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Effect of Nitrogen on Yield Attributes, Yield and Nitrogen Use Efficiencies of Buckwheat in Mustang, Nepal

Arjun Bastola[1*], Prakash Bharatee[2], Sunil Chhantyal[2]

[1]College of Natural Resource Management, Kapilakot, Sindhuli, AFU, Nepal
[2]Shree Jana Adarsha Amarsingh Secondary School, Kobang, Mustang, Nepal
[*]Corresponding author's email: abastola@afu.edu.np

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ABSTRACT

Nitrogen (N) play important role in the vegetative, reproductive characteristics and grain yield of buckwheat. To evaluate the effect of nitrogen on growth, yield attributes, yield and nitrogen use efficiencies on buckwheat a field experiment was operated during July to October of 2024 in Mustang district of Nepal consisting of five nitrogen level viz. control (0), 20, 40, and 80 kg N ha^{-1} in randomized complete block design which was replicated four times. Data on plant height, number of lateral branches per plant, yield attributes and yield were measured and analysis was done using R-stat software. Data on analysis shows that shows that plant height was found tallest in 80 kg N ha^{-1} in all the days of observations while there was no effect of N on number of lateral branches per plant. Yield attributes like number of fruit cluster per plant (19.16), number of grains per plant (89.04) and per cluster (4.78) and grain yield (662.5 kg ha^{-1}) were found significantly highest in 60 kg N ha^{-1} while stover yield (2771.76 kg ha^{-1}) was measured significantly more in in 80 kg N ha^{-1} while harvest index was recorded highest in in 60 kg N ha^{-1}. Nitrogen use efficiencies like partial factor productivity was recorded more in 20 kg N ha^{-1} while agronomic efficiency was highest in 60 kg N ha^{-1}. Thus, 60 kg N ha^{-1} was found good in growth, yield attributes, yield and agronomic efficiency based on this research findings.

Keywords: Harvest index, minor food crop, nutrient use efficiency, buckwheat

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INTRODUCTION

Buckwheat (*Fagopyrum esculentum*) is a yearly melliferous crop. From many years, the cultivation and production of buckwheat have been gradually decreased, but now days, interest in old, ancient crops has led to a revival in its cultivation. Buckwheat belongs into pseudo-cereals (Krkoskova and Mrazova 2005). The crop is called a pseudo cereal but grain have a similar use and same chemical combination and is considered a low hype crop, and rejected crop in Nepal. Buckwheat is cultivated in an area of 11,253 hectares, yielding of 14,516 kg, with a productivity of 1.29 metric tons per hectare (MoALD 2025).

Buckwheat is undemanding in its growing conditions even land is infertile or not suitable for any other crop at that condition buckwheat can easily survive. At optimum suitable ecological zone cultivation can be done not using any chemical fertilizer and pesticides. Buckwheat is grown widely in the northern side. It is cultivated in many countries, especially in Europe and Asia. Largest producer of buckwheat, is Russia with China in second position (Bonafaccia et al 2003). Nitrogen fertilization enhances to reduce nitrogen release from the leaves after flowering, low time to leaf senescence, help to a higher photosynthetic rate, and supports carbohydrates for grain filling (Huang et at 2018). It can easily tolerate the changing climate, rainfed condition, unfertilized soil, frost condition that's types of climate buckwheat crop easily standing (Luitel et al 2017).

Buckwheat is considered as an important crop which has a tendency to be cultivated in lower fertility condition with low chemical inputs, but the research found that the buckwheat production shows positive response towards the balanced nutrient management (Nath et al 2022). Among the different nutrients, phosphorous and potassium plays very important role in promoting root development, water uptake and stress resilience especially in hilly and rainfed regions. Additionally, nitrogen is a crucial ingredient for photosynthesis and vegetative growth, which boosts grain output and biomass (Kumar and Singh 2023). Even in low input, the proper nutrient management can be implemented for optimizing the productivity and health of the crops. Its nitrogen demand is rather low because of the shorter lifecycle (Valenzuela and Smith 2002). (Xu et al 2013) came to the conclusion that nitrogen plays a vital role for plant growth and regulates the process of plant aging and grain yield production. Higher nitrogen application rates together with altered nitrogen application timing can bring about the delay in senescence and the increase in yield respectively (Ma et al 2006). (Hulihalli and Shantveerayya 2018) stated that nitrogen (N) is a basic nutrient for plants and buckwheat's response to nitrogen differs with soil nitrogen content, climatic conditions, the type and timing of application of nitrogen. (Popovic et al 2019) observed that the supplementary nitrogen nutrition not only enhances grain yield but proper agronomic practices such as sowing time and method also play an important role for productivity. According to the findings of (Salehi et al 2018), nitrogen plays a vital role for the yield of buckwheat, and its effect is seen through the increase of both the amount of grain produced and amount of protein found in the grains. The N that is made available in larger quantities not only results in more plant material being formed but also in bigger leaves, more branches, and higher production of both grains and their quality. The effects of nitrogen fertilization on the grain yield and its components of buckwheat are still an untouched area of research in the high hills' areas especially in the Mustang district of Nepal so this research was designed to know the effect of N on yield attributes, yield and N use efficiencies of buckwheat.

MATERIALS AND METHODS

Experimental site

The research was conducted during July to October of 2024 in field of Shree Jana Adarsha Amarsingh Secondary School, Kobang, Mustang with the geographical location of 28° 41' 33.92" north latitude and 83° 36' 43.75" east longitudes and located 2540 m above sea level. The soil of the experimental field was neutral in pH and sandy loam in texture. The weather data during the cropping duration is presented in the Figure 1.

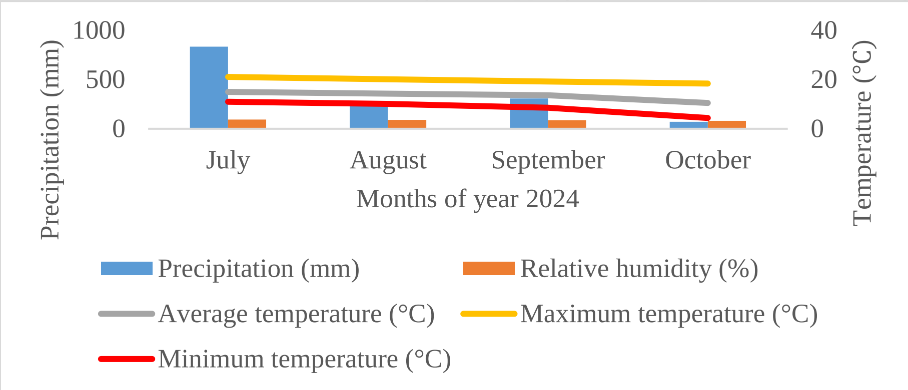

Figure 1. Weather data during the cropping duration of year 2024

Experimental details

To test the effect of N, five levels of N were used viz. control (0), 20, 40, and 80 kg N ha^{-1} which was replicated four times using randomized complete block design consisting of total 20 plots. Individual plot size was of 2m × 2m maintaining gap of 50cm between plots and 1m between replications. The planting spacing of 25cm × 5cm was maintained by which number of rows in each plot was eight and number of plants in each row was 40 comprising of total 320 plants in each plot. The variety of buckwheat used for the evaluation was Mithe phapar-1 which was collected from Regional Agricultural Research Station, Lumle, Kaski and this variety is generally recommended in lower altitudes of Himalayan regions. Full dose of P_2O_5 and K_2O (20:10 kg ha^{-1}) were applied as basal at the time of field preparation in each plot and ½ N was applied as per the treatment allocation in each plot as basal dose and remaining ½ N was top dressed 30 days after seed sowing. Source of P, K and N were supplied through Single super phosphate, Muriate of potash and Urea, respectively. Planting of seeds was done on 19 July 2024 and harvesting was done on 21 October 2024.

Data measurements

Data on plant height of buckwheat was taken three times starting from 30 days after sowing (DAS) at an interval of 30 days from 10 randomly selected plants from each plot and average value were used for analysis. Similarly, lateral branches per plant were taken on 60 and 90 DAS from 10 sample plants from each plots and average data were taken for analysis. Yield attributes like number of fruit cluster per plant, number of grain per cluster, number of grain per plant and thousand grain weight were also measured from 10 randomly selected plant and average value were used for analysis of respective parameters. Grain yield and stover yield were taken from the net plot area of (1.5m × 2m) 3m^2 excluding the border row from each side and grain yield was converted on kg ha^{-1} adjusting the moisture of 12 %. To measure the nitrogen use efficiencies following formula were used to compute the respective efficiency given by (Dobbermann 2007). For the calculation of partial factor productivity following equation was used given by Dobberman (2007);

$$\text{Partial Factor Productivity} = \frac{\text{Grain yield (kg per ha)}}{\text{N fertilizer applied (kg per ha)}}$$

Similarly, for the calculation of agronomic efficiency following equation was used given by (Dobberman 2007),

$$\text{Agronomic efficiency} = \frac{\text{Grain yield in N applied plot(kg per ha)} - \text{Grain yield in N control plot (kg per ha)}}{\text{N applied kg per ha}}$$

Statistical analysis

All the data were entered in the Microsoft excel sheet and analysis was done using R-stat software for analysis of variance and significant parameters were subjected to Duncan's Multiple Range Test (DMRT) at 5% level of significance.

RESULTS AND DISCUSSION

Plant height and number of lateral branches per plant of buckwheat

Nitrogen dose significantly affects the plant height at all the days of observation while there was no significant effect on number of lateral branches per plant at 60 and 90 DAS (Table 1). At 30 DAS plant height was significantly taller in 80 kg N ha^{-1} while significantly lower height was recorded at N dose from 0-60 kg ha^{-1}. Similar results were measured at 60 and 90 DAS where significantly tallest plant height was found in 80 kg N ha^{-1}. Higher the nitrogen dose increases the vegetative growth which might be the reason for the increase in the plant height at higher nitrogen dose. Highest plant height was also observed by (Fang et al 2018) and (Katar et al 2022) in higher nitrogen levels.

Table 1. Effect of nitrogen dose on plant height and number of lateral branches per plant of buckwheat

Nitrogen level (kg ha^{-1})	Plant height (cm)			Number of lateral branches per plant	
	30 DAS	60 DAS	90 DAS	60 DAS	90 DAS
0	58.75^{b}	113.37^{b}	111.95^{b}	4.08	4.62
20	64.41^{b}	116.45^{b}	114.54^{b}	4.16	4.75
40	64.16^{b}	119.16^{ab}	114.70^{b}	4.33	5.06
60	64.25^{b}	119.29^{ab}	119.50^{ab}	4.33	5.33
80	71.58^{a}	125.75^{a}	127.04^{a}	4.12	5.2
Grand mean	64.63	118.8	117.55	4.20	4.99
SEm (±)	1.89	2.34	3.41	0.23	0.23
F-test	**	*	*	NS	NS
$LSD_{0.05}$	5.83	7.22	10.5	0.73	0.71
CV, %	5.90	3.90	5.80	11.20	9.20

Notes: DAS: Days after sowing, NS: Not significant, *, ** Significant at 5% and 1% level of significance respectively, Treatment means followed by different letter in column indicates significant difference at $p<0.05$

Yield attributes of buckwheat

Table 2. Effect of nitrogen dose on yield attributes of buckwheat

Nitrogen level (kg ha^{-1})	Number of clusters per plant	Number of clusters per meter square	Number of grains per plant	Number of grains per cluster	Thousand grain weight (g)
0	13.91^{c}	1113.33^{c}	52.41^{d}	3.78^{b}	26.00
20	14.45^{bc}	1156.66^{bc}	65.75^{c}	4.55^{ab}	26.84
40	17.58^{ab}	1406.66^{ab}	78.95^{b}	4.49^{ab}	26.96
60	19.16^{a}	1533.33^{a}	89.04^{a}	4.78^{a}	27.11
80	15.83^{bc}	1266.66^{bc}	70.37^{c}	4.47^{ab}	26.93
Grand mean	16.19	1295.33	71.30	4.41	26.77
SEm (±)	1.02	82.30	1.78	0.27	0.48
F-test	*	*	***	*	NS
$LSD_{0.05}$	3.16	253.50	5.50	0.86	1.48
CV, %	12.70	12.70	5.00	12.60	3.60

Notes: NS: Not significant, *, *** Significant at 5% and 0.1% level of significance respectively, Treatment means followed by different letter in column indicates significant difference at $p<0.05$

Yield attributes of buckwheat except thousand grain weight were affected by N levels (Table 2). Number of fruit cluster per plant and per meter square were recorded significantly more in 60 kg N ha^{-1} which was statistically similar with 40 kg N ha^{-1} while lowest was observed in control plots. Similarly, number of grains per plant and per cluster were also seen significantly highest in 60 kg N ha^{-1} while lowest was found in control plots. Lower nitrogen level resulted poor formation of yield attributing traits due to the lower growth but at optimum N level the yield attributing traits are found better. (Fang et al 2018) also reported significant effect of N on number of grains per plant in 45 kg N ha^{-1} in both year of 2014 and 2015 but in thousand grain weight contrasting effect of

N was measured in both the years.

Grain yield, stover yield and harvest index (HI) of buckwheat

Grain yield, stover yield and harvest index of buckwheat were significantly affected by the nitrogen dose (Table 3). Significantly highest grain yield was measured in 60 kg N ha^{-1} which was followed by 40, 60 and 20 kg N ha^{-1} while lowest was found in control plots. Similarly, stover yield was recorded more in 80 kg N ha^{-1} which was statistically similar with 60, 40 and 20 kg N ha^{-1} while lowest was measured in control plots. In the harvest index, significantly highest HI was seen in 60 kg N ha^{-1} while significantly lowest was found in control plots. Higher the yield attributes like number of cluster and grain per plant and number of grains per cluster in 60 kg N ha^{-1} resulted in the higher grain yield in 60 kg N ha^{-1}. (Katar et al 2022) also observed higher grain yield at higher N level while (Fang et al 2018) reported higher grain yield in 45 kg N ha^{-1} in both the year of 2014 and 2015. (Gairhe et al 2015) also recorded higher stover yield at 60 kg N ha^{-1}.

Table 3. Effect of nitrogen dose on grain yield, stover yield and harvest index of buckwheat

Nitrogen level (kg ha^{-1})	Grain yield (kg/ha)	Stover yield (kg/ha)	Harvest index (%)
0	443.75^{d}	2429.85^{b}	18.40^{c}
20	493.75^{c}	2507.35^{ab}	19.79^{c}
40	587.50^{b}	2562.05^{ab}	23.05^{ab}
60	662.50^{a}	2726.17^{ab}	24.34^{a}
80	568.75^{b}	2771.76^{a}	20.54^{bc}
Grand mean	551.25	2599.44	21.22
SEm (±)	13.87	90.90	0.92
F-test	***	*	**
$LSD_{0.05}$	42.73	280.10	2.85
CV, %	5.00	7.00	8.70

Notes: *, **, *** Significant at 5%, 1% and 0.1% level of significance respectively, Treatment means followed by different letter in column indicates significant difference at p<0.05.

Nitrogen use efficiencies

Partial factor productivity was found highest in 20 kg N ha^{-1} which was followed by 40, 60 and 80 kg N ha^{-1} respectively (Figure 2). While agronomic efficiency was found more in 60 kg N ha^{-1} which was followed by 40, 20 and lowest was observed in 80 kg N ha^{-1}.

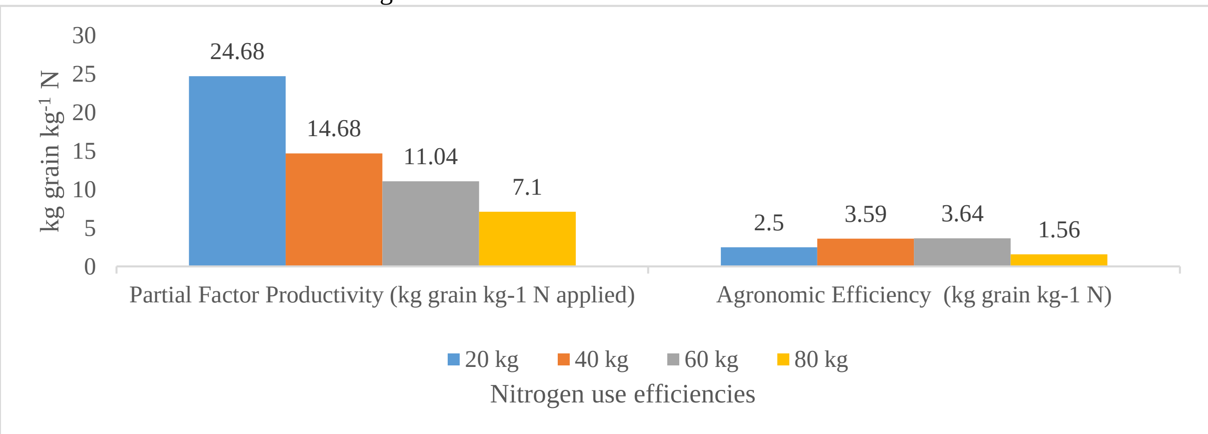

Figure 2. Effect of nitrogen dose on partial factor productivity and agronomic efficiency

CONCLUSION

Plant height and stover yield were measured highest in 80 kg N ha^{-1}. Yield attributes like number of fruit cluster per plant, number of grains per plant and per cluster and grain yield were recorded significantly highest in 60 kg N ha^{-1}. Partial factor productivity was recorded more in 20 kg N ha^{-1} while agronomic efficiency was highest in 60 kg N ha^{-1}. Thus, 60 kg N ha^{-1} was found better in terms of yield attributes, yield and agronomic efficiency based on this research findings.

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AUTHORS' CONTRIBUTION

Arjun Bastola and Prakash Bharatee conceived and designed the experiment. Arjun Bastola performed analysis of the data and wrote the whole manuscript. Prakash Bharatee and Sunil Chhantyal helped during literature review.

CONFLICT OF INTEREST

The authors have declared that there is no conflict of interest regarding the publication of this article.

REFERENCES

Bonafaccia G, M Marocchini and I Kreft. 2003. Composition and technological properties of flour and bran from common and tartary buckwheat. Food Chem. **80(1)**:9-15.

Fang X, Y Li, J Nie, C Wang, K Huang, Y Zhang and Z Yi. 2018. Effect of nitrogen fertilizer and planting density on photosynthetic characteristics, agronomic traits and grain yield of common buckwheat. Field Crops Res. **219**:160-168.

Gairhe JJ, TN Bhusal and H Neupane. 2015. Influence of seed priming and nitrogen on growth behavior of buckwheat under rainfed mid-hill conditions of Nepal. J. Inst. Agric. Anim. Sci. 47-54.

Hulihalli UK and I Shantveerayya. 2018. Effect of planting geometry and nutrient levels on productivity of buckwheat. Int. J. Curr. Microbiol. Appl. Sci. **7**:3369-3377.

Katar N, D Katar and M Can. 2022. Influence of different nitrogen doses on yield and yield components of buckwheat. Anadolu Tarım Bilimleri Dergisi. **37(3)**:593-602.

Krkoskova B and Z Mrazova. 2005. Prophylactic components of buckwheat. Food Res. Int. **38(5)**:561-568.

Kumar A and V Singh. 2023. Nutrient management practices for enhancing buckwheat productivity in cold arid regions. J. Hill Agric. **14(1)**:56-63.

Luitel DR, M Siwakoti, PK Jha, AK Jha and N Krakauer. 2017. Distribution, production and diversity of local buckwheat landraces in Nepal. Adv. Agric. **2017**:2738045.

Ma DY, TC Guo, CY Wang, YJ Zhu, YH Wang, YJ Yue, X Song and FN Cha. 2006. Effect of nitrogen fertilizer at different growth stages on photosynthetic enzyme activity in winter wheat. Plant Physiol. Commun. **42**:1091-1095.

MoALD. 2025. Statistical Information on Nepalese Agriculture 2023/24. Ministry of Agriculture and Livestock Development, Kathmandu, Nepal.

Nath R, D Sharma and L Tamang. 2022. Role of phosphorus and potassium in improving growth and productivity of buckwheat under hill conditions. Indian J. Agric. Res. **56(3)**:379-384.

Popovic V, L Kolaric, B Zarkovic, LL Zivanovic, J Sarcevic Todosijevic, J Golijan and J Ikanovic. 2019. Improvement of buckwheat production. Paper presented in: Symposium on Genetics and Plant Breeding in Cereals, Novi Sad, Serbia, p.14.

Salehi A, B Mehdi, S Fallah, HP Kaul and RW Neugschwandtner. 2018. Productivity and nutrient use efficiency under integrated fertilization of buckwheat–fenugreek intercrops. Nutr. Cycl. Agroecosyst. **110(3)**:407-425.

Valenzuela H and J Smith. 2002. Green manure crops: Buckwheat. Cooperative Extension Service, University of Hawaii, USA.

Xu Y, L Wang, W Chen, H Li and X Deng. 2013. Effect of nitrogen levels on grain filling characteristics and yield of dryland wheat cultivars. J. Triticeae Crops. **33**:489-494.