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Research Article

Evaluation on the efficacy of different chemical fungicides against rice blast *(Pyricularia oryzae*) under field condition at Siraha, Nepal

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ABSTRACT
Rice blast (*Pyricularia oryzae*) is a serious disease which hampers production of rice. The field research was conducted in PMAMP, PIU, Siraha Dhangadimai-10, Kuduwa to evaluate the efficacy of various chemicals against rice blast. The experiment was carried out in Completely Randomized Block Design (RCBD) with 7 treatments (6 chemicals and 1 control) and each treatment was replicated 3 times. Chemicals namely Hexaconazole5%(SC), Carbendazim12%+ Mancozeb 63%(WP), Azoxystrobin 18.2 % + Difenoconazole 11.4% (SC), Thiophonate-Methyl 70%wp, Kasugamycin 2% Wp and Floxystrobin+tubuconazole were used for this experiment. Azoxystrobin18.2 % + Difenoconazole 11.4 % (SC) was recorded as the best chemical followed by Carbendazim12%+Mancozeb 63%WP to control rice blast. The highest disease severity was seen at the control plot. The highest yield was observed in plot with Azoxystrobin+Difenconazole (5.16mt/ha) followed by Carbendazim12%+ Mancozeb 63%WP(5.12mt/ha).
Keywords: *Pyricularia oryzae*, Disease, Severity, Fungicides, Control, Yield

INTRODUCTION

In global scenario, more than one-third of people rely on rice for their daily meals. Rice is the primary staple food in Asia and the Pacific regions due to 39% of calories obtained from it (Yaduraju and Rao 2013).More than 80% of the population in Asian nations eats rice every day as a staple food(Hajano and Rajput 2011). With 1.49 million ha and a total production of 5.0 million tons in Nepal, rice is the most widely grown crop, with a productivity of 3.4 t ha^{-1} (Ghimire et al. 2019). Rice can be grown in a wide range of environment; from tropical plains to the foot of the mountain (Sabin et al. 2016). Rice productivity is low for a number of reasons such as inconsistent rainfall, drought, weeds, insect pest diseases, a lack of high-quality seeds, and a failure to use suggested production and plant protection techniques. One of the most significant diseases affecting rice is rice blast, caused by the fungus *Pyricularia oryzae*(Acharya et al. 2020). In Nepal, this disease was first detected in 1966. Although, rice blast is pervasive all over the rice growing regions in the country, it is quiet severe in valleys, river basins, foothills, and hills of Nepal(Magar, Acharya, and Pandey 2015a). All stages of rice growth are threatened by this disease. The pathogen spreads disease to most of the aerial parts of the plant causing lesions on them, including the leaf blade, leaf sheath, collar region, stem, panicle, and grain (hull), and also limits yield potential in disease-prone environments (Neupane & Bhusal , 2020).

Globally, blast disease accounts for 70 to 80 % reduction in yield of rice damaging vegetative as well as reproductive stages (Rijal and Devkota 2020). In Nepal, the disease reduces yield by 10-20% in susceptible varieties, but in severe cases yield reduction can reach upto 80%(Acharya et al. 2019). In an areas where rice is grown, a blast outbreak could result the crop loss from 35 to 50% and in a significant breakout of the disease, up to 100% of the crop could be lost (E.Tollen, 2013).As a result, a suitable, efficient, and economically viable method of chemical control is required for the sustainable production of rice.

MATERIALS AND METHODS

Experimental site

This experiment was carried out in the farmer’s field of Dhangadimai-10 Kuduwa, Siraha from Falgun 2077 to Ashad 2078. It is located at 26.7781° N latitude and 86.3655° Elongitude. During the experimental period the maximum temperature, relative humidity, and rainfall was33^{O} C,82%, and 553 mm respectively, whereas the minimum temperature, relative humidity and total rainfall was 23^{O}C, 53%, 128 mm respectively.

Experimental design and treatment combination

The experiment was carried out in a randomized complete block design (RCBD) maintaining three replic ations of seven treatments where each plot size was 3.5 m × 3.75 m. The distance between two blocks and two plots was 0.75cm and 0.5m respectively.

Table 1. Treatment with different fungicides used in the study

Treatment	Trade name	Common Name	Dose
T1	Krizole+5	Hexaconazole 5% SC	3ml/ltr
T2	Sixer	Carbendazim 12 % + Mancozeb 63 % (WP)	2gm/ltr
T3	Saizox	Azoxystrobin 18.2 % + Difenoconazole 11.4 % (SC)	3ml/ltr
T4	Kingsin M	Thiophanate-methyl 70%WP	2gm/ltr
T5	Kasu-B	Kasugamycin 3%SL	2ml/ltr
T6	Nativo	Trifloxystrobin 25%+Tebuconazole50% (75WG)	2gm/ltr
T7	Control	-	-

Cultural practices

Chaite-5, variety of rice was used for the purpose of this study. A slightly raised nursery bed was prepared by ploughing followed by laddering. Sprouted seeds were evenly broadcasted along the bed and light irrigation was provided whenever needed. One week before transplanting the seedlings, the main plot of the experiment was ploughed using power tiller and it was left for sundry for a week. After one week, to achieve better puddle condition, the land was continuously harrowed and ploughed followed by laddering. When final land preparation was done, 23 days old seedlings were transplanted on 21st March, 2021 by maintaining a distance of 20*20 cm^2 between the row and plant. After a week of transplanting, each plot was examined for any missing hills, which were filled in as needed with additional seedlings from the same source.

Each plot was evenly provided with FYM as a source of organic fertilizer and inorganic fertilizers such as urea, TSP, MoP, gypsum, zinc sulphate and borax were applied as a source of N, P, K, S, Zn and B respectively. A total of all inorganic sources of fertilizers were applied as a basal dose except nitrogen. Half nitrogen was applied as basal dose and the remaining half was applied evenly in two splits at tillering and panicle initiation stage. Different fungicide like Hexaconazole5%(SC), Carbendazim12%+ Mancozeb 63%(WP), Azoxystrobin 18.2 % + Difenoconazole 11.4% (SC),Thiophonate-Methyl 70%wp, Kasugamycin 2% Wp and Floxystrobin+tubuconazole were applied thrice at 15 days intervals. During the early stage of seedling establishment, to maintain a constant level of standing water up to 6 cm irrigation was provided. Later, irrigation was provided at different vegetative and reproductive stages avoiding water stress. Then 15 days piror to harvesting, field was kept dry. Weeding was done twice at 30 DAT and 60 DAT. Harvesting was done when 80-90% of the grain turned straw-colored on July 26, 2021.

Observations recorded

Disease Severity

Data on disease severity were collected from randomly selected ten plants except the plants along the borderline on a weekly basis beginning from the fourth week after transplantation until six scorings were completed. The 0-9 scale was used for scoring, and the percentage of disease was calculated using the formula (Bhusal et al. 2018).

Disease Severity =

$$\frac{Sum of Score}{Number of observation * Highest number in rating scale} * 100$$

Table 2. Scale for disease scoring of Leaf blast disease of Rice

Scale	Description	Host behavior
0	No lesion observed	Highly resistance
1	Small brown specks of pin-point size or larger brown specks without sporulating center	Resistance
2	Small roundish to slightly elongated, necrotic gray spots, about 1-2 mm in diameter, with a distinct brown margin	Moderately resistance
3	Lesion type is the same as in scale 2, but a significant number of lesions are on the upper leaves	Moderately resistance
4	Typical susceptible blast lesions 3 mm or longer, infecting less than 4% of the leaf area	Moderately susceptible
5	Typical blast lesions infecting 4-10% of the leaf area	Moderately susceptible
6	Typical blast lesions infection 11-25% of the leaf area	Susceptible
7	Typical blast lesions infection 26-50% of the leaf area	Susceptible
8	Typical blast lesions infection 51-75% of the leaf area and many leaves are dead	Highly susceptible
9	More than 75% leaf area affected	Highly susceptible

Statistical analysis

The entry of the data was done on MS-excel (2007) and analysis was done with the help of Gen-stat (15 version). Mean comparison was carried out among significant variables by fisher-LSD at 5%level of significant.

RESULTS AND DISCUSSION

There was highly significant different ($p \leq 0.001$) in mean disease severity (%) of rice blast among treatments (Table 3). The lowest disease severity was observed in Azoxystrobin+Difenconazole (7.28%) treated plot which was at par with Carbendazim+ Mancozeb (7.71%). The highest disease severity was recorded in control (31.36%) plot followed by Hexaconazole (14.65%) and Thiophanate-Methyl (12.90%) which was significantly different with each other.The highest percentage reduction in disease severity over control was brought by Azoxystrobin+Difenconazole (76.79%) followed by Carbendazim+ Mancozeb (75.45%) and Tebuconazole+ Trifloxystrobin (69.71%) and least was brought by Hexaconazole (53.28%)

The disease severity of different fungicides is shown in the graph (Fig 1). All the tested fungicides showed different severity percentages after different weeks of transplanting. Control on different weeks of transplanting showed increasing growth of severity percentage.Azoxystrobin18.2%+Difenconazol11.4%SC showed decreasing disease severity percentage and showed the least disease severity as compared to other fungicides. The highest disease severity was shown by Hexaconazole 5%SC. Six different fungicides showed a decreasing trend in disease severity after 6-7th weeks of transplanting as compared to control.

Table 3. Effect of different treatments on mean disease severity of rice blast at Dhangadhimai-12, Siraha, 2021

Treatments	Mean disease severity ^{x} (%)	PROC (Disease severity)
Azoxystrobin 18.2%+Difenconazole11.4%SC	7.28^{a} (15.65)	76.79
Carbendazim12%+ Mancozeb 63%WP	7.71^{a} (16.10)	75.45
Tebuconazole 50% + Trifloxystrobin 25%WG	9.50^{b} (17.94)	69.71
Kasugamycin 3% WP	9.75^{b} (18.19)	68.91
Thiophanate-Methyl 70%WP	12.90^{c} (21.04)	58.86
Hexaconazole 5%SC	14.65^{d}(22.50)	53.28
Control	31.36^{e}(34.06)	0
Mean	20.78	
SEd	0.565	
LSD(0.05)	1.231	

^{x}Values are mean of four replications at different date of disease scoring; PROC: Percentage reduction over control; CV: Coefficient of variation; ***: Significant at 0.1% level of significance; Values with same letters in a column are not significantly different at 5% level of significance by DMRT. Figures in parentheses indicate arcsine transformation values.

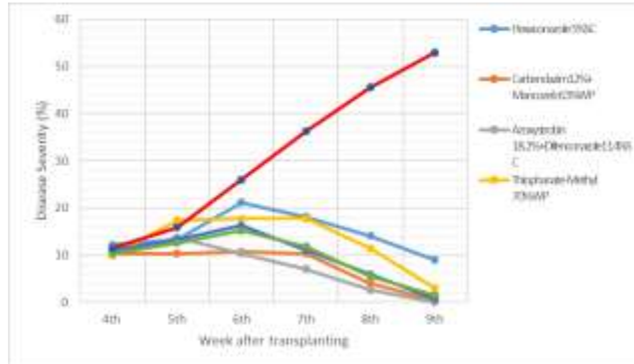

Figure 1. Disease severity at different weeks after transplanting

Yield

There was a highly significant difference ($p \leq 0.001$) in yield (mt/ha) of rice blast among treatments (Table2). The highest yield was observed in Azoxystrobin+Difenconazole 5.16mt/ha treated plot which was at par with Carbendazim12%+ Mancozeb 63%WP (5.12m/ha). The lowest yield was recorded in the control (3.62mt/ha) plot followed by Hexaconazole (4.18mt/ha) and Thiophanate-Methyl 70%WP (4.37mt/ha) which are significantly different with each other.

The highest percentage increase in yield over control was brought by Azoxystrobin +Difenconazole (42.74%) followed by Carbendazim+ Mancozeb (41.55%) and Tebuconazole + Trifloxystrobin (38.87%) and least was brought by Hexaconazole (15.48%).

Table 4. Effect of different treatments on yield of rice at Dhangadhimai-12, Siraha, 2021

Treatments	Yield^{y} (mt/ha)	PIOC(Yield)
Azoxystrobin 18.2%+Difenconazole11.4%SC	5.16^{a}	42.74
Carbendazim12%+ Mancozeb 63%WP	5.12^{ab}	41.55
Tebuconazole 50% + Trifloxystrobin 25%WG	5.02^{bc}	38.87
Kasugamycin 3% WP	4.93^{c}	36.30
Thiophanate-Methyl 70%WP	4.37^{d}	20.74
Hexaconazole 5%SC	4.18^{e}	15.48
Control	3.62^{f}	0
Mean	4.628	
SEd	0.0587	
LSD(0.05)	0.1279	

^{y}Values are mean of four replications; PIOC: Percentage increase over control; CV: Coefficient of variation; ***: Significant at 0.1% level of significance; Values with same letters in a column are not significantly different at 5% level of significance by DMRT.

There was a significant variation of all the treatments in blast disease reduction and grain yield. Compared to control, there was a significant variation of all six fungicidal treatments in reduction of the disease incidence and severity. This experiment shows that, three sprays of (Azoxystrobin18.2% + Difenconazole11.4% SC) not only reduced the disease severity but also resulted in a higher grain yield, followed by Carbendazim12% + Mancozeb 63%WP.

Similar results were also reported by many researchers earlier. The application of Azoxystrobin 18.2%+ Difenconazole 11.4%SC was found most effective in controlling leaf blast, with a significant reduction in the disease severity and maximum grain yield (Singh et al. 2019). According to Singh et.al (2010) the use of carbendazim 12% + mancozeb 63% significantly reduced the neck blasts. While testing various fungicides, researchers from around the world has discovered similar results. Upadhyay et al(2020) has also mentioned that the combination product trifloxystrobin 25% + tebuconazole 50% WG the combination product trifloxystrobin 25% + tebuconazole 50% WG significantly reduced disease severity and improved rice grain yield, followed by Azoxystrobin 11% + tebuconazole 18.3% w/w SC @ 1.5 ml/l.

Among five fungicide under study conducted by Ahmad, Shahid, Ali, Anjum, et al(2020) Tebuconazole 50% + Trifloxystrobin 25%WG was most effective for controlling blast in rice. This finding is consistent with (Gn, 2018; Acharya et al., 2020; Moktan et al., 2021;Ghazanfar et al. 2009) who discovered the fungicides application increases rice yield. Researchers from around the world also found similar results while testing the various fungicides,(Magar et al. 2015b) at Karma Research and Development Center, Jyotinagar, Chitwan, Nepal used seven fungicides for rice blast management were sprayed thrice at weekly intervals starting from the booting stage.

CONCLUSION

Diseases are a major problem that reduces the crop yield. Over the years, the rice blast severely reduced grain yields, which resulted in a food shortage. It has been discovered that various chemical fungicides can effectively control a variety of plant diseases. The study discovered that fungicide treatments were more effective against leaf blast than the control. As a result, the plot treated with Azoxystrobin+Difenconazole (7.28%) had the lowest disease severity. Azoxystrobin and Difenconazole also provided the greatest percentage reduction in disease severity over control (76.79%). Azoxystrobin+Difenconazole produced the highest yield (5.16 MT/ha). It was concluded that Azoxystrobin (18.2%) and Difenoconazole (11.4%) can be advised for farmers to combat leaf blast because they are so efficient and easily accessible on the market.

CONFLICT OF INTEREST

The author here declares that there is no conflict of interest in the publication of this article.

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