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Effect of spacing and nitrogen levels on growth and seed yield of okra

N. Soni, S.G. Bharad *, V.S. Gonge, D. R. Nandre and S. M. Ghawade
University Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, AKOLA (M.S.) INDIA

ABSTRACT
During the *kharif* season 2004 a field study was conducted at Akola (M.S.) to asses the seed yield potential and growth parameters of okra variety 'Akola Bahar' under variable spacing and different levels of nitrogen. The linear vegetative growth contributing character viz. plant height and number of internodes recorded maximum value under closer spacing (45 x15 cm) with higher dose of nitrogen (150 kg ha^{-1}). The however, horizontal vegetative growth contribution characters number of leaves and growth contributing characters number of leaves and number of branches found the maximum under wider spacing (45 x45 cm) with an application of 125 kg ha^{-1}. Seed yield per plant was found maximum under wider spacing (45 x 45 cm) while, on hectare basis it was found maximum under closer spacing (45x 15 cm). But the need per hectare and per plant found maximum with higher dose of nitrogen (150 kg N ha^{-1}).

Key words: Okra, Spacing and Nitrogen

INTRODUCTION

Okra (*Abelmoschus esculentus* (L.) Moench) is one of the important vegetable crop of India and it can be cultivate through the year. In India, the area under okra is 0.35 million ha which produced 3.5 million tonnes of fruits with an average productivity of 9.7 q per ha (Anon., 2004). It enjoys an important place among the different vegetable grown in Maharastra particularly during the rainy season. Beside its use as vegetable, stem and roots can also used in paper industry. Amongst the various factors contributing to low yield, improper cultivation practices like uneven spacing and nutritional imbalance is most important factors, which directly affects the growth and yield. Therefore, the present study was undertaken to assess the seed yield potential and other growth character of variety 'Akola Bahar' under variable spacing and different nitrogen doses with agro-climatic conditions of Akola.

MATERIALS AND METHODS

The trial was conducted at Main Garden, University Department of Horticulture, Dr. PDKV, Akola (MS) during *Kharif* season of 2004. The experiment was laid in split plot design with four replications. The treatments constituted the four spacing treatments as a main plot (60 x 30 cm (S_1), 45 x 45 cm (S_2), 45 x 30 cm (S_3), 45 x 15 cm (S_4)) and five levels of nitrogen as a subplot (0 kg ha^{-1} (N_0), 75 kg ha^{-1} (N_1), 100 kg ha^{-1} (N_2), 125 kg ha^{-1} (N_3), 150 kg ha^{-1}(N_4)). Seeds of variety Akola Bahar was sown 24th June, 2004 as per spacing treatments in the flat bed. Well-decomposed FYM @ of 250 q ha^{-1} was applied at the time of field preparation. Full dose of phosphorus (50 kg P_2O_5 ha^{-1}) and potash (50 kg K_2O ha^{-1}) and half dose of nitrogen (as per treatment) was given at the time of sowing as basal dose and remaining half dose of nitrogen was applied 30 days after sowing. Plants which were randomly selected and tagged in each treatment plot for recording observations of plant height, number of leaves per plant, number of branches per plant, leaf area and number of internodes as growth parameter while, seed yield per plant and seed yield per hectare use as the seed yield parameter of observation.

RESULTS AND DISCUSSION

Growth characters:

Height of plant:

The data in Table 1 revealed that, the effect due to different plant spacing on height of plant was found to significant. The treatment S_4 (45 x 15 cm) significantly superior over all other treatments with the maximum height of plant (117.83 cm). However, the minimum height (96.29 cm) was recorded under the treatment S_1 (60 x 30 cm). Similar results were obtained by Kuwar *et al.* (2001) and Singh *et al.* (2004) in okra crop.

In case of nitrogen, the treatment N_4 (150 kg ha^{-1}) produced significantly the maximum plant height (110.66 cm) and it was found at par with nitrogen level 125 kg ha^{-1} (108.56cm). While, the minimum plant height (102.26 cm) recorded in the treatment N_0. These results are in conformity with the findings of earlier worker like Sontakke *et al.* (1996) and Shankhe *et al.* (2003) in okra.

The interaction effects due to spacing and nitrogen levels on plant height was found to be significant, the maximum height of pant (121.23 cm) recorded with the treatment combination S_4N_4. The minimum height of plant (92.10 cm) recorded with the treatment combination S_1N_0. The favourable effect of spacing and nitrogen in promoting the growth of plant in terms of height of plant might be due to the fact that, closer plant spacing have higher plant density which creates competition among the population for light and resulted in to increased in plant height. Amongst the nutrients, nitrogen have the property to enhance the vegetative growth and capacity of plant to utilize the greater amount of nitrogen with increasing dose. This might be due to the higher utilization of nitrogen but in the closer spacing there is no scope for horizontal spread so it might have resulted in the increase in plant height. These results are confirmed due to the findings of earlier workers Birbal *et al.* (1995) in okra.

Levels per plant:

The leaves per plant (31.20) were found maximum in the treatment S_2 (45 x 45 cm) and were found at par with the treatment S_1 (60 x 30 cm). However, minimum leaves per plant (28.37) were recorded in the treatment S_4 (45 x 15 cm). Wider spacing provided more space for growth, which increased the number of branches per plant, and ultimately increases the number of leaves per plant. These observations are in agreement with the findings of Singh (2004) in okra.

The treatment N_3 (125 kg ha-1) recorded maximum leaves per plant (33.96) and it was at par with N_4 (33.26). However, minimum leaves per plant (25.74) were recorded in the treatment N_0. An increase in nitrogen supply induced more leaves per plant. This might be due to nitrogen had influenced the vegetative growth of the plant. Sontakke *et al.* (1996) found similar results in okra.

The interaction effects due to spacing and nitrogen levels on leaves per plant were found to be non- significant.

Branches per plant :

The number of branches per plant (5.12) were found to be the maximum with the treatment S_2 and was found at par with the treatment S_1 (5.11). However, minimum number of branches per plant (4.27) were recorded in the treatment S_4. More number of branches per plant under the wider spacing might be due to, in wider spacing the individual plant get plenty of light and more nutrients

***Author for correspondence**

Table 1: Plant height of okra influenced by different spacing and nitrogen levels

Treatment	Height of plant (cm) Nitrogen					
Spacing	N_0	N_1	N_2	N_3	N_4	Mean
S_1	92.10	94.08	96.25	98.50	100.53	96.29
S_2	97.55	99.30	101.33	103.98	105.68	101.57
S_3	104.85	107.48	107.98	111.15	115.25	109.34
S_4	114.55	116.45	116.28	120.63	121.23	117.83
Mean	102.26	104.33	105.46	108.56	110.67	--

Interaction (Spacing x Nitrogen)

	S	N	S x N
'F' test	Sig.	Sig.	Sig.
SE(m)±	1.25	1.36	2.72
CD at 5%	3.99	3.87	7.74

in comparison to closer spacing which have resulted into better performance in terms of number of branches per plant. Similar results were obtained by Birbal *et al.* (1995) and Singh (2004) in okra.

The treatment N_3 (125 kg ha^{-1}) showed significantly superior over all other spacing treatments and produced the maximum number of branches per plant (5.48). However, N_0 recorded minimum number of branches per plant (4.38). An application of nitrogen significantly enhanced the plant growth and through its beneficial effects, which in turn resulted in an increase in number of branches per plant. The maximum number of branches per plant with increase dose of nitrogen were recorded by Birbal *et al.* (1995) in okra.

Interaction effects due to spacing and nitrogen levels on number of branches per plant were found to be non- significant.

Leaf area :

Significantly the maximum leaf area (236.38 cm^2) was recorded with spacing S_2 (45 x 45 cm) which was found at par with the treatment S_1 (223.16 cm^2) whereas, minimum leaf area (215.88 cm^2) was noted in the treatment S_4. Wider spacing recorded the maximum leaf area. This type of behaviour of okra plant under various treatments may be explained on the basis of the fact that, plants spaced at wider spacing get the advantage of better sunshine and optimum space for uptake of nutrient as compared to close spaced plants. The above results are similar to Kuwar *et al.* (2001) in okra.

The data presented in Table 2 indicate that, significantly the maximum leaf area (238.77 cm^2) was recorded with the treatment N_4 which was found at par with the treatments N_3 (234.01 cm^2) and N_2 (226.08 cm^2). However, nitrogen level N_0, which showed minimum leaf area (206.68 cm^2) and was found at par with N_1 (211.87 cm^2). The higher dose of nitrogen enhances the leaf area because nitrogen enhances the growth of plant. Similar results were observed by Paliwal *et al*. (1999) in okra plant.

Interaction effects due to spacing and nitrogen levels on leaf area of okra were found to be non-significant.

Number of internodes :

From the data presented in Table 2 revealed that, spacing showed significant effect on the number of internodes. The highest number of internodes (19.90) were recorded in the closer spacing treatment S_4 (45 x 15 cm) that was found significantly higher than S_2 (16.58), which gave minimum number of internodes. However, it was found at par with S_3 (19.79) and S_1 (18.17). This seems to be due to mutual shedding because of dense population. This might have decreased the availability of light to the plants. The reduced

Table 2: Growth characters and seed yield of okra as influenced by different spacings and nitrogen levels

Treatment	Number of leaves per plant	Number of branches	Leaf area (cm^2)	Number of internode	Seed yield per plant (g)	Seed yield per hectare (q)
Spacing (S)						
S_1 (60 x 30 cm)	29.90	5.11	223.16	18.17	19.06	11.41
S_2 (45 x 45 cm)	31.20	5.12	236.38	16.58	21.37	10.85
S_3 (45 x 30 cm)	28.63	4.81	218.50	19.79	17.88	12.75
S_4 (45 x 15 cm)	28.37	4.27	215.88	19.90	17.49	13.51
'F' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m)±	0.44	0.07	4.59	0.73	0.22	0.15
CD at 5%	1.41	0.21	14.70	2.35	0.72	0.48
Nitrogen (N)						
N_0 (0 kg ha^{-1})	25.74	4.38	206.68	16.29	16.43	10.94
N_1 (75 kg ha^{-1})	28.01	4.73	211.87	17.39	17.42	11.93
N_2 (100 kg ha^{-1})	29.56	4.65	226.08	18.48	19.08	12.08
N_3 (125 kg ha^{-1})	33.96	5.48	234.01	19.55	20.13	12.57
N_4 (150 kg ha^{-1})	33.26	4.90	238.77	21.34	21.70	13.14
'F' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m)±	0.57	0.17	5.72	0.90	0.28	0.16
CD at 5%	1.61	0.47	16.30	2.56	0.81	0.46
Interaction (S x N)						
'F' test	NS	NS	NS	NS	NS	NS
SE (m)±	0.86	0.33	11.45	1.80	0.56	0.31
CD at 5%	--	--	--	--	--	--

light intensity at the base of plant stem might have accelerated elongation of lower internodes resulting in greater plant height which is directly related to number of internodes on main axis of plant. Similar results are obtained by Singh (2004) in okra.

The data presented in Table 2 showed that, the number of internodes had significant effect of nitrogen. The nitrogen level N_4 (150 kg ha^{-1}) produced maximum number of internodes (21.34), which was significantly higher than other treatments except N_3 (19.55), which found at par. Whereas, minimum number of internodes (16.29) were recorded under the control treatment (N_0). It may be due to the fact that, an application of nitrogen accelerates the synthesis of chlorophyll and amino acids, which are associated with major plant processes.

Interaction effects due to spacing and nitrogen levels on the number of internodes were found to be non- significant.

Seed yield :

The data presented in Table 2 indicated that, the effect of different spacing on seed yield per plant and per hectare was found significant. Maximum weight of seed per plant (21.37 g) was found with the spacing S_2 and minimum weight of seed (17.4 g/plant) was found with the spacing S_4. However, the maximum seed yield per hectare (13.51q) was recorded with the treatment S_4 and lowest seed yield per hectare (10.85 q) was associated with the treatment S_2 (45 x 45 cm). It might be due to, plants under lower plant densities failed to compensate for the loss incurred in yield due to low plant densities over all vegetative growth and seed yield per plant, which have recorded the maximum values. Therefore, the higher seed yield per plot and per hectare under the higher plant densities was attributed due to significantly more number of plants per unit area. The results are in conformity with the results of Singh (2004) in okra.

Effect of nitrogen on seed yield per hectare and per plant was found to be significant. It was observed from the Table 2 that, maximum seed yield per hectare (13.14 q) and per plant (21.07 q) was found with the application of 150 kg ha^{-1}. However, minimum seed yield per hectare (10.94 q) and per plant (16.43 g) was obtained in the treatment N_0(control). An application of nitrogen has also been reported for more vigour of plant and utilization of proteinous metabolites for development of new tissues. Thus, in the present investigation an application of the higher dose of nitrogen enhanced the seed yield per plant and per unit area. Similar results were observed by Amjad *et al.* (2002).

From the outgoing discussion it can be conducted that, closer spacing (45 x 15 cm) and higher dose of nitrogen (150 kg ha^{-1}) best suited the for seed production of okra variety 'Akola Bahar'.

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