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A comprehensive review of nano urea's impact on finger millet performance

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Abstract

The most important mineral nutrient for plants is nitrogen, which is also a structural component of many proteins, enzymes, chlorophyll, rubisco, nucleic acids, and some hormones. Nitrogen also plays a major role in the vegetative growth of crops, making N fertilization a crucial agronomic management technique to increase crop productivity. Nano urea is a special kind of nitrogen that contains 4% nitrogen in a 500 ml bottle with particles that are 30–50 nm in size. For the precise and focused administration of nitrogen, it has become a revolutionary fertilizer. Nitrogen, a significant critical nutrient needed for improved crop growth and development, is included in nano urea (4% N). Finger millet (*Eleusine coracana*) is an essential cereal crop in the hilly regions of India, particularly in Uttarakhand, where it is widely cultivated due to its high nutritional value and resilience to drought. However, challenges such as poor soil fertility and nutrient deficiencies often limit its yield and overall performance. Recent advancements in nanotechnology, particularly the development of nano urea, have shown promising potential in improving the efficiency of nutrient uptake, growth, and productivity in various crops. This review aims to comprehensively analyze the effects of nano urea on the growth, yield, and performance of finger millet.

Keywords: Nano urea, nitrogen, foliar spray, nutrient

Introduction

One of the essential elements for plants, nitrogen, is lacking in the majority of Indian soils, especially the light-textured ones. Proteins, nucleic acids, growth hormones, vitamins, and chlorophyll all need on nitrogen for their synthesis. Vigorous vegetative development and a dark green color are linked to a sufficient nitrogen supply. Due to its high nitrogen content (46 percent) and affordability, urea is a commonly utilized nitrogenous fertilizer in the nation. However, its primary disadvantage is that it places a financial burden on the government by requiring subsidies (about ₹ 3,700 per bag), in addition to its other disadvantage of volatilization. Overuse of urea caused the crop to mature later and become more susceptible to disease and insect infestation, both of which indirectly decreased productivity. We are losing the soil's fertility and sustainability as a result of population growth and the competition for greater output per unit area. The mother earth is now stressed out and has lost its capacity to produce per unit intake as a result of the extensive fertilizer application over a lengthy period of time. The world faces enormous agricultural hazards due to its rapidly growing population and ongoing soil degradation in many ways. To improve input efficiency for the vast population, new technology is needed. Now, remember to use inputs wisely in order to lessen environmental stress by making them more efficient through the use of various new technologies and research. Since 1967, the Indian Farmers Fertilizer Cooperative Organization (IFFCO) has consistently worked on behalf of farmers. About 32.1% of the nation's total P₂O₅ and 21.3% of its total N are produced by IFFCO.

The word "nano" is Greek in origin and means "dwarf." A billionth of a meter (10⁻⁹ m) is what it is. With particle sizes ranging from 1 to 100 nm, it is smaller and has a higher surface to volume ratio. Nano fertilizers are becoming more and more popular in agriculture because they raise crop yields, improve nutrient use efficiency, and decrease the use of chemical fertilizers, all of which either directly or indirectly support our environment through equitable, viable, and acceptable means.

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This technology has made it possible to create "smart fertilizer," which can lower environmental protection costs and improve nutrient use efficiency. Utilizing nano-fertilizers increases the nutritional efficiency of plants, decreases their toxicity to soil organisms, lessens the impacts of possible stress brought on by excessive fertilization, and consumes less fertilizer overall. Following the application of nano fertilizer, the soil's pH, moisture content, EC, and accessible nitrogen were all better than those of traditional fertilizer.

The adoption of nano urea in finger millet cultivation has shown potential to improve key agronomic parameters, including plant height, biomass, tillering, grain yield, and overall growth performance. However, the efficacy of nano urea can vary depending on regional conditions, soil properties, and crop management practices. Therefore, evaluating its impact under the specific agro-climatic conditions of Dehradun is essential for making informed decisions about its use in finger millet production. The motivation for this study stems from the urgent need to enhance the productivity and performance of finger millet to meet the dual challenges of rising food demand and environmental sustainability. By comprehensively evaluating nano-urea and their application methods, this research aims to bridge the knowledge gap, improve nutrient management strategies, and contribute to the broader agenda of sustainable agriculture in Uttarakhand.

For farmers that desire smart agriculture in light of climate change, nanourea is a long-term solution: -

1. An ideal particle size range is 20–50 nm.
2. Greater surface area (10,000 times greater than a urea prill of 1 mm)
3. The quantity of nitrogen particles (55,000 over 1 mm urea prill)
4. Consequently, nano urea increases crop availability by over 80%, leading to a higher efficiency in nutrient utilization.

The science underlying Nano Urea

There are 4% nanoscale nitrogen particles in the Nano Urea (Liquid). Compared to conventional urea, nanoscale nitrogen particles are smaller (30–50 nm) and have more surface area and particles per unit area. When sprayed foliarly, nano urea solutions increase nitrogen uptake, physiological development, and grain output because they readily penetrate the plant's cell wall (Kumar *et al.*, 2021)^[5].

Instructions for the application

1. Before using, give the bottle a good shake.
2. Spray the leaves using a flat fan or cut nozzles.
3. Avoid dew by spraying in the morning or evening.

4. It is recommended to reapply the nano urea spray if rain falls within 12 hours of the initial application.
5. It is simple to combine nano urea with agrochemicals, biostimulants, and fertilizers that are 100% water soluble.
6. For compatibility, a jar is always the best option before mixing and spraying.
7. Nano urea should be used within two years after manufacture for optimal results.

Precaution

1. Although nano urea is non-toxic and safe for humans, plants, and animals, it is advised to wear gloves and a face mask when spraying the crop.
2. Keep out of children's and pets' reach and store in a dry location away from extreme heat.

Mode of application possible for nano urea

- Through drone
- Through knapsack sprayer

Advantages

1. It is less expensive than traditional urea.
2. Higher agricultural yields because nanourea particles' tiny size and high surface area to volume ratio make them readily available to crops.
3. Higher crop yields (an average 8% increase based on field trials) were the consequence of increased photosynthesis in leaves, as well as an increase in root biomass and the number of efficient tillers per branch.
4. By reducing input costs, raising agricultural yields, and enhancing crop quality, nano urea boosts farmers' profits.
5. It is environmentally benign since it uses less energy and resources during production and uses less bulk urea, which means fewer losses from volatilization, leaching, and runoff.
6. Nano urea-grown crops are entirely safe to consume. Harvested vegetables has improved nutritional quality in terms of protein and vitamin content.
7. A decrease in the use of chemical fertilizers.
8. Because of its higher use efficiency, one 500 ml bottle of IFFCO nano urea can substitute at least one bag of conventional urea.

It is portable and easy to store. Bottles of Nano Urea are easier for farmers to transport than bulkier urea sacks, which significantly affects storage expenses.

Review of literature

Table 1: Effect nano urea on growth, yield attributes and yield

S	Result	Report
1.	Plant height, fresh weight and dry weight of sage plant was significantly increase biofertilizer	Hegab (2018) ^[5]
2	Application of liquid nano NPK fertilizer at a 15% concentration at 750:90:600 mg per liter produced the highest grain yield (5.93-ton ha ⁻¹) of wheat, which was 48.99% greater than the control. Burhan and Hassan (2019)	Burhan Hassan (2019)
3	With application of FFP (50% N) + 1 spray of nano urea + 1 spray of nano-Zn + 1 higher yield, response over FFP and per cent increase over FFP in wheat and check	Kumar (2020) ^[6]
4.	Application of nano urea can reduce the chemical load of convection urea (at least (11.8%))	Anony (2021) ^[1]
5	With application of FFP (50% N) + 2 spray of nano urea @ 4 ml/L recorded higher various crops like wheat, mustard, potato	Anony (2021) ^[1]
6	Grain per earhead, biomass and yield were found significantly higher with at tillering and jointing stage in wheat	Anony (2021) ^[1]
7.	Plant height, leaf area, girth of stem, weight of 100 kernel, weight of cob and yield higher with application of 50% N, 100% PK + 2 sprays of nano urea (4 ml/L) mixed	Kumar (2021) ^[5]
8	Application of N66PK + nano urea 0.4% gave significantly the highest plant height, shoot length and shoot weight of rice	Velmur <i>et al.</i>
9	50% RDN as basal + 0.5% Nano-urea FS @ P.I and booting stage in pearl millet tillers per plant, earhead length, earhead girth, no. of grain per earhead, test weight,	Arya (2022) ^[2]

10	Plant height, no. of tillers per plant, LAI, no. of panicles per square metre, grain significantly the highest with application of 50% RDN through urea + 50% N	Midde (2022) ^[8]
11	Application of 75% of RDN + 2 foliar sprays of nano urea after transplanting and at panicle initiation stage gave significantly higher no. of panicles per square metre, total no. of grain per panicle, grain yield and straw yield of rice. Nutrient uptake (NPK) was also found significantly with above including treatment	Sahu <i>et al.</i> (2022) ^[10]
12	With application of 100% RDN + FSNU @ 4 ml/L at knee height and tasseling stage dry matter accumulation, length of cob, cob per plant, grain yield, stover yield and	Samui (2022) ^[11]
13	2 sprays of nano urea at 4 ml/L at 30 and 45 DAS of pearl millet gave significantly the highest plant height and dry matter accumulation	Sharma <i>et al.</i> (2022) ^[12]
14	Significantly higher number of siliquae per plant, seed and stover yield were registered with application of 100% RDN through NCU (50% basal dose + 50% at 35 DAS) and it was at par with 100% basal RDN through NCU + 4 ml/litre two spray of nano urea at 30 and 45 DAS.	Da mor (2023) ^[3]

Table 2: Effect of nano urea on economics

Sr.	Result	Reported By
1.	Farmer Fertilizer practices (50% N) + 1 spray of nano urea + 1 spray of nano-Zn + 1 spray of nano-Cu @ 4 ml/L application in various crops gave higher economics in the term of net return over other treatment	Kumar <i>et al.</i> (2020) ^[6]
2.	In wheat, mustard and potato application of Farmer Fertilizer Practices (50% N) + 2 Nano urea spray @ 4 ml/L gave higher net return over farmer fertilizer application	Anonymo us (2021) ^[1]
3.	B:C ratio was found higher in maize by application of 50% N, 100% PK + 2 sprays of nano urea (4 ml/l) mixed with Sagarika (2 ml/l)	Kumar <i>et al.</i> (2021) ^[5]
4.	Maximum net realization and BCR was secured with application of 100% RDN through NCU (50% basal dose + 50% at 35 DAS) followed by 100% basal RDN through NCU + 4 ml/litre two spray of nano urea at 30 and 45 DAS.	Damor (2023) ^[3]
5.	Maximum net realization and benefit cost ratio of wheat were recorded under 100% RDN through NCU (50% as basal dose + 50% at CRI stage) followed by 100% basal RDN through NCU + 4 ml/litre two spray of nano urea at 25 and 45 DAS.	Suthar (2023) ^[13]

Conclusion

Based on the discussion above, it can be said that nano urea improved crop growth and production and could be one of the best urea options available to us for lowering soil pollution and the government's subsidy burden.

References

- Anonymous. AICRP on wheat and barley. Progress report during 2021-22. c2021.
- Arya GR, Manivannan V, Marimuthu S, 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.
- Damor. Effect of nano urea on growth, yield, and quality of Indian mustard (*Brassica juncea* (L.) Czern & Coss.). M.Sc. (Agri). Thesis (Unpublished). Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat; c2023.
- Hegab R, Abou Batta W, El-Shazly M. Effect of Mineral, Nano, and Bio Nitrogen Fertilization on Nitrogen Content and Productivity of *Salvia officinalis* L. J Soil Sci Agric Eng. 2018;9(9):393-401.
- Kumar K, Kumar Y, Savitha AS, Ajayakumar MY, Narayanaswamy C, Raliya R, *et al.* Effect of IFFCO nano fertilizer on growth, grain yield, and managing turicum leaf blight disease in maize. Int J Plant Soil Sci. 2021;33(16):19-28.
- Kumar Y, Tiwari KN, Singh T, Sain NK, Laxmi S, Verma R, *et al.* Nano fertilizers for enhancing nutrient use efficiency, crop productivity, and economic returns in winter season crops of Rajasthan. Ann Plant Soil Res. 2020;22(4):324-335.
- Mahmoodi P, Yarnia M, Rashidi V, Amirnia R, Tarinejhad A. Effects of nano and chemical fertilizers on physiological efficiency and essential oil yield of *Borago officinalis* L. Appl Ecol Environ Res. 2018;16:4773-4788.
- Midde SK. Evaluation of nano urea on growth and yield attributes of rice (*Oryza sativa* L.). Chem Sci Rev Lett. 2022;11(42):211-214.
- Priyantha W, Prapagar K, Dharmasena KMC. Nitrogen release patterns of urea and nano urea fertilizer under two contrasting soil moisture regimes. Int J Agric Forestry Plantation. 2016;4:10-17.
- Sahu TK, Kumar M, Kumar N, Chandrakar T, Singh DP. Effect of nano urea application on growth and productivity of rice (*Oryza sativa* L.) under midland situation of Bastar region. Pharma Innov J. 2022;11(6):185-187.
- Samui S, Sagar L, Sankar T, Manohar A, Adhikary R, Maitra S, *et al.* Growth and productivity of rabi maize as influenced by foliar application of urea and nano-urea. Crop Res. 2022;57(3):136-140.
- Sharma SK, Sharma PK, Mandeewal RL, Sharma V, Chaudhary R, Pandey R, *et al.* 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(21):502-507.
- Suthar. Effect of nano urea on growth, yield, and quality of wheat (*Triticum aestivum* L.). M.Sc. (Agri). Thesis (Unpublished). Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat; c2023.
- Velmurugan A, Subramani T, Bommayasamy N, Ramakrishna, Kumar M, Swarnam TP. The effect of foliar application of nano urea (Liquid) on rice (*Oryza sativa* L.). J Andaman Sci Assoc. 2021;26(2):76-81.