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Effect of foliar application of nano urea and nano dap on growth and yield of Wheat (*Triticum aestivum* L.)

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Abstract

Wheat (*Triticum aestivum* L.) is a globally important cereal crop and a staple food for much of the population. Modern nutrient management practices have shifted toward using nano-fertilizers to improve nutrient use efficiency and reduce environmental stress. A field experiment was conducted during the rabi season of 2024–25 at Vikram University, Ujjain, to assess the impact of nano urea and nano DAP on wheat's growth and yield parameters. Eight treatments involving different combinations of RDF (Recommended Dose of Fertilizer), foliar sprays of nano urea, and seed treatment with nano DAP were tested in a Randomized Block Design (RBD) with three replications. The treatment T₄ (100% RDF + Seed Treatment with Nano DAP + 2 Foliar Sprays of Nano Urea at 35 and 55 DAS) showed significantly better performance across growth metrics (plant height, tillers, dry matter accumulation) and yield indicators (effective tillers, grains per spike, test weight, grain, and straw yield). It also achieved the highest net return and B:C ratio. The results suggest that combining nano urea and nano DAP with RDF improves wheat productivity and profitability while reducing fertilizer input needs.

Keywords: Foliar application, growth parameters, yield, economics

Introduction

Wheat (*Triticum aestivum* L.), a member of the Poaceae family, is cultivated worldwide and plays a key role in global food security. In India, wheat is the second most important cereal after rice, contributing 32% to the country's food grain production. As concerns grow over nutrient use efficiency, soil degradation, and environmental pollution caused by traditional fertilizers, switching to nano-fertilizers presents a promising solution. Nano-fertilizers such as nano urea and nano DAP are designed to improve nutrient delivery, minimize losses from volatilization and leaching, and boost crop yields. Nano urea, produced by IFFCO, contains nano-sized nitrogen particles, while nano DAP supplies phosphorus and nitrogen in more bioavailable nano forms. These fertilizers offer higher efficiency at lower doses, lowering environmental impact and increasing farmer profitability.

Materials and Methods

Experimental Site and Design

The study was conducted during the rabi season of 2024–25 at the Research Farm, School of Studies in Agricultural Sciences, Vikram University, Ujjain (M.P.). The experiment followed a Randomized Block Design (RBD) with eight treatments and three replications.

Soil and Climatic Conditions

The soil was clay loam with a pH of 8.13, EC of 0.210 ds/m, and organic carbon of 0.60%. Available nitrogen, phosphorus, and potassium were 185 kg/ha, 18.20 kg/ha, and 220 kg/ha, respectively. The region experienced subtropical climatic conditions with 33 mm of rainfall during the crop season.

Treatments

Table 1: Details of Treatments

Symbol	Treatments
T ₁	100% RDF
T ₂	100% RDF + Foliar Spray N 35 DAS
T ₃	100% RDF + 2 Foliar Spray N 35 DAS AND 55 DAS
T ₄	100% RDF + Seed Treatment Nano P + 2 Foliar Spray 35 and 55 DAS
T ₅	75% RDF + Foliar Spray N 35 DAS
T ₆	75% RDF + 2 Foliar Spray N 35 and 55 DAS
T ₇	75% RDF + Seed Treatment Nano P + 2 Foliar Sprays 35 and 55 DAS
T ₈	Control.

Crop and Cultivation

Wheat variety Lok-1 was sown with a spacing of 22.5 cm using a seed rate of 100 kg/ha. Recommended fertilizer dose was 120:60:40 N:P: K kg/ha. Foliar application of nano fertilizers was done as per treatment schedules.

Experimental Treatments

The experiment was conducted using a Randomized Block Design (RBD) with three replications to evaluate the effect of different fertilizer management practices on wheat (LoK-1). Eight treatments were tested: T₁—100% recommended dose of fertilizer (RDF); T₂—100% RDF plus foliar spray of nitrogen at 35 days after sowing (DAS); T₃—100% RDF plus two foliar sprays of nitrogen at 35 and 55 DAS; T₄—100% RDF with seed treatment of nano phosphorus plus two foliar sprays of nitrogen at 35 and 55 DAS; T₅—75% RDF plus foliar spray of nitrogen at 35 DAS; T₆—75% RDF plus two foliar sprays of nitrogen at 35 and 55 DAS; T₇—75% RDF with seed treatment of nano phosphorus plus two foliar sprays of nitrogen at 35 and 55 DAS; and T₈—control without fertilizer application. The recommended dose of fertilizer was applied at 120:60:40 kg/ha of nitrogen, phosphorus, and potassium, respectively. Wheat was sown at a

seed rate of 100 kg/ha with 22.5 cm spacing between rows. Each gross plot measured 4.0 m × 2.7 m (10.8 m²), and the net plot was 3.0 m × 2.25 m (6.75 m²). Irrigation channels of 1.0 m and sub-irrigation channels of 0.5 m were maintained to ensure adequate water supply throughout the growing period.

Results and Discussion

The field experiment revealed that the application of 100% RDF along with seed treatment using nano DAP and two foliar sprays of nano urea at 35 and 55 DAS (T₄) significantly enhanced wheat growth and yield parameters under the agro-climatic conditions of Ujjain. Treatment T₄ recorded the highest values for tillers per square meter (100.17), spike length (17.03 cm), number of spikes per square meter (97.66), grains per spike (45.24), and test weight (46.31 g), all of which were significantly superior to the control (T₈), and statistically at par with T₃ (100% RDF + 2 foliar sprays of nano urea). Similarly, grain yield (45.00 q/ha), straw yield (55.24 q/ha), and biological yield (100.25 q/plot) were highest under T₄, accompanied by a harvest index of 44.87%, indicating improved nutrient partitioning efficiency. The superior performance of this treatment can be attributed to the enhanced nutrient use efficiency facilitated by nano-form fertilizers, which offer controlled release and targeted delivery, thereby promoting better root development, chlorophyll synthesis, enzymatic activity, and photosynthetic efficiency. These findings are in close agreement with those of Borana *et al.* (2024) [7], who reported significant yield gains under similar treatment combinations involving nano DAP and nano urea in wheat. Furthermore, the integration of nano-fertilizers with conventional RDF not only improved the yield attributes but also resulted in effective translocation of photosynthates to economic parts, thus enhancing productivity. This outcome corroborates previous studies, including those by Sahu *et al.* (2022) [23] and Liu & Lal (2014), which demonstrated that nano DAP and nano urea improve crop growth, nutrient uptake, and yield by optimizing source-sink relationships and hormonal regulation during critical growth phases.

Table 2: Effect of Foliar application of Nano Urea and Nano DAP fertilizers on yield attributes of Wheat crop

Symbol	Treatments	No. of Tillers/m ²	Spike Length (cm)	No. of Spikes/m ²	No. of Grains/Spike	Test Weight (g)
T ₁	100% RDF	94.50	14.72	91.33	40.67	42.83
T ₂	100% RDF + Foliar Spray N 35 DAS	96.83	16.48	93.67	43.98	44.77
T ₃	100% RDF + 2 Foliar Spray N 35 DAS and 55 DAS	97.50	16.58	95.33	45.34	45.75
T ₄	100% RDF + Seed Treatment Nano P + 2 Foliar Spray 35 and 55 DAS	100.17	17.03	97.66	45.24	46.31
T ₅	75% RDF + Foliar Spray N 35 DAS	92.83	11.09	89.33	37.65	40.71
T ₆	75% RDF + 2 Foliar Spray N 35 and 55 DAS	93.50	13.78	90.66	39.62	41.38
T ₇	75% RDF + Seed Treatment Nano P + 2 Foliar Sprays 35 and 55 DAS	96.17	15.88	93	41.94	43.2
T ₈	Control	84.50	7.29	82	18.09	39.97
S.Em±		3.03	0.46	0.65	0.57	0.58
CD (P=0.05)		1.01	1.4	1.97	1.72	1.75

Table 3: Effect of Foliar application of Nano Urea and Nano DAP fertilizers grain, straw, biological yield and harvest index of Wheat Crop

Treatments	Grain yield (q/ha)	Straw yield (q/ha)	Biologic al yield (q/plot)	Harvest index (%)
T ₁ : 100% RDF	35.15	47.36	82.5	42.59
T ₂ : 100% RDF + Foliar Spray N 35 DAS	39.38	49.75	89.13	44.17
T ₃ : 100% RDF + 2 Foliar Spray N 35 DAS AND 55 DAS	41.34	51.54	92.88	44.52
T ₄ : 100% RDF + Seed Treatment Nano P + 2 Foliar Spray 35 and 55 DAS	45	55.24	100.25	44.87
T ₅ : 75% RDF + Foliar Spray N 35 DAS	32.15	45.33	77.47	41.49
T ₆ : 75% RDF + 2 Foliar Spray N 35 and 55 DAS	34.18	46.76	80.93	42.22
T ₇ : 75% RDF + Seed Treatment Nano P + 2 Foliar Sprays 35 and 55 DAS	38.46	49.23	87.69	43.85
T ₈ : Control.	18.04	27.35	44.38	40.63
CD(5%)	1.71	1.16	1.78	1.64
SEm ±	0.57	0.38	0.59	0.54

Conclusion

The integration of nano urea and nano DAP with 100% RDF significantly improves wheat growth, yield, and economic returns. Treatment T₄ emerged as the most effective strategy for enhancing wheat productivity and resource use efficiency. This approach offers a sustainable alternative to conventional fertilizer practices and supports long-term soil health and profitability in wheat cultivation.

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