International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2025): 5.29
IJABR 2025; SP-9(8): 310-313
www.biochemjournal.com
Received: 14-05-2025
Accepted: 16-06-2025

RR Chavan
M.Sc. Scholar, COA, Badnapur. Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

CB Patil
Associate Professor of Agronomy, NARP, Chh. Sambhajinagar. Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

SB Pawar
Associate Director Research, NARP, Chh. Sambhajinagar. Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

SB Kadam
Assistant Professor (Agronomy), NARP, Chh. Sambhajinagar. Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

BM Mane
M.Sc. Scholar, COA, Badnapur. Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

Corresponding Author:
RR Chavan
M.Sc. Scholar, COA, Badnapur. Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

Effect of foliar application of Nano urea on growth and yield of pearl millet (*Pennisetum glaucum* L.)

RR Chavan, CB Patil, SB Pawar, SB Kadam and BM Mane

DOI: https://www.doi.org/10.33545/26174693.2025.v9.i8Sf.5152

Abstract
A field experiment entitled *"Response of Pearl Millet (Pennisetum glaucum L.) to Foliar Application of Nano Urea"* was conducted during the *kharif* season of 2024 at the National Agriculture Research Project (NARP) Chhatrapati Sambhajinagar. The experiment was laid out in Randomized Block Design (RBD) with three replications and ten treatments to evaluate the effect of different nutrient management strategies combining soil-applied nitrogen and foliar sprays of nano urea or conventional urea on the growth and yield of pearl millet. The hybrid AHB 1200 Fe was sown on July 1st, 2024 with a spacing of 45 cm × 10 cm. The study revealed that all nutrient treatments significantly influenced growth and yield parameters. Among all treatments, T_2 RDN (1/4 at basal, ½ after 3 weeks and ¼ after 5 weeks) recorded the highest grain yield (2946 kg ha^{-1}) and straw yield (6071 kg ha^{-1}). However, T_6 (75% RDN + foliar spray of nano urea @ 4 ml L^{-1} between 3-4 weeks of sowing) proved to be agronomically superior by consistently recording higher values for plant height, number of functional leaves, dry matter accumulation, ear head length and girth and harvest index, while producing a comparable grain yield (2705 kg ha^{-1}). The performance of T_6 indicates that nano urea can improve nitrogen use efficiency and reduce dependence on conventional fertilizers without compromising productivity.

Keywords: Pearl millet, Nano urea, foliar nutrition, yield, RDN

Introduction
Pearl millet (*Pennisetum glaucum* L.) is a major cereal crop widely cultivated in the arid and semi-arid regions of India, particularly during the *kharif* season. It plays a significant role in ensuring food and fodder security due to its excellent adaptability to drought, high temperatures and low-fertility soils. Maharashtra is one of the leading states in pearl millet cultivation, where the crop is often grown under rainfed conditions.

Nitrogen is a key macronutrient for pearl millet, influencing vegetative growth, chlorophyll formation and grain development. To improve nitrogen use efficiency and reduce environmental losses, innovative approaches such as foliar nutrient application are gaining prominence. Nano urea, a novel nitrogen fertilizer developed in nanometric form, offers potential advantages in crop nutrition due to its high surface area, targeted delivery and rapid absorption through leaves. Foliar application of nano urea at critical growth stages ensures direct nutrient uptake, enhances photosynthesis and minimizes nutrient losses.

Research findings suggest that integrating reduced soil-applied nitrogen with foliar sprays of nano urea can support sustainable intensification by improving growth, stress resilience and yield components. This study evaluates the impact of different nitrogen management practices involving nano and conventional urea on growth, yield and economics of pearl millet under rainfed conditions, aiming to promote efficient and sustainable nutrient strategies for semi-arid regions.

Material and methods
The field experiment was conducted at the research farm of National Agricultural Research Project (NARP) Chhatrapati Sambhajinagar during the *kharif* season of 2024. The soil of the experimental field was clayey in texture, alkaline in reaction, low in available nitrogen, moderate in phosphorus and very high in potassium content. The experiment was laid out in a Randomized Block Design (RBD) with 10 treatments and 3 replications. Each replication consisted of 10 plots randomly allotted to the treatments. The gross and net plot sizes were 4.5 × 4.0 m² and 3.6 × 3.8 m² respectively. The hybrid variety AHB 1200 Fe of pearl millet

was sown on 1st July 2024 using the dibbling method at a spacing of 45 × 10 cm2 with a seed rate of 5 kg ha^{-1}. The treatments were as follows: T_1 : Control (no nitrogen) T_2 : RDN (¼ at basal, ½ after 3 weeks, ¼ after 5 weeks) T_3 : 75% RDN + foliar spray of urea @ 1.5% at 3 and 5 weeks, T_4: 75% RDN + foliar spray of nano urea @ 2 ml L^{-1} at 3 and 5 weeks, T_5 : 75% RDN + foliar spray of urea @ 2.5% at 3 and 5 weeks, T_6: 75% RDN + foliar spray of nano urea @ 4 ml L^{-1} between 3-4 weeks after sowing, T_7 : 50% RDN + foliar spray of urea @ 1.5% at 3 and 5 weeks, T_8 : 50% RDN + foliar spray of nano urea @ 2 ml L^{-1} at 3 and 5 weeks, T_9 : 50% RDN + foliar spray of urea @ 2.5% at 3 and 5 weeks and T_{10} : 50% RDN + foliar spray of nano urea @ 4 ml L^{-1} between 3-4 weeks after sowing. The crop was harvested on 9th September 2024.

Result and discussion

A) Growth studies

Growth parameters such as plant height, number of functional leaves and dry matter accumulation were significantly influenced by various nitrogen management treatments involving soil and foliar applications of urea and nano urea. Among all treatments, T_2 **(**RDN: ¼ at basal, ½ at 3 weeks and ¼ at 5 weeks) recorded the highest plant height (194.59 cm) number of functional leaves (7.89 at harvest) Leaf area plant^{-1}(168.8 dm2 at harvest) and dry matter production (167.27 g at harvest) significantly outperforming other treatments. However, it was statistically at par with T_6 (75% RDN + foliar spray of nano urea @ 4 ml/l between 3-4 weeks of sowing) which also showed superior growth with (190.49 cm) height, (17.16) leaves and (162.74 g) dry matter at harvest. The lowest values for all growth attributes were observed in T_1 (absolute control) indicating the critical role of nutrient management in crop growth.

The enhanced performance in T_2 and T_6 may be attributed to better nitrogen availability and absorption with nano urea improving leaf nutrient uptake, prolonging photosynthetic activity and increasing biomass accumulation. These findings are supported by previous studies conducted by Sharma *et al*. (2022) [3] Arya *et al*. (2022) [10] and Vegda *et al*. (2024) [7] also reported improved growth in pearl millet under nano urea and efficient nitrogen scheduling.

Table 1: Plant height (cm), number of leaves plant^{-1}, leaf area plant-1 and dry matter production influenced by various treatments and at harvest in pearl millet.

Sr. no	Treatment	Growth parameters			
		At Harvest			
		Plant Height (cm)	Number of leaves Plant^{-1}	Leaf area plant-1 (dm2)	Dry matter plant^{-1} (g)
T_1	Control (No nitrogen)	168.46	3.01	147.96	122.08
T_2	RDN (1/4 at basal, ½ after 3 weeks and ¼ after 5 weeks)	194.59	7.89	168.85	167.27
T_3	75% RDN + foliar spray of urea @ 1.5 % at 3 and 5 weeks	182.12	5.22	151.69	152.28
T_4	75% RDN + foliar spray of nano urea @ 2 ml/l at 3 and 5 weeks	184.00	6.32	156.06	159.69
T_5	75% RDN + foliar spray of urea @ 2.5 % at 3 and 5 weeks	189.45	7.25	163.86	163.17
T_6	75% RDN + foliar spray of nano urea @ 4 ml/l between 3-4 weeks of sowing	190.49	7.37	166.53	164.43
T_7	50% RDN + foliar spray of urea @ 1.5 % at 3 and 5 weeks	177.07	3.88	148.72	124.88
T_8	50% RDN + foliar spray of nano urea @ 2 ml/l at 3 and 5 weeks	178.19	3.97	149.22	138.25
T_9	50% RDN + foliar spray of urea @ 2.5 % at 3 and 5 weeks	178.58	4.51	149.46	147.05
T_{10}	50% RDN + foliar spray of nano urea @ 4 ml/l between 3-4 weeks of sowing	181.40	5.18	150.17	149.89
	SE±	2.47	0.71	2.91	2.14
	C.D at 5%	7.34	2.13	8.73	6.35
	G.M.	182.43	5.46	156.25	148.90

B) Yield contributing character studies

The yield contributing characters of pearl millet, such as the number of effective tillers per plant, grain weight per plant and harvest index, were significantly influenced by different nitrogen management treatments. Among these, T_2 (RDN applied as ¼ at basal, ½ at 3 weeks and ¼ at 5 weeks) recorded the highest number of tillers (3.4) grain weight per plant (78.14 g) grain yield (2946 kg ha^{-1}) fodder yield (6071 kg ha^{-1}) and harvest index (47.12%) which was at par with T_6 (75% RDN + nano urea @ 4 ml L^{-1}) (3.1) tillers, (76.90 g) grain weight, (2705 kg ha^{-1}) grain yield and (45.51%) harvest index, demonstrating the effectiveness of nano urea even at reduced nitrogen levels. The lowest values were observed in T_1 (control) which recorded only (1.8) tillers (53.71 g) grain weight and (1691 kg ha^{-1}) grain yield. These findings are supported by previous studies conducted by Karanjalikar *et al*. (2024) [12] Sharma *et al*. (2022) [6] Vegda *et al*. (2024) [7] and Ojha *et al*. (2023) [8].

Table 2: number of effective tillers plant^{-1}, Grain weight plant^{-1}, Grain yield (Kg ha^{-1}), Fodder yield (kg ha-$_1$) and Harvest index of pearl millet as influenced by various treatments.

Sr. No	Treatment	Number of effective tillers plant-1	Grain weight Plant^{-1}	Grain yield (kg ha-1)	Fodder yield (kg ha-1)	Harvest index
T_1	Control (No nitrogen)	1.8	53.71	1691	3713	43.29
T_2	RDN (1/4 at basal, ½ after 3 weeks and ¼ after 5 weeks)	3.4	78.14	2946	6071	47.12
T_3	75% RDN + foliar spray of urea @ 1.5 % at 3 and 5 weeks	2.7	72.55	2386	5486	44.64
T_4	75% RDN + foliar spray of nano urea @ 2 ml/l at 3 and 5 weeks	2.7	74.56	2394	5512	44.65
T_5	75% RDN + foliar spray of urea @ 2.5 % at 3 and 5 weeks	2.8	75.75	2420	5590	44.87
T_6	75% RDN + foliar spray of nano urea @ 4 ml/l between 3-4 weeks of sowing	3.1	76.90	2705	5760	45.51
T_7	50% RDN + foliar spray of urea @ 1.5 % at 3 and 5 weeks	2.1	58.50	2349	5262	43.29
T_8	50% RDN + foliar spray of nano urea @ 2 ml/l at 3 and 5 weeks	2.3	61.55	2360	5294	43.29
T_9	50% RDN + foliar spray of urea @ 2.5 % at 3 and 5 weeks	2.5	65.83	2364	5338	44.24
T_{10}	50% RDN + foliar spray of nano urea @ 4 ml/l between 3-4 weeks of sowing	2.6	69.44	2377	5452	44.64
	SE±	0.18	0.98	179.83	187.11	1.95
	C.D at 5%	0.54	2.90	538.71	562.88	NS
	G.M.	2.67	68.69	2399	5408	44.53

C) Yield studies

The grain and fodder yield of pearl millet were significantly influenced by different nitrogen management treatments. The highest grain yield of (2946 kg ha^{-1}) and fodder yield of (6071 kg ha^{-1}) were recorded in T_2 RDN (1/4 at basal, ½ after 3 weeks and ¼ after 5 weeks) indicating that a well-timed and balanced nitrogen supply plays a vital role in maximizing productivity. This treatment also recorded the highest harvest index of 47.12%, reflecting efficient partitioning of assimilates towards economic yield.

Succeeding T_2, the treatment T_6 (75% RDN + nano urea @ 4 ml L^{-1}) also performed exceptionally well, producing (2705 kg ha^{-1}) grain yield and (5760 kg ha^{-1} fodder yield) with a harvest index of 45.51%. These results highlight the efficiency of nano urea in enhancing yield with reduced nitrogen input. Treatments T_5, T_4 and T_3 also produced yields above the general mean (2399 kg ha^{-1}) showing that both conventional and nano foliar applications had a positive impact on yield components when combined with adequate base nitrogen.

The lowest grain yield (1691 kg ha^{-1}) and fodder yield (3713 kg ha^{-1}) were recorded in the control treatment T_1, which received no nitrogen. This confirms the essential role of nitrogen in achieving optimal productivity in pearl millet. Overall, the data clearly indicate that both split application of RDN and foliar application of nano urea significantly improved grain and fodder yield, with T_2 and T_6 emerging as the most effective and efficient treatments.

D) Economics

The economic analysis revealed that T_2: RDN (1/4 at basal, ½ after 3 weeks and ¼ after 5 weeks) recorded the highest grain monetary return (₹84,004 ha^{-1}) and net return (₹52,504 ha^{-1}) with a B: C ratio of (2.67) indicating its profitability under full nitrogen application. However, T_6 (75% RDN + foliar spray of nano urea @ 4 ml/l between 3-4 weeks of sowing) also performed remarkably well, achieving a net return of (₹46,566 ha^{-1}) and a B: C ratio of (2.54) making it the most economical option among reduced nitrogen treatments. Treatments T_4, T_5, T_8 and T_{10} also recorded net returns and B: C ratios above the general mean, whereas T_1 (control) showed the lowest returns (₹20,602 ha^{-1}) and B: C ratio (1.75) confirming the importance of nitrogen and foliar nutrition in improving profitability.

Table 3: Grain monetary return (₹ ha^{-1}), net monetary return (₹ ha^{-1}) and B: C ratio of pearl millet as influenced by various treatments.

Sr. no	Treatment	Cost of cultivation (₹ ha^{-1})	Gross Monetary Return (₹ ha^{-1})	Net Monetary Return (₹ ha^{-1})	B:C Ratio
T_1	Control (No nitrogen)	27500	48102	20602	1.75
T_2	RDN (1/4 at basal, ½ after 3 weeks and ¼ after 5 weeks)	31500	84004	52504	2.67
T_3	75% RDN + foliar spray of urea @ 1.5 % at 3 and 5 weeks	30800	68119	37319	2.21
T_4	75% RDN + foliar spray of nano urea @ 2 ml/l at 3 and 5 weeks	30400	68355	37955	2.25
T_5	75% RDN + foliar spray of urea @ 2.5 % at 3 and 5 weeks	31000	69115	38115	2.23
T_6	75% RDN + foliar spray of nano urea @ 4 ml/l between 3-4 weeks of sowing	30200	76766	46566	2.54
T_7	50% RDN + foliar spray of urea @ 1.5 % at 3 and 5 weeks	29800	66923	37123	2.25
T_8	50% RDN + foliar spray of nano urea @ 2 ml/l at 3 and 5 weeks	29400	67244	37844	2.29
T_9	50% RDN + foliar spray of urea @ 2.5 % at 3 and 5 weeks	30000	67393	37393	2.25
T_{10}	50% RDN + foliar spray of nano urea @ 4 ml/l between 3-4 weeks of sowing	29200	67848	38648	2.32
	SE±	-	2572.05	2076.72	0.06
	C.D at 5%	-	7716.86	6229.03	0.19
	G.M.	29980	68387	38407	2.28

Conclusion

The study demonstrated that different nitrogen management strategies, particularly those involving nano urea, significantly influenced the growth, yield and economic returns of pearl millet. Among all treatments, T_2: RDN ((1/4 at basal, ½ after 3 weeks and ¼ after 5 weeks)) recorded the highest grain and fodder yields, along with maximum net returns and B:C ratio, attesting most effective in maximizing productivity. However, T_6 (75% RDN + foliar spray of nano urea @ 4 ml/l between 3-4 weeks of sowing) also performed exceptionally well, producing comparable yields with reduced nitrogen input and superior growth attributes, indicating improved nitrogen use efficiency. The findings suggest that foliar application of nano urea can serve as a sustainable and cost-effective nutrient management strategy, especially under semi-arid and rainfed conditions.

References

1. Aher A, Umesha C. Effect of Nano-Urea on Productivity of Different Cereal Crops. Int J Agric Plant Sci. 2022; [no volume/issue/page info provided].
2. Arya G, Manivannan M, Sritharan N. Effect of foliar application of nano urea on yield attributes and yield of pearl millet (*Pennisetum glaucum* L.). Int J Plant Soil Sci. 2022;34(21):502-507.
3. Bachate NB, Sharma PK. Effect of nitrogen level and nano-urea spray on productivity and quality of maize (*Zea mays* L.). Pharma Innov J. 2022;12(10):1561-1565.
4. Guggari AK. Effect of nitrogen levels and modified urea on growth and yield of pearl millet under rainfed condition. *J Farm Sci*. 2018;31(3):280-283.
5. Karanjalikar PN, Mamta J, Patange PK, Waghmare DB, Jadhav DB. Impact of nano fertilizer on yield attributes, economics and quality of pearl millet (*Pennisetum glaucum* L.) under rainfed condition. Int J Res Agron. 2024;7(1):420-423.
6. Sharma SK, Sharma PK, Mandeewal RL. Effect of foliar application of nano urea under different nitrogen levels on growth and nutrient content of pearl millet (*Pennisetum glaucum* L.). Int J Plant Soil Sci. 2022;34(20):149-155.
7. Vegda SN, Bhuva HM, Chauhan PN, Dodiya KJ, Shweta N. Effect of foliar application of nano urea on growth, yield and profitability of summer pearl millet (*Pennisetum glaucum* L.). Int J Res Agron. 2024;SP-7(8):16-20.
8. Ojha A, Singh R, Sinha J. Effect of nano urea and foliar spray of urea on growth and yield of wheat (*Triticum aestivum* L.). Int J Environ Clim Change. 2023;13(11):474-481.
9. Yadav PK, Verma R, Bamboriya JK, Yadav S, Jeeterwal RC. Response of pearl millet (*Pennisetum glaucum* L.) [R. Br.] to integrated nitrogen management. *USDA*. 2019;8(2):429-437.
10. Arya G, Manivannan MS, Sritharan N. Effect of foliar application of nano urea on yield attributes and yield of pearl millet (*Pennisetum glaucum* L.). Int J Plant Soil Sci. 2022;34(21):502-507.
11. Chandan BM, Sunil C, Girijesh GK, Thippeshappa GN, Mallikarjuna HB. Effect of foliar application of nano and conventional urea on growth and yield attributes of ragi (*Eleusine coracana* L.). Int J Environ Clim Change. 2023;13(11):3578-3585.
12. Karanjalikar PN, Mamta J, Patange PK, Waghmare DB, Jadhav DB. Impact of N-nano fertilizer on yield attributes, economics and quality of pearl millet (*Pennisetum glaucum* L.) under rainfed condition. Int J Res Agron. 2024;7(1):420-423.
13. Rajesh H, Yadahalli G, Chittapur B, Halepyati A, Hiregoudar S. Growth, yield and economics of sweet corn (*Zea mays* L. *saccharata*) as influenced by foliar sprays of nano fertilisers. J Farm Sci. 2021;34(4):381-385.
14. Singh N, Singh B, Sharma J. Effect of different N levels with foliar application of nano urea and urea on increasing production and productivity of wheat (*Triticum aestivum* L.). Int J Trop Agric. 2023;41(1-2):167-172.
15. Udapudi P, Pushpa K, Sukanya T, Yogesh T, Krishnamurthy R. Influence of nano nitrogen on growth and yield of finger millet under rainfed condition. Pharma Innov J. 2023;12(10):2188-2192.
16. Vyankatrao KS, Adsul PB, Ramteke RA, Kokode PJ, Ighare OA. Effect of foliar application of nano-urea on growth, nutrient uptake, yield and quality of sunflower (*Helianthus annuus* L.). Int J Plant Soil Sci. 2024;36(4):18490.
17. Thumar CM, Dhdhat MS, Chaudhari NN, Hadiya NJ, Ahir NB. Growth, yield attributes, yield and economics of summer pearl millet (*Pennisetum glaucum* L.) as influenced by integrated nutrient management. Int J Agric Sci. 2016;8(59):334443-334446.