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Effect of nano urea on growth and yield of okra (*Abelmoschus esculentus* L.)

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Abstract
The field experiment was conducted in ZAHRS, Navile, Shivamogga to study the "Effect of nano urea on growth and yield of okra (*Abelmoschus esculentus* L.)" during *kharif* 2021.The experiment was laid out in RCBD with eight treatments replicated thrice. Treatments include combination of various levels of urea and nano urea (at different intervals *viz.,* 10, 20, 30 and 40 DAS) and package of practices. Among the treatments tested, 50 per cent of recommended N as basal + 25 per cent of N as top dress at 30 DAS and one spray of nano urea at 40 DAS (T_7) recorded highest plant height (155.30 cm), plant girth (5.74 cm), number of branches (3.38) and number of leaves (13.47). Better values of these indices results in significantly higher yield parameters like number of fruits (18.43 plant^{-1}), fruit length (19.63 cm), fruit girth (6.81 cm) and fruit yield (17.89 t ha^{-1}) in the same treatment, which was on par with package of practices. There was a 9.88 per cent increase in yield over package of practices. Further, higher net returns (₹ 2,92,652) and B:C ratio (2.89) were also noticed in treatment T_7.

Keywords: Nano urea, growth, yield, okra

Introduction
Okra (*Abelmoschus esculentus* L.) is a tropical and subtropical annual vegetable that belongs to the Malvaceae family (2n=130). It is grown throughout the year in all states of India. It is widely used as a vegetable in the diet and has export potential. Okra is a nutrient-dense vegetable that's high in vitamins, calcium, potassium, and other minerals, and it is thought to help with genito-urinary issues. In the manufacturing of jaggery, mucilage from the stem and roots of okra is used to clear sugarcane juice. Fruits and stems that have fully matured and contain crude Fruits and stems that have fully matured and produce crude fibre, which is used in the paper industry. Okra is grown for its tender pods, which are primarily sold within the country, with minor exports to other countries. In India, the total area under okra was 0.52 m ha, producing 6.42 MT with productivity rate of 12.19 t ha^{-1} (Anon. 2021) [1].

Most of the Indian soils, particularly those with a light texture, are lacking in nitrogen, which is one of the most important plant nutrients. Nitrogen is a component of chlorophyll and is involved in the production of proteins, nucleic acids, growth hormones and vitamins. A sufficient nitrogen supply is linked to rapid vegetative growth and a dark green color. The recommended nutrient doses for various crops were established one to two decades ago, but fertility status, crop varieties and other inputs have all changed significantly since then. As a result, there is a pressing need to reconsider fertilizer requirements, particularly nitrogen.

Among different commercial forms of mineral N fertilizers, urea is one of the most widely used, because of its high nitrogen content, about 46 per cent, highly soluble, compatible with other fertilizers in mixing and one of the lowest market prices. However, its loss occurs through nitrate leaching, volatilization *etc*., which in turn results in environmental pollution as well as ground water pollution. According to specifications given by IFFCO, Nano urea liquid is a 500 ml bottle which provides 40,000 ppm of nitrogen, it is 10 per cent cheaper than granular urea (Rs. 240 per 500 ml bottle). It aids in crop production by increasing harvest yield by an average of 8 per cent, while also improving the quality of farm produce by providing better nutrition to crops, lowering environmental pollution, increasing efficacy, reducing fertilizer loss and

unintentional urea use in the agricultural sector. One of the main limiting factor of conventional urea is that it undergoes losses and has less use efficiency. Sandy loam soils which are light textured are more prone to these types of losses of fertilizers, hence using nano urea as partial supplement, improve nutrient use efficiency and reduce the environmental pollution.

Materials and Methods

A field experiment was conducted to study the "Effect of nano urea application on growth and yield of okra (*Abelmoschus esculentus.* L)" during *kharif 2021* at ZAHRS, Navile, Shivamogga, situated at 13^0 58' N and 75^0 34' E with an altitude of 650 m above mean sea level. The actual rainfall received during the cropping period was 601.4 mm. The field experiment was laid out in randomized complete block design with eight treatments replicated thrice. The treatment comprised of T_1: Absolute control; T_2: Package of practices; T_3: 25 per cent of recommended N as basal through commercial N fertilizer + 3 sprays of nano urea at 20, 30 and 40 DAS; T_4: 25per cent of recommended N as basal through commercial N fertilizer + 4 sprays of nano urea at 10, 20, 30 and 40 DAS; T_5: 50 per cent of recommended N as basal through commercial N fertilizer + 2 sprays on nano urea at 30 and 40 DAS; T_6: 50 per cent of recommended N as basal through commercial N fertilizer + 3 sprays of nano urea at 20, 30 and 40 DAS; T_7: 50 per cent of recommended N as basal + 25 per cent of recommended N as top dress at 25-30 DAS through commercial N fertilizer + 1 spray of nano urea at 40 DAS; T_8: 4 Sprays of nano urea at 10, 20, 30 and 40 DAS (Note: Recommended dose of fertilizer for 1 hectare as per package of practices 125 kg N: 75 kg P_2O_5: 63 kg K_2O and 25 tones of FYM. Recommended dose of P_2O_5, K_2O and FYM is applied common for treatments from T_2 to T_8. Concentration of nano urea sprayed 4 ml per litre). The okra variety Supreme was sown with spacing of 60cm × 30cm. The physico-chemical properties of the experimental soil were soil pH(5.67), electrical conductivity (0.24 dS m^{-1}), texture (Sandy loam), available nitrogen
(301.05 kg ha^{-1}), available phosphorous (54.24 kg ha^{-1}), available potassium
(251.60 kg ha^{-1}) and soil organic carbon (5.40 g kg^{-1}). The biometric observations, growth parameters like plant height (measured from basal node to the base of the fully opened leaf), plant girth (recorded from first basal node of plant), number of branches, number of leaves and total dry matter accumulation, yield parameters include number of fruits, fruit length, fruit weight, fruit girth and fruit yield were recorded from selected five plants and subjected to analysis of variance (ANOVA) as outlined by Gomez and Gomez (1984) [7].

Results and Discussion

Growth is the irreversible, permanent expansion of a plant's size and is regarded as one of the most fundamental and distinctive properties of a living entity. Development includes all alterations an organism experiences throughout its life cycle, from seed germination to senescence. The okra growth parameters which includes plant height, number of branches, number of leaves, plant girth and dry matter production as affected by nano urea application are discussed here.

Application of 50 per cent of RDN as basal + 25 per cent of RDN as top dress at 30 DAS through commercial N fertilizer + one foliar spray of nano urea at 40 DAS (T_7) registered significantly higher plant height of 155.30 cm, which was on par with package of practices (149.50 cm). Alone 4 sprays of nano urea without applying conventional urea registered significantlylower plant height of 68.39 cm in absolute control(Table 1.).In this experiment succession of tallness in the treatment is supported with varied levels of conventional urea and nano urea which might help in betterment of physiological process such as cell division, cell elongation along with timely metabolic processes. This may be due to the increased meristamatic activity of the plant cell, increased availability of nutrients to the growing plant by nano urea for quick absorption of nutrients through stomata of leaves. Benzon *et al*. (2015) [2] also revealed that plant height was more enhanced when nano fertilizer was combined with conventional ones due to the reason that nano fertilizer can either provide nutrients for the plant or aid in the transport or absorption of available nutrients resulting in better crop growth. Similarly,
Ghormade *et al*. (2011) [6] reported that, nano fertilizers can result in alteration of plant gene expression and associated biological pathways which finally resulted in plant height.

Significantly higher plant girth of 5.74 cm was observed in case of treatment supplied with 50 per cent RDN as basal + 25 per cent RDN as top dress and 1 spray of nano urea at
40 DAS. This might be due to supply of comparatively higher nitrogen dose results in stronger plant as a part by increasing its girth due to increased chlorophyll content results in better growth and development which in turn builds proteins and forms the main constituent of protoplasm in plant. Thus, increasing level of nitrogen, synthesis of amino acids is accelerated and increases the lateral meristamatic activity, which may contribute for increasing plant girth.

Maximum branches (3.38 $plant^{-1}$) noticed with application of 50 per cent of RDN as basal + 25 per cent of RDN as top dress at 30 DAS through commercial N fertilizer + 1 spray of nano urea at 40 DAS. Increased number of branches might be due to the increased production and accumulation of carbohydrate and improved vegetative growth resulted by the application of nano urea. El-hamd and Elwahed, 2018 [5] reported that foliar application of nano fertilizers resulted in highest biometric characters such as plant height, number of branches per plant and leaf area in okra. Congruous observations were recorded by Mishra *et al.* (2020) [11] in tomato

Leaves are the most important photosynthetic parts of plant which harness the solar radiation and convert solar energy to chemical energy which helps in metabolic process of plant. With application of different levels of conventional urea and nano urea significantly influenced number of leaves per plant. Significant increase in number of leaves per plant (27.50) registered in T_7 (50 per cent of RDN as basal + 25 per cent of RDN as top dress at 25-30 DAS through commercial N fertilizer + 1 spray of nano urea at 40 DAS) which was at par with package of practices. Lowest number of leaves recorded in absolute control (14.75).This might be due to foliar application of nano urea along with conventional urea, as nano particles have the ability to enter through the porous cell wall of plant cells, due to their minute particle size allowing for higher absorption of nitrogen there by increases the metabolic activity.These results are supported in basis with urea spray resulted in vigorous vegetative growth of the plant and imparted deep green colour to the foliage which favoured photosynthetic activities of plants and greater synthesis of carbohydrate in the leaves leading to formation of amino acid, protein, chlorophyll, alkaloids and amides. These complex compounds are responsible for building up of new tissues and are associated in a number of metabolic processes, which in turn favour better development of plants (Jones and Embleton, 1965) [9]. These results are in line with

Sabir *et al.* (2014) [14] that increased nitrogen absorption by foliar nano NPK spray stimulated vegetative growth, leading to an increase in leaf area. Similar observations were reported by Nithya*et al*. (2018) [12] in mulberry; Khanm *et al*. (2018) [10] in tomato and Mishra *et al*, (2020) [11] in tomato.

Dry matter accumulation is an important index indicating the photosynthetic efficiency of the crop which ultimately influences the crop yield. Dry matter accumulation increased progressively with the advancement in crop age and the most obvious rise seen from peak picking stage. Analysis of data pertaining to dry matter accumulation of okra crop showed that all the treatments significantly increased the dry matter accumulation in okra. Among the applied treatments, T_7 (50% recommended N as basal + 25% of recommended N as top dress at 25-30 DAS through commercial N fertilizer + 1 spray of nano urea at 40 DAS) resulted in significantly higher dry matter accumulation of 56.26 g plant $^{-1}$ than control and other treatments in comparison. However, it was found to be at par with the treatment package of practices. The lowest dry matter accumulation (28.85 g plant^{-1}) was observed in treatment T_8 (4 sprays of nano urea at 10, 20, 30 and 40 DAS) followed by absolute control (21.14 g plant $^{-1}$). Significant higher dry matter production might be due to the fact that comparatively higher dose of nitrogen supply and also unique property of nano urea like increasing surface area results in enhanced nutrient intake, chlorophyll production, photosynthetic surface area, and biomass production. Similar results were reported by Suriyaprabha *et al.* (2012) [15], Swati, (2017) [16]. Significantly lower dry matter accumulation may be due to low supply of nitrogen, as low nitrogen content in plant results in starch accumulation which is the main drive for deforming the chloroplast thereby indirectly affects the solar energy harnessing capacity of plant.

Improvements in seedling growth criteria, may be due to the fact that nano particles play an important role in reactive oxygen species generation (ROS) and oxidative stress as well as quickened uptake of water and oxygen (Raskar and Laware, 2013) [13].Increase in overall growth might be due to application of nano urea which releases in slow and steady manner that may be enabled for better growth of plants. The obtained results suggested that nanofertilizers can provide either nutrients for plant or help in transport and absorption of plant available nutrients resulted in better crop growth (Dimpka *et al.*, 2018) [4].

Effect of nano urea on yield of okra

Yield of vegetable crops mainly depends on factors like type of variety/hybrid, climatic conditions, soil factors, plant protection practices etc. However, for realising high yield of vegetable crops, nutrient management is the key factor in achieving increased yield. In this experiment among the practices, application 50 per cent RDN as basal + 25 per cent RDN as top dress at 30 DAS + one spray of nano urea at 40 DAS recorded significantly higher number of fruits per plant (18.43), fruit length (19.63 cm), fruit girth (6.81cm), fruit weight (25.69g) and fruit yield (17.89 t ha^{-1}) and was on par with package of practices which recorded number of fruits per plant (17.73), fruit length(24.47 cm), fruit girth (6.51 cm), fruit weight(24.47 g) and fruit yield(16.28 t ha^{-1}). Whereas significantly lower number of fruits per plant (9.13), fruit length (11.01 cm), fruit girth (3.38 cm), fruit weight(13.09 g) and fruit yield (4.13 t ha^{-1}) noticed in absolute control (Table 2.).

50 per cent of RDN as basal and 25 per cent of RDN as top dress at 30 DAS with one spray of nano urea at 40 DAS improved the plant height, number of leaves and dry matter accumulation. As supplying adequate amount of nitrogen to plant and foliar application of nano urea as a partial supplement at 40 DAS for 25 per cent of conventional urea helped in better vegetative growth.

Better crop growth results in better yields, 50 per cent of RDN as basal and 25 per cent of RDN as top dress at 30 DAS with one spray of nano urea at 40 DAS registered 9.88 per cent increase in yield over the package of practices, and 88.51 per cent increase in yield over treatment with sole four sprays of nano urea at 10, 20. 30 and 40 DAS, high crop yields are determined by ability of plants to produce high levels of photo assimilate and to partition large proportions of carbohydrate efficiently into harvestable organs. Thus, translocation of photosynthates to reproductive parts of plant in turn resulted in better fruit set. This condition indirectly influenced in increased number of fruits per plant and increased the yield of fruits per hectare. Similar findings were reported by Davarpanah *et al.* (2017) [3] and Gomma *et al.* (2018) [8].

Table 1: Effect of nano urea on growth parameters of okra

Treatments	Plant height (cm)	No. of leaves	Plant girth (cm)	No. of branches	Total dry matter (g plant^{-1})
T_1: Absolute control	68.39	14.75	3.12	1.97	21.14
T_2: Package of practices	149.50	27.10	5.46	3.25	51.05
T_3: 25% of recommended N as basal through commercial N fertilizer + 3 sprays of nano urea at 20, 30 and 40 DAS	112.23	19.53	4.86	2.50	38.44
T_4: 25% of recommended N as basal through commercial N fertilizer + 4 sprays of nano urea at 10, 20, 30 and 40 DAS	114.33	19.82	4.82	2.54	39.05
T_5: 50% of recommended N as basal through commercial N fertilizer + 2 sprays on nano urea at 30 and 40 DAS	136.25	24.00	5.32	2.92	45.72
T_6: 50% of recommended N as basal through commercial N fertilizer + 3 sprays of nano urea at 20, 30 and 40 DAS	138.82	24.14	5.35	2.93	46.51
T_7: 50% of recommended N as basal + 25% of recommended N as top dress at 25-30 DAS through commercial N fertilizer + 1 spray of nano urea at 40 DAS	155.30	27.50	5.74	3.38	56.26
T_8: 4 Sprays of nano urea at 10, 20, 30 and 40 DAS	95.85	17.19	4.48	2.17	28.85
S. Em. ±	5.03	0.79	0.12	0.11	2.04
C. D at 5%	15.27	2.39	0.35	0.34	6.19

Table 2: Effect of nano urea on yield attributes and yield of okra

Treatments	No. of fruits per plant	Fruit length (cm)	Fruit girth (cm)	Fruit weight (g)	Fruit yield(t ha^{-1})
T_1: Absolute control	9.13	11.01	3.38	13.09	4.13
T_2: Package of practices	17.73	19.11	6.51	24.47	16.28
T_3: 25% of recommended N as basal through commercial N fertilizer + 3 sprays of nano urea at 20, 30 and 40 DAS	12.03	15.51	5.18	20.31	12.28
T_4: 25% of recommended N as basal through commercial N fertilizer + 4 sprays of nano urea at 10, 20, 30 and 40 DAS	12.17	15.99	5.28	20.62	12.50
T_5: 50% of recommended N as basal through commercial N fertilizer + 2 sprays on nano urea at 30 and 40 DAS	16.76	18.03	6.29	23.23	15.06
T_6: 50% of recommended N as basal through commercial N fertilizer + 3 sprays of nano urea at 20, 30 and 40 DAS	16.80	18.17	6.38	23.51	15.11
T_7: 50% of recommended N as basal + 25% of recommended N as top dress at 25-30 DAS through commercial N fertilizer + 1 spray of nano urea at 40 DAS	18.43	19.63	6.81	25.69	17.89
T_8: 4 Sprays of nano urea at 10, 20, 30 and 40 DAS	10.40	13.14	4.23	17.56	9.49
S. Em. $\pm$	0.37	0.44	0.17	0.64	0.79
C. D at 5%	1.13	1.34	0.51	1.95	2.41

Conclusion

From this study it can be concluded that the application of 50 per cent of recommended N as basal + 25 per cent recommended N as top dress at 30 DAS + one spray of nano urea at 40 DAS increases the overall growth of crop *viz.*, plant height, plant girth, number of branches, number of leaves and total dry matter accumulation.

About 9.88 percent increase in yield was recorded with application of 50 per cent of recommended N as basal + 25 per cent recommended N as top dress at 30 DAS + 1 spray of nano urea at 40 DAS over package of practices. Whereas treatment supplied with only nano urea as inorganic source of nitrogen found less effective comparatively with package of practices.

References

1. Anonymous. Indiastat. https://www.indiastat.com/data/agriculture/okra/data-year/2012-2021.
2. Benzon HRL, Rubenecia MRU, Ultra VU, Lee SC. Nano-fertilizer affects the growth, development and chemical properties of rice. Int J Agron Agric Res. 2015;7(1):105-17.
3. Davarpanah S, Tehranifar A, Davarynejad G, Abadia J, Andkhorasani R. Effects of foliar nano-nitrogen and urea fertilizers on the physical and chemical properties of pomegranate (*Punica granatum* cv. ardestani) fruits. Scientia Horticulturae. 2017;210:1-8.
4. Dimkpa CO, Singh U, Adisa IO, Bindraban PS, Elmer WH, Gardea-torresdey JL, *et al*. Effects of manganese nanoparticle exposure on nutrient acquisition in wheat (*Triticum aestivum* L.). Agron Res. 2018;8(9):158.
5. El-hamd AASA, AAHM Elwahed. Improving the growth and yield of okra plants (*Abelmoschus esculentus* L.) using Lithovit fertilizer. Acad J Agric Res. 2018;6(5):61-4.
6. Ghormade V, Deshpande MV, Paknikar KM. Perspectives for nano-biotechnology enabled protection and nutrition of plants. Biotechnol Advanc. 2011;29(6):792-803.
7. Gomez KA, Gomez AA. Statistical procedures for agricultural research with emphasis on rice. John wiley and Sors; 1984. p. 680.
8. Gomma MA, Radwan FI, Kandil EE, Al- masri MAF. Response of some Egyptian and Iraqi wheat cultivars to mineral and nano fertilization. Egypt Acad J biology Sci. 2018;9(1):19-26.
9. Jones WW, Embleton TW. Urea foliage sprays. California Citrograph. 1965;50(9):335-59.
10. Khanm H, Vaishnavi BA, Shankar AG. Raise of nano-fertilizer era: effect of nano scale zinc oxide particles on the germination, growth and yield of tomato (*Solanum lycopersicum*). Int J Curr Microbiol Appl Sci. 2018;7(5):1861-71.
11. Mishra B, Sahu GS, Mohanty LK, Swain BC, Hati S. Effect of nano fertilizers on growth, yield and economics of tomato variety Arka Rakshak. Ind J Pure App Biosci. 2020;8(6):200-4.
12. Nithya BN, Naika R, Naveen DV, Venkatachalapathi V. Effect of foliar spray of nano zinc on growth and cocoon productivity of mulberry silkworm (*Bombyx mori* L). Agric Int. 2018;5(2):40-2.
13. Raskar S, Laware S. Effect of zinc oxide nanoparticles on cytology and seed germination in onion. Int J Curr Microbiol App Sci. 2014;3:467-73.
14. Sabir S, Arshad M, Chaudhari SK. Zinc oxide nanoparticles for revolutionizing agriculture: synthesis and applications. Sci World J. 2014.
15. Suriyaprabha R, Karunakaran G, Yuvakkumar R, Prabhu P, Rajendran V, Kannan N. Growth and physiological responses of maize (*Zea mays* L.) to porous silica nanoparticles in soil. J Nanoparticle Res. 2012;14(12):1294.
16. Swati M. Effect of integrated use of nano and non nanofertilizerson quality and productivity of wheat (*Triticum aestivum* L.) [MSc thesis]. Sher-e-Kashmir Uni. of Agri. Sci. Technol. of Jammu; 2017.