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Effect of dates of sowing and nitrogen levels on growth and yield of okra

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ABSTRACT

A field study was conducted at COA, Bikaner to elucidate the effect of dates of sowing and nitrogen levels on growth and yield in okra (Varsha Uphar) during *kharif*, 2014. Results indicated a remarkable significant influence on all the vegetative growth attributes, flower characters and yield parameters in different dates of sowing and levels of nitrogen. The maximum plant height (96.92 cm), number of fruit per plant (17.28), length of fruit at harvest (18.03 cm) and fresh fruit yield (83.44 qha^{-1}) were recorded under 20th July sowing as compared to other sowing dates. Similarly, in respect to earliness *i.e.*, days to plant emergence (9.27) and days to first flowering (37.00) were observed under 20th July sown crop. The superiority of 20th July sown crop is further manifested by higher net return (Rs. 82308.83 ha^{-1}) and B: C ratio (3.38). Application of 100 per cent RDN recorded significantly higher plant height (96.59 cm), number of fruits per plant (18.08), length of fruit at harvest (18.13 cm) and fresh fruit yield (91.64 q ha^{-1}). However, with respect to earliness *i.e.*, days to first flowering (36.33) was minimum with no nitrogen. Significantly higher net return (Rs. 93484.77 ha^{-1}) and B:C ratio (3.69) was recorded due to application of 100 per cent recommended dose of nitrogen. While 125 per cent RDN gave at par values of all these parameters. Whereas, application of different levels of N had no significant effect on plant emergence. The treatment combination of 20th July sowing date + 100 per cent RDN resulted in higher values for plant height (99.56 cm), number of fruits per plant (20.42) and fresh fruit yield per hectare (95.09 q ha^{-1}).

Key words: Okra, Nitrogen, Sowing dates, Growth, Yield, RDN, Net returns.

Okra [*Abelmoschus esculentus* (L). Moench] is one of the most important vegetable crops of both summer as well as rainy season in India. It is cultivated throughout the country for its immature pods which can be harvested over a relatively long period of time. If pods are allowed to mature on the plant, flowering will be reduced and further pod production will be hindered. It is a nutritious vegetable which plays an important role in meeting the demand of vegetables in the country when vegetables are scanty (Ahmed, 1995). Sowing time has a significant impact on growth, yield and quality of okra. Different cultivars require different climatic condition as well as different sowing time and a good cultivars sown at improper time give poor yield. Sowing date has a great impact on seed yield and quality of okra (Moniruzzaman *et al*., 2007). Due to change in agro climatic conditions, periodic evaluation of planting dates is of urgent need. Olasantan and Olowe (2006) reported that sowing dates significantly affects on vegetative growth, flowering, fruiting and harvesting stages. It is also well documented that the growth and yield of crop are greatly influenced by a wide range of nutrients. Therefore, adequate supply of nutrients, especially nitrogen is often considered important for realizing the maximum yield of any crop. Nitrogen had significant effects on plant height, number of leaves and branches per plant, number of fruits per plant, fresh fruit weight and total fresh fruit yield of okra (Uwah *et al*., 2010). An adequate supply of nitrogen is essential for vegetative growth and desirable yield (Sajjan *et al.*, 2002). Keeping these facts in view, a field experiment was conducted to find out the effect of dates of sowing and nitrogen levels on growth and yield of okra.

The study was conducted during *Kharif* - 2014 at College of Agriculture, S. K. Rajasthan Agricultural Univer sity, Bikaner which is situated at an altitude of 234.7 m above mean sea level and latitude of 28° 01' N and longitude of 73° 22' E. The analysis of soil of the experi mental field revealed that it was loamy sand in texture, slightly alkaline in reaction and poor in organic carbon. There were 12 treat ment combinations comprising of three dates of sowing (5th July, 20th July and 4th August) with four nitrogen levels (control, 75 % RDN, 100% RDN and 125% RDN). The test variety was Varsha Uphar. The experiment was laid out in the split plot design with four replications. Total numbers of plots were forty eight. The different dates of sowing were taken in main plot and nitrogen levels in the sub-plots. The treatments were randomly allotted to different plots using random number table of Fishers and Yates (1963). A uniform basal dose of 60 kg P_2O_5 ha^{-1} and 50 kg K_2O ha^{-1} through single super phosphate and murate of potash, respectively, was applied at the time of sowing and doses of N was applied in the form of urea as per treatments. The recommended

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dose of Nitrogen (RDN) was 100 kg ha^{-1}. The parameters were studied during the course of the experiment were days to plant emergence, plant height (cm) at 60 DAS, days to first flowering, number of fruits per plant, length of fruit (cm) at harvest and fresh fruit yield (q ha^{-1}).

Days to plant emergence: The data pertaining to the days to plant emergence has been presented in Table 1. The results showed that different dates of sowing did not influenced the plant emergence of okra significantly. The results further indicated that application of increasing levels of nitrogen did not influenced days to plant emergence. The interaction effect of different dates of sowing and levels of nitrogen on days to plant emergence was also found non significant.

Plant height at 60 DAS: It is evident from Table 1 that plant height differed significantly under different sowing dates. Higher value of plant height (96.92 cm) was obtained when okra was sown on 20th July. The increase was 2.32 and 8.04 per cent on 20th July sown crop over 5th July and 4th August sown crops, respectively. The result further revealed that 100 per cent nitrogen level proved superior to control and 75 per cent RDN in enhancing the plant height (96.59), which was at par with that of 125 per cent RDN. The increase due to 100 per cent RDN was to the tune of 10.54 and 2.42 per cent over control and 75 per cent RDN, respectively. Data presented in table 2 revealed that the interaction effect of different dates of sowing and levels of nitrogen had significant effect on plant height. Sowing on 20th July with 100 per cent RDN recorded maximum plant height (99.56 cm) which was at par with 20th July with 125 per cent RDN and superior to remaining treatment combinations (except 5th July sown crop with 100 per cent and 125 per cent RDN). However, plant height was found minimum (84.79 cm) under 4th August sown crop with no nitrogen application.

Days to first flowering: Perusal of data in Table 1 revealed that more days were needed for appearance of first flowering when the okra seed were sown on 4th August compared to the other sowing dates *viz.* 5th and 20th July. It is further indicated that with the increasing levels of nitrogen (125 per cent RDN) delayed appearance of first flowering. First flowering was observed at 36.33, 38.08, 39.25 and 40.00 days after sowing under control, 75, 100 and 125 per cent RDN, respectively. The interaction effect of different dates of sowing and levels of nitrogen on days to first flowering was non significant.

Number of fruits per plant: A critical examination of data in Table 1 revealed that sowing of okra on 20th July proved superior in enhancing the number of fruits per plant over 5th July and 4th August sown crops. The 20th July sowing date recorded 7.70 and 36.06 per cent higher number of fruits per plant over 5th July and 4th August sown crops, respectively. Data further showed that nitrogen level of 100 per cent RDN proved superior in enhancing the number of fruits per plant over control and 75 per cent RDN, which were at par with 125 per cent RDN. The increase recorded due to 100 per cent RDN over control and 75 per cent RDN was 86.97 and 19.34 per cent, respectively. Data presented in Table 2 revealed that the interaction effect of different dates of sowing and levels of nitrogen had significant effect on fruits per plant. Date of sowing of 20th July with 100 per cent RDN recorded maximum number of fruits per plant (20.42) compared to remaining treatment combinations, but was statistically at par with same date of sowing along with 125 per cent RDN. However, number of fruits per plant was found minimum under 4th August sown crop with no nitrogen application.

Length of fruit at harvest: The data on length of fruit at harvest have been presented in Table 1. The result revealed that sowing of okra on 20th July proved superior in enhancing the fruit length over sowing on 5th July and 4th August. Sowing on 20th July recorded 5.32 and 16.25 per cent higher fruit length as compared to 5th July and 4th August sown crops, respectively. Data further showed that nitrogen level of 100

Table 1: Effect of different dates of sowing and levels of nitrogen on growth attributes, yield, net returns and B : C ratio of okra.

Treatments	Days to plant emergence	Plant height at 60 DAS (cm)	Days to first flowering	Number of fruits per plant	Length of fruits at harvest (cm)	Fresh fruit yield (q ha^{-1})	Net returns (Rs. ha^{-1})	B : C ratio
(A) Date of sowing								
5th July	9.36	94.72	38.31	16.03	17.12	80.71	78488.58	3.26
20th July	9.27	96.92	37.00	17.28	18.03	83.44	82308.83	3.38
4th August	9.50	89.71	39.94	12.70	15.51	75.75	71542.83	3.06
S.Em.±	0.19	0.49	0.36	0.27	0.25	0.77	1075.89	0.03
C.D. (5%)	NS	1.69	1.24	0.95	0.87	2.66	3723.08	0.11
(B) Nitrogen levels								
Control	9.60	87.38	36.33	9.67	14.52	50.00	36414.33	2.08
75% RDN	9.36	94.31	38.08	15.15	16.70	85.57	85290.25	3.47
100% RDN	9.36	96.59	39.25	18.08	18.13	91.64	93484.77	3.69
125% RDN	9.19	96.85	40.00	18.44	18.20	92.66	94597.63	3.69
S.Em.±	0.14	0.48	0.36	0.25	0.27	0.53	741.79	0.02
C.D. (5%)	NS	1.40	1.03	0.72	0.77	1.54	2152.48	0.06

Table 2: Interaction effect of different dates of sowing and levels of nitrogen on plant height at 60 DAS, number of fruits per plant and fresh fruit yield of okra.

Nitrogen levels	Plant height at 60DAS (cm)				Number of fruits per plant				Fresh fruit yield (q ha^{-1})			
	Dates of sowing				Dates of sowing				Dates of sowing			
	5th July	20th July	4th August	Mean	5th July	20th July	4th August	Mean	5th July	20th July	4th August	Mean
Control	85.75	91.60	84.79	87.38	10.51	10.51	7.72	9.67	52.60	54.45	42.95	50.00
75% RDN	95.71	96.68	90.54	94.31	15.87	16.99	12.60	15.15	86.11	88.48	82.12	85.57
100% RDN	98.60	99.56	91.61	96.59	18.68	20.42	15.15	18.08	91.50	95.09	88.35	91.64
125% RDN	98.80	99.86	91.90	96.85	18.81	21.20	15.31	18.44	92.64	95.75	89.59	92.66
Mean	94.72	96.92	89.71		16.03	17.28	12.70		80.71	83.44	75.75	
		S.Em.±	**C.D.(5%)**			**S.Em.±**	**C.D.(5%)**			**S.Em.±**	**C.D.(5%)**	
	D at N	0.84	2.43		**D at N**	0.43	1.25		**D at N**	0.92	2.66	
	N at D	0.87	2.69		**N at D**	0.45	1.44		**N at D**	1.11	3.51	

D- Dates of sowing, N- Nitrogen levels.

per cent RDN was at par with the successive level of 125 per cent RDN. It significantly improved the fruit length over control and 75 per cent RDN. The response of 100 per cent RDN was higher by 24.86 and 8.56 per cent over control and 75 per cent RDN, respectively. The interaction of different dates of sowing and levels of nitrogen on fruit length was found to be non significant.

Fresh fruit yield: A perusal of data in Table 1 showed that fresh fruit yield obtained in 20th July sown crop significantly superior to rest of sowing dates. The fruit yield under 20th July sown crop was 83.44 q ha^{-1} and it was significantly higher over 5th July (80.71 q ha^{-1}) and 4th August (75.75 q ha^{-1}) sown crops and thus proved to be the best sowing date for okra. The fresh fruit yield per ha under 20th July sown crop resulted in increased fruit yield by 3.38 and 10.15 per cent over 5th July and 4th August sown crop, respectively. Further data revealed that nitrogen level of 100 per cent RDN significantly enhanced the fruit yield of okra (91.64 q ha^{-1}) over control and 75 per cent RDN. The RDN of 100 per cent increased fresh fruit yield by 83.28 and 7.09 per cent over control and 75 per cent RDN, respectively. The RDN of 125 per cent resulted in a marginal increase of 1.11 per cent in fresh fruit yield. A critical examination of data in Table 2 revealed that the interaction effect of different dates of sowing and levels of nitrogen showed significant difference. Date of sowing of 20th July with 100 per cent RDN recorded maximum fresh fruit yield (95.09 q ha^{-1}) compared to remaining treatment combinations, but was statistically at par with same date of sowing with 125 per cent RDN. However, fresh fruit yield was found minimum under 4th August sown crop with no nitrogen application.

Net returns: The data on net returns presented in Table 1 revealed that net return of okra obtained with 20th July sowing date was significantly higher over the rest of sowing dates. The net returns under 20th July sown crop were Rs. 82308.83 ha^{-1} which was significantly higher over 5th July (Rs. 78488.58 ha^{-1}) and 4th August (Rs. 71542.83 ha^{-1}) sown crops. Sowing on 20th July proved the optimum sowing date for okra. The net return under 20th July sown crop was higher by Rs. 3820.25 ha^{-1} and Rs. 10766 ha^{-1} over 5th July and 4th August sown crops, respectively**.** Data further showed that increasing levels of nitrogen up to 100 per cent RDN significantly enhanced net returns of okra over control and 75 per cent RDN. The net return in 100 per cent RDN (Rs.93484.77 ha^{-1}) was recorded higher as compared to control (Rs. 36414.33 ha^{-1}) and 75 per cent RDN (Rs. 85290.25 ha^{-1}).

B : C ratio: The data on B : C ratio (Table 1) showed that B : C ratio (3.38) of 20th July sown crop was higher over 5th July and 4th August sown crops. The B : C cost ratio of 20th July sown crop higher by 3.68 and 10.46 per cent over 5th July and 04th August sown crops, respectively. Further, results showed that application of nitrogen up to 100 per cent RDN significantly increased the B : C ratio of okra over control and 75 per cent RDN. The B : C ratio in 100 per cent RDN (3.69) was recorded higher as compared to control (2.08) and 75 per cent RDN (3.47).

The results of present study clearly indicated that plant emergence not affected by different dates of sowing and nitrogen levels (Table 1). Whereas, plant height increased significantly when crop was sown on 20th July over rest of sowing dates. These findings clearly indicated that 20th July sowing date played a significant role in enhancing the growth of okra. Improvement in plant growth attributes with 20th July sowing date might be due to fact that too early and delayed sowing of crop adversely affected the growth by variation in maximum and minimum temperature. These results were in close conformity with Meena and Malhotra (2006) who also reported significant variation in plant height and growth due to different sowing dates in coriander. Similar finding were also observed by Gautam and Mishra (2010) and Kumar *et al.,* (2015) in okra.

Application of 125 per cent RDN recorded maximum plant height of okra, which were at par with 100 per cent RDN. This might be due to increased availability of nitrogen, resulting into better nutritional environment in

the root zone leading to better growth and development. Higher dose of N might have enhanced cell division and formation of more tissues resulting in luxuriant vegetative growth and there by increased plant height in okra (Sultana, 2002). Maximum plant height of okra was recorded with application of 100 kg N ha^{-1} by Singh *et al.*, 2007.

Minimum days to first flowering was observed under 20th July sown crop. Whereas, the maximum days for first flowering was recorded under 4th August sown. Such significant differences among the sowing dates in the vegetative and flowering traits could be attributed to air temperatures difference. Perkins *et al.* (1952) suggested that environmental factors could explain the delicate balance between vegetative growth and reproductive growth in okra. Results also revealed that the maximum days for first flowering was recorded with 125 per cent RDN which was statistically at par with 100 per cent RDN. This might have happened due to the fact that optimum dose maintained the proper nutritional environment in the root zone, balanced the physiological processes and could help in proper utilization and uptake of nutrients resulted in better vegetative growth which delayed the flowering. This is in confirmation with Shrivastava (1996) who reported that first flowering was delayed by 4-6 days with higher dose of nitrogen in sweet pepper.

The crop sown on 20th July registered significant increase in yield contributing characters *viz.*, number of fruits per plant, length of fruit and fresh fruit yield per hectare over 5th July and 4th August sown crops. The date of sowing 20th July experienced a mild climate which improved the photosynthetic activity and might have been provided better opportunity of more photosynthates in 20th July sown okra crop and helped the crop to develop the sinks to accumulate synthesized photosynthates as evident by the greater heat use efficiency of okra observed in 20th July sown crop.

The increased fresh fruit yield of okra was also as the result of increased fruit yield characters. These results resembled with the findings of Iremiren and Okiy (1986), who reported that the growing response of okra to different sowing date was not uniform. Lee (1990) also observed that pod yield of okra decreased with delay in sowing time. These findings were close confirmative with the result of Kumar *et al*. (2015) and Yadav and Dhankar (1999) in okra.

Okra yield attributes *viz*. number of fruits per plant, length of fruit and yield were significantly influenced by different levels of nitrogen. Application of 125 per cent RDN recorded maximum values of number of fruits per plant, length of fruit and yield. However, all these parameters were statistically at par with 100 per cent RDN. The increase in availability of sufficient amount of nutrients through direct addition in soil might have in turn resulted in better yield attributing traits and finally higher yield of okra. Kurup *et al.* (1997) revealed that application of N up to 100 kg ha^{-1} increased fruit length, number of fruits per plant and total green pod yield of okra cv. Kiran. These results were also in close conformity with Birbal *et al*. (1995), who reported that application of 100 kg N ha^{-1} increased the number of fruit per plant, fruit size and fruit yield of okra in comparison to control and 50 kg N ha^{-1}.

Significantly higher net return and B:C ratio of okra was obtained with 20th July as compared to 5th July and 4th August sown crop (Table 1). This increase in net return and B : C ratio were due to higher fruit yield with 20th July sown crop. Thus, there was greater increase in the value of fruit obtained from 20th July sowing over the late sown one. On the other hand, change in sowing date does not involve any extra cost as it is a non- monetary input. These findings are close confirmative with the result of Sah *et al*., (2013) in cowpea.

Significantly higher net return and B:C ratio was obtained in okra crop due to 100 kg N ha^{-1} over control and 75 per cent RDN (Table 1). This increase in net return and B:C ratio might be due to the direct influence of N application on fruit yield of okra and greater return for fruit yield in comparison to more cost incurred with the increasing levels of nitrogen. The similar results were also reported by Suthar (2009) in okra.

CONCLUSION

On the basis of results obtained in present investigation, it may be concluded that significantly higher growth and fruit yield under condition of western Rajasthan in *Kharif* okra can be obtained by 20th July sown crop with use of 100 per cent RDN. This treatment combination recorded highest net returns of Rs 93484.77 ha^{-1} with benefit cost ratio of 3.69. However, these results are only indicative and require further experimentation to arrive at more consistent and final conclusion.

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