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Research Communication

Comparative evaluation of nano and neem coated urea on growth, phenology and yield of maize (*Zea mays*) in *tarai* region of Uttarakhand

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ABSTRACT

A field experiment was carried out during the *kharif* season of 2022 at NEBCRC, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Uttarakhand to evaluate the comparative evaluation of nano and commercial urea on growth, phenology and yield of maize (*Zea mays* L.). The experiment was laid out in a randomized block design with 3 replications and comprised of 12 treatments. The results revealed that improved growth parameters *viz*., plant height (198.6 cm), leaf area index (2.7) and dry matter accumulation (172.1 g/plant) and lesser number of days required to 50% tasseling, 50% silking and maturity were recorded with application of 100% recommended dose of nitrogen (RDN) (120 kg N/ha) along with 2 foliar sprays of nano urea or 2% urea at knee high (KH) and pre-tasseling (PT) stages. Maximum grain yield (7.28 t/ha), shelling (77.7%) and harvest index (HI) (34.6%) were obtained in 100% RDN + 2 foliar sprays of nano urea. However, production and monetary efficiency did not vary significantly among 100% RDN, 100% RDN + foliar spray of nano urea, 100% RDN + foliar spray of 2% urea and 5/6th RDN + nano urea. It was concluded that maize can be fertilized with 5/6th RDN (100 kg N/ha) + 2 foliar sprays of nano urea or 2% urea at the knee high and pre-tassseling stage without reduction in productivity or profitability compared to 100% RDN.

Key words: Crop phenology, Monetary efficiency, Nano urea, Production efficiency, Yield

Maize is the most important crop after rice and wheat and contributes nearly 9% in national food basket. In India, maize is mainly grown in the *kharif* season which is accompanied by monsoon and higher relative humidity. Nitrogen management is crucial due to soil and environmental conditions that promote nitrogen loss, necessitating special attention for improved growth, yield, and profitability (Dass *et al.*, 2022). The conventional use of commercial urea, a crucial fertilizer for crop growth and yield, has raised concerns about nutrient efficiency, environmental impact, and sustainability. (Chaudhary *et al.,* 2017). Nutrient management is crucial for maize crop growth and productivity, as adequate nitrogen demand is essential for yield potential realization and thus, requires adequate supply throughout the growing period. Ramthnayaka *et al.* (2018) suggested foliar sprays of nano ureato minimize the issues linked with excessive granular urea application. Nano fertilizers offer controlled nutrient release, enabling effective plant supply and potentially reducing environmental impacts (Rawat *et al.,* 2024). When nano fertilizers are used as a foliar application, it gets absorbed easily and enters through stomata, cell wall and other pores of plant cells due to their minute particle size (<50 nm) allowing for high absorption compared to conventional fertilizers (Rawat *et al*., 2024; Sarkar *et al*., 2024). Nanoparticle encapsulated N fertilizers combined with conventional fertilizers can enhance cereal crop productivity by enhancing nutrient uptake and utilization (Upadhyay *et al*., 2023). Future research should explore the effect of nano-urea on maize growth, yield, soil health, and environmental sustainability along with its economic viability and scalability.

The present investigation was carried out at Norman E. Borlaug Crop Research Centre of GBPUA&T, Pantnagar (29.02° N, 79.47° E, 243.83 m MSL), Uttarakhand during *Kharif* 2022. The experiment was laid out in a randomized block design with 3 replications. The experiment comprised of 12 treatments, *viz.* T_1, Control (0 kg N/ha); T_2, 100% RDN (120 kg N/ha); T_3, 1/3rd RDN + 2 sprays of nano urea at knee height (KH) and pre tasseling (PT) stage; T_4, 1/2 RDN + 2 sprays of nano urea at KH and PT; T_5, 2/3rd RDN + 2 sprays of nano urea at KH and PT; T_6, 5/6th RDN + 2 sprays of nano urea at KH and PT; T_7, 100% RDN + 2 sprays of nano urea at KH and PT; T_8, 100%

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RDN + 1 spray of nano urea at KH; T_9, 100% RDN + 1 spray of nano urea at PT; T_{10}, 100% RDN + 2 sprays of 2% urea at KH and PT; T_{11}, 100 % RDN + 1 spray of nano urea at KH and 1 spray of 2% urea at PT; T_{12}, 100% RDN + 1 spray of 2% urea at KH and 1 spray of nano urea at PT. The hybrid variety 'DKC 9144' was sown at a spacing of 60 cm × 25 cm on 6th July 2022 and harvested on 16th October 2022. The recommended dose of fertilizers (RDF) was 120 kg N (urea), 60 kg P_2O_5 (DAP) and 40 kg K_2O (MOP) per hectare. In control, N was not applied whereas; P and K were applied as recommended. Nano urea @ 4 ml/l and urea @ 2% were foliar sprayed in the morning hours as per the treatment. The spray volume of nano urea was 312.5 l/ha while, the spray volume of 2% urea was 600 l/ha and were sprayed using a flat fan nozzle fitted sprayer.

The data recorded were analyzed statistically by using the analysis of variance (ANOVA) technique prescribed for the randomized block design for testing the significance of differences among treatments by 'F test'. A 5% probability level was used for drawing the conclusions.

The data showed that foliar application of nano and commercial urea were significantly influenced growth parameters and phenology of maize (Table 1). The maximum plant height (199.6 cm), leaf area index (2.73) and total dry matter accumulation per plant (172.8 g), days to 50% tasseling (55.3 days), 50% silking (57.3 days) and maturity (99 days) were recorded with the application of T_7 which was statistically at par with T_{10}, T_6, T_8, T_9, T_{11}, T_{12} and T_2, which were significantly higher over the other treatments. It may be due to more availability of N in case of 2% urea and enhanced enzymatic activity in case of nano urea (Subramani *et al.*, 2023 and Rawat *et al*., 2024).

The yield attributes and yield of maize were significantly influenced by foliar application of nano and commercial urea (Table 1). The higher cob length (21.1 cm), cob girth (16.3 cm), grains/cob (497) and 100 grains-weight (27.5) grain yield (7,288 kg/ha), stover yield (10.70 t/ha) and harvest index (34.6) were recorded with the application of T_7 which did not very significantly with T_2, T_6, T_8, T_9, T_{10}, T_{11} and T_{12}. Foliar spray of nano urea or 2% urea with 100% RDN improved photosynthate translocation, resulting in higher grain weight and increased yield attributes, but did not vary statistically. Similar, results were also seen by Rawat *et al.* (2024) and Sarkar *et al.* (2024).

The production and monetary efficiency were significantly influenced by foliar application of nano and commercial urea (Fig.1). The higher production (73.9 kg/ha/day) and monetary efficiency Rs./ha/day were obtained through the application of 100% RDN + 2 foliar sprays of nano urea at KH and PT stage which was statistically at par with T2, T_7, T_6, T_8, T_9, T_{11} and T_{12}, and was significantly higher over other treatments.

Based on the preliminary study it was found that application of 100% RDN (120 kg N/ha) along with 2 foliar sprays of nano urea or 2% urea at KH and PT stage in maize is helpful in increasing growth parameters, crop phenology, yield, production and monetary efficiency over 100% RDN applied through commercial urea but it did not vary significantly. Application of 100 kg N/ha (5/6th RDN) along with 2 foliar sprays of nano urea at KH and PT stages can save 20 kg N/ha and could be economically viable option for *kharif* season maize in the tarai region of Uttarakhand.

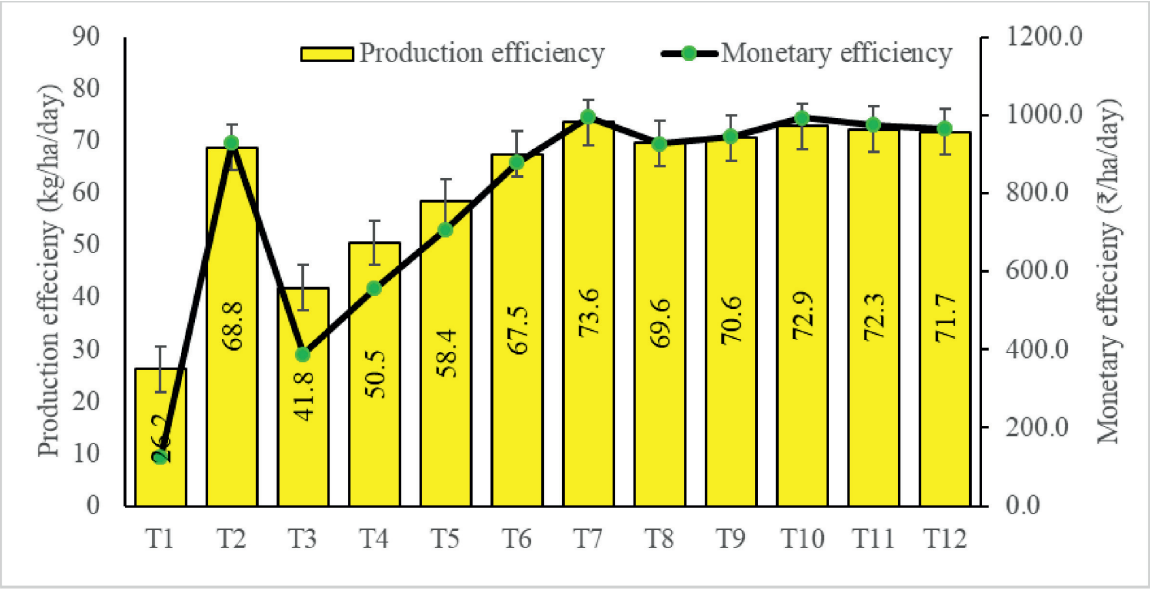

Fig. 1. Effect of different treatments on production efficiency and monetary efficiency of maize

Table 1. Effect of nano urea on crop growth parameters, crop phenology and yield of maize

Treatment	Crop growth parameters (At harvest)			Crop phenology (Days)			Cob length (cm)	Cob girth (cm)	Grains/ cob	100-grains weight (g)	Grain yield (t/ha)	Stover yield (t/ha)	Harvest index
	Plant height (cm)	LAI	DMA (g/plant)	50% tasseling	50% silking	Maturity							
T_1	119.2 ±2.06	1.60±0.07	87.3±2.088	59.7±0.335	63.7±0.335	102.6±0.332	12.3± 0.726	11.7±0.443	248±16.78	19.9±1.050	2.69±0.074	4.51±0.203	28.3±1.263
T_2	190.7±2.40	2.61±0.09	162.6±4.044	55.7±0.335	58.0±0.580	99.6±0.334	19.8± 0.729	15.5±0.323	462±9.18	26.2±0.376	6.85±0.182	10.46±0.378	33.7±0.102
T_3	136.9±5.33	1.87±0.04	119.0±1.535	57.0±0.580	61.0±0.580	100.6±0.335	14.3±0.274	13.5±0.481	299±14.42	21.4±0.493	4.20±0.073	7.13±0.192	30.2±0.322
T_4	146.2±4.96	1.94±0.12	134.2±3.823	56.7±0.886	59.3±0.886	100.6±0.580	16.5±0.667	14.2±0.349	354±15.51	23.1±1.321	5.07±0.106	8.24±0.182	31.8±0.037
T_5	171.2±1.74	2.19±0.09	144.6±4.129	56.3±0.335	58.7±0.335	100.0±0.886	17.5±0.724	14.5±0.290	398±14.21	24.1±0.339	5.84±0.156	9.22±0.327	32.8±0.379
T_6	189.9±2.34	2.45±0.24	160.3±4.244	55.3±0.335	58.0±0.580	99.0±0.580	19.1±0.373	15.1±0.227	461±17.57	25.7±1.057	6.68±0.105	10.17±0.189	33.7±0.138
T_7	199.6±2.13	2.73±0.09	172.8±4.089	55.3±0.335	57.3±0.335	99.0±0.335	21.1±0.209	16.3±0.186	497±11.44	27.5±0.290	7.28±0.430	10.70±0.357	34.6±0.973
T_8	194.3±2.30	2.69±0.13	170.9±2.471	55.7±0.886	57.7±0.886	99.6±1.460	20.3±0.783	15.5±0.290	469±7.26	26.3±0.370	6.93±0.307	10.38±0.536	34.0±0.056
T_9	195.7±1.74	2.69±0.20	171.1±1.964	55.7±0.335	57.7±0.335	99.6±1.005	20.1±0.307	15.7±0.241	470±12.69	26.4±0.273	7.02±0.304	10.55±0.365	34.0±0.546
T_{10}	198.3±3.47	2.70±0.11	172.1±1.058	55.3±0.335	57.3±0.335	99.0±0.320	21.0±0.551	16.2±0.174	495±6.45	27.0±0.301	7.22±0.454	10.72±0.265	34.5±1.062
T_{11}	198.6±2.21	2.68±0.03	171.3±1.772	55.3±0.335	57.3±0.335	99.0±0.580	20.6±0.241	16.1±0.153	481±16.08	26.9±0.619	7.16±0.252	10.75±0.395	34.1±0.348
T_{12}	198.2±3.62	2.71±0.09	170.6±1.207	55.3±0.335	57.3±0.335	99.6±0.335	20.8±0.535	16.0±0.353	479±6.58	26.8±0.222	7.13±0.364	10.60±0.318	34.3±0.553
CD (P=0.05)	16.3	0.34	11.4	1.4	1.3	1.9	1.7	0.9	43	1.9	0.81	0.98	1.9

T_1, Control (0 kg N/ha); T_2, 100% RDN (120 kg N/ha); T_3, 1/3rd RDN + 2 sprays of nano urea at knee height (KH) and pre tasseling (PT) stage; T_4, 1/2 RDN + 2 sprays of nano urea at KH and PT; T_5, 2/3rd RDN + 2 sprays of nano urea at KH and PT; T_6, 5/6th RDN + 2 sprays of nano urea at KH and PT; T_7, 100% RDN + 2 sprays of nano urea at KH and PT; T_8, 100% RDN + 1 spray of nano urea at KH; T_9, 100% RDN + 1 spray of nano urea at PT; T_{10}, 100% RDN + 2 sprays of 2% urea at KH and PT; T_{11}, 100 % RDN + 1 spray of nano urea at KH and 1 spray of 2% urea at PT; T_{12}, 100% RDN + 1 spray of 2% urea at KH and 1 spray of nano urea at PT

REFERENCES

Biswas, R., Tanmayi, C.S.N., Bindu, V.K., Reddy, M.S.L. and Mitra, B. 2024. Yields, nutrient-use efficiencies and production economics of wheat (*Triticum aestivum*) as influenced by foliar nano urea. *Indian Journal of Agronomy* **69**(3): 269–276. DOI: 10.59797/ija.v69i3.5521.

Chaudhary, B., Singh, R.P. and Singh, A.K. 2017. Role of fertilizers in crop productivity and environmental sustainability. *Journal of Environmental Science and Technology* **50**(1): 1–11.

Dass, A., Rajanna, G.A., Babu, S., Lal, S.K., Choudhary, A.K., Singh, R., Rathore, S.S., Kaur, R., Dhar, S and Singh, T. 2022. Foliar application of macro- and micronutrients improves the productivity, economic returns, and resource-use efficiency of soybean in a semiarid climate. *Sustainability* 14,5825. https://doi.org/10.3390/su14105825.

Rathnayaka, R.M.N.N., Mahendran, S., Iqbal, Y.B. and Rifnas, L.M. 2018. Influence of urea and nano-nitrogen fertilizers on the growth and yield of rice cultivar 'Bg 250'. *International Journal of Research Publications* **5**(2): 1–7.

Rawat, S., Singh, R.K., Singh, P., Upadhyay, P.K., Shekhawat, K., Sangwan, S., Dash, S., Mondal, B.K. and Shukla, R. 2024. Different nitrogen levels with nano and prilled urea spray on productivity and profitability of maize (*Zea mays*) in alfisols of Jharkhand. *Indian Journal of Agronomy* **69**(3): 326–329. DOI: 10.59797/ija.v69i3.5529.

Sarkar, A., Singh, T., Mondal, A., Kumar, S., Das, T.K., Kaur, R., Raj, R., Upadhyay, P.K., and Susheel Sarkar, S. 2024. Effect of nano-urea and herbicides on yield and yield attributes of wheat (*Triticum aestivum*). *Indian Journal of Agronomy* **68**(1): 97–100.

Subramani, T., Velmurugan, A., Bommayasamy, N., Swarnam, T.P., Ramakrishna, Y., Jaisankar, I and Singh, L. 2023. Effect of nano urea on growth, yield and nutrient use efficiency of okra under tropical island ecosystem. *International Journal of Agricultural Science* **19**: 134–139.

Upadhyay, P.K., Dey, A., Singh, V.K., Dwivedi, B.S, Singh, T., Rajanna, G.A., Babu, S., Rathore, S.S., Singh, R.K., Shekhawat, K., Rangot, M., Kumar, P., Yadav, D., Singh, D.P., Dasgupta, D. and Shukla, G. 2023. Conjoint application of nano-urea with conventional fertilizers: An energy efficient and environmentally robust approach for sustainable crop production. *PLoS ONE* 18(7): e0284009. https://doi.org/10.1371/journal.pone.0284009.