Original Research Article

Effect of Nitrogen Management on Growth and Yield of Pearl Millet (*Pennisetum glaucum* L.)

Abstract

A field experiment was conducted during *Zaid* season of 2023 at Crop Research Farm Department of Agronomy, Naini Agriculture Institute, Sam Higginbottom University of Agriculture Sciences and Technology. To determine "Effect of Nitrogen Management on Growth and Yield of Pearl Millet" The result revealed that treatment 6 [25% Nitrogen through poultry manure + 75% Nitrogen through urea] recorded significantly higher plant height (183.10 cm), higher plant dry weight (64.49 g), higher ear head length (26.10 cm), maximum number of ear head/plant (2.20), higher seed yield (2.46 t/ha) and higher straw yield (6.79t/ha).

Keywords: Pearl millet; urea; vermicompost; poultry manure; nitrogen; growth and yield.

1. INTRODUCTION

Pearl millet (*Pennisetum glaucum* L.) is one of the important millet crops of arid and semi-arid climatic condition. It belongs to the family of Poaceae. It is grown in poor sandy soil due to drought escaping character and also provides staple food in short period relatively in dry tracts of the country. After rice, wheat, maize, and sorghum, pearl millet is India's fifth most important grain and a staple diet for millions of people living in drier areas. It is nutritionally better than many cereals as good source of protein having higher digestibility (12.1%), fat (5%), carbohydrate (69.4%) and minerals (2.3%). Green fodder is either used as preserved hay or silage, which are extremely useful in dry regions.

In India pearl millet is grown over an area of about 6.70 million hectares with a production of 9.62 million tones and productivity of 1.44 t/hectare. Total area coverage under pearl millet in Uttar Pradesh is 0.90 million hectares with a production of 1.95 million tones and the productivity 2.16 t/hectare **(GOI, 2022).**

Most of the Indian soils particularly the light textured ones are deficient in nitrogen which is one of the basic plant nutrients. It is involved in the formation of proteins, nucleic acids, growth hormones and vitamins and is an integral part of chlorophyll. Poor soil fertility and erratic rains are the most important constraints to crop production in arid and semi-arid region. Nitrogen deficiency is one of the major constraints to crop production. The unique feature of N is its soils having very low soil organic matter content, soils with particular constraints on indigenous N supply, high potential of ammonia (NH3). Due to a deficiency of N, older leaves turn an orange-yellow colour and die from the tip down; young leaves are thin, short, and rigid. Similarly, a deficiency of N causes a decrease in plant height and the number of tillers.

Nitrogen plays a major role in increasing production and productivity of pearl millet. Nitrogen is considered as one of the most important plant nutrients for growth and development of crop plant. It also plays an important role in synthesis of chlorophyll and amino acids that contribute to the building unit of protein and thus, growth of plants. Nitrogen helps in early establishment of leaf area capable of photosynthesis. Pearl millet is an exhausting crop and heavy consumer of plant nutrients. Nitrogen promotes leaf and stem growth rapidly which consequently increase the yield and its quality **(Chouhan *et al.*, 2015).** Urea is the most widely used commercial nitrogen fertilizer for increasing crop productivity (**Arya *et al.*, 2022**).

Vermicompost is the end result of an organic refuse decomposition process that uses earthworms to create high-quality compost that is primarily made of worm cast and decayed

organic matter. Vermicomposting assists in transforming domestic waste, animal manure, and agricultural waste into extremely nutrient- dense fertilisers for plants and soil. Vermicompost has 3% N, 1% P, and 1.5% K content. It protects soil health, prevents environmental pollution, and enhances soil structure and water-holding ability. It increases nutrient solubility, changes soil salinity, solidity, and pH, and promotes the activity of microorganisms that enable plants to obtain macro- and micronutrients through organic processes (**Kavya *et al.*, 2023).**

Poultry manure is an important organic nutrient source used to increase pearl millet grain and stover yield. Farmers using poultry manure recognize its value for soil improvement and crop productivity. Poultry manure contains higher concentration of N, P and K than cattle manure **(Goud *et al.,* 2021)** Poultry manure is a excellent source of nutrients. Poultry manure had the greatest content of organic C, N, P, K, Ca and lowest C:N ratio. Poultry manure have been found to be richer in nitrogen than other livestock wastes. It reduces the loss of nitrogen due to its nature of slow-release pattern **(Swaroop and Debbarma, 2023).**

Judicious use of organic and inorganic combination of fertilizers will maintain long-term soil fertility and sustained higher levels of productivity. Integration of organic manure and inorganic fertilizer has been found to be promising not only in maintaining higher productivity of crops but also for providing stability in crop production, besides improving soil physical conditions **(Amarghade and Singh, 2021).**

Keeping in view of the above fact, the experiment was conducted to find out "Effect of Nitrogen Management on Growth and Yield of Pearl Millet (*Pennisetum glaucum* L.)"

2. MATERIALS AND METHODS:

The experiment was conducted during *Zaid* season 2023 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The soil of the experimental field was sandy loam in texture, with soil (pH 7.8), low level of organic carbon (0.62%), available N (225 Kg/ha), P (38.2 kg/ha), K (240.7 kg/ha) and zinc (2.32 mg/kg). The experiment was laid out in RBD with 09 treatments each replicated thrice. The treatment combinations are T1- 100% Nitrogen through urea, T2- 25% Nitrogen through vermicompost + 75% Nitrogen through urea, T3- 50% Nitrogen through vermicompost + 50% Nitrogen through urea, T4- 75% Nitrogen through vermicompost + 25% Nitrogen through urea, T5- 100% Nitrogen through vermicompost, T6- 25% Nitrogen through poultry manure + 75% Nitrogen through urea, T7- 50% Nitrogen through poultry manure + 50 % Nitrogen through urea, T8- 75% Nitrogen through poultry manure + 25% Nitrogen through urea, T9- 100% Nitrogen through poultry manure. Data recorded on different aspects of crop, *viz*., growth, yield attributes & yield were subjected to statistically analysed by analysis of variance method as described by **(Gomez and Gomez, 1976).**

3. RESULT AND DISSCUSSION

3.1 Growth Attributes

3.1.1 Plant height (cm)

The data revealed that significantly higher plant height (183.1 cm) was recorded in treatment 6 [25% Nitrogen through Poultry manure + 75% Nitrogen through Urea]. However, the treatment 2 [25% Nitrogen through Vermicompost + 75% Nitrogen through Urea], treatment 7 [50% Nitrogen through Poultry manure + 50% Nitrogen through Urea], treatment 3 [50% Nitrogen through Vermicompost + 50% Nitrogen through Urea], and treatment 1 [100% Nitrogen through Urea] were found to be statistically at par with treatment 6 [25% Nitrogen through Poultry manure + 75% Nitrogen through Urea] The significant and higher plant height was observed with application of 25% Nitrogen through poultry manure and 75% Nitrogen through urea, may be due to during initial stages of crop, nutrients are readily available through inorganic fertilizers, whereas during later stages of crop the nutrients are supplied by both inorganic as well as organic forms due to decomposition, thus making higher availability of nutrients which resulted in better root development and high photosynthetic rate, resulted higher plant height. Similar result was also reported by **Amarghade and Singh (2021).**

3.1.2 Plant dry weight (g)

Results revealed that significant higher plant dry weight (64.49 g) was recorded in treatment 6 (25% Nitrogen through Poultry manure + 75% Nitrogen through Urea). However, treatment 2 (25% Nitrogen through Vermicompost + 75% Nitrogen through Urea) was found statistically at par treatment 6 (25% Nitrogen through Poultry manure + 75% Nitrogen through Urea) Significant and higher plant dry weight was observed with application of organic and inorganic, may be due to release of macro and micro nutrients with application of inorganic and organic under favourable environment might have helped in higher uptake of nutrients, this accelerated the growth of new tissues and development of new shoots that have ultimately increased plant dry weight**.** Similar results were reported by **Togas *et al*. (2017).**

3.1.3 Crop Growth Rate (g/m2/day)

The data recorded during 60-80 DAS, significantly higher crop growth rate (16.91 g/m^2/ day) was recorded in treatment 6 [25% Nitrogen through poultry manure + 75% Nitrogen through

urea]. However, treatment 2 [25% Nitrogen through vermicompost + 75% Nitrogen through urea], treatment 7 [50% Nitrogen through poultry manure + 50 % Nitrogen through urea], treatment 3 [50% Nitrogen through vermicompost + 50% Nitrogen through urea] were found statistically at par with treatment 6 [25% Nitrogen through poultry manure + 75% Nitrogen through urea]. Significantly higher crop growth rate was recorded with the application of Poultry manure may be due to higher nitrogen availability may have incorporatied in the soil through continuous slow release of nutrients supply resulted better crop growth rate. Similar results were reported by **Ashokh *et al.* (2020).** Further, significantly higher crop growth rate was increased with the application inorganic fertilizer might be the increased availability of nutrients to plant initially through inorganic nitrogen source. Similar results were reported by **Yadav *et al*. (2019).**

3.1.4 Relative Growth Rate (g/g/day)

The data revealed that during 60-80 DAS, higher relative growth rate (0.0232 g/g/day) was recorded in treatment 5 [100% Nitrogen through vermicompost]. There was found no any significant difference among all the treatments.

3.2 Yield and Yield Parameters:

3.2.1 Ear head length

The data recorded that Significant and higher ear head length (26.10 cm) was recorded in treatment 6 [25% Nitrogen through poultry manure + 75% Nitrogen through urea]. However, the treatment 2 [25% Nitrogen through vermicompost + 75% Nitrogen through urea], treatment 7[50% Nitrogen through poultry manure + 50 % Nitrogen through urea], treatment 3[50% Nitrogen through vermicompost + 50% Nitrogen through urea] were found statically at par with treatment 6 [25% Nitrogen through poultry manure + 75% Nitrogen through urea]. Significant and higher ear head length was with the application of Poultry manure, may be due to the release of essential nutrients by the poultry manure which may have increased of nutrient availability to the plants, resulted in more nutrient uptake and its subsequent translocation to the developing spike. Similar findings were reported by **Swaroop and Debbarma (2023)** in foxtail millet. Further, significantly higher ear head length with application of urea might be due to high nitrogen uptake by plants which may have influenced better growth characters particularly ear head length. Similar findings were reported by **Devi and Debbarma (2023)** in rice.

3.2.2 Number of ear head / plant

The data recorded that Significant and maximum number of ear head was recorded in treatment 6 [25% Nitrogen through poultry manure + 75% Nitrogen through urea]. However, the treatment 2 [25% Nitrogen through vermicompost + 75% Nitrogen through urea], treatment 7[50% Nitrogen through poultry manure + 50 % Nitrogen through urea] were found statically at par with treatment 6 [25% Nitrogen through poultry manure + 75% Nitrogen through urea]. Significant and maximum number of ear head/ plant was with the application of Poultry manure may be due to produces more humic acid which form water soluble chelated phosphorus which helped in easy release of phosphorus to the crop which resulted in increased grain and straw yield as well as overall growth characteristics. Similar findings were reported by **Ledhan *et al.* (2021)** in finger millet Further, significant and maximum number of ear head /plants was with the application of Nitrogen through urea may be due to supply of nutrient from inorganic nutrient sources and prolonged availability of nutrients to the growing plant, which results into tissue differentiation from somatic to reproductive meristematic activity resulting in higher number of ear head /plant. These results were corroborated by **Patel *et al*. (2022)** in groundnut.

3.2.3 Test weight (g)

Treatment 6 [25% Nitrogen through poultry manure + 75% Nitrogen through urea], recorded higher test weight (8.50 g).There was found no any significant difference among all the treatments.

3.2.4 Grain yield (t/ha)

The data recorded Significant and higher seed yield (2.46 t/ha) was recorded in treatment 6 [25% Nitrogen through Poultry manure + 75% Nitrogen through Urea]. However, treatment 2 [25% Nitrogen through Vermicompost + 75% Nitrogen through Urea] was found statistically at par treatment 6 [25% Nitrogen through Poultry manure + 75% Nitrogen through Urea]. Significant and higher seed yield with the application of Poultry manure may be ascribed to better root growth and development, resulting in more nutrient uptake and higher dry matter accumulation per plant and its subsequent translocation to the developing panicle, and relate to the release of essential nutrient elements by the poultry litter and increase of nutrient availability. Similar findings were reported by **Goud *et al.* (2021).** Further, significant and higher seed yield with application of urea this might be due to the fact that nitrogen led to higher availability of nutrient that promoted growth and development and ultimately resulting in increasing yield attributes and yield. Similar results were reported by **Chuhan *et al.* (2015).**

3.2.5 Straw yield

Significant and higher stover yield (6.76 t/ha) was recorded in treatment 6 [25% Nitrogen through Poultry manure + 75% Nitrogen through Urea]. However, treatment 2 [25% Nitrogen through Vermicompost + 75% Nitrogen through Urea] was found statistically at par treatment 6 [25% Nitrogen through Poultry manure + 75% Nitrogen through Urea].Significant and higher stover yield was with the application of Poultry manure may be due to incorporation of organic manures increases the availability of plant nutrients and helps in formation of organic acids through decomposition process, which develops native nutrients within the soil and increases their availability to plants for better vegetative growth and leads to increase in stover yield .Similar findings were reported by **Satti *et al.* (2023)** Further, significant and higher stover yield was with application of urea may be it improves plant metabolic processes, leaf photosynthetic area, it ultimately results in greater nutrient uptake by the plant, increasing grain and straw yield in pearl millet. Similar results were reported by **Kantwa *et al.* (2023).**

3.2.6 Harvest index (%)

Treatment 4 [75% Nitrogen through vermicompost + 25% Nitrogen through urea], recorded higher harvest index (29.69%). Though there was no significant difference was found among all the treatments.

S.No.	Treatment combinations	Plant height (cm) (80 DAS)	Plant dry weight (g)	CRG ($g/m^2/day$)	RGR (g/g/day)
1	100% Nitrogen through urea	175.24	54.16	13.69	0.0207
2	25% Nitrogen through vermicompost + 25% Nitrogen through urea	180.92	62.21	15.64	0.0205
3	50% Nitrogen through vermicompost + 50% Nitrogen through urea	176.98	57.91	14.94	0.0212
4	75% Nitrogen through vermicompost + 25% Nitrogen through urea	170.42	51.09	13.22	0.0213
5	100% Nitrogen through vermicompost	167.70	48.87	13.50	0.0232
6	25% Nitrogen through poultry manure + 75% Nitrogen through urea	183.10	64.49	16.91	0.0217
7	50% Nitrogen through poultry manure + 50 % Nitrogen through urea	178.66	59.38	16.07	0.0225

8	75% Nitrogen through poultry manure + 25% Nitrogen through urea	172.76	53.62	13.60	0.0209
9	100% Nitrogen through poultry manure	168.00	49.82	13.23	0.0220
	F-test	**S**	**S**	**S**	**NS**
	SEm(±)	2.99	1.63	0.78	0.0032
	CD (P=0.05)	8.97	4.88	2.34	-

Table 1: Effect of nitrogen management on growth attributes of pearl millet.

Table 2: Effect of nitrogen management on yield and yield attributes of pearl millet.

S.No.	Treatment combination	Ear head length (cm)	Number of ear head/plant	Test weight (g)	Grain Yield (t/ha)	Straw Yield (t/ha)	Harvest Index (%)
1	100% Nitrogen through urea	23.93	1.67	7.89	1.60	4.61	25.51
2	25% Nitrogen through vermicompost + 75% Nitrogen through urea	25.33	2.13	8.40	2.28	5.94	27.86
3	50% Nitrogen through vermicompost + 50% Nitrogen through urea	24.20	1.80	8.05	1.88	5.57	25.31
4	75% Nitrogen through vermicompost + 25% Nitrogen through urea	21.10	1.47	7.35	1.48	3.81	29.69
5	100% Nitrogen through vermicompost	19.00	1.33	7.12	1.34	3.64	28.36
6	25% Nitrogen through poultry manure + 75% Nitrogen through urea	26.10	2.20	8.50	2.46	6.79	26.85
7	50% Nitrogen through poultry manure + 50 % Nitrogen through urea	24.86	1.87	8.32	1.97	5.79	25.39
8	75% Nitrogen through poultry manure + 25% Nitrogen through urea	21.53	1.47	7.50	1.51	4.43	25.21
9	100% Nitrogen through poultry manure	19.76	1.40	7.20	1.45	3.75	28.90
	F test	**S**	**S**	**NS**	**S**	**S**	**NS**
	SEm(±)	0.69	0.12	0.39	0.14	0.55	3.76
	CD (P=0.05)	2.06	0.35	_	0.42	1.63	_

CONCLUSION

It is concluded that (treatment 6), application of 25% Nitrogen through poultry manure and 75% Nitrogen through urea recorded higher growth and seed yield.

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