



ISSN Print: 2664-6064
 ISSN Online: 2664-6072
 NAAS Rating (2025): 4.69
 IJAN 2025; 7(8): 12-14
www.agriculturejournal.net
 Received: 14-05-2025
 Accepted: 17-06-2025

Nisha Jakhad
 M.Sc. Scholar, Department of
 Agriculture, Vivekananda
 Global University, Jaipur,
 Rajasthan, India

Babu Lal Choudhary
 Assistant Professor,
 Department of Agriculture,
 Vivekananda Global
 University, Jaipur, Rajasthan,
 India

Corresponding Author:
Nisha Jakhad
 M.Sc. Scholar, Department of
 Agriculture, Vivekananda
 Global University, Jaipur,
 Rajasthan, India

Effect of foliar spray of N, P, K fertilizers on nutrient content and uptake in pearl millet (*Pennisetum glaucum* L.)

Nisha Jakhad and Babu Lal Choudhary

DOI: <https://www.doi.org/10.33545/26646064.2025.v7.i8a.261>

Abstract

A field experiment was carried out during the Kharif season of 2024 at the Research Farm of Vivekananda Global University, Jaipur, on loamy sand soil. The study involved eleven fertilizer treatments with varying combinations of nitrogen (N), phosphorus (P), and potassium (K), including: a control; recommended dose of NPK (60:40:20 kg ha⁻¹) applied in two equal splits; and several combinations involving 50%, 75%, and 100% N applied either as basal, top dressing, or foliar sprays using NPK (18:18:18) at concentrations of 1.0%, 1.5%, and 2.0% at 35 days after sowing (DAS). The experiment was designed using a randomized block design (RBD) with three replications. The results demonstrated that the treatment receiving 100% N (in two equal splits) along with a 2% foliar spray of NPK (18:18:18) at 35 DAS significantly enhanced the nutrient content and uptake of N, P, and K in both the grain and straw of pearl millet compared to other treatments.

Keywords: Pearl millet, NPK fertilizer, foliar nutrition, nutrient uptake, randomized block design (RBD)

Introduction

Among the various coarse and minor millets, pearl millet (*Pennisetum glaucum* L.) stands out as a vital cereal grain and staple food crop, especially in the arid and semi-arid regions of Africa and South Asia. Commonly known as bajra in India, it is highly valued for its exceptional tolerance to heat and drought, making it a dependable crop under harsh environmental conditions. Pearl millet can produce satisfactory yields with as little as 200-250 mm of annual rainfall (Bidinger and Hash, 2003) ^[1], earning its reputation as one of the most reliable cereals in rainfed regions of the arid and semi-arid tropics. Nutritionally, pearl millet compares well with other cereals and millets. Its grains contain approximately 11.6% protein, 5% fat, 67% carbohydrates, 2.7% minerals, and 12.4% moisture, along with relatively higher levels of carotene, riboflavin (Vitamin B2), and niacin (Vitamin B4). The crop is well-suited to drought-prone, nutrient-poor, and acidic soils (Choudhary *et al.*, 2014) ^[2]. On a global scale, pearl millet ranks sixth in terms of cultivated area and contributes 42% to the total world production (Patel *et al.*, 2015) ^[6, 7]. It is widely cultivated due to its efficient drought escape mechanisms and lower water needs compared to other cereals like sorghum and maize (Meena and Gautam, 2005) ^[9]. This versatile and stress-tolerant crop is responsive to inputs and has significant potential for cultivation in non-traditional seasons such as summer, especially under irrigated and high-input conditions (Jakhar *et al.*, 2013) ^[5]. Low soil fertility and irregular rainfall are among the primary challenges to crop production in arid and semi-arid regions. Effective soil fertility or nutrient management, particularly the use of nitrogen (N), is crucial for enhancing the growth and yield of pearl millet. Nitrogen is a key macronutrient required for plant development, especially during the vegetative growth phase. It plays a fundamental role in plant metabolism, being a core component of cell wall structures and various metabolically active compounds. It is also essential in the formation of chlorophyll and amino acids, both vital for photosynthesis and energy capture.

Nitrogen supports the early expansion of leaf area, enabling more effective photosynthesis, and stimulates rapid leaf and stem growth, which directly contributes to improved yield and grain quality. Additionally, nitrogen enhances the efficiency of phosphorus and potassium utilization. In Indian soils, nitrogen is often the most limiting nutrient, and its application

typically results in a significant yield response in pearl millet (Jadhav *et al.*, 2011) ^[4]. As a nutrient-exhaustive crop, pearl millet demands substantial nitrogen input, and its response to nitrogen fertilization can vary with environmental conditions. Even when fertilizers are applied at appropriate rates and times, their efficiency can be compromised by low soil moisture. Therefore, the integrated use of chemical fertilizers—especially N, P, and K via foliar feeding—has proven to be an effective strategy to overcome soil nutrient limitations and support productivity in nutrient-poor conditions (Rundla and Bairwa, 2018) ^[8]. Foliar application is a beneficial method of fertilization, as nutrients can enter the plant through the leaf cuticle or stomata, allowing for quick and efficient absorption and utilization. It is well-documented that nutrients traditionally absorbed through the roots can also be taken up effectively through the foliage (Ganapathy *et al.*, 2008) ^[3], making foliar feeding a practical approach in regions where soil nutrient transfer is limited.

Methodological Approach

The field trial was carried out at the Research Farm of Vivekananda Global University, Jaipur. Geographically, the site is located at 26°51' North latitude and 75°47' East longitude, with an elevation of 390 meters above mean sea level, situated in Jaipur district, Rajasthan. This area falls

within the Agro-climatic Zone IIIa, also known as the Semi-Arid Eastern Plain Zone of Rajasthan.

The experiment involved eleven treatment combinations, including a control and a recommended NPK dose of 60:40:20 kg ha⁻¹ applied in two equal splits. Additional treatments included 50% nitrogen as basal dose combined with foliar application of NPK (18:18:18) at concentrations of 1.0%, 1.5%, and 2.0% at 35 days after sowing (DAS). Other treatments consisted of 75% nitrogen (applied as 50% basal and 25% top dressing at 25 DAS) with the same foliar spray concentrations at 35 DAS. Lastly, treatments with 100% nitrogen (split into two equal doses) were also evaluated along with foliar sprays of NPK (18:18:18) at 1.0%, 1.5%, and 2.0%, respectively, applied at 35 DAS.

Nutrient content in grain and straw

Separate representative samples of grain and stover were collected from each plot to assess the nitrogen (N), phosphorus (P), and potassium (K) content. The collected samples were oven-dried at 65°C for 24 hours, ground into a fine powder using a mechanical grinder, and subsequently analyzed for their respective nutrient concentrations using standard analytical procedures.

Methods of nutrient measurement in grain and stover

Nutrient	Method	Reference
Nitrogen (%)	Refined Kjeldahl Procedure	Jackson (1967)
Phosphorous (%)	Vanado-molybdate Yellow Color Method	Jackson (1967)
Potassium (%)	Flame Emission Spectroscopy	Jackson (1967)

Absorption of nutrients

The total nitrogen, phosphorus, and potassium uptake was calculated based on the N, P, and K concentrations in grain and stover at harvest, using the following formula:

$$\text{Nutrient uptake (kg ha}^{-1}\text{)} = \frac{\text{Nutrient content in grain (\%)} \times \text{Grain yield (kg ha}^{-1}\text{)} + \text{Nutrient content in straw (\%)} \times \text{Straw yield (kg ha}^{-1}\text{)}}{100}$$

Results and discussion

The findings showed that treatment T11—which involved the application of 100% nitrogen in two equal splits along with a 2% foliar spray of NPK (18:18:18) at 35 DAS—resulted in the highest concentrations of nitrogen (1.70% in grain and 0.527% in stover), phosphorus (0.297% and 0.160%), and potassium (0.803% and 0.650%) in the crop. This treatment also recorded the greatest nutrient uptake,

with nitrogen uptake of 30.34 kg ha⁻¹ in grain and 23.97 kg ha⁻¹ in stover, phosphorus uptake of 5.31 and 7.28 kg ha⁻¹, and similarly higher potassium uptake, compared to the control. These values were statistically at par with treatments T10, T9, and T8.

The increased nutrient content and uptake may be attributed to the positive influence of N, P, and K fertilization on plant growth and yield components, leading to higher grain, stover, and total biomass production, and consequently, greater absorption of nutrients by the crop. A noticeable improvement in phosphorus content in both grain and stover was observed with increasing levels of nitrogen and phosphorus, likely due to the direct effect of P and N applications, which enhanced the availability of phosphorus in the soil and its uptake by the plant. These findings are consistent with the observations reported by Pareek *et al.* (2015) ^[6].

Table 1: Effect of N, P, K fertilizers on nutrient content in pearl millet

Treatments	Nitrogen		Phosphorous		Potassium	
	Grain (%)	Stover (%)	Grain (%)	Stover (%)	Grain (%)	Stover (%)
T ₁ Control	1.28	0.250	0.248	0.112	0.407	0.337
T ₂ NPK (60:40:20 kg ha ⁻¹) in two equal splits	1.41	0.313	0.260	0.125	0.493	0.410
T ₃ 50% as basal (N)+1.0% spray of NPK (18:18:18) at 35 DAS	1.46	0.330	0.263	0.128	0.560	0.427
T ₄ 50% as basal (N)+1.5 % spray of NPK (18:18:18) at 35 DAS,	1.50	0.360	0.266	0.129	0.580	0.453
T ₅ 50% as basal (N)+2 % spray of NPK (18:18:18) at 35 DAS,	1.54	0.370	0.272	0.135	0.600	0.470
T ₆ 75% N (50% basal+25% top dressing)+1% spray of NPK (18:18:18) at 35 DAS	1.61	0.413	0.275	0.137	0.663	0.513
T ₇ 75% N (50% basal+25% top dressing at 25 DAS)+1.5% spray of NPK (18:18:18) at 35 DAS,	1.62	0.447	0.277	0.138	0.697	0.547
T ₈ 75% N (50% basal+25% top dressing at 25 DAS)+2% spray of NPK (18:18:18) at 35 DAS,	1.65	0.473	0.278	0.140	0.720	0.563
T ₉ 100% N (in two equal splits) +1% spray of NPK (18:18:18) at 35 DAS	1.68	0.500	0.283	0.154	0.750	0.600
T ₁₀ 100% N (in two equal splits) +1.5 % spray of NPK (18:18:18) at 35 DAS	1.69	0.523	0.292	0.157	0.773	0.623
T ₁₁ 100% N (in two equal splits) +2% spray of NPK (18:18:18) at 35 DAS	1.70	0.527	0.297	0.160	0.803	0.650
SEm	0.03	0.02	0.011	0.009	0.027	0.026
C.D (P=0.05)	0.08	0.055	0.034	0.026	0.079	0.077

Table: 2 Effect of N, P, K fertilizers on nutrient uptake in pearl millet

Treatments	Nitrogen		Phosphorous		Potassium	
	Grain (kg ha ⁻¹)	Stover (kg ha ⁻¹)	Grain (kg ha ⁻¹)	Stover (kg ha ⁻¹)	Grain (kg ha ⁻¹)	Stover (kg ha ⁻¹)
T ₁ Control	10.76	5.44	2.08	2.44	3.42	7.32
T ₂ NPK (60:40:20 kg ha ⁻¹) in two equal splits	14.63	8.66	2.72	3.45	5.19	11.33
T ₃ 50% as basal (N)+1.0% spray of NPK (18:18:18) at 35 DAS	18.00	10.03	3.24	3.90	6.89	13.05
T ₄ 50% as basal (N)+1.5 % spray of NPK (18:18:18) at 35 DAS,	19.63	11.19	3.48	4.02	7.65	14.11
T ₅ 50% as basal (N)+2 % spray of NPK (18:18:18) at 35 DAS,	21.23	11.93	3.74	4.37	8.31	15.11
T ₆ 75% N (50% basal+25% top dressing)+1% spray of NPK (18:18:18) at 35 DAS	23.03	14.17	3.94	4.70	9.48	17.50
T ₇ 75% N (50% basal+25% top dressing at 25 DAS)+1.5% spray of NPK (18:18:18) at 35 DAS,	24.39	17.68	4.17	5.39	10.51	21.61
T ₈ 75% N (50% basal+25% top dressing at 25 DAS)+2% spray of NPK (18:18:18) at 35 DAS,	26.05	19.80	4.39	5.86	11.39	23.57
T ₉ 100% N (in two equal splits) +1% spray of NPK (18:18:18) at 35 DAS	28.75	21.89	4.85	6.73	12.83	26.27
T ₁₀ 100% N (in two equal splits) +1.5 % spray of NPK (18:18:18) at 35 DAS	29.54	23.07	5.09	6.89	13.51	27.48
T ₁₁ 100% N (in two equal splits) +2% spray of NPK (18:18:18) at 35 DAS	30.34	23.97	5.31	7.28	14.31	29.59
SEm _—	1.32	1.01	0.32	0.44	0.70	1.16
C.D (P=0.05)	3.90	2.98	0.96	1.29	2.05	3.41

References

1. Bidinger FR, Hash CT. Pearl Millet in: Ngugen (ed) Integration of physiology and Molecular Biology in plant breeding, N.Y, U.S.A: Marcel-Decker conservation practices and N fertilization. J Soil Wat Conserv India. 2003;1(2&3):158-162.
2. Choudhary M, Prabhu G. Quality fodder production and economics of dual-purpose pearl millet (*Pennisetum glaucum*) under different fertility levels and nitrogen scheduling. Indian J Agron. 2014;59(3):410-414.
3. Ganapathy M, Baradhan G, Ramesh N. Effect of foliar nutrition on reproductive efficiency and grain yield of rice fallow pulses. Legume Res. 2008;31(2):142-144.
4. Jadhav RP, Khafi HR, Raj AD. Effect of nitrogen and vermicompost on protein content and nutrients uptake in pearl millet. Agric Sci Dig. 2011;31(4):319-321.
5. Jakhar SR, Singh M, Balai CM. Effect of FYM, Phosphorus and Zinc levels on growth, yield, quality and economics of pearl millet (*Pennisetum glaucum*). Indian J Agric Sci. 2013;(1):58-61.
6. Pareek P, Patel MR, Patel HK, Patel PM. Effect of irrigation and nitrogen levels on forage yield and quality of pearl millet [*Pennisetum glaucum* (L.) R. Br.]. Int J Agric Sci. 2015;11(2):264-267.
7. Patel NI, Patel BR, Patel CK, Patel FB. Effect of foliar spray of nutrients at different growth stages on pearl millet under Dryland condition. Int J Chem Stud. 2015;7(5):05-09.
8. Rundla S, Bairwa RC. Response of foliar supplementation of N, P and K fertilizers on yield and economics of fertilizers. Int J Curr Microbiol Appl Sci. 2018;7(4):1203-1209.
9. Meena R, Gautam RC. Effect of integrated nutrient management on productivity, nutrient uptake and moisture-use functions of pearl millet (*Pennisetum glaucum*). Indian Journal of Agronomy. 2005;50(4):305-307.