International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X

www.agronomyjournals.com
2024; SP-7(8): 131-133
Received: 18-06-2024
Accepted: 24-07-2024

Arfith Lal LV
P.G. Scholar, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Naini, Prayagraj, Uttar Pradesh, India

Rajesh Singh
Professor, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Naini, Prayagraj, Uttar Pradesh, India

Thakur Indu
Ph.D. Scholar, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Naini, Prayagraj, Uttar Pradesh, India

Corresponding Author:
Arfith Lal LV
P.G. Scholar, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Naini, Prayagraj, Uttar Pradesh, India

Effect of spacing and nitrogen on growth and yield in pearl millet

Arfith Lal LV, Rajesh Singh and Thakur Indu

DOI: https://doi.org/10.33545/2618060X.2024.v7.i8Sb.1228

Abstract
A field experiment was conducted during *Kharif* season 2022-2024 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P) on Pearl millet. The soil of the experimental plot had a sandy loam texture, low organic carbon (0.72%), a nearly neutral pH (7.2), nitrogen (178.48 kg/ha), phosphorus (27.80 kg/ha), and potassium (233.24 kg/ha). The experiment was conducted using a randomized block design with nine treatments, each replicated three times. The results revealed that significantly higher plant height (189.43 cm), dry weight (53.33 g/plant), number of ears/m2 (38.09), number of grains/ear head (1666.67), seed yield (2.76 t/ha), stover yield (5.53 t/ha) and harvest index (33.57%) were obtained in treatment T_6 (45 cm × 10 cm + 90 kg/ha N) in Pearl millet crop.

Keywords: Pearl millet, nitrogen, spacing, growth, yield

Introduction
Pearl millet (*Pennisetum glaucum*) is one of the important millet crops in hot and dry areas of arid and semi-arid climatic conditions. C4 cereals, such as millets, are water-saving crops, with most of them maturing within 60-90 days after sowing (DAS). More carbon dioxide is utilized by the C4 cereals and also gets converted to oxygen. It has low input requirement, high water use efficiency, and therefore is environment friendly. It can help in phasing out climatic uncertainties, reduce CO_2 concentration, and to contribute the mitigation of climate change. It is rightly termed a "Nutri-cereal" and a powerhouse of nutrition as it is a good source of energy, carbohydrate, protein, fat, ash, dietary fiber, iron, and zinc (AICRP, Pearl Millet, 2020). In India, pearl millet occupies a total area of 7.41 million hectares having an average production of 10.3 million tonnes with productivity of 1391 kg/ha during 2019-20 (Minz *et al.* 2021) [1].

Crop geometry acts as a major factor that governs the production. Suitable crop geometry will enhance the production through proper utilization of nutrients and moisture from below ground and above ground (crop canopy) by the absorption of photosynthetically active radiation (PAR) which results in the formation of more photosynthates. For the enhanced straw and grain yield, wider spacing is superior over narrow spacing. Moreover, the appropriate crop geometry can assure higher productivity, reduction in seed rate, and further healthy stand of the crop in the field (Minz *et al.* 2021) [1]. Therefore, there is a need to improve fertility management along with the optimum plant density of current hybrids for sustainable productivity (Rana *et al.* 2009) [2].

Nitrogen is the primary nutrient needed by pearl millet, and its growth and yield have shown variable responses to nitrogen application. Generally, pearl millet is known for its ability to grow under low nitrogen management. However, several studies, such as (Patel *et al.* 2014) [3], have shown that nitrogen management can significantly increase millet production efficiency. The main reason for low productivity is that crops are often grown under rainfed conditions on low-fertility soils. Nowadays, the use of chemical fertilizers is increasing to boost crop production (Kadem *et al.* 2019) [4]. In addition to increasing planting densities, irrigation, and nitrogen fertilizer can help small-scale farmers produce more grain and fodder for their families and livestock in areas where households engage in subsistence agriculture. The grain and biomass yield of pearl millet are constrained by low plant population densities and nutrient and water stress, which reduce radiation and water use efficiencies.

Materials and Methods

The field trial was conducted during the *Kharif* season of 2023 at the Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj, U.P. The farm is situated at 25°09'03" N latitude, 81°45'14" E longitude, and an altitude of 98 meters above mean sea level. The site is located on the right bank of the river Ganga, 10 km away from Prayagraj city. ". The pH of the soil is 7.3. The texture of the soil is sandy loam, high in Nitrogen (N) Potassium (K), and a medium in phosphorus (P). The experiment was laid out in Randomized Block Design consisting of nine treatment combinations *viz*., T_1- 35 cm x 10 cm + 50 kg/ha Nitrogen, T_2- 35 cm x 10 cm + 70 kg/ha Nitrogen, T_3- 35 cm x 10 cm + 90 kg/ha Nitrogen, T_4- 45 cm x 10 cm + 50 kg/ha Nitrogen, T_5- 45 cm x 10 cm + 70 kg/ha Nitrogen, T_6- 45 cm x 10 cm + 90 kg/ha Nitrogen, 71- 60 cm x 10 cm + 50 kg/ha Nitrogen, T_8- 60 cm x 10 cm + 70 kg/ha Nitrogen, T_9- 60 cm x 10 cm + 90 kg/ha Nitrogen were replicated thrice. The experimental field was brought to a fine tilth by plowing and removing stubbles. 27 plots of each 3.0 m x 3.0 m were made. The recommended nutrients were applied in 60:30:30 kg/ha amount through Urea, SSP, and MoP to all treatments after opening the furrows and covering them properly. The variety of dabang is sown according to the treatment. The growth parameters *viz*., plant height (cm), dry weight (g/plant), CGR (g/m2/day), and RGR (g/g/day) were recorded at 20 days-time intervals till physiological maturity and data was statistically analyzed by using ANOVA technique. (Gomez and Gomez, 1994) [5].

Results and Discussion

Growth attributes

According to the shown data in Table 1 the height of the plant was recorded at 20 days intervals. The maximum plant height was recorded in treatment 6, 45 cm x 10 cm + 70kg/ha Nitrogen. However, treatment T_5 (45 cm × 10 cm + Nitrogen 70 kg/ha) was found to be statistically at par with treatment T_6. Also in plant dry weight treatment 6 (45 cm × 10 cm + Nitrogen 90 kg/ha) shows the highest dry weight. However, treatment T_5 (45 cm × 10 cm + Nitrogen 70 kg/ha) and treatment T_4 (45 cm × 10 cm + Nitrogen 50 kg/ha) were found to be statistically at par with treatment. The wider plant spacing (paired row) produced superior absolute plant height compared to the single row *Singh et al*., (2019) [6]. The overall improvement in crop growth under the influence of nitrogen application could be attributed to a better environment for growth and development, which might be due to the increased availability of nitrogen to plants.

Plant growth is a function of cell division and cell enlargement, which depends upon the availability of nutrients, especially nitrogen Rinku *et al*., (2014) [7]. Nitrogen is the main component of the protoplasm involved in various metabolic processes *viz*. photosynthesis, stimulation of cell division, and elongation. This leads to an increase in dry matter accumulation, greater plant height, and tillers per plant Prasad *et al*., (2014) [9]. The increased availability of nitrogen to plants in turn increases auxin supply with higher levels of nitrogen bringing about an increase in the dry matter and shoots per plant Rinku *et al*., (2014) [7]. Nitrogen is the main component of the protoplasm involved in various metabolic processes *viz*. photosynthesis, stimulation of cell division, and elongation that leads to an increase in dry matter accumulation Kumari *et al*., (2016) [8].

Yield Parameters

Table 2 shows the number of ear heads per m2 recorded at the harvest stage, presented in Table 2. The data showed that there was a significant effect among treatments. However, the highest number of ear heads/m2 (38.09) was observed in treatment T_6 (45 cm × 10 cm + Nitrogen 90 kg/ha). However, treatment T_5 (45 cm × 10 cm + Nitrogen 70 kg/ha) and treatment T_4(45 cm × 10 cm + Nitrogen 50 kg/ha) were statistically at par with treatment T_6. The number of ear heads per m2 recorded at the harvest stage. The data showed that there was a significant effect among treatments. However, the highest number of ear heads/m2 (38.09) was observed in treatment T_6 (45 cm × 10 cm + Nitrogen 90 kg/ha). However, treatment T_5 (45 cm × 10 cm + Nitrogen 70 kg/ha) and treatment T_4(45 cm × 10 cm + Nitrogen 50 kg/ha) were found to be statistically at par with treatment T_6. Maximum seed yield (2.76 t/ha) was observed in treatment T_6 (45 cm × 10 cm + Nitrogen 90 kg/ha). However, treatment T_4 (45 cm × 10 cm + Nitrogen 50 kg/ha) and treatment T_9 (60 cm × 10 cm + Nitrogen 90 kg/ha) were found to be statistically at par with treatment T_6. Maximum stover yield (5.53 t/ha) was observed in treatment T_6(45 cm × 10 cm + Nitrogen 90 kg/ha). However, treatment T_5 (45 cm × 10 cm + Nitrogen 70 kg/ha) and treatment T_4(45 cm × 10 cm + Nitrogen 50 kg/ha) were found to be statistically at par with treatment T_6. Maximum harvest index (41.82%) was recorded in treatment T_1 (35 cm × 10 cm + Nitrogen 50 kg/ha) whereas, minimum harvest index (32.51%) was recorded in treatment T_5 (45 cm × 10 cm + Nitrogen 70 kg/ha), respectively.

The increase in grain and straw yields with enhanced nitrogen application can be attributed to the increased activity of cytokinin in plants, which leads to greater cell division and elongation, resulting in improved plant growth, dry matter production, and higher photosynthesis (Reddy *et al*., 2016) [8]. Similarly, Rinku *et al*. (2014) [7] observed that the increase in grain and straw yields with enhanced nitrogen application was due to the increased activity of cytokinin, leading to better plant growth and photosynthesis. The highest grain and straw yields can be attributed to the cumulative effect of improved yield attributes, such as the number of effective tillers per plant, ear head length, and girth. The improvement in straw yield was mainly due to the increase in growth parameters as a result of nitrogen application (Kadam *et al*., 2019) [4].

Table 1: Effect of Plant Density and Nitrogen Management on growth attributes (cm) of Pearl millet

S. No.	Treatment combinations	80 DAS	
		Plant height (cm)	Plant dry weight (g)
1.	35 cm × 10 cm + Nitrogen 50 kg/ha	161.42	33.19
2.	35 cm × 10 cm + Nitrogen 70 kg/ha	166.33	34.50
3.	35 cm × 10 cm + Nitrogen 90 kg/ha	170.70	36.13
4.	45 cm × 10 cm + Nitrogen 50 kg/ha	183.92	43.15
5.	45 cm × 10 cm + Nitrogen 70 kg/ha	188.62	46.73
6.	45 cm × 10 cm + Nitrogen 90 kg/ha	189.43	53.33
7.	60 cm × 10 cm + Nitrogen 50 kg/ha	174.27	36.47
8.	60 cm × 10 cm + Nitrogen 70 kg/ha	178.28	39.52
9.	60 cm × 10 cm + Nitrogen 90 kg/ha	181.29	41.05
SEm(±)	1.71	4.27	
CD (p=0.05)	5.14	12.82	

Table 2: Effect of Plant density and Nitrogen management on Yield Attributes of Pearl millet

S. No.	Treatments	Number of ear heads/m2	Number of grains/ear head	Test weight (g)	Grain yield (t/ha)	Stover yield (t/ha)	Harvest Index (%)
1.	35 cm × 10 cm + Nitrogen 50 kg/ha	29.43	1500.00	3.80	2.38	3.31	41.82
2.	35 cm × 10 cm + Nitrogen 70 kg/ha	32.21	1316.00	3.80	2.53	3.73	40.41
3.	35 cm × 10 cm + Nitrogen 90 kg/ha	32.21	1400.00	3.83	2.65	3.85	40.90
4.	45 cm × 10 cm + Nitrogen 50 kg/ha	34.28	1610.00	4.10	2.75	4.93	36.23
5.	45 cm × 10 cm + Nitrogen 70 kg/ha	36.19	1596.67	4.47	2.45	5.13	32.51
6.	45 cm × 10 cm + Nitrogen 90 kg/ha	38.09	1666.67	3.65	2.76	5.53	33.57
7.	60 cm × 10 cm + Nitrogen 50 kg/ha	32.59	1516.67	3.67	2.45	4.13	37.59
8.	60 cm × 10 cm + Nitrogen 70 kg/ha	32.55	1523.33	4.57	2.61	4.33	38.21
9.	60 cm × 10 cm + Nitrogen 90 kg/ha	34.81	1543.33	4.40	2.73	4.88	35.87
	SEm (±)	1.07	68.29	0.43	0.18	0.42	3.16
	CD (p=0.05)	3.21	204.74	-	0.55	1.27	9.49

Conclusion
From the results, it can be concluded that plant density of 45 cm x 10 cm and Nitrogen 90 kg/ha brought about significant improvement in the production and economic viability of pearl millet.

Acknowledgement
I extend my heartfelt thanks to my advisor Dr. Rajesh Singh for his continuous support and expert guidance throughout the research process. I am also grateful to my friends for their valuable feedback and suggestions that have enriched the content of this work.

Conflict of Interest: No.

Ethical Statement: Not applicable.

Copyright Statement: The article does not contain any copyright-protected material.

Authorship Statement
Name of Author: Arfith Lal LV - Experimentation, Manuscript writing, Data analysis, Idea conceptualizing manuscript editing.

Name of co-author: Thakur Indur- Manuscript correction

Name of co-author: Dr. Rajesh Singh - Supervision, Validation, and Data correction

References

1. Minz SD, Singh AK, Kumar NM, Singh BK. Effect of crop geometry and nitrogen management on growth attributes of pearl millet (*Pennisetum glaucum* L.) under guava-based agri-horti system. Pharma Innov J. 2021;10(9):2191-2195.
2. Rana VS, Rathore BS, Nanwal RK, Kumar A, Vasist R. Effect of hybrids, plant density, and fertility levels on nutrient concentration, uptake and productivity of pearl millet in a semi-arid environment. South Pac J Nat Sci. 2009;27:45-48.
3. Patel PR, Patel BJ, Vyas KG, Yadav BL. Effect of integrated nitrogen management and bio-fertilizer in Kharif pearl millet (*Pennisetum glaucum* L.). Adv. Res. J Crop Improv. 2014;5(2):122-125.
4. Kadam SB, Pawar SB, Jakkawad SR. Impact of integrated nutrient management on growth, yield of summer pearl millet. Trends Biosci., 2019, 12(4).
5. Gomez KA, Gomez AA. Statistical procedures for agricultural research. John Wiley & Sons; c1984.
6. Singh S, Singh V, Shukla RD, Yadav B. Effect of planting geometry and phosphorus levels on pearl millet (*Pennisetum glaucum*). Prog. Res. Int J Soc. Sci. Dev. 2019;14(1):18-22.
7. Rinku, Shekhawat PS, Kumawat N, Rathore PS, Yadav PK, Om H, *et al*. Effect of nitrogen levels and biofertilizers on growth and yield of pearl millet (*Pennisetum glaucum* L.) under north-western Rajasthan. Ann. Agric. Res. 2014;35(3):311-314.
8. Kumari CR, Shanthi PM, Nivedtha M, Sudheer KV, Reddy YPK, Reddy BS, *et al*. Response of Bajra Hybrid to spacings and nitrogen levels in rainfed Alfisols. Andhra Pradesh J Agric Sci. 2016;2(2):96-103.
9. Prasad SK, Singh MK, Singh R. Effect of nitrogen and zinc fertilizer on pearl millet (*Pennisetum glaucum*) under agri-horti system of Eastern Uttar Pradesh. Bioscan. 2014;9(1):163-166.