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Research Article

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Production performance and chemical constituents of fodder maize at different levels of nitrogen in the inner terai region of Nepal

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ABSTRACT
An experiment was conducted to compare the fodder biomass yield and major chemical constituents of different varieties of fodder maize (*Zea mays*) sown at varying levels of nitrogen at the National Cattle Research Program (NCRP), Rampur, Chitwan (Inner Terai), during the winter season (September to December) 2021. The treatments were set in a 3×2×2 factorial arrangement of three factors, variety, density, and nitrogen level in a Randomised Complete Block Design (RCBD). The fodder maize varieties were Arun-2, African Tall, J-1006, and Pratap Makka Chari-6, the fodder density were 1,66,666 numbers of plants/ha (low-high) and 2,22,222 numbers of plants/ha (high-high), and the nitrogen levels were 150 kg/ha, 200kg/ha. Findings revealed that dry matter yield differed significantly ($p<0.05$) among the interactive combination of treatments during winter season. At 90 DAS, J-1006 had the highest dry matter (9.52 t/ha) at a high nitrogen level (300 kg/ha) and the least dry matter (5.02 t/ha) at a low nitrogen level (150 kg/ha) whereas Pratap Makka Chari-6 had the highest dry matter (9.29 t/ha) production in the low-high plant population with the lowest dry matter (6.46 t/ha) for high-high plant population. Besides, it was more palatable with the highest mean crude protein percentage (12.76%) in low-high plant density, though it was not varied significantly. Thus, J-1006 emerged as most promising in terms of dry matter at high nitrogen level, and Pratap Makka Chari-6 in terms of low plant density, reflecting its suitability over other fodder maize varieties to be grown under the inner terai context of Nepal.
Keywords: variety, density, nitrogen level, dry matter, crude protein

INTRODUCTION
The feeding administration is pivotal aspects in ruminant rearing for increasing commercial dairy farming especially in inner terai region of Nepal. Nepalese livestock are largely dependent on the feeding of rice straw, seasonally available grasses and shrubs, maize stover and legumes hulls besides the contribution of some of the crop land grown seasonal weeds and fodder-forages from forests. The national feed deficit in the country is 20.56 percent that demands more fodder production in the country and there was a need of 15,597,950-ton TDN at that time (NAFLQML, 2019). A prediction was done via the same insists an increase by 1.54 times by the year 2021/22 to cope up with the rising number of milking animals. The major green fodder species cultivated in the country are Berseem, Oat, Winter Vetch, Teosinte, Joint Vetch, Stylo, Molasses, Napier, Broom Grass, Setaria, Mulato, White Clover and Rye Grass. These fodder species are cultivated in 67061 hectares of land producing around 1,147175 metric ton of dry matter (NAFLQML, 2019). Although maize is not directly considered as cultivated fodder it is being popular in the recent years mainly its high fodder production, potential with good nutrient content and digestibility that is possible to cultivate more or less almost all the year round at the farmer's field. So far, GoN/NARC has released and well adopted 46 varieties of grain maize, but none of them were intended for fodder production (MoALD, 2022) whereas maize is pivotial due to its availability in abundance irrespective of different climate and geography. The fodder maize is important leafy forage with its potential herbage mass yield of 40-50 t/ha. Additionally, it has been regarded as wholesome and pleasant fodder, without any anti-quality components. Dahmardeh *et al.* (2009) also considers maize's capacity to supply abundant energy-rich supplement for daily animal diets. This fodder has no oxalic or prussic acid hazards and can be fed at any stage of growth, regardless of age or stage of development. It

is an important cereal fodder crop because of some desirable characteristics viz., high fodder yield, good palatability and absence of toxic substances like oxalic acid, HCN etc. (Dhasarathan et al., 2015).

The policy makers in three levels of government, Local, Provincial and Federal Government, has realized the need to promote the commercial dairy farming in the country that needs more herbage production to reduce the cost of production (NAFLQML, 2019). Furthermore, the Regional Technical Working Group (RTWG) and Provincial Agricultural Technical Working Group (PATWG) organized by NARC have also decided to promote fodder production to support the emerging dairy industry in Nepal. Hence, fodder maize is getting priority to promote the emerging commercial dairy industries, but the fodder maize production comprehensive technology and package of practices relevant to the Nepalese farming system is not adequately available in the country.

MATERIALS AND METHODS

Experimental location

The field experiment was done at the National Cattle Research Program (NCRP), Rampur, Chitwan during the winter season (September to December) 2021.The area is located at 27°39’15.93” N latitude and 84°21’05.22” E longitude with an elevation of 184.0992 masl (LRMP,1986).

Climatic information

The weather records showed that September had the highest temperature (monthly average = 28.74ºC) and November had the lowest temperature (monthly average =13.30ºC) as showed in Table 1.

Table 1. Status of major weather variables recorded during research period at Rampur, Chitwan in 2021

Weather records	Different dates of the research period (°C)			
	September	October	November	December
Maximum temperature	28.74	26.9	19.5	9.4
Minimum temperature	24.57	22.2	13.3	13.4
Average temperature	26.65	24.6	16.4	11.4

Source: National Maize Research Program, Rampur, Chitwan

Soil Characteristics

The properties of the soil as referred to the Agricultural Technical Centre (ATC) are presented in the Table 2.

Experimental design and treatment details

The experiment was conducted during the winter season (September to December) 2021. The treatments were used in 3×2×2 factorial arrangements of three factors, viz variety, density, and nitrogen level. randomised complete Block Design with three factors and four replications were used.

Factor A: Three fodder maize varieties -African Tall, J-1006 and Pratap Makka Chari-6

Factor B: Two density -Plant population 2,22,222 numbers/ha as a high-high density and 1,66,666 numbers/ha as a low-high density

Factor C: Two Nitrogen levels- 150 kg/ha (N1) and 300 kg/ha (N2)

Table 2. Nutrient content of soil at research site Rampur, Chitwan, 2021

Parameter	Value
pH (1:2.5)	6.12
N (%)	0.19
Organic Matter (%)	3.38
P_2O_5 (kg da^{-1})	38.37
Sand (%)	72.32
Silt (%)	21.18
Clay (%)	6.50
Texture Classification	Sandy Loam

Source: Agricultural Technology Centre Pvt Ltd, Lalitpur

Cultivation Practices

The experimental plot was plowed 2-3 times with a disc harrow and made the soil friable. FYM at the rate of 10 t/ha was added before 5 days of sowing. The row-row and plant-plant distance was maintained at 30 x 15 cm (D1) and 30 x 20 cm (D2) in a net plot size of 4.20 × 2.4m. The fertilizer containing nitrogen, phosphorus, and potassium was applied at the rate of 150:60:40 kg/ha (N1) and 300:60:40 kg/ha (N2), respectively. During the land preparation process, phosphorus and potash were administered, and nitrogen fertilizer was applied in three separate doses: half during the first cut (75 DAS) and half after the second cut (90 DAS). The plot was irrigated after sowing and then once in 10 days depending on the soil moisture. Weeding and hoeing were done on a when basis. Destructive harvesting was done at 75 and 90 days after sowing.

Data observation

The treatment-wise green biomass yield was taken from each net plot and averaged to get green biomass yield per plot whereas for dry matter, harvested the weight of green matter was used to calculate dry biomass yield. The morphological characteristics (plant height, leaf length, leaf breadth, and leaf numbers) were determined on the basis of randomly selected 5 plants from each plot.

Laboratory analysis

The main chemical elements of fodder maize were examined. DM was estimated using continuous heating method. Standard AOAC (1980) procedure was utilized to assess crude protein, whereas the Goering and Van Soest (1970) protocol was employed to analyze the sample's NDF, ADF, and ADL. The phosphorus and calcium minerals were examined using a spectrophotometer and a titration technique, respectively.

Statistical analysis

All the collected data were processed and ANOVA was done to test the significance of the treatments. A mean comparison of the treatments was done using LSD ($p<0.05$). Statistical software GenStat discovery 18th Edition (VSNi 2015) was used to analyze the data.

RESULTS AND DISCUSSION

Fodder maize dry matter (DM) yield and biomass attributing characters considering varieties, different densities and different levels of nitrogen fertilizer

During our study period, at 75 days after sowing (DAS), plant height differed significantly ($p<0.05$) among the fodder maize varieties where Pratap Makka Chari-6 attained the highest plant height (245.50 cm) (Table 3) which was, however, statistically similar ($p>0.05$) to the plant height of J1006 (231.60 cm). The lowest plant height (211.30 cm) was measured for African Tall. Similarly, at 105 DAS, there was a significant difference ($p<0.05$) in plant height among the fodder maize varieties. Accordingly, Pratap Makka Chari-6 attained the highest plant height (242.10 cm) (Table 3) while the varieties African Tall and J-1006 had statistically similar ($p>0.05$) plant height. The lowest plant height (214.10 cm) was measured for African Tall. It could be now argued that biomass attributing characters such as plant height varied with respect to growth stage. On the other hand, plant height could increase during vegetative stage and decrease as the reproductive stage progressed (Marziliano et al., 2019), which looks pretty established learning in science. Further, Andrade et al. (1993) and Sangoi et al. (2002) reported that plant height significantly impacted the biomass production. These findings are in agreement with our studies that Pratap Makka Chari-6 had the highest plant height among other fodder maize varieties at 105 DAS and had the highest biomass production.

At 90 DAS, leaf area was statistically different ($p<0.05$) among the fodder maize varieties where J-1006 accumulated the highest leaf area (257.10 cm^2/plant), while the varieties Pratap Makka Chari-6 had similar leaf area (252.60 cm^2/plant) to those of J-1006 whereas the lowest leaf area (217.70 cm^2) per plant was measured for the variety African Tall (Table 3). Amole *et al.* (2022) recorded that leaf area of fodder maize as 375 cm2, which was higher than in our experiment. Herbage mass of the fodder maize is a function of leaf area, which is calculated by the number and size of leaves depending on environmental conditions and the optimum harvesting time of the crops (Edoka, 2006). Physiological and agronomic processes of crops is affected by leaf area, and the leaf area is a crucial physiological trait which is used to indicate the performance of a plant canopy for growth and production (Gao et al., 2012; Nangju & Wanki, 1980; Pandey & Singh, 2011). There was a significant difference ($p<0.05$) in leaf area among the densities, with the highest leaf area (257.80 cm^2/plant) for the low-high density. Djamana *et al.* (2022) reported that height and leaf area of the maize varied with plant population and planting date.

Similarly, leaf numbers differed statistically ($p<0.05$) when different densities of fodder maize were considered, with the highest leaf numbers (9.44 numbers) for lower plant density (1,66,666 numbers per hectare) at 105 DAS. As Carpici *et al.* (2010) findings are in agreement with our study that the leaf number per plant significantly decreases with increasing plant population. Leaf number differed statistically ($p<0.05$) among the fodder maize varieties with the highest leaf number (9.26 leaves/plant) for Pratap Makka Chari-6, where the African Tall and J-1006 had statistically similar ($p>0.05$) leaf number per plant. The lowest leaf number (8.18 leaves/plant) per plant was measured for African Tall (Table 3). Maize leaf numbers can be varied with the variety of the plant and environmental conditions (Ren et al., 2014 & Pecina-Martínez et al., 2009).

The plant height varied statistically ($p<0.05$) when different densities of fodder maize were considered, with the highest plant height (243.70 cm) for low-low density (Table 3). Ciampitti and Vyn (2012) and Timlin *et al.* (2014) reported that high plant population negatively affects plant growth due to insufficient sunlight. The light availability per plant decreases with increasing plant population, while the yield per plant decreases with increasing plant population. Thus, under high plant populations, the efficient use of energy within a plant becomes essential for plant growth (Wang et al., 2019). Similarly, leaf numbers differed statistically ($p<0.05$) when different densities of fodder maize were considered, with the highest leaf numbers (9.44 leaves/plant) for high-low density (Table 3). As Carpici *et al.* (2010) findings are in agreement with our study that the leaf number per plant significantly decreases with increasing plant population.

At 105 DAS, the plant height was significantly ($p<0.05$) influenced by the interaction of densities and nitrogen level. The highest plant height (249 cm/plant) was measured for the treatment with nitrogen level one for low-high density. Similarly, the lowest plant height (237.90 cm) was measured for the treatment with nitrogen level two for low-high density (Table 4). At different growth stages, the plant height of maize was affected by plant population and nitrogen levels (Tajul et al., 2013 & Workuet al., 2020). The results of our study well matched with the previous study that the interaction of densities and nitrogen level significantly ($p<0.05$) influenced the plant height. The highest plant height (249.40 cm) was measured for lower density fortified with a low-high level of nitrogen (150 kg/ha), as lower plant population adequately utilised the available nitrogen for its better growth and development.

Fodder maize varieties, plant population, nitrogen level and effect of treatment combination /interaction for green matter and dry matter yield

Table 3. Plant height and leaf characters of fodder maize varieties at different densities and nitrogen levels at Rampur, Chitwan, Nepal in 2021

Treatments	Plant height (cm)			Leaf area (cm^2)			Number of leaves per plant		
	75 DAS	90 DAS	105 DAS	75 DAS	90 DAS	105 DAS	75 DAS	90 DAS	105 DAS
Varieties (V)									
African Tall	211.30^{b}	218.00	214.10^{b}	238.70	217.70^{b}	208.20	13.40	8.83	8.18^{b}
J-1006	231.60^{a}	228.00	226.30^{b}	276.70	257.10^{a}	235.80	12.20	8.93	8.39^{b}
Pratap Makka Chari-6	245.50^{a}	283.00	242.10^{a}	261.40	252.60^{a}	226.00	9.70	9.30	9.26^{a}
SEM (±)	8.80	30.80	4.68	10.69	11.00	12.35	2.23	0.23	0.27
$F_{Probability}$	0.002	NS	<0.001	NS	0.011	NS	NS	NS	0.01
LSD (=0.05)	17.91	62.60	13.47	30.75	31.64	35.53	6.41	0.67	0.78
Densities (D)									
D1	218.40	244.00	211.20^{b}	250.20	226.70^{b}	211.00	10.50	9.73^{a}	7.78^{b}
D2	240.60	242.00	243.70^{a}	267.70	257.80^{a}	235.70	13.00	9.58^{b}	9.44^{a}
$F_{Probability}$	NS	NS	<0.001	NS	0.004	NS	NS	<0.001	<0.01
Nitrogen levels (N)									
N1	227.80	260.00	227.50	255.80	241.90	215.70	10.80	10.42	8.71
N2	231.10	227.00	227.40	262.20	257.70	230.90	12.70	8.88	8.51
SEM (±)	7.19	25.10	3.82	8.73	8.98	1.50	1.82	0.19	0.22
$F_{Probability}$	NS	NS	NS	NS	NS	NS	NS	NS	NS
LSD (=0.05)	14.63	51.10	11.00	25.11	25.83	29.01	5.24	0.54	0.63
CV, %	34.20	35.80	8.20	16.50	18.20	22.1	75.90	10.30	12.6
Interactions									
V × D	NS	NS	NS	NS	NS	NS	NS	NS	NS
V × N	NS	NS	NS	NS	NS	NS	NS	NS	NS
D × N	NS	NS	0.04	NS	NS	NS	NS	NS	NS
V × D × N	NS	NS	NS	NS	NS	NS	NS	NS	NS

Note: DAS=Days After sowing, D1=Plant population 2, 22,222 numbers/ha, D2= Plant population 1, 66,666 numbers/ha, N1= Nitrogen level 150kg/ha, N2= Nitrogen level 300kg/ha, NS=Non-Significant, SEM=Standard Error of Mean, LSD=Least Significant Difference, CV=Coefficient of Variation, V=Varieties, D=Density, N=Nitrogen level

In our study, at 75 DAS, the green matter content of different treatments considered in this experiment differed statistically ($p<0.05$) when different nitrogen level was applied, with the highest green matter for nitrogen level two. Similarly, the green matter content of the different treatments differed statistically ($p<0.05$) when different nitrogen level was applied, with the highest green matter for nitrogen level two at 90 DAS and 105 DAS. The use of fertiliser levels to increase biomass production could be progressive (Khan et al., 2014; Carpici et al., 2010).

At 90 DAS, green matter content of the different treatments varied statistically ($p<0.05$) among the fodder maize varieties where Pratap Makka Chari-6 had highest green matter content (30.82 t/ha) (Table 5) which was, however, statistically similar ($p>0.05$) to the green matter of African Tall (30.75 t/ha). The lowest green matter (23.85 t/ha) was measured for the treatment J-1006. Adhikari *et al.* (2021) reported that varieties should be selected according to specific agro-ecological region, season and maturity to get maximum production.

Table 4. Plant height (cm) of fodder maize varieties at different densities and nitrogen levels at 105 DAS at Rampur, Chitwan, Nepal in 2021

Densities (D)	Nitrogen level (N)	
	N1	N2
D1	205.60^{b}	216.90^{b}
D2	249.40^{a}	237.90^{a}
SEM (±)	5.41	
$F_{Probability}$	0.04	
LSD (=0.05)	15.55	

Note: D1= (2, 22, 222 numbers/ha), D2= (1, 66, 666 numbers/ha), N1= (150 kg /ha), N2= (300 kg/ha), SEM= Standard Error of Mean, LSD=Least Significant Difference

Table 5. Biomass of fodder maize varieties at different densities and nitrogen levels at Rampur, Chitwan, Nepal

Treatments	Green matter (t/ha)			Dry matter (t/ha)		
	75 DAS	90 DAS	105 DAS	75 DAS	90 DAS	105 DAS
Varieties (V)						
African Tall	33.41	30.75[a]	31.40	7.23	7.87	8.43
J -1006	31.39	23.85[b]	29.30	7.21	7.27	7.99
Pratap Makka Chari-6	31.96	30.82[a]	34.40	6.19	7.88	9.20
SEM (±)	2.46	2.22	1.83	0.87	0.75	0.86
$F_{Probability}$	NS	<0.007	NS	NS	NS	NS
LSD (=0.05)	5.00	4.52	5.27	1.77	1.52	1.76
Densities (D)						
D1	32.13	27.76	31.30	6.67	7.39	8.57
D2	32.38	28.65	32.10	7.08	7.96	8.51
$F_{Probability}$	NS	NS	NS	NS	NS	NS
Nitrogen levels (N)						
N1	30.17[b]	25.50[b]	30.30	6.24	6.78	8.09
N2	34.34[a]	36.91[a]	33.00	7.51	8.57	8.99
SEM (±)	2.01	1.81	1.50	0.71	0.61	0.70
$F_{Probability}$	0.04	0.005	NS	NS	NS	NS
LSD (=0.05)	4.01	3.69	4.31	1.44	1.24	1.43
CV, %	21.20	22.3	23.1	36.00	27.7	28.8
Interactions						
V × D	NS	NS	NS	NS	0.025	NS
V × N	NS	NS	NS	NS	0.003	NS
D × N	NS	NS	NS	NS	NS	NS
V × D × N	NS	NS	NS	NS	NS	NS

Note: DAS=Days After sowing, D1=Plant population 2, 22,222 numbers/ha, D2= Plant population 1, 66,666 numbers/ha, N1= Nitrogen level 150kg/ha, N2= Nitrogen level 300kg/ha, NS=Non-Significant, SEM=Standard Error of Mean, LSD=Least Significant Difference, CV=Coefficient of Variation, V=Varieties, D=Density, N=Nitrogen level

Table 6. Dry matter (t/ha) of fodder maize as influenced by varieties and different densities at 90 DAS at Rampur, Chitwan, Nepal in 2021

Varieties (V)	Densities (D)	
	D1	D2
African Tall	7.70[ab]	8.04[ab]
J-1006	8.01[ab]	6.54[b]
Pratap Makka Chari-6	6.46[b]	9.29[a]
SEM (±)	1.06	
$F_{Probability}$	0.025	
LSD (=0.05)	2.16	

Note: D1= (2, 22, 222 numbers/ha), D2= (1, 66,666 numbers/ha), SEM= Standard Error of Mean, LSD=Least Significant Difference

The dry matter content differed statistically (Table 6), in interaction with different fodder maize varieties and different densities, where Pratap Makka Chari-6, with low-high density,, had the highest dry matter content (9.29 t/ha). The finding revealed that lower plant density could respond to produce higher dry matter yield. As lower plant density allows access of sunlight that ultimately facilitates photosynthesis. In addition, there is less competition for nutrient uptake by the plants (Farnia & Mansouri, 2015). Likewise, dry matter was significantly ($p<0.05$) by the interaction of varieties and nitrogen. It was highest on nitrogen level two than nitrogen level one (Appendix 8) for J-1006 (9.52 t/ha) and Pratap Makka Chari-6 (8.84 t/ha). Carpici *et al.* (2010) mentioned that dry matter production increases with the use of high levels of nitrogen.

Nutrient composition, polyphenolic and minerals of fodder maize varieties at different level of nitrogen and density

During our study period, at 75 DAS, Crude protein, NDF, ADF, ADL, Ca and P was statistically similar among the fodder maize varieties in low-high density (Table 7) with the highest CP (13.31%) for Pratap Makka Chari-6; NDF for J-1006 (77.04%), ADF for Pratap Makka Chari-6 (44.46%), ADL for of Pratap Makka Chari-6 (14.96%). The Ca content differed significantly with low nitrogen level interaction with low plant density at 75 DAS. The calcium content of the tested fodder maize ranges from 0.33 to 0.41 per cent in interaction with density and nitrogen level. Feedipedia (2016) reported lower Ca rate in the range of 0.18 to 0.67 per cent. Htet *et al.* (2016) reported a 0.052 to 0.057% range of calcium. Calcium content in the used fodder maize varieties was adequate for cell wall formation and the growth and development of the fodder maize. Besides, the calcium concentration in forages determines the quantity of exchangeable calcium in the soil, and the level of other elements, particularly nitrogen and potassium (Wattiaux, 1994).

ADL content varied statistically ($p<0.05$) among the nitrogen levels in low-high density in 105 DAS, with the highest ADL of African Tall (11.98%) and lowest (7.83%) was recorded in J-1006 (Table 8). In our study, ADL content was statistically varied ($p<0.05$) in fodder maize varieties with lower plant density at 105 DAS. This could be due to an excess of sunlight and nutrients that enhance faster growth, which favours higher lignin accumulation in the stem and root that supporting the well-being of the plant. Lignin is found in cell walls, which binds the cell protein along with cellulose and further reduces its availability to microbes (Holtzapple, 2003). Lignin provide strength to the plant to grow upright (Smith, 2016). It makes it difficult in fibre digestion as it obstructs the enzyme access to the digestible fibre fraction, cellulose and hemicellulose. In addition, rumen microorganisms cannot break down lignin (Ferraretto, 2019). Lignin content is 7-8% in the plant impacts on the digestibility. Lignin level increases as the plant matures, which reduces digestibility and deteriorates forage quality (Holtzapple, 2003 & Casli, 2016). Normally, maize contains 12 to 20% lignin (Wozniak et al., 2021), but in our study, tested fodder maize varieties ranged between 7.83 to 11.98%.

Table 7. Nutrient composition, polyphenolic and minerals of fodder maize varieties at different levels of nitrogen and density D2 (1, 66,666 numbers/ha) in 75 DAS at Rampur, Chitwan, Nepal in 2021

Nitrogen levels	CP	NDF	ADF	ADL	Ca	P
N1 (150 kg/ha)	9.56	74.79	39.18	13.28	0.41	0.16
N2 (300 kg/ha)	13.67	71.21	41.86	11.58	0.33	0.16
p value	NS	NS	NS	NS	0.04	NS
Fodder maize varieties						
African Tall	11.92	67.84	39.22	10.84	0.42	0.16
J-1006	9.62	77.04	37.95	11.50	0.35	0.16
Pratap Makka Chari-6	13.31	74.14	44.41	14.96	0.35	0.15
p value	NS	NS	NS	NS	NS	NS
Grand mean	11.62	73.00	40.52	12.43	0.37	0.16

Note: CP=Crude Protein, NDF=Neutral Detergent Fibre, ADF=Acid Detergent Fibre, ADL= Acid Detergent Lignin

Table 8. Nutrient composition, polyphenolic and minerals of fodder maize varieties at different level of nitrogen and density D2 (1, 66,666 numbers/ha) in 105 DAS at Rampur, Chitwan, Nepal in 2021

Nitrogen levels	CP	NDF	ADF	ADL	Ca	P
N1 (150 kg/ha)	8.92	73.02	39.11	9.47	0.36	0.11
N2 (300 kg/ha)	7.52	71.86	42.64	9.90	0.35	0.12
p value	NS	NS	NS	NS	NS	NS
Fodder maize varieties						
African Tall	6.55	72.15	40.35	11.98	0.37	0.12
J-1006	7.34	75.53	40.97	7.83	0.35	0.13
Pratap Makka Chari-6	9.29	69.65	41.32	9.26	0.35	0.10
p value	NS	NS	NS	0.01	NS	NS
Grand mean	7.72	72.44	40.88	9.69	3.58	0.12

Note: CP=Crude Protein, NDF=Neutral Detergent Fibre, ADF=Acid Detergent Fibre, ADL= Acid Detergent Lignin, Ca=Calcium, P=Phosphorous, p value= Probability Value, NS=non-significant

CONCLUSION

Based on the result, there was a variation in the response levels of nitrogen and fodder maize density for DM yield among the treatments. J-1006 was more responsive to the nitrogen fertiliser, whereas Pratap Makka Chari-6 was better responsive to the density than other tested varieties. This shows the need for consideration of such variation in response while promoting them. Impact on crop minerals composition and digestibility was found to be low due to considerable non-nutritive component (ADL) in low-high plant density. These variations are worth considering while developing a package of cultivation practices.

CONFLICT OF INTEREST

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

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REFERENCES

Adhikari, K., Bhandari, S., Aryal, K., Mahto, M., & Shrestha, J. 2021. Effect of different levels of nitrogen on growth and yield of hybrid maize *Zea mays* L. varieties. *Journal of Agriculture and Natural Resources,* **4**(2), 48–62. DOI: 10.3126/janr.v4i2.33656

Carpici, E. B., Necmettin, C., & Bayram, G. 2010. Yield and quality of forage maize as influenced by plant density and nitrogen rate. *Turkish Journal of Field Crops,* **15**(2), 128–132.

Ciampitti, I. A., & Vyn, T. J. 2012. Physiological perspective of changes over time in maize grain yield dependency on nitrogen uptake and associated nitrogen efficiencies: A review. *Field Crops Research,* **133**, 48–67.

Dahmardeh, M., Ghanbari, A., Syasar, B., & Ramroudi, M. 2009. Effect of intercropping maize (*Zea mays* L.) with cowpea (*Vigna unguiculata* L.) on green forage yield and quality evaluation. *Asian Journal of Plant Sciences,* **8**(3), 235–239.

Djaman, K., Allen, S., Djaman, D. S., Koudahe, K., Irmak, S., Puppala, N., Darapuneni, M. K., & Angadi, S. V. 2022. Planting date and plant density effects on maize growth, yield and water use efficiency. *Environmental Challenges.* DOI: 10.1016/j.envc.2021.100417

Dhasarathan, M., Babu, C., & Iyanar, K. 2015. Genetic analysis for fodder yield and component traits in maize (*Zea mays* L.). *Electronic Journal of Plant Breeding,* **6**(1), 43–53.

Edoka, P. N., & Fakultät, L. G. 2006. Influence of leaf area development of early and mid-early maturity varieties of silage maize on dry matter yield and forage quality. https://doi.org/10.18452/15441

Farnia, A., & Mansouri, M. 2015. Study on the morphological characteristics of maize (*Zea mays* L.) cultivars under different plant densities. *Indian Journal of Natural Science,* 8391–8397.

Gao, M., Heijdena, G., Vosb, J., Eveleensc, B., & Marcelis, L. 2012. Estimation of leaf area for large-scale phenotyping and modeling of rose genotypes. *Scientia Horticulturae,* **138**,

Khan, N. A., Khan, M. I. R., Asgher, M., Fatma, M., Masood, A., & Syeed, S. 2014. Salinity tolerance in plants: Revisiting the role of sulfur metabolites. *Journal of Plant Biochemistry & Physiology,* **2**(2). https://doi.org/10.4172/2329-9029.1000120

Marziliano, P. A., Menguzzato, G., Scuderi, A., Scalise, C., & Coletta Agraria, V. C. 2019. Biomass conversion and expansion factors in Douglas-fir stands of different planting density: Variation according to individual growth and prediction equations.

MoALD. 2022/23. *Statistical Information on Nepalese Agriculture.* Ministry of Agriculture and Livestock Development, Nepal.

NAFLQML. 2019. *Balance Sheet of Animal Feed and Forage Seed of Nepal and Impact Study of Forage Mission Program* (pp. 1–102). National Animal Feed and Livestock Quality Management Laboratory.

Nangju, D., & Wanki, S. B. C. 1980. Estimating leaf area of cowpea and soybean using dry weights of terminal leaflets. *Experimental Agriculture,* **16**(3).

Pandey, S. K., & Singh, H. 2011. A simple, cost-effective method for leaf area estimation. *Journal of Botany,* **2011**, Article ID 658240. https://doi.org/10.1155/2011/658240

Pecina-Martinez, J. A., Mendoza-Castillo, M. C., López-Santillán, J. A., Castillo-González, F., & Mendoza-Rodríguez, M. 2009. Phenological and morphological response of Tamaulipas maize to contrasting environments in Mexico. *Agrociencia,* **43**(7), 681–694.

Ren, B., Zhang, J., Xia, L., Xia, F., & Zhou, B. 2014. Effects of waterlogging on the yield and growth of summer maize under field conditions. *Canadian Journal of Plant Science,* **94**, 23–31.

Timlin, D. J., Fleisher, D. H., Kemanian, A. R., & Reddy, V. R. 2014. Planting density and leaf area index effects on the distribution of light transmittance to the soil surface in maize. *Agronomy Journal,* **106**, 1828–1837.

Wang, J., Lu, W., Tong, Y., & Yang, Q. 2016. Leaf morphology, photosynthetic performance, chlorophyll fluorescence, stomatal development of lettuce (*Lactuca sativa* L.) exposed to different ratios of red light to blue light. *Frontiers in Plant Science,* **7**, 250.

Tajul, M. I., Alam, M. M., Hossain, S. M. M., Naher, K., Rafii, M. Y., & Latif, M. A. 2013. Influence of plant population and nitrogen fertilizer at various levels on growth and growth efficiency of maize. *The Scientific World Journal,* **2013**, https://doi.org/10.1155/2013/193018

Wattiaux, M. 1994. Nutrition and feeding. In *Technical Dairy Guide* (pp. 1–121). The Board of Regents of the University of Wisconsin System.

Worku, A., Derebe, B., Bitew, Y., Chakelie, G., & Andualem, M. 2020. Response of maize (*Zea mays* L.) to nitrogen and planting density in Jabitahinan district, Western Amhara region. *Cogent Food & Agriculture,* **6**(1), 1770405. https://doi.org/10.1080/23311932.2020.1770405

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