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Effect of nitrogen and phosphorus levels on growth and yield of pearl millet (*Pennisetum glaucum* L.)

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Abstract

A field experiment entitled “Effect of Nitrogen and Phosphorus Levels on Growth and Yield of Pearl millet (*Pennisetum glaucum* L.)” research was done on the farm at the crop research centre-1, School of Agriculture, ITM University Gwalior (M.P) during the *Kharif* season 2022. The experiment was laid out in a Factorial randomized block design with 9 treatment combinations, This has three levels of nitrogen: N1-40 kg N ha⁻¹, N2-80 kg N ha⁻¹, and N3-120 kg N ha⁻¹., three levels of phosphorous: P1-20 kg P₂O₅ ha⁻¹, P₂-40 kg P₂O₅ ha⁻¹ and P₃-60 kg P₂O₅ ha⁻¹ and one control, and each treatment were replicated thrice. The experiment's findings showed that increasing the amount of nitrogen and phosphorus applied greatly boosted pearl millet growth and production viz., plant height (cm), No. of tillers plant⁻¹, plant dry matter (g m⁻²) No. of effective tillers plant⁻¹, length of the ear, grith of the ear, grain yield (kg ha⁻¹), Stover yield (kg ha⁻¹) of pearl millet, the application of 80 kg N/ha⁻¹ and 40 kg P₂O₅ ha⁻¹ were significantly superior over the application of 40 kg N/ha⁻¹ and 20 kg P₂O₅/ha⁻¹ and control.

Keywords: Pearl millet, growth, yield

Introduction

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 can tolerate prolonged periods of drought thanks to its extensive root system, which enables it to access moisture from deeper soil layers Nitrogen is a vital component of chlorophyll, which is responsible for photosynthesis, the process by which plants convert sunlight into energy. In addition, nitrogen is important for the synthesis of proteins and is essential for the creation of enzymes and amino acids. Adequate nitrogen supply helps improve plant growth, overall health, and grain yield. The development and growth of plants depend on the nutrient phosphorus, including pearl millet (*Pennisetum glaucum* L). It plays a vital role in various physiological processes within the plant, such as energy transfer, photosynthesis, and the formation of DNA and RNA. Phosphorus is especially important for the development of strong root systems and promoting early seedling growth in pearl millet.

Materials and Methods

A research was carried out in the field during the 2022 kharif season at the Crop Research Center-1, School of Agriculture, ITM University Gwalior (M.P) to determine how much nitrogen and phosphorus levels affected the growth and yield of pearl millet (*Pennisetum glaucum* L.). This has three levels of nitrogen: N1-40 kg N ha⁻¹, N2-80 kg N ha⁻¹, and N3-120 kg N ha⁻¹., three levels of phosphorous: P1-20 kg P₂O₅ ha⁻¹, P₂-40 kg P₂O₅ ha⁻¹ and P₃-60 kg P₂O₅ ha⁻¹ and one control, and each treatment were replicated thrice. Pearl millet hybrid variety “Bajra Nandi-75” was sown by line sowing (seed drills) method. The soil of the experiment field was sandy loam in texture with a low in organic carbon, medium in available N, P₂O₅, and K₂O content. The trial field was ploughed with a tractor-drawn cultivator, then harrowed and planked to create a fine seed bed. The experiment field done as per layout plan and bunds are prepared manually. In accordance with the treatment, half of the nitrogen and phosphorus doses are administered at the base in the form of urea and SSP, and the remaining half is treated as a top dressing at 30 DAS in the form of urea and SSP at the appropriate moisture level. The irrigation are done through rain and two irrigation are done manually. The data on plant height, length of the ear, grith of the ear, plant dry matter, no of tillers, no of

effective tillers, grain yield, stover yield were recorded.

Result and Discussion

(A) Impact on growth of pearl millet by nitrogen levels.

The effect of different levels of nitrogen play significant role on plant height, plant dry matter, no of tillers, no of effective tillers, grain yield, stover yield and biological yield.

In general, significantly plant height (170.48 cm) was recorded with the application of 80 kg N ha⁻¹ and significantly superior over the 40 kg N ha⁻¹ and control. The nitrogen fertilizer helps in growth, increase the internodes and inter node length P.R. PATEL *et al.* (2014) [4].

Significantly the length of the ear (24.50 cm), grith of the ear (7.73cm) a considerable improvement over the 40 kg N ha⁻¹ and control was observed with the application of 80 kg N ha⁻¹. The length of the ear and grith of the ear was gradually increased with the help of the nitrogen levels these calculations was suggested by Maitrik P Joshi *et al.* (2018) [7].

Significantly the plant dry matter (67.44) was recorded when 80 kg N ha⁻¹ was applied, which was substantially better than the 40 kg N ha⁻¹ and control. The plants get taller, create more LAI, and eventually produce higher total dry matter accumulation when there is an appropriate supply of nitrogen. These outcomes support the conclusions made by Bhanuchandar *et al.* (2020) [3].

Significantly the no of tillers plant⁻¹ (2.86) was recorded with the use of 80 kg N ha⁻¹ and considerably superior to the 40 kg N ha⁻¹ and control. The more no of tillers are obtain by increase in the nitrogen fertilizer has reported by sadhana R Babar *et al.* (2021) [2] and Sunil p. Arshewar *et al.* (2018) [1].

The no of effective tillers plant⁻¹ (2.46) significantly was recorded with the application of 80 kg N ha⁻¹ over the 40 kg N ha⁻¹ and control. The increase in the nitrogen the effective tillers are increased significantly has been reported by SB Kadam *et al.* (2019) [8].

(B) Impact on yield of pearl millet by nitrogen levels.

The grain yield and stover yield was significantly influenced due to increase of nitrogen. However the grain yield (2892 kg ha⁻¹) and stover yield (7717 kg ha⁻¹) was obtained in 80 kg N ha⁻¹ and superior over the 40 kg N ha⁻¹ and control the results are also in agreement with the findings of SB Kadam *et al.* 2019 [8], S Bhanu Prasad Reddy *et al.* 2016 [10], Sunil p. Arshewar *et al.* (2018) [1] and Rinku *et al.* (2016) [12].

(C) Impact on growth of pearl millet by phosphorus levels.

The effect of different levels of phosphorus play significant role on plant height, plant dry matter, no of tillers, no of effective tillers, grain yield, stover yield and biological yield.

The plant height (170.27cm) is notable with the application of 40 kg P₂O₅ ha⁻¹ was superior to the 20 kg P₂O₅ ha⁻¹ and control treatments. The maximum plant height attained by regular supply of phosphorus and nitrogen and develop the plant height throught the crop growth period reported by Satybhan Singh *et al.* (2019) [14] and vangala siva nagi reddy *et al.* (2022) [11].

Significantly the length of the ear (24.67 cm), grith of the ear (7.72 cm) the result recorded was achieved through the application of 40 kg P₂O₅ ha⁻¹, which was notably better than the results from using 20 kg P₂O₅ ha⁻¹ and the control. The length of the ear and grith of the ear also make changes with the increase in phosphorus levels reported by CM Thumar *et al.* (2016) [15].

Significantly the plant dry matter (66.21) When 40 kg P₂O₅ ha⁻¹ was used, a considerably better outcome was obtained than when 20 kg P₂O₅ ha⁻¹ and the control were used. Phosphorus helps in increase in plant dry matter reported by Shivuam ashish gautam *et al.* (2019) [5].

Significantly the no of tillers palnt⁻¹ (2.85) the application of 40 kg P₂O₅ ha⁻¹ resulted in a recorded value that was significantly superior to both the 20 kg P₂O₅ ha⁻¹ application and the control. The more no of tillers are obtain by increase in the phosphorus fertilizer has reported by Lakhan Singh *et al.* (2016) [16].

Significantly the no of effective tillers plant⁻¹ (2.45) was measured with an application of 40 kg P₂O₅ ha⁻¹ and was noticeably better than the 20 kg P₂O₅ ha⁻¹ and control. The more no of tillers are obtain by increase in the phosphorus fertilizer has reported by MC Gojariya *et al.* (2021) [6] and HM Bhuva *et al.* (2018) [4].

(D) Impact on yield of pearl millet by phosphorus levels.

The grain yield and stover yield was significantly influenced due to increase of phosphorus. However the grain yield (2886 kg ha⁻¹) and stover yield (7398 kg ha⁻¹) was obtained in 40 kg P₂O₅ ha⁻¹ and superior over the 20 kg P₂O₅ ha⁻¹ and control. The outcomes concur with the conclusions of SB Kadam *et al.* (2019) [8], S Bhanu Prasad Reddy *et al.* (2016) [10] and Sunil p. Arshewar *et al.* (2018) [1].

Table 1: Growth and yield of pearl millet as influenced by nitrogen and phosphorus levels.

Treatments	Plant height (cm)	Length of the ear	Grith of the ear	No of tillers plant ⁻¹	No of effective tillers plant ⁻¹	Plant dry matter	Grain yield (kg ha ⁻¹)	Stover yield (kg ha ⁻¹)
control	123.15	19.07	5.96	2.16	1.95	50.93	2020.42	5136.34
Nitrogen levels (kg ha⁻¹)								
N ₁ – 40	155.79	21.79	6.68	2.55	2.23	57.79	2576.60	6596.29
N ₂ – 80	170.48	24.50	7.73	2.86	2.46	67.44	2892.74	7375.08
N ₃ – 120	178.06	25.75	8.55	2.94	2.56	68.81	3066.56	7717.41
S.Em ±	4.34	0.66	0.28	0.07	0.06	1.69	75.20	208.49
C.D at 5%	12.90	1.96	0.84	0.22	0.19	5.02	223.44	619.45
Phosphorus levels (kg ha⁻¹)								
P ₁ – 20	157.07	22.12	6.68	2.62	2.26	60.99	2660.29	6776.00
P ₂ – 40	170.27	24.67	7.72	2.85	2.45	66.21	2886.10	7398.58
P ₃ – 60	176.99	25.25	8.34	2.91	2.54	66.84	2989.52	7514.21
S.Em ±	4.34	0.66	0.28	0.07	0.06	1.69	75.20	208.49
C.D at 5%	12.90	1.96	0.84	0.22	0.19	5.02	223.44	619.45
Interaction								
S.Em ±	7.52	1.14	0.49	0.13	0.11	2.93	130.26	361.11
C.D at 5%	NS	NS	NS	NS	NS	NS	NS	NS

Conclusion

Nitrogen and phosphorus levels had significant impact on growth and yield attributes of pearl millet. Notably, 120 kg nitrogen ha⁻¹ and 60 kg phosphorus ha⁻¹ treatments consistently yielded the best results regarding plant height, Length of the ear, Grith of the ear, no of tillers, no of effective tillers, Plant dry matter, Grain yield, Stover yield. So, use of 120 kg nitrogen ha⁻¹ and 60 kg phosphorus ha⁻¹ levels is helpful to get higher production and returns.

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