Eco. Env. & Cons. 29 (4) : 2023; pp. (1604-1607)
Copyright@ EM International
ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2023.v29i04.023

Effect of Application of Nano-urea on Maize (C-1415 Variety) Growth and Yield under Punjab Conditions

Avick Kumar Kundu and Vandna Chhabra

Department of Agronomy, School of Agriculture,
Lovely Professional University, Phagwara, Jalandhar 144 411, Punjab, India

(Received 10 March, 2023; Accepted 16 May, 2023)

ABSTRACT

To meet the increasing demand for food due to the increasing population, nitrogen fertilizers are being used extensively. Uncontrolled use of nitrogen leads to decreased soil health along with polluting the environment. Maize is one of the important crops in the rainfed regions of Punjab. Therefore, there is a need to optimize the usage of nitrogen fertilizers and that's where nano fertilizers come in. The current investigation was conducted in an RBD (Randomized block design) with 9 treatments and 3 replications. The study showed that the application of 75 % RDN + foliar spray of nano urea 0.1% at knee high and tasseling stage gave superior results concerning growth and yield attributes in *kharif* maize. However, since the application of 75 % RDN + 2 foliar spray of nano urea at knee high and tasseling stage was significantly at par with a full doze of RDN, therefore this might be an appropriate management alternative for sustainable cultivation practice of maize.

Key words: *Maize, Growth and yield, Nano-nitrogen*

Introduction

To achieve more production per unit of land, the world agricultural cropping system uses a huge amount of fertilizers, but more doses than the optimum leads to pollution, lesser input use efficiency, quality of food decreases, degradation of soil, micronutrient deficiency in soil and soil microorganism toxicity (Laghari *et al.*, 2010; Tan *et al.*, 2008). Apart from that many biotic and abiotic factors affects the growth and productivity of crops Abu Obaid *et al.*, 2018; Ali-Rifaee *et al.*, 2004 and Musallam *et al.*, 2004). Nitrogen and Phosphorus fertilizers play important roles in biochemical and physiological reactions such as photosynthesis, nutrient transfer, etc. (Nikus *et al.*, 2004).

The third most essential cereal crop is Maize, after rice and wheat. The people of Rainfed areas use maize as a staple food crop. In India about 30.16 million tonnes of maize is produced from an area of 9.87 million hectares, having an average productivity of 3057 kg ha^{-1}. The only cereal crop to attain the highest yield potential is maize. The rapidly growing population is creating a demand pressure for food and it is necessary to reduce the yield gap of maize crops (Maitra, 2019). Application of nutrients at the right time from the right source is one of the most important strategies to improve yield potential.

Among the essential nutrients, nitrogen has a good influence on the vegetative growth of plants, and due to its easy availability, it is widely adopted and used indiscriminately (Li *et al.*, 2017). But nitrogen faces availability issues due to its high rate of leaching loss through volatilization and denitrification (Meena *et al.*, 2021; Nduwimana *et al.*, 2020).

Therefore we should use high-efficiency nitrogen fertilizers, which would otherwise lead to poor quality of maize and environmental pollution. So there is a need to adopt slow-release nitrogen fertilizers with high efficiency to attain agricultural sustainability.

Adopting nano fertilizers like nano urea as a source for nitrogen application can be a good alternative to commercial nitrogenous fertilizers (Madzokere *et al.*, 2021). The nano size of the nano fertilizer possesses a high surface area to volume ratio so it optimizes the fertilizer requirement. The availability of data on the performance of nano nitrogen on maize was limited, therefore the current study was undertaken to check the effect of foliar application of nano nitrogen along with the reduced amount of urea at two different stages of maize namely- knee high and tasseling stage.

Materials and Methods

The study was conducted during the *kharif* season of the year 2022 at the research fields of Lovely Professional University, Phagwara, Punjab (31.2560° N, 75.7051° E). The soil texture of the field was sandy loam, with a basic pH of 7.8, along with nitrogen content of 278 kgha^{-1}, medium phosphorus and high potassium content. The maize hybrid variety C-1415 seeds were sown on 17th June 2022 with recommended seed rate of 24 kgha^{-1} on a flatbed at spacing (60 cmx 20 cm). The various agronomic practices and other management practices apart from the treatments were performed according to the package and practices of Punjab.

The experiment was conducted on RBD (Randomized Block Design) with 9 treatments and 3 replications. The treatments used are – T_1: control 100% RDF, T_2: 75% RDN, T_3: 50% RDN, T_4: 50 % RDN + Foliar spray of Nano Urea @ 0.1% at knee high stage, T_5: 75 % RDN + 0.1 % Foliar spray of Nano Urea at knee high stage, T_6: 50 % RDN + 0.2% Foliar spray of Nano Urea at knee high stage, T_7: 75% RDN + 0.2% nano urea at knee high stage, T_8: 50% RDN + 2 foliar spray of 0.1% nano urea at knee high and tasseling stage, T_9: 75% RDN + 2 foliar spray of 0.1% nano urea.

The number of rows per cob, number of grains per row of cob, plant height (m), dry matter accumulation (kgm^{-2}), number of grains per plant, and 100 seed weight (g) were recorded at the harvesting stage.

Results and Discussion

Morphological Parameters

Maximum plant height was observed with treatment T_9 (75% RDN + 2 foliar spray of nano urea) followed by T_1 (full RDF) along with a minimum plant height of T4 (50 % RDN + 0.1% nano N) applied at the knee-high stage. However, T_8 (50 % RDF + 2 foliar spray of Nano urea) gave slightly better results compared to T_2 (75 % RDF). The minimum plant height was observed with treatment T_4 (50 % RDF + 1 foliar spray of nano urea) applied at knee high stage. Similar results were obtained throughout the growth stages of the Maize crop. The increase in plant height may be due to the easier penetration of nanoparticles which led to increased availability of nitrogen through the stomata of leaves as mentioned by Abdel-Aziz *et al.*, 2018.The highest dry matter was obtained in treatment T_5 and the lowest was obtained in treatment T9 (Table 1) because foliar feeding of nano fertilizers along with commercial fertilizers helped increase plant height and chlorophyll content, as a result aiding in plant growth and dry matter production as a whole as observed by Abdel-Aziz *et al.*, 2016 and Ali, 2012. The results agreed with the findings of Mohapatro, 2021.

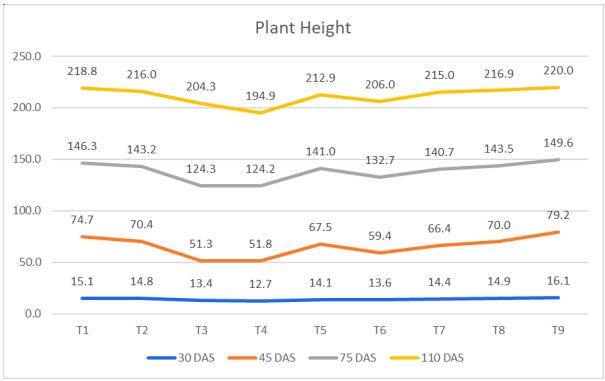

Fig. 1. Plant height

Yield Attributes

The yield parameters, *viz.*, length of cob, cob per plant, grains rows per cob, grains per row, seed index, grain yield, stover yield, biological yield and harvest index were statistically analyzed and given in Table 2. Apart from seed index (gram), it was observed that T_9 gave significantly higher values for the parameters like grain yield, number of grains per cob, and number of grains per row. The applica-

Table 1. Morphological parameters at 90 DAS

Treatments		Morphological Parameters	
		Plant height (cm)	Dry matter (g)
T_1	RDF	146.3	177.74
T_2	75% RDN	143.2	181.26
T_3	50% RDN	124.3	179.81
T_4	50% RDN + 0.1% Nano N	124.2	175.95
T_5	75% RDN + 0.1 % Nano N	141.0	184.97
T_6	50% RDN + 0.2 % Nano N	132.7	175.95
T_7	75% RDN + 0.2% Nano urea at knee high stage	140.7	178.01
T_8	50% RDN + 2 foliar spray of 0.1% Nano urea at knee high and tasselling stage	143.5	180.70
T_9	75% RDN + 2 foliar spray of 0.1% Nano urea at knee high and tasselling stage	149.6	174.54
	CD	2.8	2.51

Table 2. Yield parameters of maize as influenced by urea and foliar application of nano-urea

Treatments		Yield Parameters			
		Cobs plant^{-1}	Grain rows cob^{-1}	Grain rows^{-1}	100 seed weight (g)
T_1	RDF	1.2	13.7	24.0	27.0
T_2	75% RDN	1.2	10.7	20.0	20.5
T_3	50 % RDN	1.1	10.0	18.3	19.3
T_4	50 % RDN + 0.1% Nano N	1.2	10.3	19.0	17.4
T_5	75 % RDN + 0.1 % Nano N	1.3	11.3	20.7	23.0
T_6	50 % RDN + 0.2 % Nano N	1.1	10.3	20.0	22.5
T_7	75% RDN + 0.2% Nano urea at knee high stage	1.1	12.0	22.0	25.4
T_8	50% RDN + 2 foliar spray of 0.1% Nano urea at knee high and tasselling stage	1.0	13.3	23.3	25.7
T_9	75% RDN + 2 foliar spray of 0.1% Nano urea at knee high and tasselling stage	1.2	14.3	25.0	28.1
	CD	N/A	1.049	1.312	3.18

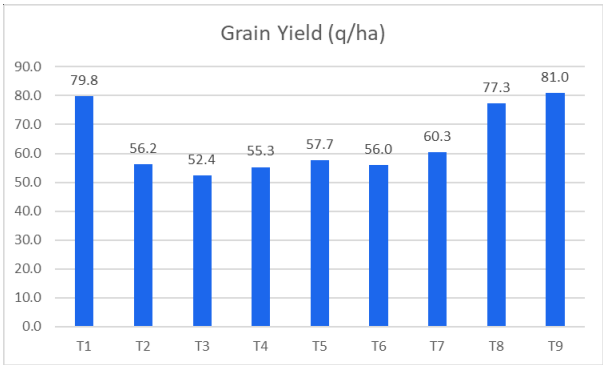

Fig. 2. Grain Yield

tion of nano urea along with 75 % RDN produced more grains per row and number of rows per cob, which was at par with T1 (RDF). The minimum values were recorded in T_4 (50 % RDF). The results obtained are similar to the findings of Al-Juthery *et al.*, (2018) and Manikandan *et al.* (2016).

The grain yield was highest in T_9(81 q ha^{-1}) which was statistically at par with T_1 (79.8 q ha^{-1}). The lowest grain yield was observed in T_3 (52.4 q ha^{-1}). Abdel-Aziz *et al.*, 2016 observed improved yield parameters in wheat crops due to the spray of nano fertilizers. The epidermis of the leaves easily absorbs nano fertilizers and gets translocated within the stems which helps in the uptake of active molecules and therefore improved growth and productivity (H. Abdel-Aziz *et al.*, 2018). Due to the large surface area and smaller particle size, the penetration into the plant tissues increases and therefore the nutrient uptake and use efficiency increases (Dimkpa *et al.*, 2015; Qureshi *et al.*, 2018).

Conclusion

The present study, therefore, concludes that the adoption of 75 % RDN + 2 foliar spray of nano urea @ 0.1% at knee high and tasselling stage could be a sustainable management alternative for *kharif* maize under Punjab conditions because this treatment was at par with 100 % RDF concerning growth and yield parameters of maize.

References

Abdel-Aziz, H.M.M., Hasaneen, M.N.A. and Omer, A.M. 2018. Foliar application of nano chitosan NPK fertilizer improves the yield of wheat plants grown on two different soils. *Egypt. J. Exp. Biol. (Bot.).* 14(1): 63-72.

Abdel-Aziz, H.M.M., Hasaneen, M.N.A. and Omer, A.M. 2016. Nano chitosan-NPK fertilizer enhances the growth and productivity of wheat plants grown in sandy soil. *Spanish Journal of Agricultural Research*. 14(1): e0902–e0902.

Obaid, A.A., Melnyk, A.V., Onichko, V.I., Ismael, F.M., Al-Abdullah, M.J., Al-Rifaee, M.K. and Tawaha, A.M. 2018. Evaluation of Six Sunflower Cultivar for Forage Productivity under Salinity Condition. *Advances in Environmental Biology*. 12(7): 13-16.

Ali, E.A. 2012. Effect of iron nutrient care sprayed on foliage at different physiological growth stages on yield and quality of some durum wheat (*Triticum durum* L.) varieties in sandy soil. *Asian Journal of Crop Science*. 4(4): 139–149.

Al-Juthery, H. and Habeeb, K.F.A.B. 2018. Effect of foliar application of different sources of nano-fertilizers on growth and yield of wheat. *Bioscience Research*. 15(4): 3988–3997.

Al-Rifaee, M.O.H.D., Turk, M.A. and Tawaha, A.R.M. 2004. Effect of seed size and plant population density on yield and yield components of local faba bean (*Vicia faba* L. Major). *International Journal of Agriculture and Biology*. 6(2): 294-299.

Dimkpa, C.O., McLean, J.E., Britt, D.W. and Anderson, A.J. 2015. Nano-CuO and interaction with nano-ZnO or soil bacterium provide evidence for the interference of nanoparticles in metal nutrition of plants. *Ecotoxicology*. 24(1): 119–129.

Laghari, G.M., Oad, F.C., Tunio, S., Gandahi, A.W., Siddiqui, M.H., Jagirani, A.W. and Oad, S.M. 2010. Growth, yield and nutrient uptake of various wheat cultivars under different fertilizer regimes. *Sarhad Journal of Agriculture*. 26(4): 489–497.

Li, J., Wang, M., She, D. and Zhao, Y. 2017. Structural functionalization of industrial softwood kraft lignin for simple dip-coating of urea as highly efficient nitrogen fertilizer. *Industrial Crops and Products*. 109: 255–265.

Madzokere, T.C., Murombo, L.T. and Chirириwa, H. 2021. Nano-based slow releasing fertilizers for enhanced agricultural productivity. *Materials Today: Proceedings*. 45: 3709–3715.

Maitra, S. 2019. Present Status and Future Prospects of Maize Cultivation in South Odisha. *International Journal of Bioresource Science*. 6(1): 27–33.

Manikandan, A. and Sci, K.S.I.J.P.S. 2016. Evaluation of zeolite based nitrogen nano-fertilizers on maize growth, yield and quality on inceptisols and alfisols. *International Journal of Plant & Soil Science*. 9(4): 1–9.

Meena, A.K., Meena, R.N., Choudhary, K., Devedee, A.K. and Meena, K. 2021. Neem Coated Urea (NCU), An Efficient Nitrogen Source for Paddy Cultivation: A Review. *Agricultural Reviews*. 42: 111–115.

Mohapatro, S. 2021. Growth and Productivity of Maize (*Zea mays* L.) as Influenced by Nitrogen Management Options. *International Journal of Agriculture Environment and Biotechnology*. 14(2).

Musallam, I.W., Karaki, G.Al, Ereifej, K. and Rahman, A. 2004. Yield and Yield components of Faba Bean Genotypes Under Rainfed and Irrigation Conditions. *Asian Journal of Plant Sciences*. 3(4): 439–448.

Nduwimana, D., Mochega, B., Danga, B., Masso, C., Maitra, S. and Gitari, H.I. 2020. Optimizing Nitrogen Use Efficiency and Maize Yield under Varying Fertilizer Rates in Kenya. *International Journal of Bioresource Science*. *7*(2): 63–73.

Nikus, O., Turk, M.A. and Al-Tawaha, A.M. 2004. Yield response of sorghum (*Sorghum bicolor* L.) to manure supplemented with phosphate fertilizer under semi-arid Mediterranean conditions. *Int. J. Agric. Biol*. 6(5): 889-893.

Qureshi, A., Singh, D. and Sci, S.D. 2018. Nano-fertilizers: a novel way for enhancing nutrient use efficiency and crop productivity. *International Journal of Current Microbiology and Applied Sciences*. 7(2): 3325–3335.