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Performance of Promising Rice Genotypes as Affected by Different Nitrogen Levels in Central Terai of Nepal

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ABSTRACT

Application of appropriate level of nitrogen (N) for rice is a key to increase nitrogen use efficiency thereby yields. Six rice genotypes under six N levels were evaluated in a split plot design with three replications under irrigated conditions in National Rice Research Program, Dhanusha during 2020 with the objective of determining the high yielding variety and the best dose of N for obtaining higher yield. The six rice genotypes were NR 2168, NR 2158, NR 2157-122, NR 2175, NR 2182 and PR 126 while various N levels were 0. 75, 100, 125, 150 and 175 kg N ha^{-1}. The results indicated that NR 2182 recorded the highest grain yield of 5.28 t ha^{-1} while PR 126 recorded the lowest grain yield 3.98 t ha^{-1}. A linear increase in grain yield was observed with a continuous increase in N level from 0 to 150 kg ha^{-1} while it decreased thereafter. The grain yield was significantly higher with the application of 150 kg N ha^{-1} as compared to control. Agronomic N use efficiency for studied rice genotypes varied significantly and ranged from negative to 12.63 kg grain yield per kg of N applied. NR 2182 recorded the highest value of agronomic nitrogen use efficiency for the N level of 150 kg ha^{-1}. It can be concluded that increasing nitrogen levels resulted in significant variations in the response of different varieties, with all varieties consistently recording lower yields at highest N levels. Thus, opting for an intermediate N level appears both economically prudent and environmentally sustainable.

Keywords: Agronomic nitrogen use efficiency, grain yield, nitrogen levels, rice genotypes

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INTRODUCTION

Rice stands as the foremost staple food crop in Nepal, surpassing maize and wheat, and contributes significantly to the Agricultural Gross Domestic Product (AGDP), accounting for a 20% share (Tripathi et al 2019). It thrives across a diverse range of ecological zones in Nepal, spanning from 60 meters in the Terai region to as high as 3050 meters above sea level in Jumla. With approximately 1.447 million hectares of cultivated land, rice yields an average of 3.789 tons per hectare, resulting in an annual production of 5.486 million tons (Krishi Diary 2023). This crop plays a pivotal role in Nepal's economy, contributing 7% to the Gross Domestic Product (GDP) and a substantial 20% to Agricultural Domestic Products (ADP) (Dhungel and Acharya 2017). Furthermore, rice accounts for nearly 53% of total cereal production and meets 33% of the total calorie requirements of the Nepalese population (Tripathi et al 2019). However, the challenge of feeding 30 million people, particularly amidst shrinking agricultural land, necessitates increased productivity per unit area and optimizing land utilization (Bhattarai et al 2023). Despite its significance, rice production in Nepal faces several challenges. These include various biotic and abiotic stresses, as well as the inefficient or imbalanced use of nutrients, which considerably hinder rice productivity and returns (Zafar et al 2018). Among these nutrients, nitrogen (N) emerges as one of the most critical limiting factors, profoundly influencing rice growth and metabolic processes essential for achieving optimal grain yield (Fagaria et al 2017). The prevalent approach to nitrogen fertilizer recommendations in many rice-growing regions worldwide, including Nepal, often adopts a blanket approach, overlooking site-specific differences in crop nitrogen requirements.

Efficient utilization of nitrogen fertilizers is crucial to enhancing rice productivity and mitigating environmental concerns. Suboptimal nitrogen use can lead to excessive post-harvest residual soil nitrogen, which may subsequently affect the following season's crop (Fagaria and Baligar 2003). Given the low fertility status of rice-growing soils in Nepal and the prevalent issue of excessive inorganic fertilizer application by farmers (Aryal et al 2021), there is a pressing need for tailored and efficient nitrogen management practices. To address these challenges, this study was conducted to evaluate the efficiency of different nitrogen levels on rice growth, productivity, and agronomic nitrogen use efficiency among promising rice genotypes in the central Terai region of Nepal, specifically under Hardinath conditions.

Hence, the objective of this study was to investigate the impact of varying nitrogen levels on rice growth, productivity, and agronomic nitrogen use efficiency within the context of the central Terai region of Nepal, under the specific environmental conditions of the Hardinath.

MATERIALS AND METHODS

A field experiment was conducted during the rainy seasons of 2020 at National Rice Research Program (NRRP), Hardinath, Dhanusha, Nepal. The experimental site was in 26° 48’ E latitude and 85° 59’ N longitude with an elevation of 75 meter above sea level and has a sub-tropical climate. The average maximum and minimum temperature during rice growing season was 31 °C and 21 °C, respectively. Likewise, the total rainfall during crop growing period was 775 mm (Figure 1). In general, the site receives ample rainfall during the monsoon, which starts in June and continues up to September.

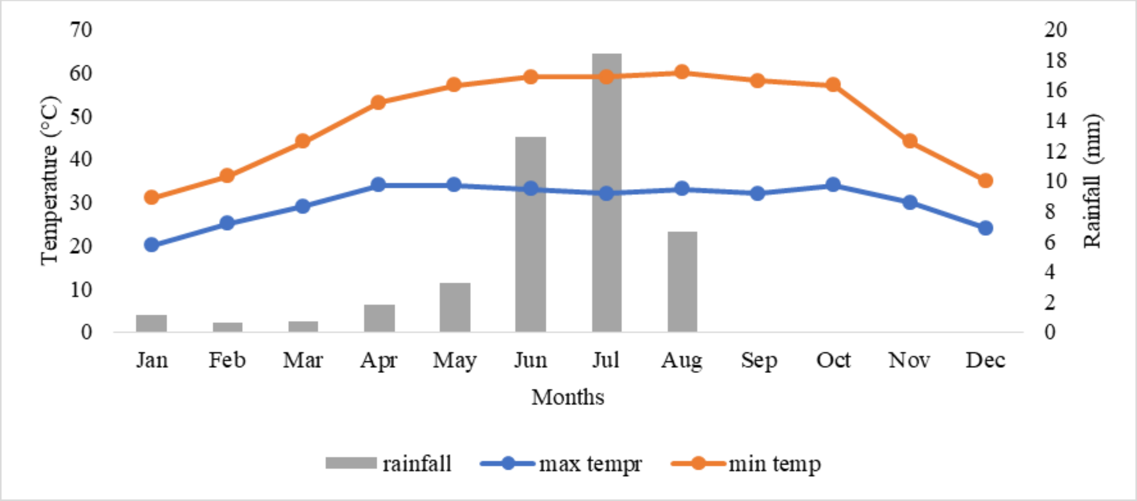

Figure 1. Average monthly temperature and rainfall of NRRP, Hardinath Dhanusha during 2020

The initial soil status of the field where experiment was conducted is illustrated in Table 1:

Table 1. Physical and chemical properties of the initial soil sample

SN	Parameters	Methods	Value
1	Soil texture	Hydrometer (Bouyoucos 1927)	Sandy loam (57.6% sand, 29.8 silt and 12.6 clay)
2	pH	Potentiometric 1:2 (Jackson 1973)	6.4
3	Soil organic matter (%)	Walkley and Black (1934)	0.87%
4	Total N (%)	Kjeldahl (Bremner and Mulvancey 1982)	0.14%
5	Available P_2O_5 (kg ha^{-1})	Olsen (Olsen et al 1954)	58 kg ha^{-1}
6	Available K_2O (kg ha^{-1})	Ammonium acetate (Jackson 1973)	106 kg ha^{-1}

The soil where the experiment was conducted is weakly acidic, sandy loam in texture, low in soil organic matter, medium in total nitrogen, high in available phosphorus and medium in available potassium.
The experiment was laid out in a split plot design with three replications. Two factors, namely genotypes, and nitrogen levels were included in the main plot and sub plot, respectively. The plot size of experiment was 5 x 2.5 m^2.

Table 2. Genotypes and nitrogen levels used under experiment

Main plot (Genotypes)	Sub plot (Nitrogen levels kg ha^{-1})
NR 2168	0
NR 2158	75
NR 2157-122	100
NR 2175	125
NR 2182	150
PR 126	175

Half dose of N, full dose of phosphorus (40 kg P_2O_5 ha^{-1}) and muriate of potash (40 kg K_2O ha^{-1}) were applied as basal dose in rice. Remaining half dose of nitrogen fertilizer was applied as top dress in two-split doses i. e., 1/4th at active tillering stage and 1/4th at panicle initiation stage. Fertilizers were applied through Urea, DAP and Muriate of Potash. Twenty-three days old seedlings were transplanted in well puddled soil with the spacing of 20 cm x 20 cm and seed rate of 40 kg ha^{-1} for all genotypes. Plant protection measures were applied as per requirement and standard crop management practices were followed apart from the treatment factors. The border rows were harvested first and then net plot area was harvested and the produce was threshed by beating on threshing bench, cleaned and sun dried to 14% or lower moisture level.

For measuring plant height 10 plants were randomly selected and tagged from different rows other than boarder row were used for the measurement of plant height at harvesting. Plant height was taken from the base of the plant to the top of the panicle in cm, whichever is longer. Days to heading (50%) and maturity (80%) for each treatment were recorded. Prior to harvest, the number of effective tillers per square meter was determined for each plot. Effective tillers were identified as those with filled grains, while tillers lacking filled grains were categorized as non-effective tillers. The randomly selected ten panicles from each hill were used to measure the panicle length and mean value is taken as panicle length in cm. The panicle length in cm was taken from the base of the rachis to the tip of the panicle. 10 panicles were randomly selected from each hill, and their individual panicle lengths were measured in centimeters. The mean value of these measurements was then considered as the panicle length, which was measured from the base of the rachis to the tip of the panicle. The total number of grains per panicle was manually counted from panicles selected randomly from 5 hills within each plot. Thousand gains were selected randomly from the grain yield of each plot and weighed with the help of potable automatic electronic balance at about 14% moisture content. Grain yield and straw yield of net plot were recorded.

Agronomic nitrogen use efficiency is the efficiency of applied N in increasing grain or biomass yield. It is calculated as the increase in yield per unit of N applied.

$$\text{Agronomic NUE: } \frac{\text{Crop yield (kg ha}^{-1}\text{) with applied N} - \text{Crop yield (kg ha}^{-1}\text{) without applied nitrogen}}{\text{Amount of N applied (kg ha}^{-1}\text{)}}$$

Statistical analysis was done to evaluate different parameters using the R studio program (R core team 2022).

RESULTS AND DISCUSSION

Days to heading

The result showed that days to heading were significantly affected by the genotypes (Table 3). PR 126 was early in heading compared to other varieties; meanwhile, NR 2182 took the longest duration to complete 50% of heading. Similarly, rice genotypes were found to be statistically significant for days to heading due to various levels of nitrogen at 5% level of significance. The highest level of nitrogen (175 kg kg N ha^{-1}) took longest time for heading while control showed earlier heading. Nature of varieties, which is mainly affected by genetic and partially by the environmental factors such as fertilizers, soil condition and weather may contribute towards the significant differences in number of days to heading among genotypes may be attributed to (Seedak et al 2009). Low N fertilizer application and higher temperature during the growing season of rice may also be attributed towards early heading (Ren et al 2023). Likewise, application of nitrogenous fertilizer improves rice growth, internode elongation, photosynthesis and metabolism and assimilation of production, enhances to delay the heading of rice varieties (Noor 2017). Metwally et al (2011) also illustrates a similar result. Likewise, the interaction between N levels and genotypes was also found to be significant.

Days to maturity

Rice genotypes differed significantly in their days to complete 80% physiological maturity (Table 3). PR 126 was the earliest in maturity while NR 2182 took the longest duration. Days to maturity for promising rice genotypes were found to be non-significant with respect to nitrogen levels. Nitrogen level and genotypes interaction was also found to be non-significant. Differences in days to maturity may be attributed either to varietal characteristics or by various environmental factors such as weather, soil status and nutrient sources (Gyawali et al 2020). Similar findings were obtained by Gyawali et al (2021).

Table 3. Days to heading, Days to maturity, plant height and effective tillers per square meter of promising rice genotypes as affected by different levels of N

Treatments	Days to heading	Days to maturity	Plant height (cm)	Effective tillers/m2
Genotypes				
NR 2168	99	126	105	206
NR 2158	104	132	101	178
NR 2157-122	103	132	99	163
NR 2175	106	134	109	205
NR 2182	108	138	109	193
PR 126	96	124	93	137
CV %	1.52	1.97	3.83	19.01
p-value	<0.001	<0.001	<0.001	<0.001
LSD $_{0.05}$	1.96	2.91	2.92	25.47
Nitrogen levels (kg ha^{-1})				
0	102	131	98	170
75	103	130	103	185
100	103	131	102	178
125	103	131	105	185
150	103	131	103	185
175	104	132	104	178
CV %	1.09	1.2	4.09	14.01
p-value	0.003	0.05	<0.001	0.42
LSD $_{0.05}$	1.82	ns	2.8	ns
Genotype X Nitrogen level				
p-value	<0.001	0.02	0.64	0.75
LSD $_{0.05}$	1.85	1.35	ns	ns

Plant height

Plant height was found to be significantly affected by genotypes and nitrogen levels (Table 3). PR 126 recorded the shortest height while NR 2182 and NR 2175 gave the tallest plant during the rice growing season. Application of various levels of N significantly increased the plant height for rice varieties. The shortest plant was seen in the control plot and with increasing Nitrogen levels plant height increased. The plant height increased up to 125 kg N ha^{-1} and thereafter further increment in nitrogen level decreased plant height. The interaction between genotypes and nitrogen levels for plant height was non- significant. This variation may be due to the genetic makeup of studied lines. Likewise, increment in plant height with increasing N levels may be attributed to improved plant growth, internode elongation, photosynthesis due to the important role of nitrogen. The results are similar to those of Metwally et al 2011, Khatri et al 2015 and Gyawali et al 2021).

No of effective tillers

The result showed that the number of effective tillers per meter square was significantly affected due to genotypes (Table 3). Among the promising genotypes, the highest number of effective tillers per meter square was found on NR 2168 and NR 2175 while the fewest number of effective tillers per meter square was seen in PR 126. Likewise, the effective number of tillers was nonsignificant with N levels. The interaction effect between genotypes and N levels for number of effective tillers per square meter was non-significant. Similar findings were observed by Gyawali et al (2020).

Grain moisture percentage

The result in Table 4 showed that moisture percentage was significantly affected due to genotypes while N levels were found to be non-significant with respect to moisture percentage. Rice genotype, PR 126 showed lowest moisture percentage while NR 2182 showed highest. Moreover, the interaction between genotypes and N levels for moisture percentage was non-significant.

Panicle length

The panicle length was markedly influenced by the promising rice genotypes and nitrogen levels (Table 4). NR 2168 showed the highest panicle length while PR 126 showed lowest panicle length. With increasing Nitrogen level, the panicle length also increased up to certain limit. After 125 kg N ha^{-1}, with increasing N level, the panicle length decreased. Similar results were obtained by Metwally et al (2011).

Number of filled grains

NR 2157-122 recorded maximum number of filled grains per 5 panicles while NR 2168 recorded lowest filled grains per five panicles (Table 4). The filled grains were found to be significantly affected due to rice genotypes. The response of different nitrogen levels was non-significant with respect to filled grains. Likewise, the interaction effect between rice genotypes and nitrogen levels was non-significant.

Number of unfilled grains

The rice genotype, PR 126 recorded the maximum number of unfilled grains per 5 panicles while NR 2182 exhibited the lowest number (Table 4). With the increase in Nitrogen level upto 100 kg N ha^{-1}, increase in number of unfilled grains per 5 panicles were observed. However, an increase in nitrogen level upto 125 kg N ha^{-1} decreased the unfilled grains while higher dose thereafter increased the number of unfilled grains. The interaction between rice genotypes and nitrogen levels on quantity of unfilled grains per 5 panicles were non-significant. This increase in the number of unfilled grains might be associated with production of more spikelet's per plant and photo assimilation.

Table 4. Moisture percentage, panicle length, number of filled grains per 5 panicle, number of unfilled grains per 5 panicles of promising rice genotypes as affected by different N levels

Treatments	Moisture percentage (%)	Panicle length (cm)	filled grains/5 panicle	unfilled grains/5 panicle
Genotypes				
NR 2168	12.8	25.61	430	91
NR 2158	13.2	23.39	508	102
NR 2157-122	13.0	23.5	935	91
NR 2175	12.8	25.17	611	109
NR 2182	13.4	24.44	757	84
PR 126	12.4	22.33	641	111
CV %	5.81	4.07	20.24	27.34
p-value	0.02	<0.001	<0.001	0.23
LSD $_{0.05}$	0.56	0.72	97	ns
Nitrogen levels (kg ha^{-1})				
0	12.9	23.11	593	76
75	13.0	24.28	685	94
100	13.1	24.31	635	113

125	12.8	24.56	663	80
150	13.0	24.17	661	125
175	12.9	24.22	647	101
CV %	3.7	4.94	19.35	29.44
p-value	0.7	<0.01	0.35	0.23
LSD $_{0.05}$	ns	0.79	ns	ns
Genotype X Nitrogen level				
p-value	0.57	0.82	0.13	0.06
LSD $_{0.05}$	ns	ns	ns	ns

Number of filled grains

NR 2157-122 recorded maximum number of filled grains per 5 panicles while NR 2168 recorded lowest filled grains per five panicles (Table 4). The filled grains were found to be significantly affected due to rice genotypes. The response of different nitrogen levels was non-significant with respect to filled grains. Likewise, the interaction effect between rice genotypes and nitrogen levels was non-significant.

Number of unfilled grains

The rice genotype, PR 126 recorded the maximum number of unfilled grains per 5 panicles while NR 2182 exhibited the lowest number (Table 4). With the increase in Nitrogen level upto 100 kg N ha^{-1}, increase in number of unfilled grains per 5 panicles were observed. However, an increase in nitrogen level upto 125 kg N ha^{-1} decreased the unfilled grains while higher dose thereafter increased the number of unfilled grains. The interaction between rice genotypes and nitrogen levels on quantity of unfilled grains per 5 panicles were non-significant. This increase in the number of unfilled grains might be associated with production of more spikelet’s per plant and photo assimilation.

Thousand grain weight

The result revealed that rice genotypes differ significantly with respect to the 1000 grain weight (Table 5). The highest thousand grain weight was observed in NR 2158 with 24.25 gram while the lowest of 15.39 gram was found in NR 2182. Application of different levels of nitrogen was found to be non-significant with respect to the 1000 grain weight. Likewise, the interaction effect between rice genotypes and nitrogen level was also non-significant.

Grain yield

Grain yield was statistically significant with respect rice genotypes and the highest grain yield was obtained with NR 2182 followed by NR 2158 and the lowest was obtained with genotype PR 126 (Table 5). Increasing nitrogen levels from 0 to 150 kg N ha^{-1} significantly increased grain yield for all promising rice genotypes. Further increment in nitrogen level decreased grain yield (Table 5). The interaction effect between the different genotypes and N levels was found to be non-significant. The higher grain yield in most of the genotypes may be attributed to abundant rainfall of around 745 mm from July to August during vegetative phase of the crop. Likewise, a few genotypes were having lower grain yield as compared to others which may be due to higher maximum temperature (32 °C) during reproductive stage indicating the negative impact of high temperature at flowering stage. Similar results were observed by Abbas and Mayo 2020. With the increase in N levels, the grain yield increased which could be due to adequate supply of nitrogen which is essential to boost yield of rice. However, increasing N level above the critical level resulted in a decline in yield. Similar results were observed by Adhikari et al (2018), Gyawali et al (2020) and Gyawali et al (2021).

Table 5. Effect of different levels of N in 1000 grain weight, grain yield and straw yield of promising rice genotypes during 2020

Treatments	**1000 grain weight (g)**	**Grain yield (t ha^{-1})**	**Straw yield (t ha^{-1})**
Genotypes			
NR 2168	23.53	3.9	7.56
NR 2158	24.25	5.1	6.51
NR 2157-122	17.71	4.76	7.67
NR 2175	17.81	4.84	7.29
NR 2182	15.39	5.28	7.55
PR 126	18.94	3.98	8.11
CV %	5.47	12.97	24.14
p-value	<0.001	<0.001	0.25
LSD $_{0.05}$	1.24	0.44	ns

Nitrogen levels (kg ha^{-1})			
0	19.69	4.22	6.39
75	19.58	4.4	6.93
100	19.81	4.68	7.3
125	19.47	4.91	8.07
150	19.47	5.31	7.89
175	19.50	4.33	8.1
CV %	2.01	8.64	12.29
p-value	0.06	<0.001	<0.001
LSD $_{0.05}$	ns	0.27	0.61
Genotype X Nitrogen level			
p-value	0.93	0.19	0.99
LSD $_{0.05}$	ns	ns	ns

For all rice genotypes the highest grain yield was obtained with 150 kg N ha^{-1} while minimum was obtained with treatment without Nitrogen application (Figure 2). Moreover, decrease in grain yield was observed with increase in nitrogen level from 150 kg N ha^{-1} to 175 kg N ha^{-1} for all promising rice genotypes (Figure 2). The highest grain yield was obtained with genotype NR 2182 followed by NR 2158, NR 2157-122, NR 2175, PR 126 respectively with the application of 150 kg N ha^{-1}. However, for genotype NR 2168 the highest grain yield was obtained at 125 kg N ha^{-1} (Figure 3). Statistically, grain yield was found to be not affected for mean interaction between promising genotypes and N levels. The increase in grain yield might be due to nitrogen application enhancing the dry matter production, improving rice growth rate, promoting elongation of internodes and activity of growth hormones like gibberellins. These results are supported by the findings of Singh et al (2000) and Gyawali et al (2021).

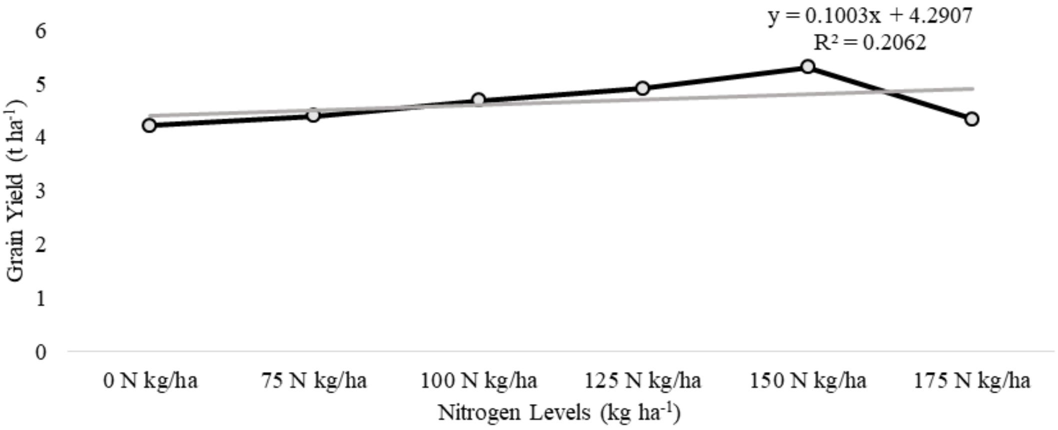

Figure 2. Grain yield of promising rice genotypes at different levels of Nitrogen

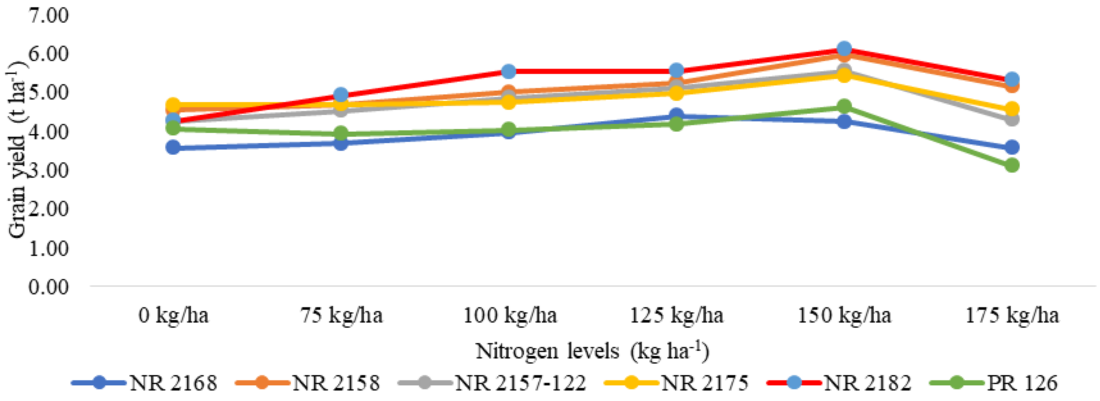

Figure 3. Interaction effect of promising rice genotypes and nitrogen levels on grain yield

Straw yield

Rice genotypes had no effect on straw yield. However, straw yield was significantly affected by different levels of N. PR 126 recorded the highest straw yield while NR 2158 recorded the lowest straw yield (Table 5). The highest straw yield was obtained with 175 kg N ha^{-1} which was statistically similar with 125 kg N ha^{-}

^{1} (Figure 4). The interaction between rice genotypes and N levels with respect to straw yield was non-significant. Similar results were obtained by Gyawali et al (2020). Four rice genotypes, namely, NR 2158, NR 2157-122, NR 2175 and NR 2182 produced highest straw yield at 175 kg N ha^{-1} while PR 126 and NR 2168 obtained highest yield at 125 kg N ha^{-1} and 150 kg N ha^{-1} respectively (Figure 5). Most of the genotypes showed an increase in straw yield with an increase in N level from control to 175 kg N ha^{-1}.

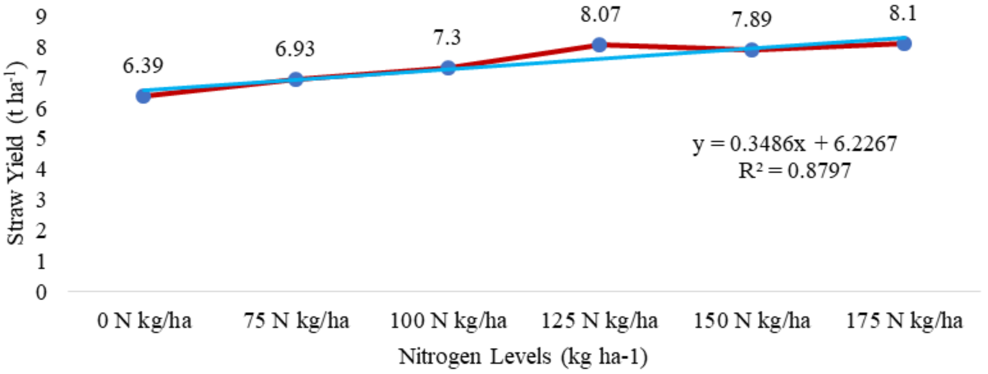

Figure 4. Straw yield of promising rice genotypes as affected by different N levels

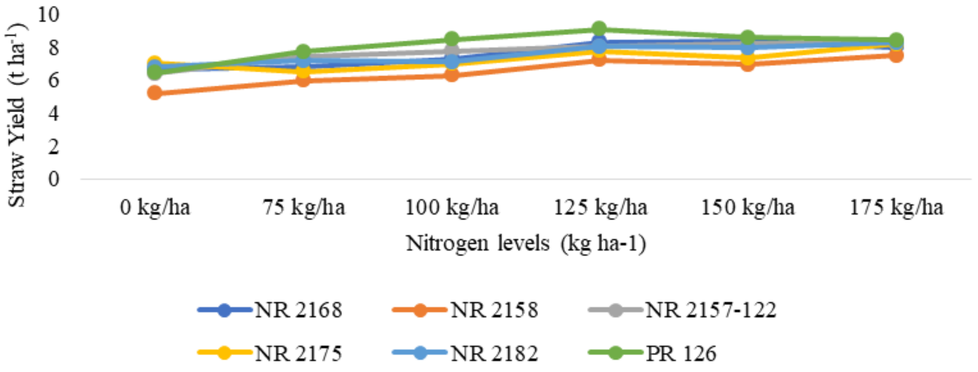

Figure 5. Interaction effect of promising rice genotypes and N levels on straw yield

Economics of Nitrogen dose

The total cost of production of rice in Dhanusha district is shown in table 6. Economic analysis of nitrogen dose under central terai region of Nepal shows that the application of 150 kg N ha^{-1} is best option for net benefit which can earn Rs. 25460/-. Likewise, benefit by increment in urea dose is also highest in 150 kg N ha^{-1} which is Rs. 15677/-. Moreover, among all the doses the highest marginal benefit of Rs. 25480 can be achieved with 150 kg N ha^{-1} (Table 7). Further application of the N fertilizers above the one producing highest yield will not be beneficial as it causes cause monetary loss for the increment in the N dose (Table 7).

Table 6. Cost of production of rice in Dhanusha district during 2020

Particulars	unit	No.	Rate	Cost
Variable cost				
Labor	ha	100	500	50000
Machinery	ha			22500
Inputs	ha			25750
Total variable cost	ha			98250
Total fixed cost	ha			1000
Total costs (variable + Fixed)	ha			99250

Table 7: Economics of nitrogen dose at NRRP, Hardinath during 2020

Trt (kg N ha^{-1})	urea (kg ha^{-1})	Price (NRs 30)	GY (t ha^{-1})	SY (t ha^{-1})	Gross income (Rs)	Cost incurred (Rs)	Benefit by increment in urea dose (Rs)	Net benefit (Rs)	Marginal benefits (Rs)
0	0	0	4.22	6.39	99230.00	99250	-20.00	-20.00	0.00
75	163.05	4891.50	4.40	6.93	103730.00	99250	-411.50	4480.00	4500.00
100	217.40	6522.00	4.68	7.30	110260.00	99250	4488.00	11010.00	11030.00
125	271.75	8152.50	4.91	8.07	116090.00	99250	8687.50	16840.00	16860.00
150	326.10	9783.00	5.31	7.89	124710.00	99250	**15677.00**	**25460.00**	**25480.00**
175	380.45	11413.50	4.33	8.10	103360.00	99250	-7303.50	4110.00	4130.00

Agronomic nitrogen use efficiency (ANUE)

Agronomic nitrogen use efficiency was influenced with the application of nitrogen and showed increasing trend with increased nitrogen levels up to 150 kg N ha^{-1} for genotypes, NR 2158, NR 2157-122, NR 2175 and PR 126. While genotype NR 2168 showed highest ANUE at 125 kg N ha^{-1} and genotype NR 2182 showed highest ANUE at 100 kg N ha^{-1}. Further increment in nitrogen level from 150 kg N ha^{-1} to 175 kg N ha^{-1} resulted in decreased ANUE for NR 2168, NR 2158 and NR 2157-122 and NR 2182 whereas in genotypes PR 2157 and PR 126 there was negative ANUE. For NR 2168, application of 125 kg N/ha was found to be highly efficient, and 100 kg N ha^{-1} was efficient for genotype NR 2182 while for all other genotypes, namely, NR 2158, NR 2157-122, NR 2175, PR 126 agronomic efficiency was high at 150 kg N ha^{-1} (Figure 6) showing variation in efficiency among genotypes. The decreased or negative ANUE may be attributed to over application of N fertilizers. Other reasons could be low organic matter content and slightly acidic soil also could limit the plant’s ability to access nitrogen. Similarly, genetic factors, biochemical and physiological processes such as translocation, assimilation and nitrogen remobilization may contribute towards the variations in ANUE (Fageria and Baligar 2003).

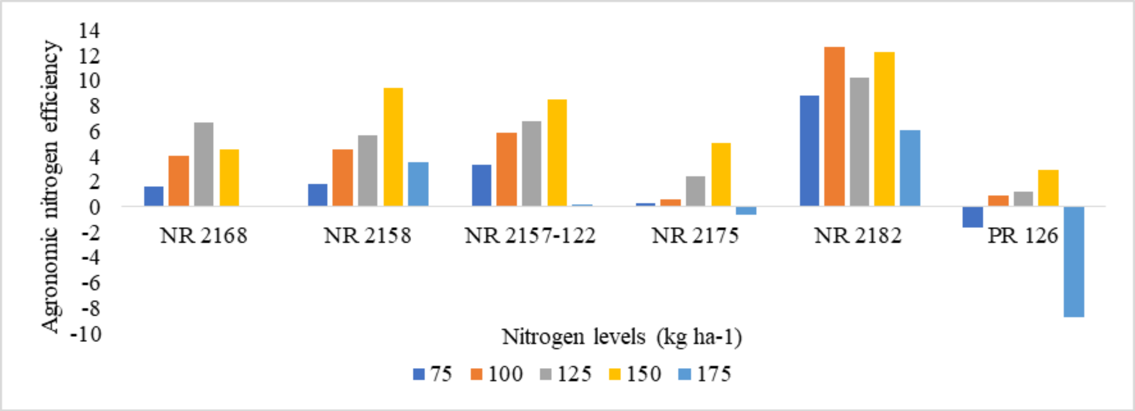

Figure 6. Effects of interaction between promising rice genotypes and nitrogen levels on agronomic nitrogen use efficiency during 2020.

CONCLUSION

Optimizing the application of nitrogen fertilizers is a crucial factor in enhancing nitrogen use efficiency in rice cultivation. Achieving improved agronomic nitrogen use efficiency primarily relies on determining the ideal nitrogen application rates. The findings of this research demonstrate that increasing nitrogen rates up to 150 kg N ha^{-1} resulted in a significant boost in grain yield, yield-related parameters and marginal economic benefits. Notably, agronomic nitrogen use efficiency varied among different rice genotypes. The ideal nitrogen fertilizer dosage for a specific rice variety depends not just on the variety itself but also on the individual soil conditions of a particular site. Establishing the site-specific N application rate is not only vital for maximizing rice yield for promising rice genotypes of Nepal but also plays a pivotal role in enhancing soil fertility. Therefore, to establish a site-specific N dosage for a given variety, it is necessary to conduct trials across various locations.

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AUTHORS' CONTRIBUTION

Chetan Gyawali in consultation with Pankaj Gyawaly formulated the research proposal, carried out the experiment, collected the data, and prepared ANOVA and manuscript. Prakash Paneru and Prakash Pant helped him in all aspects but particularly in write-up of the manuscript.

CONFLICTS OF INTEREST

The authors have no any conflict of interest to disclose.

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