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IMPACT OF NITROGEN LEVELS AND PLANT SPACING ON GROWTH, YIELD, AND ECONOMICS OF PROSO MILLET (*PANICUM MILIACEUM* L.)

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ABSTRACT

A field experiment was conducted on Cowpea during Zaid season 2024 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Faculty of Agriculture, Sam Higginbottom University of Agriculture, Technology and Sciences. The experiment was laid out in a Randomized Block Design with 10 treatments and replicated thrice. A composite soil sample was taken between 0 and 30 cm down. It was crushed, let to air dry, and its chemical and physical qualities examined. The soil reaction of the sandy clay loam was 7.6, the organic matter content was 0.69 (0.72%), the available nitrogen was 152.7 kg/ha, the phosphorus was 10.4 kg/ha, the potassium was 174.0 kg/ha, the sulfur content was 7.2 mg/kg, the zinc was 0.72 mg/kg, and the available B was 0.56 mg/kg. Findings of the investigation briefly summarized as below based on the objectives under taken: The significantly maximum ear head length (26.67), number of grains/ear head (147.54), higher test weight (5.58 g), higher seed yield (1227.42 kg/ha),and maximum stover yield (1601.27 kg/ha) were recorded in (treatment 7) Nitrogen 90 kg/ha + Spacing 25 cm × 10 cm. Maximum gross return (INR 87,085.87/ha), net return (INR 57,285.87/ha) and B:C ratio(1.74) were also recorded in (treatment 5) Nitrogen 60 kg/ha + Spacing 35 cm × 10 cm. It can be concluded that the application of Nitrogen 60 kg/ha + Spacing 35 cm × 10 cm recorded higher yield and benefit cost ratio in Proso millet.
***Keywords*:** Prosomillet, Nitrogen, spacing and economics.

Introduction

Proso millet (*Panicum miliaceum* L.) is a warm season grass with a growing season of 60-100 days. Proso millet (*Panicum miliaceum* L.) is locally known as cheena, common millet, hog millet, broom corn, yellow hog, hershey and white millet. It is a highly nutritious cereal grain used for human consumption, bird seed and/or ethanol production. Unique characteristics, such as drought and heat tolerance, make proso millet a promising alternative cash crop. Millets are generally among the most suitable crops for sustaining agriculture and food security on marginal lands with low fertility. Millet crops are grown on marginal lands and under low-input agricultural conditions/situations in which major cereal crops often produce low yields (Amadou *et al.,* 2013). Millet can be productive even under harsh growing conditions, especially in regions such as India and Sub-Saharan and West Africa, where average rainfall is often less than 500 mm. An efficient strategy for producing crops under water-deficient conditions is to grow crops adapted to drought instead of crops that require more water (Seghatoleslami *et al.,* 2008). Since millets are adapted to drought conditions, they can be keystone crops to avert food shortage and famine (Amadou *et al.,* 2013).

These favorable traits may play an important role in promoting sustainable agricultural food systems, facilitating agro-ecosystems crop diversity, and making this species a climate-smart crop (Li, 2020). Millet-based foods also have a beneficial effect on human health thanks to their reduced glycemic index, high amount of fiber, and absence of gluten protein, which

makes them suitable also for people with celiac disease (Habiyaremye, 2017).

Three plant densities and three levels of fertilization were tested over two years of field experiments to evaluate the best combination to improve millet agronomic performances. Considering the future water scarcity scenario that will afflict all Mediterranean areas, it is crucial to employ resilient crops and to clarify the possible role of agronomic practices to mitigate this phenomenon and provide food security

Materials and Methods

Experimental site

The experiment was conducted at *kharif* season of 2024-2025 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj which is located at 25^0 24 42 N latitude, 81^0 50 56 E longitude and 98 m altitude above the mean sea level. This region is located approximately 5 kilometers from Prayagraj city on the right bank of the Yamuna River beside Prayagraj Rewa Road.

Treatment Details

The treatments included varying nitrogen levels and plant spacing as follows: T1 – 40 kg N/ha + 25 cm × 10 cm, T2 – 40 kg N/ha + 35 cm × 10 cm, T3 – 40 kg N/ha + 45 cm × 10 cm, T4 – 60 kg N/ha + 25 cm × 10 cm, T5 – 60 kg N/ha + 35 cm × 10 cm, T6 – 60 kg N/ha + 45 cm × 10 cm, T7 – 90 kg N/ha + 25 cm × 10 cm, T8 – 90 kg N/ha + 35 cm × 10 cm, T9 – 90 kg N/ha + 45 cm × 10 cm.

Details of Variety under study

Prosomillet variety TNAU-202 was selected for sowing. Seeds were sown in line manually on 2024. Seeds were covered with the soil immediately after sowing. The spacing adopted was plant to plant 10 cm and row to row 30 cm according to the treatment details and the seeds were drilled at 3-4 cm depth. All the treatments were applied by balancing to the initial soil test values and crop requirements to justify the crop response to the supplied nutrients in both years.

Data collection and Statistical analysis

Plant at harvest, yield attributes like the Ear head length (cm), number of grains/ear head, Test weight (%), seed yield (kg/ha), and stover yield (kg/ha), were recorded. All data were statistically analyzed using the analysis of variance (ANOVA) for the randomized block design, as outlined by Gomez and Gomez (1984). The F-value was computed at a 5% level of probability, and the critical difference was calculated for comparing treatment means.

Results and Discussion

Yield attributes

Significant differences were observed among treatments for ear head length, number of grains per ear head, test weight, and seed yield. The application of Nitrogen 60 kg/ha + Spacing 35 cm × 10 cm consistently outperformed other treatments. It recorded the longest ear head (26.67 cm), highest number of grains per ear head (147.35), maximum test weight (5.58 g), and highest seed yield (1244.08 kg/ha). Nitrogen 40 kg/ha + Spacing 35 cm × 10 cm also showed competitive performance, with values statistically at par with the best treatment in ear head length (25.32 cm), number of grains (141.30), and seed yield (1210.66 kg/ha).

The lowest values across most parameters were found under Nitrogen 90 kg/ha + Spacing 45 cm × 10 cm, with the shortest ear head (18.92 cm), lowest grain count (112.18), and lowest seed yield (1032.37 kg/ha). Although test weight differences were not statistically significant, the lowest test weight (3.57 g) occurred under Nitrogen 40 kg/ha + Spacing 25 cm × 10 cm. Overall, moderate nitrogen levels combined with 35 cm × 10 cm spacing proved most effective for maximizing crop growth and yield.

It is well known fact that grain yield is the outcome of yield attributing characters, which also increased with increasing levels of nitrogen. Increasing in grain yield may be due to nitrogen being a major nutrient, affected all physicochemical process. The finding of present investigation corroborates with the findings of Alkaff and Saeed (2007) and Ayub *et al*., (2009). The length of the ear head was gradually increased along with the nitrogen levels these calculations was suggested by Joshi *et al*. (2018). It could be due to iron which plays a very important role in DNA synthesis, photosynthesis, respiration and transfer of energy in the metabolic reactions of living cells. The maximum no of tillers were obtained by increase in the nitrogen fertilizer stated by Babar *et al*. (2021). The significant increase in grain and straw yield of pearl millet was largely a function of improved growth and the consequent increase in different yield attributes as mentioned above. This favorable effect feasible owing to the fact that Fe play important function in development and energy transformation in various metabolic processes of the plant, Saini *et al*. (2018).

Economics

The treatment with Nitrogen 60 kg/ha + Spacing 35 cm × 10 cm recorded the highest gross return (Rs. 87,085.87/ha) and net return (Rs. 57,285.87/ha),

indicating superior economic performance among all treatments. In contrast, the lowest gross return (Rs. 72,265.67/ha) and net return (Rs. 42,465.67/ha) were observed under Nitrogen 90 kg/ha + Spacing 45 cm × 10 cm.

The highest benefit-cost (B:C) ratio of 1.65 was achieved with Nitrogen 90 kg/ha + Spacing 25 cm × 10 cm, while the lowest B:C ratio of 1.26 was again found in Nitrogen 90 kg/ha + Spacing 45 cm × 10 cm.

Conclusion

Based on one year of experimentation, the combined application of Nitrogen 60 kg/ha + Spacing 35 cm × 10 cm recorded higher yield and benefit cost ratio in Proso millet.

Table 1 : Effect of Nitrogen levels and Spacing yield attributes and yield of prosomillet

Treatment combinations	Ear head length (cm)	Number of grains/ear head	Test weight (g)	Seed yield (kg/ha)	Stoveryield (kg/ha)
T1.	23.16	138.69	4.87	1144.30	2155.50
T2.	25.32	141.30	4.06	1210.66	2182.19
T3.	23.35	130.20	5.30	1123.40	2162.28
T4.	22.61	137.88	4.14	1133.43	2166.10
T5.	26.67	147.54	5.58	1244.08	2236.05
T6.	23.13	138.61	5.44	1131.97	2178.48
T7.	22.88	133.03	4.84	1059.97	2086.04
T8.	23.72	127.28	4.70	1110.07	2137.56
T9.	18.92	112.18	4.96	1032.37	2068.29
S. Em (±)	0.87	2.62	0.45	25.94	21.61
CD (p = 0.05)	2.60	7.86	-	77.77	64.80

Table 2 : Evaluation of Nitrogen levels and Spacing on Economics of Proso millet.

Treatment combinations	Gross returns(INR/ha)	Net returns(INR/ha)	B:C ratio
T1.	80,101.00	50,301.00	1.55
T2.	84,746.39	54,946.39	1.70
T3.	78,638.00	48,838.00	1.52
T4.	79,340.33	49,540.33	1.50
T5.	87,085.87	57,285.87	1.74
T6.	79,238.08	49,438.08	1.51
T7.	74,197.67	44,397.67	1.31
T8.	77,704.90	47,904.90	1.41
T9.	72,265.67	42,465.67	1.26

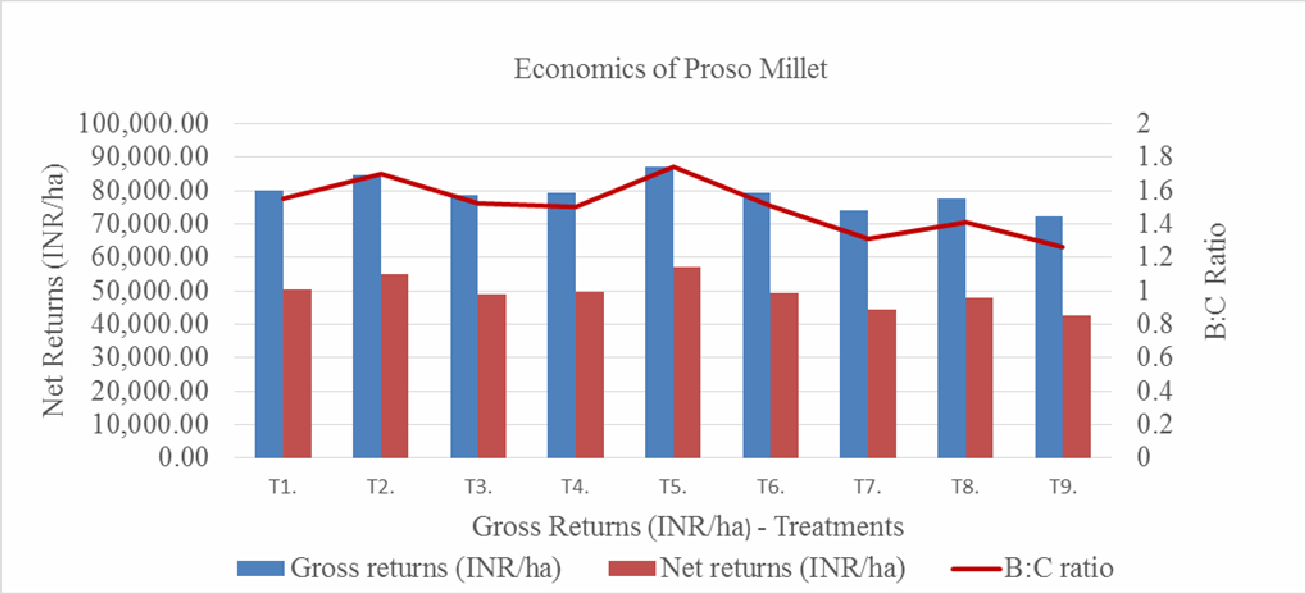

Fig. 1 : Impact of Nitrogen Levels and Plant Spacing on Growth, Yield, and Economics of Proso Millet (*Panicum miliaceum* L.)"

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