaf area Duration were significant by various treatments. Among the treatment M5G2 (soil + sand + *azotobacter*; 1:1+5g/ kg+ AZO & GA₃ 50ppm) was found to be significantly superior to rest of the treatments under study.

Keywords: - Acid lime, GA₃, *Azotobacter*, Growing Media, Growth parameters, Vikram etc.

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Farm mechanization and post-harvest technologies to enhance farm profitability

Sheetal Patel and Pooja Puri

ABSTARCT

Mechanized agriculture is **the process of using agricultural machinery to mechanize the work of agriculture**, greatly increasing farm worker productivity. In modern times, powered machinery has replaced many farm jobs formerly carried out by manual labour or by working animals such as oxen, horses and mules. Agricultural machinery applications are divided into preharvest and postharvest operations. In the preharvest preparation phases, soil sampling and analysis, field preparation, transplantation or broadcasting, and crop scouting and intercultural operations could be mechanized. The postharvest phases cover harvesting, yield monitoring, transportation, threshing, drying, storage, parboiling, milling, and packaging. Machinery companies and original equipment manufacturers are attempting to offer more smart applications involving user registration for the tracking of harvesting, drying, threshing, milling, and packaging operations, ensuring the traceability of products from farm to table. Sharing cost-effective farm machinery systems and technologies including digital technology-enabled automated farm machinery and devices in various stages of farm operation are critical.

POSSIBLE WAYS OF IMPROVING FARMMECHANIZATION

1. Education of farmers to accept and adopt modern method of farming.
2. Loans should be given to farmers to enable them purchase farm machines.
3. The system of farm ownership should be reviewed to enable farmers acquire land.
4. Simple and less expensive machine should be developed to suit our local soil type.
5. Farmers should be encouraged to form co-operative societies to enable them buy farm machines.
6. More extension agent should be employed to educate farmers.

Post-harvest technologies identified fourteen post-harvest technologies were described by farmers using the attributes; technology function and storage life They were broadly classified into-traditional and improved

Traditional technologies - technologies were those that are local by nature and have evolved over time through transfer from one farmer generation to the other. They comprised insitu storage, house floor storage, grass silos, roof top drying, tree hanging, open fires and underground pits.

Imported or improved technologies- Imported or improved technologies

The imported technologies comprised, metal tanks, concrete tanks, maize crib, warehouse storage and bag/bale storage.

Conclusion- The conclusion is confirms that consistent knowledge about farms leads to optimal decisions for improving farm mechanization and post-harvest technologies to enhance farm income and greatly increasing farm worker productivity.

ROLE PERFORMANCE OF DAESI DEALERS

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ABSTARCT

Agricultural Extension plays a crucial role in providing real time information based on farmers needs. Continuous extension support becomes crucial for all the farmers all the time. Ministry of Agriculture, GOI stressed to have multi agency extension services to help farmers to improve in agricultural practices by disseminating the suitable technologies. Among all agencies the input dealer agency constitutes 2.82 lakh input dealers and farmers themselves contact input dealers for their problems or for input requirement. Majority (90.00%) of the dealers do not have formal education related to agriculture. With this, MANAGE, Hyderabad has designed one year Diploma in Agricultural Extension Services for input dealers (DAESI) in 2003. Self financed one year training programme for dealers by providing required agricultural knowledge and to build their capacity in ordered to handling of agri-inputs according to laws and rules has designed. And it helps to reduce the problem of technical know –how and do how, importantly on local problems in the farms. The DAESI training programme helps input dealers of DAESI programme to carry out the effective work in the field and they become the most important source of information to farmers and can be transformed as para agricultural extension professionals.

OBJECTIVE OF THE STUDY:

So, keeping in view of above information it is considered as more important to “know the role performance of input dealers of DAESI programme”.

METHODOLOGY:

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The study was carried out in two districts of Karnataka state during 2019-2020. Sample size was 120 respondents constituted DAESI dealers (60), non-DAESI dealers (60). An ex-post facto research design was followed. A pre-tested and self structured questionnaire was used to collect data from input dealers. The collected data was tabulated and analyzed by applying suitable statistical tests. ‘t’ test was applied to know the difference between DAESI input dealers and non-DAESI input dealers role performance

RESULTS:

Cent per cent (100.00%) of DAESI input dealers performed high roles. Among non-DAESI input dealers, nearly two third respondents performed low (63.33%) and more than one third (36.66%) respondents performed medium roles. Input dealers own experiences helped them to perform better roles in their profession.

The mean score of DAESI dealers’ role performance was 35.4833 and non-DAESI dealers mean value was 20.4667. It represented role performance of dealers, there was highly significant difference was noticed between DAESI and non-DAESI dealers’ role performance. DAESI input dealers performed high role than non-DAESI input dealers. The DAESI training programme helped respondents of DAESI dealers to carry out the work in the field effectively. It also helped them to identify the field problems, finding out the solutions, reporting the services to the officers, to ensure the quality of services to adopt appropriate inputs and to identify appropriate technologies and also they have collected feedback from farming community and reported to the concerned officers. One of the adult learning principles states that adults learn best when their thinking is stimulated. DAESI programme effective to the extent it stimulates thinking of understanding about the problems. Identify the cause- effect relationship will be more in this mode. It helped individuals to make concrete things than abstract things. Thus DAESI programme helped to work better as input dealers compared to non-DAESI dealers roles. The study findings supported by Ganiger (2012) and Sharma (2017) expressed that most of the DAESI dealers were medium category to high category of role performance.

CONCLUSION:

Cent per cent of the DAESI dealers performed high level of roles or services. Non-DAESI dealers were performed low to medium level of roles. DAESI course was more useful and effective for input dealers. It provided location specific information and knowledge to the dealers and made them as para-extension professionals to serve the farmers in a better way.

It was noticed that there was high significance difference between DAESI and non-DAESI dealers role performance. So we can predict DAESI programme builds DAESI individuals capacity to perform better roles. Hence, DAESI programme made compulsory and very much necessary to the overall development of input dealers as well as farmers

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Constraints faced by livestock farmers of Central Kashmir in using Indigenous Technical Knowledge (ITK)

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ABSTRACT

The present study was carried out in the central Kashmir part of the Kashmir Valley to know about the constraints faced by livestock farmers regarding the use of Indigenous technical Knowledge. Three districts of the central Kashmir were chosen for the study and from each district two blocks were taken. A total of 180 respondents were chosen for the study. A number of constraints were faced by farming most important being the non-availability of the raw material and least important being less faith of the younger generation towards ITKs. There is urgent need of the Government agencies and NGO’s to give attention towards this untapped natural resource.

Introduction: India is having a rich heritage of the traditional health control methods and several treatment systems. After independence as the country shifted its focus from indigenous to modern methods both in agriculture and veterinary sciences, efforts of the government sector were more centred towards developing an allopathic based veterinary structure. The shift towards modern practices was the need of hour but in this course of time less attention was given towards the indigenous

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technical knowledge, its preservation and documentation. All this resulted in less awareness and more skepticism about ancient literature and ITKs among the main stakeholders associated with livestock production (Rangnekar, 1998). Modern medicine that was once thought to solve all the problems related to human and animal health is presently facing many challenges like side effects, drug resistance and has put its use under question mark (Devaki and Mathialagan, 2015). Giving a full time attention to conventional medicine and total negligence towards the traditional practices can prove disadvantageous to both the systems as the two complement each other. There is no doubt that the modern medicine has revolutionized the treatment aspect but the need of the hour is to take the traditional healing system along with it. From last few decades due to replacement of traditional practices with modern scientific practices both at national and international levels, majority of people consider the traditional practices as ineffective and useless (Bizimana, 1997). In spite of all these efforts research in this field is still in its early stages and only a little portion is documented till now (Das and Tripathi, 2009). Despite acknowledgement of the important role indigenous knowledge plays in sustainable development many governments, donors, and NGOs appear to take little efforts towards this valuable resource. The recognition of indigenous knowledge often amounts to little more than lip service, seldom translating into action or funding (Gachanga, 2005). There is an urgent need for integration of traditional practices with modern scientific knowledge so that the society in general and farming community in particular can make better use of ITKs to take best advantage (Shubeena *et al.* 2018)¹

Materials Methods: The Kashmir division of Jammu and Kashmir state consists of 10 districts. Central Kashmir the locale of the study consists of three districts viz., Budgam, Ganderbal and Srinagar. For the present study two blocks from each of the above districts were purposively selected based on the greater use of ITKs in livestock rearing by the farmers of the region. On similar grounds from each of the block chosen two villages were selected purposively that made a total of 12 villages for the study. Finally from each selected village 15 livestock farmers were chosen by snowball sampling with the condition that respondent must be rearing at least one livestock unit. Thus a total of 180 livestock farmers/respondents were selected and interviewed on various identified variables based on the objectives of the study.

Results and discussion: A number of constraints were perceived by farmers regarding the use of indigenous technical knowledge in livestock rearing. The major constraints as mentioned in the table 1 include non-availability of raw materials used in preparation of ITKs, longer healing duration of ITKs and hit and trail method of use of ITKs. Similarly the constraints perceived less serious by the farmers include lesser faith of younger generation over use of ITKs and constant decline in number of persons with precise knowledge of ITKs. Since the ingredients for most of the ITKs are rarely available in ordinary markets, the farmers have to face a lot of inconvenience in getting hold of these items. Further as there is no strict regime regarding dose and dosage of these ITKs, the farmers are forced to follow hit and trail method of ITK usage. The new generations believes in the scientific rationale of the things and believes what is experimentally validated. Among less severe constraints includes less faith of the younger generation over ITKs that can be due to availability of established scientific knowledge at an ease. Similar results were documented by Singh (2004), De (2003) and Ponnusamy *et al.*, (2009). Less availability of scientific literature regarding the usage of the ITKs was also a constraint reported by majority of the farmers (60.00%). The documentation of ITK’s remains a problem as less work has been done in this regard. It was also reported by Shubeena *et al.* (2018)² that documentation of ITKs is extremely important as it will help in creating a way towards sustainable development, protecting the intellectual property rights and will give deep insight into livestock related social realities that generally go unnoticed. Lack of any government and research initiative for promotion of ITKs was a contain reported by majority (71.11%). Modernization and popularity of the scientific knowledge has resulted in less popularity of the ITKs among the people. It was reported by Sujeetha and Asokhan (2020) that availability of modern technologies make it difficult for people to go for ITK’s and Khateeb *et al.* (2017) reported that there is lack of attention paid by Government agencies towards the use and documentation of ITKs. The time of healing by ITKs is one of the constraints as the ITKs have plant based crude preparations that take time to show their action. This constraint can also be due to the indiscriminate use of modern drugs and sometimes the drug resistance that makes it difficult for ITKs to show their action. This can be also a reason for the less effectiveness of the ITKs on the cross bred animals. The traditional healers once found to be in every village now are almost extinct. With the death of the traditional knowledgeable person there is loss of the so much precious knowledge that shows the importance of the documentation of the ITKs.

Table 1: Constraints perceived by livestock owners regarding use of indigenous technical knowledge (ITK)

(N=180)

S.No.	Constraints	Yes	No	Low (1)	Medium (2)	High (3)	Score	Rank
1.	Lack of scientific validation and standardization	105 (58.33)	75 (41.66)	30 (28.57)	40 (38.09)	35 (33.33)	2.04	VI

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2.	Take time in healing and bringing about desired results	90 (50.00)	90 (50.00)	20 (22.22)	30 (33.33)	40 (44.44)	2.22	II
3.	Unstable nature of the ITKs.	120 (66.66)	60 (33.33)	40 (33.33)	45 (37.05)	35 (29.16)	1.95	VII
4.	Constant decline of persons with precise knowledge of ITKs	85 (47.220)	95 (52.77)	35 (41.17)	30 (35.29)	20 (23.52)	1.82	IX
5.	Non availability of raw materials round the year	110 (61.11)	70 (38.88)	20 (18.18)	30 (27.27)	60 (54.54)	2.36	I
6.	ITKs are used on basis of hit and trail method without proper dosage regime	80 (44.44)	100 (55.55)	20 (25.00)	25 (31.25)	35 (43.75)	2.18	III
7.	Less effectiveness in cross bred animals.	93 (51.66)	87 (48.33)	25 (26.88)	33 (35.48)	35 (37.63)	2.10	V
8.	Lack of any government and research initiative for promotion of ITKs	128 (71.11)	52 (28.88)	50 (39.06)	40 (31.25)	38 (29.68)	1.90	VIII
9.	Non availability of documented literature to be consulted for usage, dosage and side effects if any.	108 (60.00)	72 (40.00)	33 (30.55)	33 (30.55)	42 (38.88)	2.08	IV
10.	Lesser faith of Young generation over indigenous treatments.	88 (48.88)	92 (51.11)	43 (48.86)	25 (28.40)	20 (22.72)	1.73	X

(Figure in parenthesis indicate percentage)

Conclusion: With every passing day the traditional knowledge is losing its battle to exist in front of the modern treatment avenues available at ease. This calls for a need of documentation and validation of the Traditional Knowledge along with the conservation and preservation of the traditional plants and the tracts where they mostly grow. The government and private agencies, NGO’s should give due consideration towards this treasure of the knowledge.

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Zero Tillage Technology and Farm profits through FLD with small land holding farmer of district Begusarai, Bihar

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ABSTRACT

Purpose

Conservation tillage, such as stubble mulch tillage, minimum tillage, reduced tillage, and no-tillage, leaves at least 30% of the soil surface covered by plant residue after planting to reduce erosion and surface runoff. Zero Tillage indicates “sowing without tillage”. Zero tillage (ZT) is interpreted here as the planting of crops (wheat) in previously untilled soil. Zero tillage (ZT) is also known as zero till, no till, direct seeding and direct drilling (Erenstein et al., 2008b). The prevailing ZT technology in the IGP uses a tractor drawn zero-till-seed drill to seed wheat directly into unplowed fields with a single pass of the tractor. The typical ZT drill has inverted-T openers and opens a number (6–13) of narrow slits for placing seed and fertilizers at the depth of 7.5–10 cm into the soil (Mehla *et al.*, 2000). Tillage is the mechanical manipulation of soil to provide favorable condition for crop growth. Surface of earth remain hard and compact which is unfavorable for the sowing of seed. Soil tillage consists of breaking the compact earth surface to a certain depth and loosening the soil mass to enable the roots of the crop to penetrate and spread into the soil. Tillage creates the favorable condition for the plant growth. It is the first operation for the crop production and requires higher amount of energy as well as it is a high cost operation. Primary tillage and secondary tillage are required for the complete seedbed preparation. Primary tilling implements may be animal drawn or tractor drawn. Secondary tillage is the lighter and finer operation and performs after primary tillage operation. It includes different types of implements like Disc harrow, cultivator, levellers, and similar implements. The main objectives of secondary tillage operations are-

- To break the clods of soil which are left after primary tillage and pulverize the soil
- To make the field surface uniform for the sowing operation.
- To destroy weeds and seeds left on the surface of soil

Both tillage operations are required for complete seedbed preparation which is costly for the farmers.

Methods

Agro Ecological sub region (ICAR) Eastern plain of Begusarai is hot sub humid (moist) eco sub region. A front line demonstration conducted with 20 farmers of the district. Total geographical area of Begusarai is 187.8 ha and cultivable area is 159.5 ha. Cropping Intensity is 137%. Main cropping system of Begusarai district is Rice-Wheat, Maize –Wheat, Rice-Wheat- Green gram, Vegetable-Wheat, Rice-Rabi Maize, Maize-Rabi Maize, Rice-Pulses, Rice-Oilseeds, Rice-Vegetables, Rice-Potato & Soybean-Wheat. Frontline demonstration has been conducting by KVK Begusarai since 2016. The primary data on output of wheat yield were collected from the selected farmers who sown wheat by zero tillage under this programme (FLD plots), besides the data on local practices commonly adopted by the farmers of this region were also collected with the help of interview schedule and presented in term of percentage and qualitative data was converted in to quantitative form and expressed in term of percent increased yield was calculated by the using formula.

$$\text{Percentage increase yield} = \frac{\text{Demonstration yield} - \text{Local check yield}}{\text{Local Check yield}} \times 100$$

Benefit cost ratio calculated by the formula given below-

$$\text{B: C Ratio} = \frac{\text{Net Return}}{\text{Cost of Cultivation}}$$

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Most the respondents having average land holdings 1.48 acre. They mainly grows paddy, maize, wheat, some spices and vegetable crops like potato, cauliflower, cabbage etc. In Rabi season, they mainly grows wheat for domestic purpose as well as income purpose. In Traditional method they firstly prepared seedbed before sowing. During seedbed preparation two pass of cultivator and one pass of Rotavator was done. They hired the tractor along with implements for these operations.

Results

Harvesting of wheat done under the supervision of the KVK scientists. The yield from both the plots, *i.e.* demonstration and farmers' practices were compared and it is observed that an average yield of demonstrated plots was 15 per cent higher than that of farmer's practices. The average productivity under demonstrated plots was found 52.50q/ha in the year 2019. However, it was found 42 q/ha under farmers practice. Due to timely sowing and adoption of other recommended technologies, increase of yield under demonstrated plots was observed, It was also observed the higher wheat yield in zero tillage as ZT wheat farmers could sow the crop much earlier than their conventional counterpart and early sowing is associated with higher yield, as it was observed by Premet *al*; 2018 *i.e.* higher wheat yield in zero tillage as ZT wheat farmers could sow the crop much earlier than their conventional counterpart and early sowing is associated with higher yield, a significant and positive yield impact (Increased by 8 per cent) observed in the study area.

Conclusion

Zero tillage technology is beneficial and helpful for increasing income generation especially for small farmers. As early and timely sowing is possible due to mechanization, so beneficial effect of early sowing on grain and straw yields of wheat may be obtained by zero tillage technology. It maintains the soil moisture also, So by adopting this technology a farmer can increase his benefit by an approximately 40 per cent.

Key Words: Zero tillage, wheat cultivation, mechanization, impact.

Effect of levels and sources of phosphorus application on yield and Soil fertility status of black gram (*Phaseolus mungo* L.)

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ABSTARCT

Purpose: - Blackgram (*Phaseolus mungo* L.) is the most important pulse crop, grown across India and used as food for human and as fodder for livestock, as well as for green manuring. The blackgram crop is resistant to adverse climatic conditions and improves the fertility of soil through biological nitrogen fixations. Phosphorus is a key nutrient for increasing productivity of pulses and the most important single factor responsible for poor productivity of pulses (Deo and Khaldelwal, 2009).

Method:- The field experiment was conducted to study effect of levels and sources of phosphorus (P) application on yield and their fertility status in black gram (*Phaseolus mungo* L.) during kharif season of 2015-16 at research farm of R.V.S.K.V.V. Gwalior (M.P.). The experiment was laid out in RBD comprising of 8 treatments with 4 replications.

Result :- Results revealed that most of growth and yield parameters were significantly influenced by different levels and sources of P. The highest yield of grain (677.6 kg ha⁻¹) and straw (1443.4 kg ha⁻¹) were recorded with the application of 60 kg P₂O₅ ha⁻¹ through SSP along with N₃₀ K₃₀ closely followed by 60 kg P₂O₅ ha⁻¹ (656.6 kg ha⁻¹) through DAP and was significantly superior over application of 20 and 40 kg P₂O₅ ha⁻¹. Application of 60 kg P₂O₅ ha⁻¹ gave maximum higher net return and B.C. ratio as compared to 30 kg P₂O₅ ha⁻¹. SSP applied treatments gave more net return and B.C. ratio as compared to equivalent doses applied through DAP. Status of the available N, P, K and S improved significantly with increasing levels of P in post harvest soil however, but the soil pH decreased with levels of P. Both the sources of P were statistically at par with respect to pH, available N, P, K and S build up in soil.

Conclusion:- On the basis of results, it may be concluded that the present investigation, seed yields are affected by different P sources and increased with the increasing level of phosphorus. The economic feasibility in terms application of SSP gave more net return and B: C ratio as compared to same doses applied by DAP because per kg of phosphorus in SSP was cheaper as compared to DAP. The overall study clearly indicates that the application of phosphorus different doses (DAP & SSP) that indicated that is sustenance of soil health in terms of increase the soil fertility status *i.e.* organic carbon, N, P, K, & S. and it is significantly with increasing levels of phosphorus in post harvest soil. The status of available phosphorus increased in post-harvest soil with SSP than that of DAP.

Keywords: Phosphorus, physico-chemical properties, Fertilizer, Yield, economic

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Effect of Invigoration Treatment of Different Soaking Periods on Germination Performance of Bottle Gourd Seeds

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ABSTRACT

Purpose

This current experiment was conducted in a Seed Testing laboratory, Department of Genetics and Plant Breeding Sam Higginbottom University of Agriculture Technology and Sciences, Allahabad, Uttar Pradesh during January 2021 with calabash, so as to subsume the foremost method of invigoration of priming specific to calabash.

Methods

Method of invigoration as in priming viz., halopriming were assessed by checking a different period of durations and chemical concentrations viz., 1st treatment– Unprimed seeds (control), 2nd treatment - 50 ppm KNO₃ for 12 hrs, 3rd treatment - 50 ppm KNO₃ for 18 hrs, 4th treatment -100 ppm KNO₃ for 12 hrs, 5th treatment -100 ppm KNO₃ for 18 hrs, 6th treatment - 125 ppm KNO₃ for 12 hrs, 7th treatment- 125 ppm KNO₃ for 18 hrs. Experiment perform by between paper method and by sand method at control condition and where, the statistical data was done by using factorial experiment allocate by Completely Randomised Design (CRD).

Results

In this experiment it was found that, treatment 6th 125 ppm KNO₃ for 18 hrs., has the noteworthy result as compared to all the other treatments accompanying the seedling parameters, the highest germination %, seedling length, weight and vigor index I & II. This study showed that Seed priming with KNO₃ found to increases the seed quality parameters.

Conclusions

In this study demonstrated the market high paying and most reasonable method. This study makes possible to improve the worth and interpretation of seeds with the help of seed priming with KNO₃ treatments which have effect on market price rate and budgetary, innocuous, nature-friendly sources.

Keywords Bottle gourd, Potassium Nitrate (KNO₃).

A Study on Constraints Encountered in Animal Husbandry by Tribal Women of Southern Rajasthan

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ABSTRACT

Purpose

Animal husbandry is generally considered as a job of women where numbers of activities are performed by them. In spite of active involvement of women in different animal husbandry activities, lack of exposure and access to new technology and many other constraints have restricted women to show their full potential for the growth of livestock sector. The present research is an attempt to see the constraint faced by tribal women viz. personal, technical, operational and economic constraints have been examined.

Methods

The study was conducted in three districts of Rajasthan state namely Udaipur, Dungarpur and Banswara. Total sample of the study consisted of 100 tribal women. Investigator used interview schedule for gathering the data from the respondents. Frequency, percentage and mean percent scores were used for the analysis of data.

Results

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The results of the study pointed out that the most constraints expressed by the tribal women in animal husbandry were lack of decision making capabilities were expressed to a great extent by the majority of the respondent (70%) with 84 MPS. lack of information about government programmes and facilities provided for cattle keepers (90 MPS), insufficient knowledge of the important management practices like deworming, castration (85 MPS), non-availability of improved fodder seed (92.5 MPS), lack of credit facilities for purchase of cattle feed and mineral mixture (91 MPS), lack of knowledge about scientific method of milking (82 MPS) and lack of knowledge about cattle diseases and their control (80 MPS) were also major constraints perceived by the majority of the respondents.

Conclusions

It is clearly evident from the study that the respondents faced constraints to a greater extent in all the livelihood activities. There is a need to make efforts for minimizing and overcoming the constraints which are coming on the way.

Key words: Constraints, Animal Husbandry, Tribal Women and Southern Rajasthan

Isolation and screening of zinc solubilizing bacteria as potential bioinoculant for agriculturally important crops

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ABSTRACT

Purpose

Zinc is an essential micronutrient involved in various biochemical processes in plants including photosynthesis, respiration, chlorophyll biosynthesis, protein, lipid, carbohydrate and nucleic acid synthesis and degradation. Zinc deficiency is the most common cause of yield reduction in numerous agronomic crops cultivated around the globe. Plants can absorb only divalent form of zinc whose available (soluble) form in soil is present in very minute amount. Due to unavailability of zinc in soil, zinc deficiency occurs which is one of the most widespread micronutrient deficiency. For fulfilling the plant's zinc requirement, zinc solubilizing bacteria are potential alternatives which convert applied inorganic zinc to available forms. In present study, we aim to assess the potential of bacteria for zinc solubilization.

Methods

Ten bacterial isolates ZnSB-1, ZnSB-2, ZnSB-3, ZnSB-4, ZnSB-5, ZnSB-6, ZnSB-7, ZnSB-8, ZnSB-9 and ZnSB-10 were retrieved from different soil samples collected from farms of Chaudhary Charan Singh Haryana Agricultural University, Hisar on different media (Nutrient Agar, Luria-Bertani, Yeast Extract Mannitol Agar). All isolates were screened for their zinc solubilization potential on zinc minimal medium having zinc oxide as insoluble zinc compound.

Results

Zinc solubilization index of different isolates varied between 1.10-3.66 after 48 hours of incubation at 30±2°C. The isolate ZnSB-1 showed maximum zinc solubilization index (3.66) followed by ZnSB-6 (2.15) and ZnSB-9 (2.00).

Conclusion

Bacterial isolates ZnSB-1, ZnSB-6 and ZnSB-9 can be of agricultural importance after assessing their other plant growth promoting traits and mineral solubilization activities.

Keywords: Zinc, zinc solubilization, zinc deficiency, zinc solubilizing bacteria, micronutrient

FORMULATION & INVITRO EVALUATION OF GASTRO RETENTIVE DOSAGE FORM USING ALGINATE BEADS OF CLA RITHROMYCIN

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ABSTARCT

PURPOSE

Clarithromycin is an advanced generation macrolide antibiotic widely prescribed in H. pylori upper respiratory tract infections, mediated peptic ulcer. It is widely used in a standard eradication treatment of gastric H. pylori infection combined with a second antibiotic and an acid – suppressing agent. This was selected as the drug in the study since it has the highest rate of eradication of H.pylori in monotherapy in vivo. The organism lives deep inside the gastric mucosa;also the oral bioavailability of Clarithromycin is 55% therefore a traditional sustained release formulation of Clarithromycin may not be useful in the eradication of H.pylori. Thus, it is a logical way to improve therapeutic efficacy of the antibiotic if the gastric residence time of the dosage form is increased in the ecological niche of bacterium. Effective localized treatment for the pathogen will be ensured by high concentration of clarithromycin in the stomach. This makes the necessity for the development of gastro retentive dosage forms of Clarithromycin .

METHOD

The present study was done to investigate the suitability of mineral oils as a floating aid for gastro retentive drug delivery using in vitro method with sodium alginate and different polymer. Floating alginate beads contains various proportion of mineral oils were prepared by emulsion gelation method . The beads were evaluated for percentage buoyancy and drug content were subjected to in vitro drug release studies in 0.1 N HCl . optimised batch of floating alginate beads were prepared with emulsion gelation method with different drug:Na alginate ratio.

Results

The prepared beads of Clarithromycin have floated in simulated gastric fluid for prolonged time of period and observed that the batch without minerals oil fails to float. There was gradual increase in floating percentage as the concentration of oil goes on increasing i.e. from 5% to 15% w/w due to its hydrophobic nature but as the concentration of oil goes above 20% w/w the percentage buoyancy decreased. When the amount of oil was increased up to 20% and 30%, this enhanced volume of oil occupied the most of the volume of a single bead and prevented the entrapment of sufficient amount of drug.

Conclusion

It can be concluded that an intermediate optimum level of oil is necessary for preparation of beads with maximum drug content. It was observed that an increase in the concentration of mineral oil resulted in an increase in entrapment efficiency in Clarithromycin loaded alginate beads but as the concentration of mineral oil goes above optimum value, entrapment efficiency goes on decreasing.

KEYWORDS-GASTRO RETENTIVE DOSAGE FORM, MACROLIDE ANTIBIOTICS, MONOTHERAPY

Reactions analysis of different tomato cultivars to root-knot nematode, *Meloidogyne incognita*

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ABSTARCT

Purpose: The current investigation was conducted to determine the resistance or susceptibility response of tomato cultivars to root-knot nematode, *Meloidogyne incognita*.

Methods: In this investigation, nine cultivars of tomato were screened against root-knot nematode, *Meloidogyne incognita* at the inoculum level of 1500 second-stage juveniles (J2s) per pot. Five replications of each tomato cultivar were used and arranged in a completely randomized design (CRD) under greenhouse conditions. The data were subjected to one-way

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analysis of variance (ANOVA) using SPSS-17 statistical software (SPSS Inc., Chicago, IL, USA). Mean values were statistically analyzed according to Duncan’s Multiple Range Test (DMRT) at $P \leq 0.05$.

Results: The statistical analysis of means revealed that the nematode displayed variable influence on the plant growth of each examined cultivar. All the cultivars varied significantly in causing reductions in plant growth parameters over their respective controls. During the investigation, none of the examined cultivars was observed immune or highly resistant to *M. incognita*. The cultivars S-22 and Tomato-Ped were recorded as highly susceptible to *M. incognita* as they displayed the maximum number of galls. On the contrary, cultivar T9 was observed moderately resistant, having the minimum number of galls. Similarly, the cultivars Jyoti-4, Navuday, Pusa-sheetal, P-21, and Tomato-Round, were found susceptible, followed by cultivar Pusa-Rohney which was observed moderately susceptible. A positive and significant correlation was found between the galls and percent reduction in plant growth parameters.

Conclusion: All cultivars exhibit a significant decline in plant growth parameters due to *M. incognita* infestation compared with their respective controls. This study demonstrates that cultivating resistant or moderately resistant cultivars could minimize nematode infestation and yield losses. The use of resistant cultivars is an efficient and environmentally acceptable approach to manage root-knot nematode. Resistant cultivars are the low-cost strategy because there is no extra cost to spend as nematicide or pesticide. Furthermore, resistant cultivars can use in breeding programs for developing new cultivars resistant to the nematodes.

Keywords; Cultivars, *Meloidogyne incognita*, Resistance, Screening.

Bryophytes of Sal Forest area at Ranibagh, District Nainital, Kumaun Himalaya.

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ABSTARCT

Purpose: Bryophytes are the smallest group of plants that consisted of three distinct group Marchantiophyta (Liverworts), Anthocerotophyta (Hornworts) and Bryophyta (Mosses). These non-vascular, eco-sensitive organisms are the important component of different forest ecosystems. Kumaun region of Western Himalaya is well known in its rich bryodiversity. However, the forest wise bryoexploration has not been documented. Keeping in view, the present study is undertaken to explore the bryophytic vegetation of varied bryophyte incorporated habitats.

Method: Both liverworts and mosses were collected from different habitats of sal forest area at Ranibagh(640-800m). Collected specimens were separated morphologically and further examined under microscope. Temporary slide of different plant parts were prepared in 30% Glycerine and permanent slides in Gum Chloral mounting medium (Watson 1955). The delicate liverwort specimens were preserved in 70% alcohol and mosses were kept in herbarium packets. Identification work is performed with the help available literature and also by seeking expert advice.

Result: In all, **41** bryophytes species including, **15** liverworts (both thalloid and leafy) and **26** mosses were recorded. Amongst mosses, **10** acrocarpous and **16** as pleurocarpous were documented from the study site. **Fissidentaceae** and **Bryaceae** were turned out to be the dominant acrocarpous families followed by **Pottiaceae**. **Entodontaceae** and **Brachytheciaceae** succeed by **Hypnaceae** were identified as dominant families of pleurocarpous mosses. Out of **41** bryotaxa, **7** species (both liverworts and mosses) were recognized as gemmiferous. An interesting leafy liverwort, *Gymnocolea inflata* (Huds.)Dumort. was turned out to be a new record for India and two species of *Fissidens* viz., *F. laxitextus* Broth. ex Gangulee & *F. griffithi* Gangulee as new addition to the Western Himalayan bryoflora.

Discussion: Bryophytic vegetation of sal forest area at Ranibagh was explored thoroughly to document the existing bryodiversity of varied habitats. Due to the frequent rainfall, mesicness, and high humidity prevailing throughout the year, the study site area (Ranibagh) which is known as the ‘Cherrapunji of Kathgodam’ provided a perfect microclimate and support the luxuriance growth of bryophytes.

Keywords: Bryodiversity, Sal Forest, Western Himalaya, Ranibagh, Gemmiferous.

Epiphytic bryophytes of *Cedrus deodara* (Roxb. ex D. Don) G. Don forest at Lohaghat, (district Champawat), Uttarakhand

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ABSTRACT

Purpose: Bryophytes are naturally occurring, green group of shade loving, non-vascular cryptogams. These poikilohydric plants are important component of different ecosystem forming miniature forest on variety of habitats. At different elevations, Himalayan forests are the home of bryophytic diversity and luxuriance. Western workers have repeatedly observed that gymnospermous phorophytes do not have much adaptive support for the growth of bryophytes in comparison to angiospermic phorophytes. In contrast, to the general belief that bryophytes shun coniferous trees, we have observed bryophytic cover on number of gymnospermous trees including pure *Cedrus deodara* forest at Lohaghat (1600-1754 m), Champawat. The present bryoexploratory study deals with the documentation of epiphytic bryophytes flourishing on the acidic bark (pH 4.20- 4.74) of *C. deodara* tree trunks and branches.

Method: Epiphytic bryophytes colonizing the bark of *C. deodara* were collected almost from the trees of varied girth classes and brought to the laboratory. Temporary slides were prepared in 30% glycerine and permanent slides in gum chloral mounting medium (Watson,1955) for further identification work. With the help of available literature, floras, monographs, herbarium consultation as well as by seeking expert advice, the identification work was performed.

Results: The present documentation of epiphytic bryophytes thriving on *C. deodara* phorophytes revealed a total 36 taxa including 12 leafy liverworts and 24 species of mosses. Amongst leafy liverworts, Frullaniaceae was turned out to be the dominant family followed by the Lejeuneaceae. Pleurocarpous mosses were observed to be dominant over acrocarps. Amongst pleurocarps, the members of family Sematophyllaceae were found constantly dominant on each phorophyte. The members of family Bryaceae were observed as dominant acrocarps. Interestingly, many of the members of both liverworts and mosses were found gemmiferous.

Conclusion: The present study indicates, that *C.deodara* forest supports the dominant colonization of pleurocarpous mosses followed by acrocarps. Maximum bryophyte growth was noticed on the water trickling sites; near the junction of branches; humus accumulated sites as well as the buttressed tree base. The giant girth class trees of *Cedrus* forest were found supporting the maximum diversity of bryo-epiphytes. It is noteworthy to mention that, *Cedrus* saplings were also found writhed with the members of hanging mosses belonging to the family Meteoriaceae.

Key words: Bryophyte, Diversity, Cedrus, Gemmiferous, Phorophyte.

Integrated Hill Farming System for Year Round Food, Nutritional and Livelihood Security
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ABSTARCT

Manipur is nestled in the North East corner of our country bordering Myanmar. Manipur agriculture can be characterized by low productivity, diverse food basket, rainfed and based on traditional wisdom. Despite of favourable climatic condition and abundant natural resources, the productivity, profitability and sustainability of agricultural and allied sector in Manipur is still low. The faulty land use pattern and non-adoption of conservation measures has aggravated the degradation of resource base. There is acute scarcity of water during winter months. The crop productivity is low mainly due to use of low yielding

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local varieties, low moisture retention capacity of soil, lack of irrigation facilities, inadequate integration of various farm components, seasonal nature of cultivation, slow-adoption of improved technologies along with traditional management practices. In hilly terrains, mixed farming system during *kharif* season is the order and the land remains fallow for the remaining part of the year that results in low cropping intensity. Livestock is an integral part of most of the farm households. As a result, the hill farmers are facing varying degrees of food and nutritional insecurity coupled with degradation of natural resource base. Given this background, one participatory research and extension programme on "Livelihood Improvement of the Farming Community of Manipur through Adoption of Farming System Approach" was undertaken to translate the traditional resource degrading farming practices into sustainable integrated farming system.

METHODOLOGY

Before implementation of the programme, interaction programmes were organized with village authority, line departments, KVKs and as well as social institutions for analyzing the socio-economic profile of the farmers, prioritizing the activities in each and individual locations and approaches for implementing the programme etc. The information thus collected was analyzed to identify the alternative livelihood option for the farmers to ensure increase in productivity, sustainable employment generation and enhance income round the year. Thereafter, a series of capacity building programmes were organized through which the farmers were educated about the technical know-how of different aspects of farming system for uplifting their attitude-skill-knowledge. Finally, all total seven locations were selected across the altitude for standardization of location specific IFS models through participatory mode. The selected areas comprise hilly slopes, narrow valleys and terraced land containing a wide range of microclimate (tropical to sub-temperate). All the locations suffer from acute water scarcity during winter. Hence, the models were developed following two approaches, first by utilizing the existing water body available with the farmers and second, by constructing water harvesting structure (Jalkund). The beneficiaries were constantly given technological back-up to bridge the gap between potential and actual yields and ensuring sustainability through conservation and enhancement of the ecological foundations especially soil and water.

RESULTS

All total 7 sustainable IFS models were developed under different agro-ecosystems at varying elevations ranging from 808-1723 m above msl.

Table 1. brief description of the IFS models developed.

IFS Model	Components	Location	Water body
Model I	Horticultural crops (1.25 ha) + field crops (1 ha) + circular carp hatchery (1 unit with 100 brooders) + piggery (3 nos.) + poultry (300 nos.) + jalkund (2 units) + agro-shade net house (2 nos.) + bee box (3 units) + vermicomposting (3 units) + fruit processing (1 unit).	Purul Akutpa Village, Senapati district, Manipur (1723 m amsl)	1 ha
Model II	Horticultural crops (3 ha) + field crops (2 ha) + circular carp hatchery (1 unit with 80 brooders) + poultry (50 nos.) + poly house (1 no.) + bee box (10 units) + jalkund (1 unit) + mushroom production (1 unit) + vermicomposting (1 unit).	Nungshangkong Village, Ukhrul district, Manipur (1435 m amsl)	0.75 ha
Model III	Horticultural crops (8 ha) + field crops (2 ha) + cattle (5 nos.) + piggery (5 nos.) + agro-shade net house (1 no.) + water harvesting tank (1 unit) + vermicomposting (3 units) + fruit processing (1 unit).	Kachai Village, Ukhrul district, Manipur (1371 m amsl)	0.25 ha
Model IV	Field crops (1.25 ha) + Horticultural Crops (0.75 ha) + Fishery (80 brooders) + Piggery (14 nos.) + Poultry (60 nos.) + Vermicomposting (1 unit).	Chandel Khullen Village, Chandel district, Manipur (899 m amsl)	Jalkund (45000 L)
Model V	Field crops (1.5 ha) + vegetable crops (0.75 ha) + mushroom production (1 unit) + poultry (65 nos.) + bee box (3 units).	Chandonpokpi village, Chandel district, Manipur (837 m amsl)	Jakund (45000 L)
Model VI	Field crops (2 ha) + Horticultural Crops (1.25 ha) + Fishery (2 ponds; 0.20 ha, 25 brooders) + Piggery (7 nos.) + Poultry (120 nos.) + Vermicomposting (1 unit) + Apiculture (2 hives)	T. Champhai village, Churachandpur district, Manipur (808 m amsl)	Jalkund (45000 L X 2 Nos.)

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Model VII	Field crops (1 ha) + horticultural crops (0.5 ha) + poultry birds (100 No.) + Piggery (6 Nos.).	Sekmai Khunou Thoubal Manipur (813 m amsl)	Hijam village, district,	0.25 ha
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The performance of each models was evaluated for five consecutive years. After the intervention, the cropping intensity was increased up to 180 to 300% compared to 120% in traditional farming system. The farming intensity has also been increased 300 to 500%, as compared to 150-200% in traditional farming system. Adoption of IFS ensured minimum soil loss and run off, better residue/waste recycling and also maintained/improved soil health. Moreover, adoption of integrated farming system resulted in year round food availability, nutritional security and sustainable income and employment generation for the farm family. On an average, 409 to 570 days of employment was generated as compared to 110 days in traditional farming system. The average B:C ratio of various IFS models was increased to the tune of 3.01 to 6.49. Profit generated from various enterprises was used for further intensification of the enterprises. The IFS programme has also increased the knowledge and skill of the participatory farmers. They learned about the horizontal and vertical intensification through adoption of resource conservation technologies and soil health management. Besides, they gained the skill to integrated various farm components through waste recycling and crop residue management. The on-farm and off-farm activities were also effectively linked through secondary agricultural activities which ensures additional income generation and improvement in purchasing power.

CONCLUSIONS

The integrated farming system has emerged as important approach to break the vicious cycle of low productivity-profitability-sustainability as well as food-nutritional-livelihood insecurity in hill agriculture.

IDENTIFICATION OF MICROBES FROM DIFFERENT ORGANIC SUBSTRATES FOR RICE STUBBLE DECOMPOSITION

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ABSTARCT

Introduction

Rice is the most important food in the world for humans, people feeding more than any crop. In 2018, around half of the world's population 3.5 billion people depend on rice every day. It is also known as the staple food across Asia around more than half of the world's poorest people live either as worker or consumer. Wide variety of rice species is important for human nutrition like *Oryza sativa*, *Japonica*, *Indica*. Rice stubble is the uncut part of the crop after harvest that can be burned and show harmful effects like loss of nutrients from soil, air pollution from smoke, affects soil fertility. To avoid harmful effects in environment introduced some recent techniques for combating stubble burning like conversion of residue in composting, bioethanol production, gasification, biogas formation etc. Different combination of microbes and organic matter was used to degrade straw and activity of microbes was checked in regular intervals. It was found that the microbe inoculums along with cow dung and cow urine worked best in the degradation process and counted for highest microbial activity. The study can provide beneficial outcomes for the worldwide straw degradation and is beneficial for our future. Because the stubble degradation by microbes firstly helps in avoid burning of crop residue by farmers which can produce harmful gases in air, maintain soil fertility, nutrient enhancement of soil.

OBJECTIVES:

1. To isolate diverse microbes from stubble degradation of rice in field set up with organic ingredients
2. To characterize the class of microbes from different set ups

Methodology

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Procedure of experimental setup: The experiment was conducted in field. Three experimental setup are (A), (B), (C) :

Stubble was collected two weeks after harvest from different localities of the experimental field: no fertilizer has been used. First of all, stubble was chopped in small parts.

After chopped of stubble, three experimental setups were carried out which are underground. These three experimental setups were contained three layers of decomposer, cow dung, cow urine and finally, covered with thin sheet which is made up of jute.

And this sheet should always be wet for maintaining the moisture content and temperature. Because proper moisture and low temperature helps in microorganism growth. The thin sheet layer was removed for study after every 10 days and checked microorganism's growth

Results:

- Observation carried out after 20 days: Growth of microorganisms were taken place. After 20 days soil sample were collected from different experimental setup for isolation of microbes with proper precautions.
- Collected soil samples in separate plastic pouch A, B, C for experimental setup A, B, C, respectively. After collected soil samples zip the plastic pouch to avoid contamination and started serial dilution process for result.

Table 4.2 : Tabular form showing characterisation of bacteria

Experimental setup	Petri plates	Shape	Gram staining	Catalyse test
Setup A	A1	Rod shape (single bacillus)	Negative	Negative
	A2	Rod shape	Negative	Negative
	A3	Cocci	Positive	Negative
Setup B	B1	Rod shape (diplobacilli)	Negative	Negative
Setup C	C1	Rod shape (vibrio)	Negative	Negative
	C2	Rod shape (single bacillus)	Negative	Negative

Conclusions:

Rice stubble degradation is a dynamic process undergoing a temporal succession. Some fungal genera were more involved in degradation of straw, while some bacterial taxa immediately decomposed straw. Only small population of the whole fungal and bacterial community became labelled and indicating that small part of soil microbial population from rice straw as carbon source either indirectly or directly by degradation products. The most important straw degraders were fungal species and some aerobic bacterial species. Stubble degradation in paddy soil undergo in crop rotation occur to be an aerobic process, the total microbial community in the soil remains as it is. Rotation of crop management contributes to a reduction of methane emission and other harmful gases that may affect human health when rice stubble returned back to the soil. The rice stubble degradation process is completely aerobic from the starting on even under field condition remains to be evaluated. The present study was aimed to harness the role of microbes and organic matter combination for degrading rice straw. Some efforts are made to develop techniques of using field residues alternative to rice stubble burning, which are eco-friendly and economically viable. Recycling of plant nutrient is also another major step that should be taken to avoid burning. To reduce burning of stubble some microorganisms are used for residue degradation. Six bacterial strains were selected for lignin, cellulose, hemicellulose, lignocellulosic and degradation.

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Estimation of Carbon sequestration in different trees in agri-silvi-horti system in northern transitional zone of Karnataka

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ABSTARCT

PURPOSE

Climate change is one of the major environmental threats that are likely to impact forest cover and livelihood of the farmers. Global warming is certain and more alarming than ever. Most of the observed increase in global average temperatures since mid 20th century is due to the observed steady increase of CO₂ in our atmosphere and also increase in the concentration of greenhouse gases (GHGs). Forest cover more than 1/3rd of the world’s land area constituting the major terrestrial carbon pool. The carbon sequestered in each part differs greatly depending on various factors viz., agro climate region, the type of system, site quality and type of species (Chavan and Rasal, 2010).

METHODOLOGY

A study was made to measure carbon sequestration rate and assess the biomass in different tree species raised in black soil at Agricultural Research Station, Dharwad. The experiment involved horticultural crop Sapota and silvicultural trees viz.. Eucalyptus tereticornis, Tectona grandis, Acacia auriculiformis, Lagestromia lanceolata and Dalbergia sisso. Sapota planted at 10 x 10 m spacing and in between two Sapota plants, tree species were planted across the slope during the year 1976 on deep clay soils. Trees adjoining to Sapota were harvested during the year 1992-93 and one tree is retained in between Sapota plants.

RESULTS

The results indicated that growth of tectona grandis, Eucalyptus tereticornis and Dalbegia sissoo were significantly higher as compared to Lagestromia lanceolata. The total biomass and crobon sequestration was significantly higher in Tectona gradis (82.79 ton/ha and 41.39 ton/ha, respectively). Among the Sapota trees, total biomass and carbon sequestration was significantly higher when Sapota grown alone (58.88 ton/ha and 29.44 ton/ha, respectively) followed by Sapota + Lagestromia lanceolata (58.80 ton/ha and 29.40 ton/ha, respectively).

CONCLUSION

The study concluded that total biomass and carbon sequestration was higher in Sapota + Tectona gradis and Sapota + Eucalyptus tereticornis as compared to other combinations of agroforestry systems.

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KEYWORDS: Carbon, sequestration, Biomass, CO₂

Effect of feeding dried *Moringa oleifera* leaves on drymatter intake, average daily weight gain, body condition score and milk composition in Osmanabadi goats

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ABSTRACT

Purpose

One of the major constraints to increase livestock production in the tropics is the scarcity of animal feed, especially during the dry season. This shortage can be overcome with supply of non-conventional feed resources such as *Moringa oleifera*. *M. oleifera* leaves (MOL) are the rich source of protein and contain greater proportion of minerals (Ca, P, Mg, Na, K, Zn and Cu) especially iron, with substantial amount of Provitamines (A, vit B, vit C and vit K), carbohydrate, fat, and amino acids. With regard of aforementioned characteristics, MOL can partially replace expensive protein supplements such as soybean meal and can be incorporated in the ruminants diet effectively. With this background the present investigation was undertaken to study the effect of feeding dried MOL on nutrient intake, body weight gain, body condition score and milk composition in Osmanabadi goats.

Methods

Total 24 lactating Osmanabadi goats comprising of 1st to 3rd parity were randomly selected and grouped into four dietary treatment regime with 6 goats in each group. All the experimental goats were fed green tree leaves. T0 group (control) animals were fed formulated concentrate (16 % crude protein) while T1, T2 and T3 groups were fed with formulated concentrate in which 10%, 20 % and 30% of soy DOC was replaced by dried *Moringa oleifera* leaves respectively. Tree leaves were collected from *Moringa oleifera* trees planted under Directorate Research Services, DSVCKV, Anjora Durg. Leaves were spread on thick plastic sheet and shade dried for 4-5 days and then stored for incorporation in the concentrate mixture.

Proximate analysis: Various feed ingredients of concentrate mixture viz. maize, soy DOC, broken rice, DORB, along with *Moringa oleifera* and *Ficus racemosa* leaves were analyzed for different proximate principles viz., moisture, crude protein (CP), crude fibre (CF), ether extract (EE), total ash (TA), and nitrogen free extract (NFE) as per Association of Official Analytical Chemists (AOAC,2000).

Daily feed intake - Feeds offered to individual animals and refusals left were measured daily and daily feed intake was calculated by following formula: Daily feed intake = daily feed offered – daily feed refusal

Dry Matter intake - The samples of feeds were collected every week and subjected to DM determination to calculate DMI.

Body weight – Body weight of goat were measured at 0 day and at the end day of experiment with the help of electronic weighing balance machine and thereafter average daily gain was measured as per the given formula: Average daily gain= Difference between initial and final body weight / Total number of days in trial

Body condition score (BCS): Body condition score was measured at 0 day 21 and 42 day of experiment. BCS of goats ranging from 1.0 to 5.0 with 0.5 increments. An under-condition (emaciated) goat with a BCS of 1.0 would have no fat reserves, whereas an overweight (obese) goat would have a BCS of 5.0. It is generally recommended that healthy goats have a BCS score of 2.5 to 4.0. The BCS score indicate the following conditions of the goat:

Body condition score	Condition of goat
1	Emaciated
2	Thin
3	Average

4	Fatty
5	Obese

Milk composition – Initial average milk composition of each animal was analysed by automatic milk analyser (ULTRASONIC MILK ANALYSER) at the start the experiment. Thereafter, milk samples were analysed at weekly intervals (0th, 7th, 14th, 21th, 28th, 35th, 42th day) for Protein %, Lactose %, SNF % and Fat %.

Statistical analysis

The data obtained were analysed by one way analysis of variance. If significance of difference exists, Duncan's Multiple Range Test were applied.

Result

Proximate

composition: The proximate analysis revealed that dried MOL are rich source of protein. MOL had higher crude protein content compared to maize, broken rice, and *Ficus racemosa*; but lower than that of Soy DOC. MOL had lower crude fibre and ether extracts than *Ficus racemosa*, but greater value obtained in comparison to other feed ingredients. **Feed intake-** feed intake in Osmanabadi goats showed a significant difference among the groups from 1st to 4th weeks and 6th week of experiment except 5th week. The effect of dietary supplementation of MOL meal on feed intake was significant during 1st week of the study. The intake was significantly ($P<0.01$) higher in all the groups . During 2nd week the intake was significantly ($P<0.05$) higher in groups fed concentrate with 20 and 30% level of Moringa (T2 and T3) compared to control and T1. The feed intake during 3rd week was significantly ($P<0.05$) lower in group T1 as compared to T2 and T3. The inclusion of higher level of Moringa (30%) significantly ($p<0.05$) improved the feed intake during 4th week of study as compared to all other groups, however the intake differ non-significantly amongst the groups during last week *i.e.* 5th week of experiment. The daily feed intake at 6th week increased significantly in all groups from their initial value.

Dry matter intake and Crude protein intake: No significant effect of *Moringa oleifera* supplementation on DMI and CPI was observed during 1st to 5th week of the study. Although on 6th week a significant difference was observed in DMI and CPI of group T2 as compared to all other groups

Body weight gain: No significant difference existed between the control group (T0) and the treatment groups (T1, T2 and T3) during the entire experimental period.

Body condition score: In the control (T0) and treatment groups (T1 T2 and T3) no significant difference in BCS was observed over the entire experimental period.

Milk composition: There was no significant difference among the groups during experiment in different milk constituents. Moreover the composition remained relatively constant with a small variation in milk lactose whose value differed significantly at the fifth week of the experiment.

Conclusion:

It is concluded that feeding of concentrate containing 20% dried MOL resulted in better feed intake, dry matter intake, crude protein intake and body weight gain in Osmanabadi goats. There was no adverse effect of MOL feeding at the inclusion level of 20% in Osmanabad goats. Goat productivity can be sustainable during scarcity period by incorporating dried MOL in to concentrate feed Therefore, Moringa can be successfully used as an alternative protein source to substitute the soy DOC.

Keyword: *Moringa oleifera* leaf meal, body weight, DMI, CPI, milk composition.

Biochemical and Transcript analysis of differentially expressed water stress responsive candidate genes in Minor millets & rice (*Oryza sativa* L.).

Pooja Kathare, Patil Arun H, Girish Chandel

ABSTRACT

Purpose

Water stress occurs severely in major producing areas of the world. India is the largest grower of minor millets. Millets are Lower in economic competitiveness. Known for their great level of tolerance against water stress and salinity. Rice is the staple food crop & Second largest crop in the world with *High Drought Sensitivity Index*. All these important facts necessitates to dissect the transcriptome information to provide valuable information on molecular mechanism and dynamics underlying their water stress tolerance potential.

Methods

The current study was taken to identify important water stress responsive gene orthologs, from candidate genes in the selected fifteen genotypes, i.e seven genotypes of Little millet five genotypes of Barnyard millet and three genotypes of Rice. Biochemical traits (Chlorophyll a, b and total, Leaf proline, Carbohydrates Protein, estimated by Acetone method given by Arnon (1949), Bates et al., (1973), Krishnaveni et al. (1984) & Lowryl method respectively was determined under control and stress condition. Water was withdrawn from pots on 21 up to 29 days from the green house grown plants. Setting up of experiment under STRESS and CONTROL condition

Results

The photosynthetic pigments like chlorophyll a, chlorophyll b and total chlorophyll decreased and the biochemical components like, leaf proline, leaf protein and leaf carbohydrate increased under water stress. These findings were found to be in correlation with a set of known water stress responsive genes which were selected for expression analysis using semi-quantitative RT-PCR.

Conclusions

Among the three crops highest expression was found in Little millet genotype RLM-37, which was showing tolerance characteristics, this can be taken as a base for water stress tolerance response of the crop to select the gene and genotype for the ortholog gene isolation, which may be useful for further validation studies of genes for water stress tolerance in millet and other crop plants.

Key words: Abiotic stress, water stress, vegetative stage, semi quantitative RT PCR, cDNA.

Transcript-level differential candidate gene expression analysis & Characterization of Physiological Responses among Minor millet & rice (*Oryza sativa* L.) under water stress.

Pooja Kathare, Patil Arun H, Girish Chandel

ABSTARCT

Purpose

The plants abscond from expressing its full potential to give maximum yield due to biotic and abiotic stresses such as diseases, water stress, etc. Among these water stress is major one, as it occurs severely in major producing areas of the world. It activates a series of changes in plants by affecting growth and productivity negatively. Various morphological mechanisms functioning under water stress has also been identified. Water stress occurs severely in major producing areas of the world. India is the largest grower of minor millets. Millets are Lower in economic competitiveness. Known for their great level of tolerance against water stress and salinity. Grains of small millets are extremely resistant to pest. Millet is a *Healthy food*, mainly due to the lack of gluten in their grain, also known as “*Orphan crop*”, “*food for the poor*” (Sharma and Khurana, 2014). Rice is the staple food crop & Second largest crop in the world with *High Drought Sensitivity Index* (Karl, 1983). All these important facts necessitates to dissect the transcriptome information to provide valuable information on molecular mechanism and dynamics underlying their water stress tolerance potential.

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Methods

The current study was taken to identify important water stress responsive gene orthologs, from candidate genes (EcNAC 67, SiNAC29L, OsNAC 29, TaNAC 4, CDPK, U2-SnRNP, Synaptotagmi), in the selected fifteen genotypes, i.e seven genotypes of Little millet (RLM-37, BL-4, OLM-203, MM-23, BL-8, BL-15-1, MM-10), five genotypes of Barnyard millet (SAWA, VL-29, MELGHAT-1, MELGHAT-3, MM-03) at 5.5 to 6.5 % SMC (Soil moisture content) and three genotypes of Rice (R-RF-127, MOROBEREKAN and MTU-1010) at 15-18 % SMC. Biochemical traits (Chlorophyll a, b and total, Leaf proline, Carbohydrates Protein, estimated by Acetone method given by Arnon (1949), Bates et al., (1973), Krishnaveni et al. (1984) & Lowryl method respectively) was determined under control and stress condition. **Growth Conditions:** Planted in pots and maintained in green house condition at $28 \pm 2^\circ\text{C}$ in Department of Plant Molecular Biology and Biotechnology, Indira Gandhi Agricultural University, Raipur, Chhattisgarh, India. Pots were watered normally until plant attain 21 day periods. Water was withdrawn from pots on 21 up to 29 days.

Setting up of experiment under STRESS and CONTROL condition

Stress imposition at vegetative stage (After 21 DAS) before panicle initiation. Harvested samples after stress imposition are stored immediately in liquid Nitrogen for RNA extraction followed by cDNA synthesis. RNA extraction from leaf tissues at vegetative stage - Trizol+Himedia protocol. RT-PCR analysis was performed to analyze expression among the genotypes under control and stress conditions for different genes(using designed expression primers). Actin gene primer was used for Internal control followed by cDNA synthesis (Bio RAD iSCRIPT cDNA synthesis kit). The florescence data of Semi-quantitative RT-PCR gels were digitalised to numerical values using *Gel quant NET software*.

Results

The photosynthetic pigments like chlorophyll a, chlorophyll b and total chlorophyll decreased and the biochemical components like, leaf proline, leaf protein and leaf carbohydrate increased under water stress. These findings were found to be in correlation with a set of known water stress responsive genes which were selected for expression analysis using semi-quantitative RT-PCR. Differential expression was found among almost all the genes and genotypes. OsNAC29 (RLM-37), SiNAC29L (MELGHAT-3), TaNAC 4 (R-RF-127) showed highest positive up-regulation in the expression analysis of Little millet, Barnyard millet & Rice genotypes respectively, followed by other gene & genotypes.

Conclusions

Among the three crops selected for our study, Little millet genotype, RLM-37 and Rice genotype, R-RF-127 were found to be tolerant ones in the morphological, physiological, biochemical and molecular aspects. MTU-1010 was found to be susceptible one in most of the aspects. Majority of genes were up regulated under water stress in Millets and Rice. Among the three crops highest expression was found in Little millet genotype RLM-37 (gene OsNAC 29) was showing tolerance characteristics, this can be taken as a base for water stress tolerance response of the crop to select the gene and genotype for the ortholog gene isolation, which may be useful for further validation studies of genes for water stress tolerance in millet and other crop plants.

Key words: Abiotic stress, water stress, vegetative stage, semi quantitative RT PCR, cDNA.

STUDIES ON CONSERVATION MACHINERY SYSTEM UNDER RICE-CHICKPEA CROPPING SYSTEM

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Purpose

In a present era many improved implements are available for different tillage and seeding operation. It is very crucial to identify good practice and suitable implements combination for desired seedbed preparation to maximise crop establishment and yield under rice-chickpea cropping system. To understand, this study was conducted on “studies on conservation machinery system under rice-chickpea cropping system” at Research cum Instructional Farm, IGKV, Raipur (Chhattisgarh) during *Kharif-Rabi* season of year 2016 and 2017. The site of experiment having soil as clayey in texture, neutral in reaction, available N is low, available P₂O₅ is medium, and available K₂O is high.

Methods

In this study two different experiments were conducted. In rice, different combination of tillage and sowing/planting treatments were tested for cultivation under dry and wet tillage system during kharif. In dry seeding of rice there were five tillage treatments and two methods of sowing whereas, in wet tillage, five tillage treatments were used in combination with mechanical transplanting method. In *rabi* season, the chickpea was cultivated under residual of rice plots (dry and wet plots) with four different combination of tillage and seeding method. All the treatments alone or in combination were evaluated in terms of machine parameters and their effect on energy parameters, soil parameters, economic parameters and yield and yield attributing parameters.

Results

The finding of the first experiment on the effect of various tillage and sowing practices for rice cultivation and their effect on soil physical properties showed that all the soil parameters, crop growth parameters such as height of plant, tillers number per plant, yield attributes parameter *i.e.* length of panicle, weight of panicle, number of sound grains per panicle, test weight (g), yield of grain and straw, net return and B:C ratio were significantly higher in DT₃ (cultivator x 2 + direct seeded rice DSR drill sowing). However, the above characters values were found lower and recorded under broadcasting followed by transplanted rice. The optimum desired seed bed for seeding rice was found under tillage treatment DT₃ (cultivator x 2 + DSR drill sowing) and the optimum planting bed for transplanting rice was found under treatment WT₂ (cultivator x 2 + rotavator x 1 + transplanting). Amongst the methods of establishment, the maximum grain yield was produced in dry tillage direct seeded rice treatment DT₃, 57.5 quintal ha⁻¹ and 50 quintal ha⁻¹ during 2016 and 2017 respectively and the maximum value of benefit cost ratio was registered 2.65 on mean basis of two year in treatment DT₃. The output energy, output-input energy ratio and energy productivity was found best in DT₃ (cultivator x 2 + rotavator x 1+ DSR drill) amongst different treatments on the basis of mean data of two years. Based on practices being followed for chickpea cultivation, the best treatment for till condition was found to be DT₁C (M.B. Plough x 1 + Cultivator x 2 + Rotavator x 2 + ridge and furrow sowing) followed by DT₂C (Cultivator x 2 + Rotavator x 2 + conventional seed cum fertilizer drill sowing) whereas under no till condition, DT₃C (No till + Zero till drill sowing) treatment followed by DT₄C (No till+ happy seed drill sowing) proved to be better based on energy, cost economics and crop parameters.

Conclusions

The combination DT₃ (rice- cultivator x 2 + DSR drill sowing of rice) and DT₁C (Chickpea- M.B. plough x 1 + cultivator x 2 + rotavator x 2 + ridge and furrow sowing in residual of dry sowing of rice) was found most effective combination in terms of total productivity of rice-chickpea cropping system under till condition than the other combination of different treatments of rice-chickpea tillage and sowing methods. The zero till drill sowing (DT₃C) in chickpea and DT₃ (rice- cultivator x 2 + DSR drill sowing of rice) of rice recorded maximum benefit cost ratio, output-input energy ratio and energy productivity for chickpea production under no till condition. The decision support system software was created for the selection of appropriate tractor or machines/implements of a particular size from different makes and model of commercially available tractors and machines/implements for the rice-chickpea cropping system. With a case study the validation of designed DSS software demonstrates its effectiveness in forecasting any conservation machinery system selection.

Key words: Rice establishment method, Energy input-output, Machine performance, Field capacity, Cost Economics, Rice-Chickpea cropping system, Conservation machinery system.

Molecular Docking Studies of Acetylcholinesterase enzyme involved in Alzheimer disease with chlorogenic acid and Lactucin of *Cichorium intybus*

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ABSTARCT

Purpose

Cichorium intybus, commonly known as chicory, is a perennial herb with immense medicinal activity and being used in traditional medicine. Due to the presence of abundant active phytoconstituents, chicory plant used as a cardi tonic, stomachic, liver tonic, diuretic and anti-inflammatory agent. Chlorogenic acid and Lactucin are two major phytochemical ingredients obtained from *Cichorium intybus*; they are biologically active with antioxidant, anti-inflammatory and other

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pharmacological activity. Neuroprotection by chlorogenic acid has been reported in several *in-vitro* studies. It has been demonstrated that it protects neurons from oxidative injury by lowering lipid peroxidation. Our aim was to predict the predominant binding mode(s) of chlorogenic acid and lactucin with an enzyme-acetylcholinesterase and the binding characteristics (affinities, sites, forces..etc) for their future development as an anti-Alzheimeric agent.

Methods: Docking of acetylcholinesterase with chlorogenic acid and lactucin was performed via Maestro (Schrodinger, USA) software. LigPrep module, version 2.4, 2019, was used for geometrical refining of chemical structures (drawn in Maestro module) of ligands and Protein preparation wizard of Maestro software was used for protein preparation. Receptor Grid Generated by using in-built module and based on receptor grid, docking was performed using the extra precision (XP) feature of Glide module, version 12.1, 2019. The interaction of protein and ligand was visualized by the XP visualizer.

Results: Molecular docking studies revealed that acetylcholinesterase interact with chlorogenic acid and lactucin by hydrogen and hydrophobic bonds, respectively with docking scores of (-9.7 and -6.7). Docking of acetylcholinesterase and chlorogenic acid shown the more number of H-bond ARG229, PHE268, SER296 (2 H), TYR121 as compared to lactucin which shows hydrogen bonding with PHE288, ARG289, TYR70 amino acid.

Conclusion: These results confirmed the formation of acetylcholinesterase stable complexes with chlorogenic acid and lactucin, contributed to our understanding for their binding characteristics (affinities, sites, modes, forces..etc). Docking results proved that chlorogenic acid and lactucin can be implemented for the treatment of Alzheimer disease, however, different *in-vitro* and clinical trials are needed for further validation of the chlorogenic acid and lactucin as an anti-Alzheimeric agent.

Keywords: *Cichorium intybus*, Chlorogenic acid, Lactucin, Anti-Alzheimer agent, Molecular docking.

Economic analysis of poultry farming in Dantola village (Almora), Uttarakhand Latika Pandey^{1*}, Ayyanadar Arunachalam², Namita Joshi¹, Deepak Kumar Mishra² and Inder Dev² Gurukul Kangri University, Haridwar, India

ABSTRACT

For the sustainable development of mountain agriculture, it is needful to find the alternative sources of income for the hill farmers. Backyard poultry is a traditional practice in rural ecosystem, mostly as a subsidiary source of benefit to the farmer. In Uttarakhand hills, the agricultural productivity is challenged by wild crop-raiders. Under such circumstances, farmer cannot rely only on the field crops. Poultry farming can be a suitable alternative option for hilly region as it requires less labour and other input cost and occupies a small area. The poultry birds also eat insects from the kitchen gardens around the house, thus decreasing insect-pest attacks in the kitchen gardens. With this background, the efficiency of traditional backyard poultry farming system was assessed in Dantola village of district Almora.

Methods

During the field survey of various hill agricultural systems during 2017-18, backyard poultry system was found to be practiced in the study village. In order to assess its efficiency, the records of all the inputs and outputs were collected in order to quantify the overall cost and the benefit of the backyard poultry system.

Results

After the monetary estimation of all the inputs and outputs, the benefit-cost (B:C) ratio worked out to be 1.8. As labour availability is a major concern in the hills, less-labour intensive backyard poultry provisions alternative income generating opportunity to the rural households.

Conclusions

Our results reveal that integrated poultry farming could potentially be a diversification opportunity for rural farmers in the hills.

Key words: Hill agriculture, poultry, B:C

Assessment and economic evaluation of provisioning services from agroforestry system in the Garhwal Himalaya, Uttarakhand.

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ABSTRACT

Purpose

Agroforestry is known for its wide ranges of the ecosystem services. The aim of this study was to assess the provisioning services (fuelwood and fodder) provided by the agroforestry systems, consumption pattern and their economic evaluation.

Methods

The survey with structured questionnaire was used for this study. The economic evaluation of provisioning services was done based on the market values of these products in the local and regional market.

Results

The fuelwood, fodder and fruits are the main ecosystem services that farmers are getting from agroforestry systems in the study area. Fuelwood consumption was found to be highest at the higher altitude (0.65 kg/capita/day), followed by middle altitude (0.54/capita/day) and 0.49 kg/capita/day at lower altitude respectively. The per capita value of fuelwood ranged from Rs. 857.46/year to 1431.82/year from lower altitude to higher altitude while fodder consumption varied from 18.37 tonnes/year to 194.08 tonnes/year. The monetary values of fodder consumption varied from Rs. 879.48/capita/year to Rs. 2003.89/capita/year. The combined economic value of ecosystem services (fuelwood + fodder) was found to be between Rs. 1736.94/capita/year to 3400.26/capita/year. Values of these services on basis of population at village levels was between 1.87 lakhs/year to 23.71 lakhs/year

Conclusions

Agroforestry system provides direct consumable services that have higher market value as food, fuelwood, fibre, feed, fodder, medicines and others. The study also visibly identified the role of agroforestry in meeting fuel wood and fodder requirements. In Tehri Garhwal region, the agroforestry system is basically supplementing the requirement of fuel wood and fodder, which reduces the dependency of villagers on the adjacent forest.

Key words: Agroforestry system, ecosystem services, fuel wood, fodder, farm income

A standardized protocol for genomic DNA isolation from *Terminalia bellirica* for population genetic analysis.

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ABSTRACT

Purpose

Terminalia bellirica are of great commercial importance because of their high timber, economical, medicinal values and are being over-exploited because of their importance leading to loss of valuable genetic resources. The existing populations are under great pressure. For sustainable utilization and conservation, assessment of genetic diversity, population genetic structure and mating system therefore becomes imperative leading to search for a more efficient means of extracting DNA of both higher quality and yield.

Methods

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Total genomic DNA was extracted from young leaves following the CTAB-activated charcoal method. 5 g of leaves were grounded in liquid nitrogen, homogenized in 1ml of preheat extraction buffer (100 mM Tris–HCl, 20 mM EDTA, 2M NaCl, 3% CTAB, 0.5% Charcoal, 3% PVP having pH 8.0) and incubated at 65°C for 1 hr, extracted with chloroform:isoamylalcohol (24:1 v/v). The DNA was pelleted with chilled isopropanol and washed twice with 70% ethanol. The DNA pellet was air dried and stored at -20°C.

Results

The standardized protocol is appropriate for both dry and fresh leaves. Purity of extracted DNA was excellent as evident by A260/A280 ratio ranging from 1.71-1.86 and A260/A230 ratio was >2, suggesting that the preparations were sufficiently free of proteins and polyphenolics/polysaccharide compounds.

Conclusions

In this study, a new and reliable method developed for the extraction of quality DNA can be used for the routine molecular biology experiment. Here we have described a simple, safe, reliable, and cost efficient CTAB-activated charcoal DNA extraction protocol that provides high quality DNA from *T. bellirica* containing elevated concentrations of polysaccharide and polyphenolic compounds. The proposed method enables the extraction of DNA even from dried leaves of *T. bellirica*. Therefore, CTAB-activated charcoal method is recommended even in low-technology laboratories for high-throughput sample preparation suitable for various molecular analytical techniques.

Keywords DNA Extraction, Genetic resources, *Terminalia bellirica*.

Development of instant fish cutlet mix from Nile tilapia-an attempt in utilizing farmed fish for ready to cook product

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ABSTRACT

Purpose

Indian families are now witnessing a changing trend in food consumption pattern as more women in the family are engaged in jobs. As time spend for cooking is now getting reduced, people are affording ready to prepare/ready to eat food products. In this aspect the role of instantly prepared food products are gaining importance. Hence in this study a ready to cook instant cutlet mix was developed.

Methods

Nile tilapia was collected from brackish water ponds for preparing the mince which was then dehydrated to form dehydrate fish flour. The product was then used as the main ingredient in preparing instant tilapia cutlet mix. Other ingredients such as potato, green chilly, carrot slices, onion, curry leaves, ginger, pepper, clove, cinnamon, batter mix were dried and added as crushed ingredients. The powder was mixed properly to which required quantity of boiled water was added to reconstitute the products. Proximate analysis, Powder characteristics shelf life was studied for the instant cutlet mix.

Results

Powder characteristics and shelf life was studied for the instant cutlet mix. Proximate analysis of the mix showed that moisture content was around $6.691 \pm 0.21\%$, protein content around $22.003 \pm 0.18\%$, ash content around $4.359 \pm 0.31\%$, fat content around $5.758 \pm 0.13\%$ and carbohydrate $61.030 \pm 0.24\%$. The product was stored until 4 months where it was sensorially acceptable. Sensory analysis of the instant cutlet TVBN value showed an initial value of 15mg N/100g and at the end of four months it reached to around 23 mgN/100g sample. Peroxide value was initially nil and which reached upto 2.2 meq O₂/ kg of fat by the end of 4 months. It has shown the shelf life of 4 months by retaining all its properties.

Conclusions

The developed food product was having better acceptability and can be introduced as a ready to eat product which is now having better acceptability in the present market.

Key words: Instant food, Ready to eat product, Nile tilapia, farmed fish, cutlet

Role of Self-Help Groups (SHGs) for all round development of farm women

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ABSTARCT

Women are an integral part of society. All-round development and harmonious growth of a nation would be possible only when women are given their desired place and position in the society and are treated as equal partners of progress with men. However, in most of the regions, women have a low social and economic status. In such areas, effective empowerment of women is essential to harness the women in the main stream of economic development.

The role of women and the need to empower them are central to human development programmes, including poverty alleviation programmes. In spite of safeguards provided in many of the poverty alleviation programmes, it has been observed that women in rural areas, especially from poor families, are not benefited.

Women are a vital parts of the Indian economy, constituting one-third of the national labor force. In Agriculture and allied sector too, women play a major role. Emancipation of farm women is a pre-requisite for nation's economic development and social upliftment..

"Empowerment of women" is the central issue that has been pervading the development debate after the 80s. Women empowerment is always considered as the key aspect of social development throughout the world. In India more attractive schemes have been introduced , to eradicate women unemployment, one of which with less effort is **Self Help Group (SHG)**. Self Help Group is one of the most important approaches for socio-economic transformation of rural women in India.

SHG is a group of rural poor females who have volunteered to organize themselves into a group for eradication of poverty of the members. They agree to save regularly and convert their savings into a Common Fund known as the Group corpus. The members of the group agree to use this common fund as a group through a common management. The members of an SHG face similar problems. They **help** each other, to solve their problems. SHGs promote small savings among their members. The savings are kept with the bank. The SHG collects the minimum voluntary saving amount from all the members. The group devises a code of conduct to bind itself. This is in the form of regular meetings (weekly or fortnightly), functioning in a democratic manner, allowing free exchange of views, participation by the members in the decision making process. The SHG corpus fund is used to give advance to the members in the form of loans. The group develops the financial management norms covering the loan sanction procedure, repayment schedule and interest rates.

The **Self Help Group** (SHG) is a viable organized setup to disburse micro credit to the rural women for the purpose of making them enterprising and encouraging them to enter into entrepreneurial activities. The formation of SHG is not solely a micro-credit project but it aims to empower women.

SHG addresses various dimensions of empowerment – political, material, cognitive, perceptual and relational

The origin of **self-help group** can be traced from Grameen bank of Bangladesh, which was **founded** by Mohamed Yunus. SGHs were **started** and formed in 1975. In India NABARD **initiated** in 1986-1987. The absence of institutional credits available in the rural area has led to the establishment of SHGs. Formation and functioning of SHGs is based upon the concept of group approach to decision making and programme implementation. Most of the successful functioning organisations be it at micro level (a single firm) or at macro level (parliament, as for instance) reinforce the significance of group approach to problem solving.. Access to credit can help in expansion of material base of women by enabling them to start and expand small businesses, often accompanied by market access.

Many governmental and non-governmental organizations have been trying to organize women into groups integrate them into the development process by actively involving them in Group Farming, transfer of technology, production and marketing, agriculture and allied sector development, natural resource management, etc.

The women members feel empowered as a result of the following characteristics of self-help groups.

REGULAR ATTENDANCE INCREASES SELF-EFFICACY

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Self-efficacy is the belief that people have in their own ability to achieve goals. The higher this level is, the more confident a person is that he or she will be able to succeed at something

PROVIDES PARTICIPANTS WITH SOCIAL CONTACT

Spending time in a room with people who are going through similar issues helps participants to feel as though they are not alone. They can also see that others understand exactly what they're going through. This is a much healthier form of social contact.

DECREASES THE ODDS OF A RELAPSE

Attending group meetings, getting support from other members, and seeing for themselves that a sober lifestyle can be achieved over a long-term in spite of life stresses is inspiring to members. They know exactly what it feels like to commit to the lifestyle change involved in getting help and keep following through even when life throws a curve ball at them.

OPEN TO EVERYONE

No special preparation or knowledge is required to attend a self-help group. They welcome anyone who is suffering and is in need of help. It doesn't matter if a participant in the group has had a setback or relapse. Group members can come back and start again.

SELF – HELP GROUPS IN INDIAN MOVEMENT

India has adopted the Bangladesh's model in a modified form. To alleviate the poverty and to empower the women, the micro-finance has emerged as a powerful instrument in the new economy. With availability of micro-finance, self-help groups (SHGs) and credit management groups have also started in India. And thus the movement of SHG has spread out in India.

Impact of Self-Help Groups on Women Empowerment

1) Micro- Financing benefit for rural poor households

Self-help has aimed at enhancing profitability for rural people. The low economic growth of this country was perceived to be due to lack of capital resources, especially in rural areas. A vicious cycle of low capital, low productivity, low incomes, low savings and weak capital base was perceived to be operating perpetuating a permanent poverty syndrome. Therefore, cheap rural credit policies like micro financing SHGs were designed to provide rural poor with access to adequate capital. Microfinance through SHG has become a ladder for the poor to bring them up not only economically but also socially, mentally and attitudinally and above all help them break through the stronghold of exploitative money lenders.

2) Bank – SHG linkage

In this type of linkage banks provided financial support to SHGs which had grown almost spontaneously without any intervention of any SHPI. The SHGs were initially on the basis of a common activity, Problem and took up thrift and credit activities. The case of such linkages is not very common. In this model, the SHPI have taken the role of a financial intermediary between the banks and a number of SHGs.

3) Economic empowerment

According to the report by National Commission for Women (NCW) - (Status of women 2011), in India, women work for longer hours than men do. The proportion of unpaid activities to the total activities is 51% for females as compared to only 33% for males. Over and above this unpaid work, they have the responsibilities of caring for household which involves cooking, cleaning, fetching water and fuel, collecting fodder for the cattle, protecting the environment and providing voluntary assistance to vulnerable and disadvantaged individuals in the family. This shows that though there is still a long journey ahead towards women empowerment. Women's can save small amount of money regularly and mutually agree to contribute a common fund.

4) Social empowerment

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The social empowerment means that the woman should get an important place in her family and society, and should have a right to enable her to make use of available resources. It has resulted in developing self-confidence, self-esteem and self-respect also.. As the woman has now increased presence in banks, Gram Panchayats, various Government committees etc., her social status is seen somewhat elevated. The social impact of the SHG program increased involvement in Decision-making, awareness about various programs and organizations, increased access to such organizations, increased expenditure on Health and Marriage events, there is a Change in the attitude of male members of the families, now they are convinced about the concept of SHG and encourage women to participate in the meetings and women reported that they have savings in their name and it gives them confidence and increased self-respect.

5) Saving and Financial Decision Making

One of the primary benefits of participation in a SHG is the opportunity to save regularly, access formal savings institutions and participate in the management of these savings. They save regularly, have their own bank accounts and make deposits into these accounts. SHG is having a good impact on members, in their ability to save their hard earned money.

6) Access to credit

SHGs results into an improvement in woman’s access to credit. The financial mobility due to participation in the SHG leads to an improvement in the quality of life, according to some of the successful groups. Overall, many families were able to address their basic needs better than before. Some of NGOs reports have shown that the record on the repayment of loans by women was often better than that of men, and that women were also more likely to spend the income earned, on their families, leading to improved health and nutrition of the poor population and for improving the quality of their lives.

7) Employment

The implementation of SHG has generated Self-employment opportunities for the rural poor. This has been shown by many SHGs formed by JEEVIKA in Bihar.

In a case study on impact of SHG on women empowerment in Patna district ,Kumar Amresh (2018) concluded that 25 per cent of the respondents) had no occupation in the pre-SHG stage whereas cent per cent is occupied at the post-SHG stage. The occupation chosen by the SHG members depends on the availability of skill and resources. He also observed that the income of the members of the SHG had increased substantially

Further, Kumar Amresh revealed that SHGs have the power to create a socio-economic revolution in the rural areas of our country. SHGs have not only produced tangible assets and improved living conditions of the members, but also helped in changing much of their social outlook and attitudes. In the study area SHGs have served the cause of women empowerment, social solidarity and socio-economic betterment of the poor.

According to Bihar State Women Development Corporation (BSWDC) managing director N Vijaya Lakshmi “Bihar has the potential to get about a million self-help groups (SHGs) engaged in real productive activities in the next few years”as reported in newspaper TNNTimes of India on 18-07-2009.The objective can be achieved by maintaining a synergy between state-level working group and action plan," she added. According to her, three agencies Rural development department, JEEVIKA Project and Women Development Corporation (WDC) are engaged in SHG formation in Bihar under their separate book keeping method, processes and action plan.Lakshmi said the new approach would require one process, similar bookkeeping method and a common action plan so that the SHGs of he three agencies are able to work together in tandem with banks, which give loans to the SHGs to make their activities a massive social movement.

CONCLUSION:

SHG is an important approach focusing the empowerment of individual woman as well as of the groups themselves for becoming self reliant not only by farming but by opting some economic activities in allied sectors also. But, to be more effective, the groups need some technological support.

SHGs of all types have an important role in development. They provide space for participation, which contributes to group member's ownership of the issue at hand as well as any solutions. This in turn builds group cohesiveness, solidarity and promoters mutual support. They can be the platform for building a sense of community a social support system, increasing self-confidence, learning together and providing a sense of equality.

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SHGs will however become sustainable, only if they have backward linkages with technology, credit and forward linkages with processing and marketing organization, Steps will have to be taken to convert micro-finance into livelihood finance through appropriate support system.

There is also need for establishing SHG Capacity Building and Mentoring Centers. Further, scaling up of bank linkages and increased SHG activities would require a large force of trainers. Besides, there has to be common training approach, common book keeping approach, and common rating system It will be useful to promote SHGs at the production end of the farming enterprise involving men. This will be particularly helpful in the case of integrated pest management, integrated nutrient supply, scientific water management and improved post-harvest technology, marketing etc.

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Gamma ray induced M₂ generation polygenicvariability in medium grain non-basmati aromatic rice

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ABSTRACT

Purpose: This experiment was conducted to study the genetic variability in the quantitative characters after induction of gamma irradiation in M₂ generation of non-basmati aromatic rice Badshah Bhog.

Materials and methods; The seeds were irradiated with four different doses of gamma rays viz. 25 kR, 30 kR, 35 kR and 40 kR from ⁶⁰Co source at Bidhan Chandra Krishi Viswa vidyalaya (BCKV), West Bengal. The unexposed seed packet was used as control. In M₁ generation plants are selected for harvesting on the basis of panicle fertility. Seeds from bagged panicles of suspected mutant plants which harvested in M₁ generation were sown in nursery bed to raise M₂ generation. The M₂ populations were thoroughly screened for micro-mutations and other mutations based on visual observation.

Results: The results of PCV, GCV, h² and GA revealed that there was differential response of polygenic traits to different doses of mutagen. The genotypic and phenotypic coefficients (GCV and PCV) of variation ranged from 2.97% and 4.83% at 35 KR respectively in plant height to 81.50% and 92.42% at 40 KR respectively in panicle exertion. The estimates of heritability in broad sense were very high (>75%) for secondary branch, plant height panicle exertion, total tiller, productive tiller, panicle length, primary branch, secondary branch, total grain, spikelet fertility and yield per panicle at all four doses of gamma rays in M₂ generation. The estimation of genetic advance as percent of mean were high (>50%) for total grain, filled grain at all four doses and spikelet fertility at 30 KR in M₂ generation.

Conclusion: Micro-mutations are more important for direct use in plant breeding than macro-mutations because micro mutations or quantitatively inherited genetic changes occur in minor genes or polygenes and it can be detected by help of statistical methods. Efficient use of induced variability in breeding through selection would be possible when the generation in which maximum variability is likely to be released is known. Thus, induced genetic variability can effectively be exploited for improving yield and its attributes.

Keywords: Induced mutation, Gamma ray, M₂ generation, Polygenic variability

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Under Long-Term Biochar and Mycorrhiza Applications and Their Effects on CO₂ Flux and Carbon Capture Under Maize Plant Conditions

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Purpose

In recent years, with increasing climate changes the restoration of degraded areas due to soil-crop management for sustainable agriculture and food security is getting necessary. Increasing soil organic carbon content in agricultural soils is an urgent need. The most important soil organic carbon sources are addition of organic fertilizers such as manure, green manure, compost, biochar and cover crops. Also, a sustainable soil-crop, water and soil organisms' management is vital. Pyrolyzed carbon sources biochar as an alternative soil amendments and organic fertilizer reminds in soil for a long term. Biochar and plants symbioses arbuscular mycorrhizal fungi have the potential to promote sustainable agriculture by improving soil quality and reducing commercial fertilizer use/cost. Also, both biochar and mycorrhiza have significant effects on soil organic carbon sink. A long-term biochar doses and mycorrhizal inoculation experiment was set up to investigated the effects of biochar and mycorrhizal inoculation on carbon dioxide flux and total CO₂ respiration. The purpose of the study is to investigate CO₂ flux, CO₂ emission and soil carbon sinks under long term conditions with addition of different doses of biochar and mycorrhizal inoculated maize plant.

Methods

In 2018 a long-term field experiment was established with four different doses of biochar (0, 10, 20 and 40 tons ha⁻¹) with and without mycorrhizal inoculation. Biochar was made from citrus feedstock. During the experiment, under field conditions, the CO₂ released from the soil to the atmosphere was measured at different time intervals with LiCOR LI-8100 an equipment. At the same time soil atmosphere CO₂ emission was measured as well. At the end of experiment, measured CO₂ flux and cumulative carbon release was calculated.

Results

There were no significant differences in different biochar doses addition with AM fungal colonization of maize plants growth on cumulative CO₂ flux. On average, in zero biochar doses and without mycorrhizal inoculation, the highest CO₂ flux (16.00 ton CO₂ ha⁻¹) was captured compared to other treatments. The average CO₂ flux in the mycorrhiza inoculated plots was 15.11 ton CO₂ ha⁻¹, in without mycorrhizal inoculated plots 15,61-ton CO₂ ha⁻¹ was captured. The CO₂ emission released from the soil to the atmosphere, generally the highest emission was measured in B4 (40 tons ha⁻¹) and non- mycorrhiza treatments (436.52 µm/m²s), the lowest emission was observed in B0 (0 tons ha⁻¹) with mycorrhiza treatments (425.50 µm/m²s). General, CO₂ emission average in mycorrhiza-inoculated plots was 431.04 (µm/m²s), and in without mycorrhiza-inoculated treatment was 434.15 (µm/m²s).

Conclusion

Obtained results shown that biochar application and mycorrhizal inoculation have no significant effect on soil CO₂ flux and respiration. Biochar and mycorrhiza can be used to mitigate atmospheric CO₂ to soil. It seems that mycorrhizal inoculation and biochar dual addition are not releasing more CO₂ to atmosphere. The synergy between biochar and AM fungi help to reduce fertilizer costs and/or improve maize yield and nutriment uptake.

Keywords: Mycorrhiza, Maize, Biochar and CO₂ flux, Carbon sink

Differential impact of heavy metal (As, Cd and Pb) stress on seed germination and seedling stages in rice

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Purpose: Heavy metals contamination in soil and water is serious concern today, show deleterious effects on all living organism. Seed germination is one of the most important stage in a plant's life, affected by chemical and physical conditions of the rhizosphere. Thus, an effort was made to understand the effect of different heavy metal (As, Cd and Pb) stress on seed germination and seedling stage at variable concentration in basmati and non-basmati rice genotypes.

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Methods: IR-64 and Pusa basmati were evaluated at germination and seedling stage at variable concentration of different heavy metals (As, Cd and Pb) stress. Seed germination and plant growth parameter including root system architecture were evaluated and further elemental analysis was done by atomic absorption spectroscopy (AAS) for each treatment.

Result: Among the metals, the As stress showed little increase in all seed germination parameters while negatively correlation was observed in case of Cd stress. In contrast, Pb stress stimulated the seed germination and growth at early stage. In contrast, dose dependent decrease was observed for plant height and shoot biomass at seedling stages. Beside these, both the variety showed significant increase in root length and number of lateral roots at variable concentration of As and Cd stresses.

Conclusion: Cd was found as the most affecting heavy metal among As and Pb. Lower levels of As and Pb do not cause any toxicity at the germination stage, compared to Pb, which showed stimulatory effect on the seed germination and early-stage seedling growth. Understanding the effects of heavy metals on the critical stages of seed germination and further development will enable us to develop appropriate priming and other agronomic measures to minimize the damages.

Keywords: Seed germination, Heavy metals stress, Seed vigour.

Development of novel non- lodging mutants of cluster bean (*Cyamopsis tetragonoloba* (L.) Taub.) and deciphering their stability for yield-related traits

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MDU 1 is a high yielding cluster bean variety rich in vegetable protein and dietary fibres, but susceptible to crop lodging due to its indeterminate growth nature. Therefore, an attempt was made to develop novel non-lodging mutants of MDU 1 through induced mutation and testing the mutant genotype's stability across different environments.

Methods

Seeds of MDU 1 were mutagenized using various sub lethal doses of gamma rays, electron beam and combination of gamma rays and EMS. The mutants generated were screened for early maturity and non-lodging character from M₁-M₃ generation. In M₄ generation, fourteen best non-segregating mutant accessions were selected and evaluated along with the parental genotype, MDU1 for yield and twelve yield attributing traits. Five best mutant accessions viz. APMC-020-04, APMC-020-7, APMC-020-08, APMC-020-10 and APMC-020-11 were selected based on the pod yield per plant and non-lodging nature and forwarded to M₅ generation for testing stability under three different environments in Tamil Nadu viz. Madurai (E1), Arupukottai (E2) and Ramanathapuram (E3).

Results

500 Gy gamma rays was identified as the best treatment in developing non-lodging mutant of MDU 1 without compromising the yield. All the five mutants identified had higher yield with shorter crop cycle contributing towards better crop productivity compared to the parent. From the study, APMC-020-10 was identified as the most stable determinate mutant. APMC-020-10 was the most ideal genotype for E1 (Madurai), APMC-020-07 for E2 (Arupukottai), and APMC-020-04 for E3 (Ramanathapuram).

Conclusions

Selected novel cluster bean mutants from this research can be further studies using more diverse environments for the release of the mutants as varieties.

Key words: Mutation, Stability, Non- lodging, Cluster bean

The effect of incorporation of edible fibre from fruit and vegetables on sensory properties of biscuits

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Purpose

Traditional biscuit as one of the popular bakery products lacks fibre and nutrients. Besides, the essential role of fruit and vegetables in a healthy diet is noticeable worldwide. The addition of alternative non-wheat components such as fruit and vegetables, which are comprised of nutrients as well as phytonutrients can change the sensory quality of the biscuit. Sensorial characteristics are of most essential parameters of customers' acceptance of the product. In this way, the present research mainly aims to assess the effect of the added edible fibre from chiku, Indian plum, beetroot leaves and turnip leaves at different levels on sensory parameters of biscuits, namely colour, texture, taste, aroma and overall acceptability.

Methods

In this research, the sensory quality viz, colour, texture, taste, aroma and overall acceptability of biscuits prepared with different levels (0, 4.5, 7, 9.5 and 12%) of two kinds of edible fibres from vegetables, turnip leaves powder (TrLP) and beetroot leaves powder (BrLP), and two kinds of edible fibres from fruits, chiku fibre powder (ChFP) and Indian plum fibre powder (IPFP), was evaluated by non-parametric Friedman's test to screen the biscuits regarding preference ranking in overall acceptability. In addition, the proximate compositions of biscuits have been evaluated.

Results

This study demonstrated that the development of biscuits by incorporation of edible fibre from fruit and vegetables could be possible as a potential source of fibre for consumers. However, the addition of edible fibre from fruit and vegetables could affect the quality of biscuit, mainly sensory properties, which depending on the source of edible fibre, it can have a positive or negative effect on the desirability of biscuits to the customers. The biscuit containing ChFP gained the highest overall acceptability among other fibre-enriched biscuits followed by biscuit added with BrLP, then biscuit with IPFP and finally biscuit incorporated with TrLP. The total edible fibre and crude fibre contents for biscuit supplemented with 7% ChFP were 14.03% and 3.41%, and for biscuit containing 4.5% BrLP were 5.02% and 2.01%, respectively.

Conclusions

The ChFP and BrLP could be used as health-promoting substances in biscuits at levels of 7% and 4.5% without any detrimental results in sensory characteristics, respectively.

Key words: Chiku, Indian plum, beetroot leaves, turnip leaves, sensory properties

Seasonal Abundance of Chilli mites in Marathawada Region of Maharashtra

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Chilli, (*Capsicum annum* L.) Chilli occupies a pride place among the vegetables for its delicious taste and pleasant flavour. India is rich in maximum diversity of chilli varieties i.e. heatless and hot varieties with different quality factors. Several sources concordantly put the origin of chilli in Bolivia or Brazil (Andrews, 1984 and Paterson, 2000). It was first introduced to India from Brazil by the Portuguese towards the end of fifteenth century and its cultivation became popular in the Seventeenth century and since then, it has gained importance as an important spice and vegetable crop and also become a key element in many cuisines (Greenleaf, 1986). Reason which attributes to low productivity of chilli is infestation of insect pests and diseases. Over 53 species of insects and mites have been reported as pests of chilli in India which includes thrips, mites, whiteflies, fruit borers, cutworms, plant bugs, mites and other minor pests (Sorensen, 2005). Chilli mite (*Polyphagotarsonemus latus* Banks) is a tiny spider like creature that is found in large numbers on the underside of leaves, covered with fine webs. Both nymphs and adults suck the cell sap and devitalize the plants (Butani, 1976). Feeding of *P. latus* causes different types of physical deformities like thickening, brittleness and shortening, twisting, downward curling and crumpling of young leaves. Midrib of young infested leaves bend in a zigzag fashion, ventral surface becomes silvery, petiole of mature leaves elongates and the plant becomes stunted with rosette symptoms. Infestation at flowering stage caused falling of flower bud. (Karmakar, 1997). so, the present investigations were planned and carried out with objectives to study

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chilli mite’s status on chilli in Marathwada region of the Maharashtra state, to provide a comprehensive picture on it’s population build up and behavior which can help in it’s sustainable management.

METHEDODOLOGY

For this purpose, Randomly fields were sampled from each Tahsil of chilli growing areas following survey procedure *i.e.* collecting data of mites infestation from five random plants from five random spots in each field, representing all the cropped area by visiting twice in the season at same location. Data was collected and compiled and mean population of mites in each tahasil was worked out and final figure was used for assessing pest status in the region.

RESULTS

Results indicated that Mites infestation on chilli was noticed in the range between 2.02 to 8.86 and 4.42 to 8.96 mites/leaf during 2016-17 and 2017-18 respectively during survey and least intensity of mites was observed in 2016-17 at Bhokardan tahasil of Jalana districts and Phulambri tahasil of Aurangabad districts in 2017-18 and maximum infestation was recorded at Dharmabad and Naigaon tahasils of Nanded district.during 2016-17, the mites population first appeared during 36th SMW (5-11 Sept.) and it was gradually increased and attained peak (6.98/leaf) during 46th SMW (14-20 Nov.) when the prevailing maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, evaporation, bright sunshine hours and wind velocity were 30.3^oC, 12.1^oC, 76 per cent, 32 per cent, 4.1 mm, 9.6 hrs and 2.5 kmph, respectively. Then activity of mites was declined by the end of season *i.e.* 4th SMW (22-29 Jan.).

During 2017-18, the activity of mites initiated during 39th SMW (26 Sept.-02 Oct.) with gradual increase in its population and reached peak of 8.46 mites/leaf during 47th SMW (21-27 Nov.) when the prevailing maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, evaporation, bright sunshine hours and wind velocity were 32^oC, 17^oC, 77.0 per cent, 42.0 per cent, 4.5 mm, 7.4 hrs and 2.4 kmph, respectively. Thereafter during 48th SMW the population declined and again increased up to 5.96 mites/leaf in 49th SMW (5-11 Dec.). Afterwards, the population gradually decreased but sustained up to 3rd SMW (15-21 Jan).

CONCLUSION

Mites was found to be major pest of chilli and its presence was moderate to high during the experimental period and it’s population was at peak during intial growth period.

Table No. 1 Status of chilli mites on chilli in Marathwada during 2016 and 2017

Sr. No.	Districts	Tahsils	No. of Fields visited		Mites/leaf		Visit Period (MW)	
			2016	2017	2016	2017	2016	2017
Scarcity zone								
1	Aurangabad	Gangapur	5	3	4.32	6.84	40&50	43&52
		Vaijapur	4	2	4.48	8.62	40&50	43&52
	Mean		5	2	4.40	7.73		
Assured Rainfall zone								
1.	Aurangabad	Phulambri	2	4	6.02	4.42	40 50	43&52
		Sillod	8	5	8.42	8.18	42&51	43&52
2	Hingoli	Sengaon	3	4	8.00	6.68	42&51	42&50
3	Jalna	Ambad	3	2	8.06	6.18	40&50	43&52
		Bhokardan	4	7	2.02	6.04	40&50	43&52
		Ghasawangi	5	4	2.46	5.38	40&50	43&52
4	Latur	Ahmadpur	4	3	4.84	8.44	43&52	44&51
		Renapur	2	3	5.86	8.68	43&52	44&51
5	Nanded	Biloli	5	8	3.38	4.48	42&51	42&50
		Deglur	4	5	6.56	5.86	42&51	42&50
		Dharmabad	7	5	8.86	8.12	42&51	42&50
		Naigaon	4	3	4.28	8.96	42&51	42&50
6	Parbhani	Gangakhed	4	5	8.80	8.06	42&51	42&50
		Parbhani	4	6	8.04	8.42	42&51	42&50
		Purna	2	4	8.52	6.96	42&51	42&50
	Mean			6.27	6.99			
Moderate rainfall zone								

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1.	Hingoli	Basmat	3	2	8.38	6.58	42&51	42&50
2	Nanded	Mudkhed	3	5	6.82	8.62	42&51	42&50
		Umri	4	4	8.42	8.86	42&51	42&50
Total Visits			80	84				
Mean Visits			3	4	7.87	8.02		

* Average pest population are mean of two visits

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Effect of sowing dates and fertilizers on wheat

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Wheat (*Triticum aestivum* L.) is known as king of cereals. In India, wheat has covered an area of 31.76 million hectares with a total production of 109.52 million tonnes and productivity 3464 Kg ha^{-1} (USDA, 2021). The choice of sowing date is an important management option to optimize grain yield of wheat. In general, all wheat varieties, when sown late, faces severe temperature stress that significantly affects phenology, growth and finally yield (Hossain and da Silva, 2012).The productivity of wheat depends upon the nutrient supplying capacity of the soil. The integrated use of chemical and organic fertilizer/manures can play an important role to sustain soil fertility and crop productivity. The reduction of grain yield caused by lodging ranged from 7 to 35% is commonly reported under Indian condition. The use of growth retardants found to be most effective for managing the problem of lodging (Zhang *et al.*, 2017).

Keywords: Wheat, Sowing Date, FYM, PGR etc.

METHOD AND MATERIALS

Experiment was conducted at BTC CARS, Bilaspur (Chhattisgarh) during *rab* 2020-21. The soil of experimental site was clay in texture (Vertisols). The soil was neutral in reaction. The wheat cultivar (GW366) was sown. The treatment consists of four sowing dates i.e D₁ (25th October), D₂ (5th November), D₃ (15th November) and D₄ (25th November) and three nutrient management option i.e NM₁ (RFD), NM₂ (150% RFD + FYM 15 t ha⁻¹) and NM₃ (150% RFD + FYM 15 t ha⁻¹+ Growth regulators) were taken in split plot design with three replications. The dose of PGR was calculated as per the treatment, Chlormequat chloride (Lihocin) @ 0.2 % + Tebuconazole (Folicure 430 SC) @ 0.1 % of commercial product dose at first node and flag leaf stages. Wheat was sown in 20 cm row spacing with 100 Kg ha⁻¹seed rate.

RESULT

It is clear from Table 1 that the sowing date 5th November (D₂) produced significantly higher yield (46.33q ha) than sowing in 25th October (D₁) and 25th November (D₄), but at par with 15th November (D₃) (44.28 q ha). Higher grain yield of wheat under 16th November have also reported by *Goverdhan et.al.* (2019). Among different nutrient managements grain yield was higher under treatment (NM₃) 150% RFD + FYM 15 t ha⁻¹+ Growth regulators (44.83 q ha) followed by (NM₂) 150% RFD + FYM 15 t ha⁻¹ (43.46 qha⁻¹) the lowest grain yield was obtained under RFD (NM₁) (37.36.q ha⁻¹). Similar results were reported by Convertry et al (2011). The straw yield of wheat followed the trend of variations similar to that of seed yield for different date of sowing treatment. Among nutrient management practices the treatment 150% RFD + FYM 15 t ha⁻¹+ Growth regulators (NM₃) recorded higher straw yield which was significantly superior then RFD (NM₁) and 150% RFD + FYM 15 t ha⁻¹ (NM₂) under study. Among different date of sowing 5th November (D₂) recorded higher harvest index and 25th October (D₁) date of sowing treatment had the lower harvest index. However, the nutrient management practices could not bring

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about any significant difference for harvest index. The higher B:C ratio was observed under 5th November (D₂) (2.14) and among nutrient management under RFD (NM₁) (1.54)

However, interaction effect between date of sowing and nutrient management has non-significant for grain and straw yield..

Table1. Effect of sowing dates and nutrient managements on grain & straw yield, harvest index and B:C ratio of wheat.

Treatments	Grain Yield (q ha ⁻¹)	Straw yield (q ha ⁻¹)	Harvest Index (%)	B:C Ratio
Date of sowing				
D ₁ (25 th Oct)	37.20	42.27	46.82	1.53
D ₂ (5 th Nov)	46.33	49.53	48.44	2.14
D ₃ (15 th Nov)	44.28	48.84	48.05	2.01
D ₄ (25 th Nov)	39.72	43.49	47.68	1.70
SEm ±	1.13	0.87	0.38	-
C.D.(P=0.05)	3.90	3.01	NS	-
Nutrient Management				
NM ₁ (RFD)	37.36	41.45	47.84	1.54
NM ₂ (150%RFD+FYM 15t ha ⁻¹)	43.46	46.83	48.07	1.38
NM ₃ (150%RFD+FYM15tha ⁻¹ +GR)	44.83	49.83	47.33	1.28
SEm ±	0.85	0.96	0.47	-
C.D.(P=0.05)	2.55	2.88	NS	-
Interaction (A × B)				
SEm ±	1.70	1.92	0.94	-
C.D.(P=0.05)	NS	NS	NS	-

CONCLUSION

For yield maximization of timely sown wheat, sowing should be done in 5th to 15th November with application of 150%RFD+FYM15tha⁻¹+PGR.

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Integrated effect of tillage and weed control methods on weed dynamics, growth and yield attributes of chickpea after harvest of rice in c.g. plains

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Chickpea (*Cicer arietinum* L.) ranks as the third most important annual major food grain legume in the world after dry bean and peas (Singh and Saxena, 1999). Global chickpea area is 10.94 M ha with Production of 8.59 M tones and Productivity of 786 kg ha⁻¹. It is also known as gram or chana and belongs to the leguminosae family and mostly grown in rabi season (Oct-Nov to Feb-March). In India, chickpea is cultivated on 6.93 M ha with production of 5.60 M tonnes (GOI, 2007). In tropical, subtropical, and temperate regions of the country and in recent years, the area, production and productivity is in the increasing trend due to its profitability under rainfed conditions. But its poor productivity makes it non-competitive in comparison to present day high yielding varieties of cereals. In Chhattisgarh, chickpea is cultivated in an area of about 3.20 Lakh ha with an average production of 2.12 Lakh tonnes and productivity of 663 kg ha⁻¹. The average productivity of chickpea is still below one ton per hectare, which is considered low by any standards. Under irrigated conditions weeds are a potential threat to the crop reducing the yield by 40 to 87% under severe infestation (Moorthy *et al.*, 2003). Chickpea is a poor competitor to weeds because of slow growth rate and limited leaf area development at early stages of crop growth and establishment. Weed competition is considered as one of the most important causes of low productivity and inferior quality of chickpea in Chhattisgarh. Considerable yield losses in chickpea recorded to the extent of 88 per cent if weeds are not controlled within critical growth period (Bhalla *et al.*, 1998). Tillage and/or herbicides are used for weed control, but the degree of control achieved may vary widely depending on weed species present, soil type, climatic condition, crop grown, tillage method and cropping system (Unger *et al.*, 1999). Rice-chickpea cropping system have been found to be the most remunerative (Chauhan, 2007). There is no registered Post-emergence herbicide with broad spectrum weed control is available at the moment. Imazethapyr 10% seems to be promising as it has been proved to be effective against number of leguminous oilseed and pulse crops. Hence, it has the potential to control mixed weed flora when applied as Pre and Post-emergence. Performance of Imazethapyr in chickpea as Pre and Post-emergence has yet not been assessed in Chhattisgarh.

MATERIALS AND METHODS:

A field experiment to study the combined effect of tillage and weed control methods on weed dynamics, growth and yield attributes of chickpea cultivar JG-226 after harvest of soybean was carried out at the Research cum Instructional Farm of IGKV, Raipur during two consecutive *rabi seasons* of 2010-11 & 2011-12. The soil of experimental field was *clayey* in texture with neutral pH. The experiment was laid out in Split Plot Design with three replications. The treatment comprised of Three tillage practices viz. conventional tillage (T₁), minimum tillage (T₂) and zero tillage (T₃) in main plot and nine weed management practices as pendimethalin @ 1000 g ha⁻¹ PE (W₁), imazethapyr @ 80 g ha⁻¹ PE (W₂), imazethapyr @ 90 g ha⁻¹ PE (W₃), imazethapyr @ 100 g ha⁻¹ PE (W₄) at 2 DAS, imazethapyr @ 70 g ha⁻¹ POE (W₅), imazethapyr @ 80 g ha⁻¹ POE (W₆), imazethapyr @ 90 g ha⁻¹ POE (W₇) at 20 DAS, one hand weeding at 20 DAS (W₈) and weedy check (W₉), in sub plots. The chickpea seeded @ 80 kg ha⁻¹ was sown with the space of 30 × 10 cm.

RESULTS:

1. Growth parameters: - Growth and growth attributes like plant population, plant height, number of branches, dry matter accumulation etc. were recorded higher under conventional tillage which was superior over other tillage practices. Among the weed management practices, these attributes were maximum under one hand weeding at 20 DAS (W₈), followed by imazethapyr @ 90 g ha⁻¹ POE (W₇).

2. Yield attributed and yield: - Yield and yield attributes of chickpea viz. number of pods plant⁻¹, test weight were recorded highest under conventional tillage and one hand weeding at 20 DAS (W₈), followed by imazethapyr @ 90 g ha⁻¹ POE (W₇). The mean seed yield of chickpea sown after harvest of rice was 878.25 kg ha⁻¹ under conventional tillage. Mean stover yield under conventional tillage in rice-chickpea, the mean stover yield under conventional tillage was 1169.60 kg ha⁻¹ with an increase of 18.12% over zero tillage. However, chickpea sown after harvest of rice produced 914.68 and 1314.5 kg ha⁻¹ mean seed and stover yield under post-emergence application of imazethapyr @ 90 g ha⁻¹ at 20 DAS.

3. Weed studies: - Among weed management practices, one hand weeding at 20 DAS, proved significantly superior over other weed management treatments and registered lowest weed density, dry matter production, weed index and higher weed control efficiency. However, POE application of imazethapyr @ 90 g ha⁻¹ also proved significantly at par to hand weeding at 20 DAS and registered with lower weed density, weed dry matter production, weed index and higher weed control efficiency as compared to other herbicidal treatments.

CONCLUSIONS

Growth, yield attributes and seed yield of chickpea in both the experiments were higher under conventional tillage. An average seed yield increase by 18.66 and 17.64 % under conventional tillage was obtained over zero tillage, respectively, in chickpea sown after harvest of soybean and rice.

Among different herbicide treatments, POE application of imazethapyr @ 90 g ha⁻¹ was found as effective as that of one hand weeding in controlling mixed weed flora, lower dry matter production, higher growth and yield attributes and seed yield. The lower doses of POE application of @ 80 and 70 g ha⁻¹ were next in order. All the three were found better than pre-emergence application of imazethapyr as well as pendimethalin. An average increase of seed yield by 44.57 and 44.59 % was estimated under imazethapyr POE @ 90 g ha⁻¹ over weedy check, respectively, in chickpea sown after harvest of rice. Pre-emergence application of pendimethalin and imazethapyr decreased the microbial activities up to 20 DAS, thereafter it increased till harvest stages. Post-emergence application of imazethapyr decreased the microbial activity at 30 DAS, thereafter it increased from 40 DAS till harvest stages. Highest dehydrogenase activity was measured under the weedy check plot (W₉), followed by hand weeding twice at 20 DAS (W₈).

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