International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating: 5.29
IJABR 2025; 9(6): 51-53
www.biochemjournal.com
Received: 20-04-2025
Accepted: 26-05-2025

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Effect of foliar application of nano urea on plant growth and quality of okra

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DOI: https://www.doi.org/10.33545/26174693.2025.v9.i6a.4500

Abstract
A field experiment entitled, "Effect of foliar application of nano urea on plant growth and quality of okra" was conducted at research farm of Horticulture Section, College of Agriculture, Nagpur, Dr. PDKV, Akola. The experiment was laid out in randomized block design with three replications consisting of eight treatments. The treatments composed of foliar spray of nano urea of different concentrations. The results of present investigation included the growth parameters viz., plant height, leaves plant^{-1}, internodal length and days to emergence of first flower and quality parameters viz., fruit length (cm), fruit diameter (cm), shelf life (days) and seeds fruit^{-1}. The growth parameters and quality parameters viz., fruit length and fruit diameter were most beneficial for crop and found maximum with the treatment T_5 (100% RDF + nano urea @ 6%). Quality parameters viz., shelf life and seeds fruit^{-1} were found non-significant.

Keywords: Nano urea, foliar spray, growth, quality, okra

Introduction

Okra is an economically valuable crop grown in the tropical or subtropical areas of the world. It is also known as Bhendi or Lady's finger. Okra is a valued vegetable in India, despite its origin in Tropical Africa. It is a common fruit vegetable in India for its tender pods, and it can be grown as a garden crop or in commercial farms. Okra belongs to family malvaceae and genus *Abelmoschus*. Okra is erect, herbaceous, annual, 1 to 2 m tall, stem green or with purple reddish tinge, leaves are alternate broadly cordate, palmately 3 to 7 lobed, hirsute and serrate, flowers solitary often cross pollinated, axillary with about 2cm long peduncle, hermaphrodite in nature, epicalyx up to ten, calyx split longitudinally as flower opens, 5 petals yellow with crimson spot on claw, 5 to 7 cm long staminal column united to the base of petals with numerous stamens, ovary superior, stigma 5 to 9 deep red, fruits capsule, light green or sometimes red in colour. The number of chromosomes found in cultivated okra varies significantly. The Indian varieties belong to the 2n=130 chromosome group.

Okra is highly nutritious, particularly in the edible fruit, with high levels of vitamin C (66 mg/100 g), calcium (0.35 mg/100 g) and iron (0.35 mg/100 g). Protein and minerals are also abundant, 88% moisture, 7.7% carbohydrate, 1.1% fibre and 0.7% mineral, 0.08% phosphorus and 41 (kcal) calorific content. The level of vitamin A is 58 IU, Vitamin B is 0.06 mg, and Nicotinic acid is 0.06 mg, and Riboflavin is 0.06 mg. As a cooked vegetable, often fresh but often soaked and frozen the tender fruits are eaten. It was also used for other domestic and medical applications.

PDKV Pragati, a promising variety of okra has been released by Chilli and Vegetable Research Unit, Dr. PDKV, Akola possesses desirable characters like high yield, moderately resistance to the YVMV and qualities suitable for export. New variety was developed through hybridization followed by mass selection from derivatives of cross between Parbhani Kranti × AKO-75 and back cross with AKO-75. PDKV Pragati having horticultural characters like, more in fruit yield by 25.56 per cent over, earliness in flowering (39.26 days), normal crop duration (100-105 days), resistance for YVMV, moderately resistant to sucking pests and fruit borer.

Okra requires a lot of mineral nutrients, especially nitrogen, to grow, to develop and produce flowers and fruits. Nitrogen is one of the important elements in plant owing to its major part in chlorophyll production, which is essential for the photosynthesis process. Nitrogen is part of different enzymatic proteins that catalyze and regulates plant development processes.

Nitrogen fertilizer applied in okra crop through conventional urea is partially lossed through different mechanisms, including ammonia volatilization, denitrification, and leaching. These losses may cause environmental problems such as polluting atmosphere, aquatic system, and ground water. Moreover, nutrient use efficiency of conventional fertilizers is very low.

Keeping the view of above problems there is need to adopt nano urea fertilizer for the beneficial nitrogen management in okra. Foliar application of nano urea liquid at critical crop growth stages of a plant effectively fulfils its nitrogen requirement and leads to higher crop productivity and quality in comparison to conventional urea. Thus, the research work has been conducted on "Effect of foliar application of nano urea on plant growth and quality of okra". The present investigation would be helpful to find out suitable nano urea dose for better growth and quality of okra.

Materials and Methods

An experiment was conducted at research farm of Horticulture Section, College of Agriculture, Nagpur on "Effect of foliar application of nano urea on plant growth and quality of okra". The experiment with three replications was laid out in randomized block design consisting of eight treatments i.e. T_1 (Absolute control), T_2 (100% RDF i.e. N:P:K @ 100:50:50 kg ha^{-1}), T_3 (100% RDF + nano urea @ 0.2%), T_4 (100% RDF + nano urea @ 0.4%), T_5 (100% RDF + nano urea @ 0.6%), T_6 (75% RDF + nano urea @ 0.2%), T_7 (75% RDF + nano urea @ 0.4%), T_8 (75% RDF + nano urea @ 0.6%). The nano urea with different concentrations was mixed in water to make 1 litre of solution and sprayed on okra plants at interval of 30 DAS, 50 DAS, 70 DAS. Growth parameters were recorded at 30 DAS, 45 DAS, 60 DAS, 75 DAS and 90 DAS and quality parameters were recorded after each harvesting.

The data were examined in accordance with the steps outlined by Panse and Sukhatme (1967) [8] for the study with randomized block design under three replications at 5% level of significance.

Results and Discussion

Growth parameters

- The data regarding the effect of foliar application of nano urea on growth parameters presented in Table 1 showed that, the effect of foliar application of nano urea on growth parameters i.e. plant height, leaves plant^{-1}, internodal length, and days to emergence of first flower were found significant.
- **Plant height (cm):** Significantly, highest plant height (160.90 cm) was recorded in the treatment T_5 (100% RDF + nano urea @ 0.6%) which was followed by T_8 (75% RDF + nano urea @ 0.6%), having plant height 148.60 cm. T_1 (control), on the other hand, noted the shortest plant height (114.10 cm). The use of nano urea increases the efficiency of added nitrogen and promotes various physiological activities in the plant that are necessary for proper growth and development. This is in accordance with Sharma and Bhalla (1995) [10] and Naidu *et al.* (2000) [6] in okra.
- **Leaves plant^{-1}:** Significantly, maximum leaves plant^{-1} (23.47) were recorded in the treatment T_5 (100% RDF + nano urea @ 0.6%), which was followed by T_8 (75% RDF + nano urea @ 0.6%), having 21.10 leaves plant^{-1}. T_1 (control), on the other hand, noted the minimum leaves plant^{-1} (16.27). Sontakke *et al.* (1996) [14] reported that increase in concentration of nitrogen in okra increased plant height and number of leaves plant^{-1}. This is also in accordance with Singh *et al.* (1997) [12].
- **Internodal length (cm):** Significantly, highest internodal length (11.20 cm) was recorded in the treatment T_5 (100% RDF + nano urea @ 0.6%), which was at par with T_8 (75% RDF + nano urea @ 0.6%), having internodal length 10.93 cm, T_4 (100% RDF + nano urea @ 0.4%), having internodal length 10.87 cm and followed by T_3 (100% RDF + nano urea @ 0.2%), having internodal length 10.60 cm. T_1 (control), on the other hand, noted the minimum internodal length (9.47 cm). Maximum internodal length might be due to higher absorption of nutrients, mainly nitrogen which increased the cell division, cell elongation with related increase in metabolic activity by meristematic activity of tissue which led to increase in internodal length (Pandey *et al*., 1994) [7]. Donnel (1973) [3] reported that increase in internodal length might be due to auxin like activity of nano urea on cane growth.
- **Days to emergence of first flower:** Significantly, minimum days to emergence of first flower (37.27) was recorded in T_1 (control), which was followed by T_6 (75% RDF + nano urea @ 0.2%), where 38.67 days were recorded for emergence of first flower. T_5 (100% RDF + nano urea @ 0.6%), on the other hand, noted the maximum days to emergence of first flower (44.53). As flowering requires resources to develop sink tissues for reproduction, nutrient availability is tightly linked to this process. High N levels reduce the speed of floral transition. Under high N conditions, phosphorylation levels are increased. Increased phosphorylation inhibits nuclear localization and transcriptional activation of the direct target and reduce florigen that increase the period of flowering. P. K. Singh (2010) [13] reported the same results in okra.

Quality parameters

The data regarding the effect of foliar application of nano urea on quality parameters presented in Table 1 showed that, the effect of foliar application of nano urea on quality parameters i.e. fruit length and fruit diameter were found significant. However, shelf life and seeds fruit^{-1} were found non-significant.

- **Fruit length (cm):** Significantly, maximum fruit length (13.59 cm) was recorded in T_5 (100% RDF + nano urea @ 0.6%), followed by T_8 (75% RDF + nano urea @ 0.6%), where the fruit length was 12.97 cm. T_1 (control), on the other hand, noted the minimum fruit length (12.22 cm). Nitrogen enhances the plant growth and development when compared to control and also provided better nutrition to okra to attain higher length. Prabhu *et al.* (2002) [9] and Miglani *et al.* (2017) [5] reported similar results.
- **Fruit diameter (cm):** Significantly, maximum fruit diameter (1.71 cm) was recorded in T_5 (100% RDF + nano urea @ 0.6%), followed by T_4 (100% RDF + nano urea @ 0.4%), where the fruit diameter was 1.59 cm. T_1

(control), on the other hand, noted the minimum fruit diameter (1.37 cm). This might be attributed to the synergistic effects of NPK fertilizers and nano urea which make more nutrients available to the plants. The increased vegetative growth, balanced C/N ratio and increased synthesis of carbohydrates help in increasing the fruit size. Similar findings were reported by Bodamwal *et al.* (2006) [2], Bairwa *et al.* (2009) [1] and Shelar *et al.* (2011) [11].

- **Shelf life (days):** The shelf life was not influenced significantly by different concentrations of nano urea. The fruits were marketable in all treatments on the first day. However, poor appearance and non-marketability was observed from 4thday in all treatments. According to Kulkarni (2004) [4] general appearance and market acceptance was not much influenced by the different treatments.
- **Seeds fruit^{-1}:** The seeds fruit^{-1} was not influenced significantly by different concentrations of nano urea. The seeds fruit^{-1} was not influenced by the nano urea. It was nearly same in all the treatments. The nitrogen does not affect seed count in the fruits. The seed count might get influenced by the plant growth hormones like gibberellic acid. But the nitrogenous fertilizers don't play role in the seed count.

Table 1: Effect of foliar application of nano urea on different plant growth and quality parameters of okra

Treatments	Growth parameters				Quality parameters			
	Plant height (cm)	Leaves plant^{-1}	Internodal length (cm)	Days to emergence of first flower	Fruit length (cm)	Fruit diameter (cm)	Shelf life (days)	Seeds fruit^{-1}
T_1	114.10	16.27	9.47	37.27	12.22	1.37	3.47	59.33
T_2	124.13	18.23	9.93	39.80	12.69	1.46	3.87	65.07
T_3	135.07	18.83	10.60	41.47	12.81	1.52	3.93	60.27
T_4	147.70	19.57	10.87	42.40	12.96	1.59	3.87	57.86
T_5	160.90	23.47	11.20	44.53	13.59	1.71	3.73	62.27
T_6	125.63	18.53	10.07	38.67	12.47	1.44	3.70	59.80
T_7	136.27	19.57	10.53	40.73	12.52	1.51	3.33	63.93
T_8	148.60	21.10	10.93	40.13	12.97	1.56	3.47	62.53
F test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	NS	NS
SE (m) ±	1.58	0.43	0.18	0.39	0.23	0.04	0.31	3.18
CD at 5%	4.71	1.25	0.52	1.15	0.68	0.11	-	-

From the above investigation it is concluded that the growth parameters viz., plant height, leaves plant^{-1}, internodal length and days to emergence of first flower and quality parameters viz., fruit length and fruit diameter, were recorded maximum with the treatment T_5 (100% RDF + nano urea @ 0.6%). However, the quality parameters viz., shelf life and seeds fruit^{-1} were found non-significant. Hence, the treatment T_5 (100% RDF + nano urea @ 0.6%) can be used to obtain maximum growth and quality parameters in okra.

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