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Impact of foliar nitrogenous source on growth and yield of okra

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Abstract
The present investigation entitled "Impact of foliar nitrogenous source on growth and yield of okra, conducted at University Research Farm, GHRU, Saikheda in *Rabi* Season of 2023, are presented and described in this chapter. The research trial conducted in nine treatments with control, and replicated in three times, the data was anlysed in Randomized Block Design. The research trail was carried on Okra crop cv. Red Okra for observed the growth, yield and economics. The treatment details are T_1- Control, T_2- 0.5% urea (30 DAS) + 1% urea (45 DAS), T_3- 0.75% urea (30 DAS) + 1% urea (45 DAS), T_4- 1% urea (30 DAS) + 1% urea (45 DAS), T_5- 2% urea (30 DAS) + 1% (45 DAS), T_6- 0.5% urea (30 DAS) + 0.5% $CaNO_3$ (45 DAS), T_7- 0.5% urea (30 DAS) + 1% CaNO3 (45 DAS), T_8- 0.5% urea (30 DAS) + 0.5% KNO_3 (45 DAS) and T_9- 0.5% urea (30 DAS) + 1% KNO3 (45 DAS). In the research trial observation was taken such as plant height (cm) at 45 and 75 DAS, number of leaves per plant 45 and 75 DAS, number of branches per plant at 75 DAS, number of nodes per plant, fruit length (cm), fruit width (cm), yield per plot (kg), yield per ha (q/ha). The results revealed that plant height at 45 and 75 DAS (38.63 and 71.98 cm), number of leaves per plant at 45 and 75 DAS (13.68 and 28.01), number of branches per plant at 75 DAS (12.68), number of nodes per plant (22.12), fruit length (14.09 cm), fruit width (6.24 cm), yield per plot (20.58 kg) and yield per ha (175.26 q/ha), while the minimum value of all the above parameters was observed under the control plot.

Keywords: $CaNO_3$, urea, Okra, KNO_3 and growth of red okra

Introduction
Okra (*Abelmoschus esculentus* L. Moench), belongs to the family Malvaceae. It is an annual or perennial vegetable crop grown throughout the tropical and subtropical part of the world. Although okra is a rainfed crop, it also comes up well under irrigated condition during *kharif* and summer seasons.

Foliar fertilization is the practice of applying liquid fertilizer to plant leaves. The leaves are green factories where the complex chemical processes of photosynthesis produce the compounds plants needed for growth. Foliar application are absorbed right at the site where they are used as quite fast acting, whereas much of the soil fertilizers may never get used by plants. For instance, 80% of phosphorus applied through conventional fertilizer may get fixed up in the soil but up to 80% of foliar-added phosphorus directly absorbed by the plants. Foliar fertilization is widely used practice to correct nutritional deficiencies in plants caused by improper supply of nutrients to roots Silberbush (2002) [1]. Two concentrations of urea sprays (1 and 2%) were applied to okra, it was reported that urea application enhanced the growth and fruit yield of okra significantly Naruka and Singh (1998) [2].

A number of studies highlighted the benefits of foliar spray of nitrogen or foliar fertilization in improving plant growth, crop yield, nutrient uptake and product quality. An increase in nitrogen levels increased the growth parameters including number of leaves, fresh weight of stem and roots and leaf area widen and plant height of Okra (Abbasi *et al.*, 2010) [3]. It also increased yield components and yield of Okra. The increase in plant growth and development leads to higher marketable yield of okra which increases the gross and net return. Application of nitrogen in the form of foliar spraying can proof beneficial in improving the yield and yield components of okra.

Materials and Methods

The present investigation entitled "Impact of foliar nitrogenous source on growth and yield of okra, conducted at University Research Farm, GHRU, Saikheda in *Rabi* Season of 2023, are presented and described in this chapter. The research trial conducted in nine treatments with control, and replicated in three times, the data was anlysed in Randomized Block Design. The research trail was carried on Okra crop cv. Red Okra for observed the growth, yield and economics. The treatment details are T_1- Control, T_2- 0.5% urea (30 DAS) + 1% urea (45 DAS), T_3- 0.75% urea (30 DAS) + 1% urea (45 DAS), T_4- 1% urea (30 DAS) + 1% urea (45 DAS), T_5- 2% urea (30 DAS) + 1% (45 DAS), T_6- 0.5% urea (30 DAS) + 0.5% $CaNO_3$ (45 DAS), T_7- 0.5% urea (30 DAS) + 1% CaNO3 (45 DAS), T_8- 0.5% urea (30 DAS) + 0.5% KNO_3 (45 DAS) and T_9- 0.5% urea (30 DAS) + 1% KNO_3 (45 DAS). In the research trial observation was taken such as plant height (cm) at 45 and 75 DAS, number of leaves per plant 45 and 75 DAS, number of branches per plant at 75 DAS, number of nodes per plant, fruit length (cm), fruit width (cm), yield per plot (kg), yield per ha (q/ha).

Results and Discussion

Plant height (cm) at 45 and 75 DAS

At the growth stage of 45 DAS of okra crop, the maximum plant height was observed under the treatment T_7 (0.5% urea (30 DAS) + 1% $CaNO_3$ (45 DAS) i.e. 38.63, cm, which was at par with the treatment T_6 (38.07 cm), T_8 (37.76 cm) and T_9 (36.84 cm), while the minimum plant height at 45 DAS was observed under the treatment T_1 (Control) 32.95 cm. At the growth stage of 75 DAS of okra crop, the maximum plant height was observed under the treatment T_7 (0.5% urea (30 DAS) + 1% $CaNO_3$ (45 DAS) i.e. 71.98 cm, followed by the treatment T_6 (0.5% urea (30 DAS) + 0.5% $CaNO_3$ (45 DAS) i.e. 71.36 cm, T_8 (0.5% urea (30 DAS) + 0.5% KNO_3 (45 DAS) i.e. 70.51 cm, while the minimum plant height at 75 DAS was observed under the treatment T_1 (Control) i.e. 58.22 cm.. The increased plant height may be due to higher dose of nitrogen might have enhanced cell division and formation of more tissues resulting in luxuriant vegetative growth thereby increased plant height. These results were in conformity with Firoz (2009) [4] and Khan *et al.* (2010) [5]. This may be due to increased absorption of nitrogen which resulted in increased synthesis of carbohydrates which are utilized in building up of new cells. These results are in accordance with the reports of Shelar *et al*., (2011) [6]. Significant increase was observed in growth attributes when nitrogen was applied nitrogen as soil application or foliar applicatio. This increase may be due to highest level of nitrogen, which promoted the axillary buds in to new shoots. Similar variation in number of branches has also been reported by Srivastava *et al*., (2009) [7] and Khan *et al*., (2013) [8].

Number of leaves per plant at 45 and 75 DAS

The maximum number of leaves per plant at 45 and 75 DAS was observed under the treatment T_7 (0.5% urea (30 DAS) + 1% $CaNO_3$ (45 DAS) i.e. 13.68 and 28.01, which was at par with the treatment T_6 (0.5% urea (30 DAS) + 0.5% $CaNO_3$ (45 DAS) (13.33 and 26.41), while the minimum number of leaves per plant at 45 and 75 DAS was observed under the treatment T_1 (Control) i.e. 10.33 and 19.84. An application of nitrogen significantly increased the leaves per plant. Such behaviors of nitrogen can be explained due to the fact that nitrogen plays an important role in the plant metabolism. It forms the main constitutes of protoplasm in plants. Thus, the increase in nitrogen supply, accelerate synthesis of amino acids in plants which indirectly exhibited by enhanced growth of plants and their parts. The beneficial effects of nitrogen in increasing vegetative growth are in conformity with the findings of Singh (1995) [9]. The increase in number of leaves per plant due to application of nitrogen was also reported by Amjad *et al.*, (2001) [10] in okra plants where higher number of leaves (32.41) per plant was obtained by application of 150kg N/ha. The same result was also reported by Singh *et al.*, (2012) [11] and Akanbi *et al.*, (2010) [12] where application of higher doses of nitrogen leads to increase in plant height and more vegetative growth. This was linked to the positive effect of availability of sufficient amount of nitrogen for the use of plants. The increase in N doses might have enhanced the cell division and formation of more tissue resulting in excessive vegetative growth and thereby increase the number of leaves per plants.

Number of branches per plant at 75 DAS

The maximum number of branches per plant at 75 DAS was observed under the treatment T_7 (0.5% urea (30 DAS) + 1% $CaNO_3$ (45 DAS) i.e. 12.86, followed by the treatment T_6 (0.5% urea (30 DAS) + 0.5% $CaNO_3$ (45 DAS) i.e. 12.80, while the minimum number of branches per plant at 60 and 75 DAS was observed under the treatment T_1 (Control) i.e. 4.89 and 9.43. The above findings was reported by Abbasi *et al.*, (2010) [3] where foliar nitrogen fertilization leads to more number of branches (4.8) per plant and also Narayanamma *et al.*, (2006) [13] in Brinjal.

Number of nodes per plant

The maximum number of nodes per plant was observed under the treatment T_7 (0.5% urea (30 DAS) + 1% $CaNO_3$ (45 DAS) i.e. 22.12, followed by the treatment T_6 (0.5% urea (30 DAS) + 0.5% $CaNO_3$ (45 DAS) i.e. 21.81, while the minimum number of nodes per plant was observed under the treatment T_1 (Control) i.e. 19.03. Akanbi *et al.*, (2010) [12] reported that the number of nodes per plant increased when fertilizer rate increased up-to 75kg N/ha.

Fruit length (cm)

The maximum fruit length was observed under the treatment T_7 (0.5% urea (30 DAS) + 1% $CaNO_3$ (45 DAS) i.e. 14.09 cm, which was at par with the treatment T_8 (0.5% urea (30 DAS) + 0.5% KNO_3 (45 DAS) i.e. 13.33 cm, while the minimum fruit length was observed under the treatment T_1 (Control) i.e. 11.25 cm. This increase in fruit length may be due to the sufficient supply of nitrogen to the plants for the development of growth and yield characters. The increase in fruit length due to the effect of nitrogen application was reported by Abassi *et al.*, (2012) [14] where highest okra fruit length (9.1cm) was obtained with foliar application of nitrogen source. Similar findings were also reported by Phillip *et al.*, (2010) [15] and Khan *et al.*, (2013) [8] in okra plant.

Fruit width (cm)

The maximum fruit width was observed under the treatment T_7 (0.5% urea (30 DAS) + 1% $CaNO_3$ (45 DAS) i.e. 6.24 cm, which was at par with the treatment T_8 (0.5% urea (30 DAS) + 0.5% KNO_3 (45 DAS) i.e. 6.04 cm, while the minimum fruit width was observed under the treatment T_1 (Control) i.e. 4.45 cm. Almost similar increase in fruit width due to application of nitrogen source was reported by Yassen *et al.*, (2011) [16] in potato and Khan *et al.*, (2007) [17] in onion. Increased in fruit size and weight may be due to the adequate supply of nitrogen to the plants. This improved their vegetative growth, synthesis and

translocation of photosynthesis from the source to sink, thus resulting in significant increase in number, weight and size of fruits, i.e. the yield and yield components of the plant.

Fresh weight of fruit (g)

The maximum fresh weight of fruit was observed under the treatment T_7 (0.5% urea (30 DAS) + 1% $CaNO_3$ (45 DAS) i.e. 26.24 g, which was at par with the treatment T_8 (0.5% urea (30 DAS) + 0.5% KNO_3 (45 DAS) i.e. 25.19 g, while the minimum fresh weight of fruit was observed under the treatment T_1 (Control) i.e. 20.40 g. The findings above are in accordance with the findings of Narayanamma *et al.*, (2006) [13] in brinjal who reported that higher doses of N application lead to increase in size and weight. Similar results were also reported by Singh *et al.*, (2012) [11] in okra and Yildirim *et al.*, (2007) [18] in broccoli.

Dry weight of fruit (g)

The maximum dry weight of fruit (g) was observed under the treatment T_7 (0.5% urea (30 DAS) + 1% $CaNO_3$ (45 DAS) i.e. 18.32 g, followed by the treatment T_8 (0.5% urea (30 DAS) + 0.5% KNO_3 (45 DAS) i.e. 16.11 g, while the minimum dry weight of fruit (g) was observed under the treatment T_1 (Control) i.e. 11.09 g.

Yield per plot (kg)

The maximum yield per plot was observed under the treatment T_7 (0.5% urea (30 DAS) + 1% $CaNO_3$ (45 DAS) i.e. 20.58 kg/plot, which was at par with the treatments T_6 (0.5% urea (30 DAS) + 0.5% $CaNO_3$ (45 DAS) i.e. 18.99 kg/plot, while the minimum yield per plot was observed under the treatment T_1 (Control) i.e. 11.38 kg/plot.

Yield per ha (q/ha)

The maximum yield per ha was observed under the treatment T_7 (0.5% urea (30 DAS) + 1% $CaNO_3$ (45 DAS) i.e. 175.26 q/ha, which was at par with the treatments T_6 (0.5% urea (30 DAS) + 0.5% $CaNO_3$ (45 DAS) i.e. 158.26 q/ha, while the minimum yield per ha was observed under the treatment T_1 (Control) i.e. 97.19 q/ha.

Table 1: Impact of foliar nitrogenous source on growth and yield of okra

Treat.	Plant height (cm)		Number of leaves per plant		Number of branches/plant at 75 DAS	Number of nodes per plant	Fruit length (cm)	Fruit width (cm)	Dry weight of fruit (g)	Yield per plot (kg)	Yield per ha (q/ha)
	45 DAS	75 DAS	45 DAS	75 DAS							
T_1	32.95	66.77	10.33	19.84	9.43	19.03	11.25	4.45	11.09	11.38	97.19
T_2	34.22	67.08	10.60	21.33	9.87	20.71	12.85	5.34	14.24	16.09	134.12
T_3	35.08	67.82	10.67	23.03	10.24	20.98	12.54	5.30	14.42	16.75	139.56
T_4	35.49	68.47	10.73	23.18	10.30	21.22	13.05	5.50	15.74	16.88	140.69
T_5	35.66	69.45	10.87	23.62	10.43	21.43	13.22	5.55	15.94	17.45	151.20
T_6	38.07	71.36	13.33	26.41	12.80	21.81	13.23	6.04	15.72	18.99	158.26
T_7	38.63	71.98	13.68	28.01	12.86	22.12	14.09	6.24	18.32	20.58	175.26
T_8	37.76	70.51	12.91	25.73	12.80	21.61	13.33	6.04	16.11	18.51	154.27
T_9	36.84	70.41	11.80	24.55	11.33	21.45	12.96	5.99	16.10	18.29	152.38
S.Em.±	0.970	0.041	0.576	0.800	0.030	0.031	0.266	0.302	0.631	0.710	5.104
CD at (5%)	2.907	0.122	1.727	2.399	0.089	0.093	0.798	0.906	1.893	2.130	15.302

Conclusion

The application of T_7 (0.5% urea at 30 DAS + 1% $CaNO_3$ at 45 DAS) proved to be the most effective treatment, enhancing vegetative growth and yield components in okra plants.

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