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Effect of nitrogen management on yield and economics of pearlmillet

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Abstract
A field experiment was conducted at Research farm, Vivekananda Global University, Jaipur during *Kharif* season¸ 2024-25 on loamy sand soil. The experiment comprises ten treatments of nitrogen *viz*., (Control, 100% Nitrogen at Sowing, 50% Nitrogen at sowing + 50% at 25 DAS, 50% Nitrogen at sowing + 25% at 25 DAS + 25% at 50 DAS, 33% Nitrogen at sowing + 33% at 25 DAS + 33% at 50 DAS, 50% Nitrogen at sowing + 30% at 25 DAS + 20% as foliar spray, 50% Nitrogen at sowing + 40% at 25 DAS + 10% as foliar spray, 40% Nitrogen at sowing + 40% at 25 DAS + 20% as foliar spray, 60% Nitrogen at sowing + 30% at 25 DAS + 10% as foliar spray, 70% Nitrogen at sowing + 30% as foliar spray) was laid out in randomized block design and replicated thrice. The results indicated that among the treatments application of T_8 40% Nitrogen at sowing + 40% at 25 DAS + 20% as foliar spray recorded significantly higher grain yield (1563 kg ha^{-1}) and biological yield (5905 kg ha^{-1}). However, maximum net return (Rs. 32991 ha^{-1}) and B: C ratio (2.20) obtained with the application of same treatment.

Keywords: Yield, economics, nitrogen management

Introduction
Among all coarse and minor millets Pearl millet, scientifically known as (*Pennisetum glaucum* L.) is an important cereal grain and a staple food crop primarily grown in arid and semi-arid regions of Africa and South Asia. Pearl millet, often referred to as bajra in India, is prized for its ability to withstand heat and drought, making it an essential crop in areas with harsh environmental conditions. It flourishes satisfactorily and can yield grain under rainfall as low as 200 to 250 mm, which makes it one of the most reliable cereal in the rainfed regions of arid and semi-arid tropics. The nutrient content of pearl millet is very well comparable with other cereals and millets. Its grain contains about 11.6% protein, 5% fat, 67% carbohydrate, 2.7% minerals and about 12.4% moisture. It also contains higher amount of carotene, riboflavin (Vit B_2) and niacin (Vit B_4). Traditionally, Bajra chapatti known as Sogra/Hogra is the part of daily diet in the western Rajasthan. Besides it, “Khichadi” and “churma” are the delicious dishes prepared from pearl millet flour. The Crop is also valued as an important source of green and dry fodder (karbi) for cattle in this belt. A small proportion of grains is used for poultry feed. Now a day, pearl millet grain is also gaining importance as a cheap source of starch for making fine quality breweries.
Poor soil fertility and erratic rains are the most important constraints to crop production in arid and semi-arid region. Soil fertility management i.e., nutrient management particularly nitrogen (N) plays a major role in increasing production and productivity of pearl millet. Nitrogen is an essential major nutrient for plant growth, which is closely associated with vegetative growth and development of plants. It plays an important role in plant metabolism by virtue of being an essential constituent of structural component of the cell wall and many metabolically active compounds. It is also a constituent of chlorophyll and amino acids, which is important for harvest of solar energy. It helps in early establishment of leaf area capable of photosynthesis. It promotes leaf and stem growth rapidly which consequently increase the yield and its quality. Nitrogen to some extent enhances the utilization of phosphorus and potassium. Nitrogen is most commonly deficient nutrient in Indian soil and gives considerable response in pearl millet crop (Jadhav *et al*., 2011) [4].

Pearl millet is an exhaustive crop, nitrogen is the major nutrient required by pearl millet and has shown variable growth and yield response to N application (Chouhan *et al*., 2015) [3].

Materials and Methods

The experiment was conducted at Research farm, Vivekananda Global University, Jaipur. Geographically, is situated Geographically this place is situated at 750 47' East longitude, 260 51' North latitude and at altitude of 390 m above mean sea level in Jaipur district of Rajasthan. This region falls under Agro-climatic zone IIIa (Semi-arid eastern plain zone) of Rajasthan. The experiment comprises ten treatments of nitrogen *viz*., (Control, 100% Nitrogen at Sowing, 50% Nitrogen at sowing + 50% at 25 DAS, 50% Nitrogen at sowing + 25% at 25 DAS + 25% at 50 DAS, 33% Nitrogen at sowing + 33% at 25 DAS + 33% at 50 DAS, 50% Nitrogen at sowing + 30% at 25 DAS + 20% as foliar spray, 50% Nitrogen at sowing + 40% at 25 DAS + 10% as foliar spray, 40% Nitrogen at sowing + 40% at 25 DAS + 20% as foliar spray, 60% Nitrogen at sowing + 30% at 25 DAS + 10% as foliar spray, 70% Nitrogen at sowing + 30% as foliar spray) was laid out in randomized block design and replicated thrice.

Grain yield

After threshing, winnowing and cleaning, the produce of each plot was weighed separately in kg per plot and then converted to grain yield in kg ha^{-1}.

Stover yield

Stover yield (kg ha^{-1}) was obtained by subtracting grain yield (kg ha^{-1}) from the biological yield (kg ha^{-1}).

Biological yield

The weight of the thoroughly sun dried harvested produce of each plot was recorded separately before threshing and expressed as biological yield in (kg ha^{-1}).

Harvest index

Harvest index was computed by using the formula outlined by Singh and Stoskopf (1971).

$$\text{Harvest index (\%)} = \frac{\text{Economic yield (kg/ha)}}{\text{Biological yield (kg/ha)}} \text{ X } 100$$

The economics of treatments is the prime consideration before making any recommendation to the farmers for its adoption. Hence, to evaluate the effectiveness and profitability of the treatments, comprehensive economics in terms of net returns (₹ ha^{-1}) and B:C ratio was calculated so that the most effective and remunerative treatment could be recommended. The details of calculation with prevailing market rates of the inputs and produce are given in appendices at the end.

Net returns = Gross returns – Total cost of cultivation

$$\text{B: C ratio} = \frac{\text{Gross returns (₹ ha}^{-1})}{\text{Cost of cultivation (₹ ha}^{-1})}$$

Results and Discussion

The grain, straw as well as biological yield differed significantly due to addition of different combinations of nitrogen at different stages of growth. Grain and biological yield of pearlmillet was ranged between 734 to 1563 kg ha^{-1} and 2439 to 5905 kg ha^{-1}, respectively with different treatments and the highest yield was obtained in T_8 40% Nitrogen at sowing + 40% at 25 DAS + 20% as foliar spray which found at par with the treatment T_7 50% Nitrogen at sowing + 40% at 25 DAS + 10% as foliar spray and T_6 50% Nitrogen at sowing + 30% at 25 DAS + 20% as foliar spray. The increase in yield under all treatment combination was significantly higher as compared to control presented in table 1. Significant increase in yield might due nitrogen improves the improvement of strong cell walls and consequently, straw which might be resulted into profuse tillering. These results are already in agreement reported by Rajput (2008) [8], (Ayub *et al*., 2007) [1], Pathan and Bhilare (2009) [7]. Application of nitrogen and zinc levels improve grain yield. Higher number of grains per panicle might due to the application of nitrogen increases the fertility of flowers and increase in leaf area and duration and resulted into increase in supplying assimilates for the sink (Mousavi *et al*., 2012) [6]. The application of nitrogen in different splits resulted in an increased nitrogen availabilitywhich might have ascribed to higher grain yield in pearl millet. Similarly, the dry matter accumulation at harvest was also influenced by increased nitrogen availability which might have contributed to the increase in the straw and biological yield. Similar results were also confirmed by Singh *et al*. (2013) [11] in wheat, Mathukia *et al*. (2014) [5] in wheat and Sagar *et al*. (2023) [10] in rice.

The highest net return of Rs.32991 was obtained from T_8 40% Nitrogen at sowing + 40% at 25 DAS + 20% as foliar spray which closely followed by T_7, and T_6 with the respective values of (31291 and 27837 Rs.ha^{-1}). While, The highest B: C ratio of (2.20) was obtained from T_8 40% Nitrogen at sowing + 40% at 25 DAS + 20% as foliar spray which found statistically close to T_7 50% Nitrogen at sowing + 40% at 25 DAS + 10% as foliar spray and T_6 50% Nitrogen at sowing + 30% at 25 DAS + 20% as foliar spray with the respective values of (2.14 and 2.01). These results are in accordance with the findings of Chavan *et al*., 2023 [2] and Ravishankar *et al*., 2008 [9].

Table 1: Effect of nitrogen management on grain, stover, biological yield and harvest index of pearlmillet

Treatments	Grain yield (kg/ha)	Stover yield (kg/ha)	Biological yield (kg/ha)	Harvest index (%)
T_1 Control	734	1705	2439	39.38
T_2 100% Nitrogen at Sowing	1092	2984	4076	36.81
T_3 50% Nitrogen at sowing + 50% at 25 DAS	1259	3405	4664	37.07
T_4 50% Nitrogen at sowing + 25% at 25 DAS + 25% at 50 DAS	1340	3673	5044	36.39
T_5 33% Nitrogen at sowing + 33% at 25 DAS + 33% at 50 DAS	1315	3574	4890	36.87
T_6 50% Nitrogen at sowing + 30% at 25 DAS + 20% as foliar spray	1448	3904	5352	37.11
T_7 50% Nitrogen at sowing + 40% at 25 DAS + 10% as foliar spray	1529	4183	5712	36.51
T_8 40% Nitrogen at sowing + 40% at 25 DAS + 20% as foliar spray	1563	4342	5905	35.94
T_9 60% Nitrogen at sowing + 30% at 25 DAS + 10% as foliar spray	1408	3738	5089	38.51
T_{10} 70% Nitrogen at sowing + 30% as foliar spray	1351	3704	5081	36.22
SEm±	49	134	178	1.37
CD (P=0.05)	144	397	528	NS

Table 2: Effect of nitrogen management on net returns and B:C ratio of pearlmillet

Treatments	Net returns (Rs/ha)	B:C ratio
T_1 Control	6082	1.31
T_2 100% Nitrogen at Sowing	20062	2.00
T_3 50% Nitrogen at sowing + 50% at 25 DAS	23314	2.14
T_4 50% Nitrogen at sowing + 25% at 25 DAS + 25% at 50 DAS	26137	2.27
T_5 33% Nitrogen at sowing + 33% at 25 DAS + 33% at 50 DAS	31176	2.51
T_6 50% Nitrogen at sowing + 30% at 25 DAS + 20% as foliar spray	36592	2.78
T_7 50% Nitrogen at sowing + 40% at 25 DAS + 10% as foliar spray	33282	2.62
T_8 40% Nitrogen at sowing + 40% at 25 DAS + 20% as foliar spray	35024	2.70
T_9 60% Nitrogen at sowing + 30% at 25 DAS + 10% as foliar spray	28628	2.39
T_{10} 70% Nitrogen at sowing + 30% as foliar spray	24718	2.20
SEm±	1913	0.09
CD (P=0.05)	5685	0.28

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