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Effect of Spacing and Fertilizers on Yield Attributing Characters in Kakrol (*Momordica dioica* Roxb.)

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ABSTRACT

The studies on the effect of spacing and fertilizer levels on kakrol revealed that between two spacings, wider spacing at 2 x 1 m produced male / female flowers at higher nodes (12.65) and significantly higher vine length (3.42 m), fruit weight (17.83 g), number of seeds per fruit (21.22), fruit size (3.30 cm), greater number of fruits per vine (55.54) and yield per plant (1.01 kg/plant) over narrow spacing at 1 x 1 m. Among the fertilizer levels, NPK at 240 : 160 : 75 kg/ha recorded significantly higher vine length (4.22 m), lower number of nodes at which first female or male flower appeared (10.31), lesser number of days taken for flowering (60.22 days), greater number of fruits per plant (65.79), greater number of seeds per fruit (23.07), higher fruit weight (19.29g), higher fruit yield per plant (1.28 kg/plant) when compared to rest of the fertilizer levels. The interaction between spacing x fertilizer levels revealed that 240 N : 160 P : 75 K kg/ha + 2 x 1 m spacing recorded significantly higher vine length (4.69 m), weight of fruit (20.22), greater number of fruits per plant (77.50) and yield per plant (1.57 kg/plant) over 240 N : 160 P : 75 K kg/ha + 1 x 1 m.

Key words : Fertilizers, Kakrol, N P K

Kakrol (*Momordica dioica* Roxb.) (2n = 2x = 28) is a cucurbitaceous, dioecious perennial vegetable. The fruit of *M. dioica* is nutritious and recognized as diuretic and laxative possessing vitamin C. Fruits are used against diabetis, malaria, allergy and inflammatory problems. Fruits are also used to cure ulcers, piles, sores and obstruction of liver and spleen. It is good for those suffering from cough and digestive problems. The unripe fruits are sweet, oily and laxative. The seeds are used for chest problems and stimulate urinary discharge. The root contains a triterpenoid saponin which can be used as substitute for soap. It cures piles, migraine, excess sweating and cough (Ram *et al.,* 2001). Regarding production technology, not much information is available. Therefore, the present investigation was carried to find out the suitable spacing and fertilizer level to improve the yield in kakrol.

MATERIAL AND METHODS

The present investigation was carried out at Agricultural Research Institute, Rajendranagar, Hyderabad from June 2005 to November 2006. The experiment was carried out with two spacings *i.e.,* S_1 : 2 x 1 m and S_2 : 1 x 1 m and six fertilizer levels *i.e.,* F1 : 15:10:15 NPK kg/ha, F2 : 30:20:30 NPK kg/ha,F3 : 60:40:45 NPK kg/ha,F4 : 120:80:60 NPK kg/ha,F5 : 240:160:75 NPK kg/ha and F6 : Control, each replicated four times using factorial RBD as suggested by Panse and Sukhatme (1967). FYM @ 25 t/ha was incorporated into the soil in the experimental plot before sowing. Nitrogen in the form of urea, phosphorus in the form of single super phosphate and potassium in the form of muriate of potash were applied according to their levels and thoroughly incorporated into the soil. Nitrogen was applied in three split doses. One third was applied as basal and remaining in two splits on 20^{th} day and 50^{th} day after tuber sprouting. Entire dose of phosphorus was applied as basal dose. Potassium was applied in two split doses, half as basal and remaining half as top dressing on 20^{th} day after tuber sprouting. The observations were recorded on length of the vine, number of node at which male/female flower appear,number of days taken for first flowering,number of fruits per plant,fruit size,fruit weight,number of seeds per fruit and yield per plant.

RESULTS AND DISCUSSION

In the present experiment, vine length was significantly affected due to different spacings and fertilizers at different levels. Between two spacings, 2 x 1 m (3.42 m) recorded significantly higher vine length over 1 x 1 m (2.77 m). The percentage of increase in vine length with 2 x 1 m spacing was 23 per cent over 1 x 1 m spacing. This could be due to availability of more space, nutrients, water and less competition from the adjacent plants when compared to closer spaced plants (Table). Pandey *et al.* (1994) reported increased plant height at wider spacing compared to closer spacing in okra.

The vine length in general increased markedly with increase in levels of fertilizers from 2.13 m with control to 4.22 m with 240N:160P:75K Kg/ha. Among different levels of fertilizers, 240N:160P:75K Kg/ha (4.22m) recorded significantly higher vine length. The increase in vine length at higher levels of nitrogen could be due to higher uptake of nitrogen. Nitrogen is an important component of protoplasm and its favourable effect on chlorophyll content of leaves might have increased synthesis of carbohydrates, amino acids etc. from which the phytohormones such as auxins, gibberellins, cytokinins and ethylene have been synthesized resulting in increased plant height. While reduced growth with control might be due to increase in ABA content and very minimal production of auxins and cytokinins. Under the conditions of nitrogen deficiency, the ABA content increased sharply in all parts of the shoot, root and xylem exudates. The nitrogen also has the most prominent effect on gibberellic acid levels. Krauss and Marschner (1982) reported that an interruption of nitrogen supply induced a sharp drop in gibberellic acid of the shoots associated with sharp increase in the ABA levels and after restoration of nitrogen supply, the gibberellic acid increased and ABA decreased resulting in normal growth. Suresh and Pappiah (1991) in bittergourd and Premalakshmi *et al.* (1997) in gherkins also reported increased plant height with increase in fertilizer levels.

The number of node at which first female/ male flower appeared also significantly affected with the fertilizer levels and spacing. Between two spacings, the first female/male flower appeared at lower nodes in case of 1 x 1 m spacing (12.15) than in 2 x 1 m (12.65) spacing. Among different levels of fertilizers, the first female/male flower appeared at lower nodes with 240N:160P:75K Kg/ha (10.31)(Table). The number of days taken for first flower appearance in the present study was found not significant. Among the fertilizer levels, 240N:160P:75K Kg/ha (70.65) took lower number of days for flowering. There was hastening of flowering with higher level of nutrients(Table). There were divergent views on the effect of nitrogen on flowering. The increased vegetative growth due to increased nitrogen level might have helped to produce more photosynthates and flowering stimulus, thus causing early flowering. The increased nitrogen levels stimulated early flowering may be contradictory to the general belief that the plant would normally in vegetative phase with delaying the blooming as also reported by Umamaheswarappa *et al.* (2002) in bottlegourd.

The data recorded on number of fruits per plant revealed significant differences between the spacing, fertilizer levels and their interaction(Table). Between two spacings, the wider spacing at 2 x 1m (55.54) recorded greater number of fruits per plant than 1 x 1 m (39.13). The increase in number of fruits per plant in wider spacing could be due to more vegetative growth. Maya *et al.* (1997) in sweet pepper reported greater number of fruits per plant at wider spacings than at narrow spacing. Among interaction effect, 2 x 1 m +240N:160P:75K Kg/ha (77.50) recorded greater number of fruits than rest of the treatment combinations. Among fertilizer levels, 240N:160P:75K Kg/ha recorded (65.79) greater number of fruits over rest of the treatments. The number of fruits per plant ranged from 23.54 with control to 65.79 with 240N:160P:75K Kg/ha as also reported by Suresh and Pappiah (1991) in bittergourd and Premalakshmi *et al.* (1997) in gherkins.

Fruit weight was significantly affected due to different spacings and application of fertilizers at different levels. Between two spacings, 2 x 1 m recorded significantly higher fruit weight (17.83g) over 1 x 1 m (15.56g) (Table). Among fertilizer levels, the fruit weight ranged from 13.53g with control to 19.29g with 240N:160P:75K Kg/ha. Among interaction effects, 2 x 1 m + 240N:160P:75K Kg/ ha (20.22g) recorded higher value when compared to all other treatment combinations. The increase in fruit weight in wider spacing and higher fertilizer levels could be attributed to less competition for nutrient uptake, light and there by such plants were able to absorb more nutrients and water at wider spacing from the soil. This might have resulted in the production of relatively fruits of more weight . Suresh and Pappiah (1991) in bittergourd, Umamaheswarappa *et al.* (2002) in bottle gourd, Pandey *et al.* (1994) in okra and Maya *et al.* (1997) in sweet pepper also reported increased fruit weight at wider spacing and higher fertilizer levels than at narrow and lower fertilizer levels.

A significant difference in number of seeds per fruit and fruit size were observed due to different spacings and fertilizer levels. Between two spacings, the number of seeds per fruit were significantly higher at 2 x 1 m (21.22) spacing than at 1 x 1 m spacing (18.09) (Table). Among fertilizer levels, number of seeds per fruit ranged from 13.97 with control to 23.07 with 240N:160P:75K Kg/ha which was on par with 120N:80P:60K Kg/ha 22.12)

Table. Effect of spacings and fertilizer levels on length of the vine (m) at the final harvest, number of node at which first female/male flower appear, days taken for flowering, number of fruits plant^{-1}, fruit weight, number of seeds fruit^{-1}, fruit size and yield plant^{-1} in kakrol.

Spacings/ Fertilizer levels	Length of the vine			Number of node			Days taken for flowering		
	S_1 2 x 1 m	S_2 1 x 1 m	Mean	S_1 2 x 1 m	S_2 1 x 1 m	Mean	S_1 2 x 1 m	S_2 1 x 1 m	Mean
F_1 15:10:15 NPK Kg/ha	2.37	2.13	2.25	13.08	12.79	12.93	68.70	71.05	69.87
F_2 30:20:30 NPK Kg/ha	3.08	2.47	2.77	13.00	12.40	12.70	64.76	62.64	63.70
F_3 60:40:45 NPK Kg/ha	3.48	2.92	3.19	12.91	12.78	12.85	62.26	63.95	63.11
F_4 120:80:60 NPK Kg/ha	4.62	3.38	3.99	12.20	12.06	12.13	60.35	60.34	60.35
F_5 240:160:75 NPK Kg/ha	4.69	3.74	4.22	10.44	10.19	10.31	59.78	60.67	60.22
F_6 Control	2.27	1.98	2.13	14.25	12.67	13.46	69.24	72.05	70.65
Mean	3.42	2.77		12.65	12.15		64.18	65.11	

	F-test	S.Ed	CD (0.05)	F-test	S.Ed	CD (0.05)	F-test	S.Ed	CD (0.05)
S (Spacings)	*	0.056	0.115	*	0.181	0.369	NS	0.513	1.047
N (Nutrient levels)	*	0.097	0.198	*	0.313	0.640	*	0.888	1.813
S x N	NS	0.137	0.280	NS	0.443	0.905	NS	1.255	2.564

* = Significant at 5% level of significance NS - Non-significant

Number of fruits plant^{-1}			Fruit weight			Number of seeds fruit^{-1}			Fruit size			Yield plant^{-1}		
S_1 2 x 1 m	S_2 1 x 1 m	Mean	S_1 2 x 1 m	S_2 1 x 1 m	Mean	S_1 2 x 1 m	S_2 1 x 1 m	Mean	S_1 2 x 1 m	S_2 1 x 1 m	Mean	S_1 2 x 1 m	S_2 1 x 1 m	Mean
28.28	22.72	25.49	16.40	13.48	14.94	18.66	15.57	17.11	2.96	2.67	2.81	0.46	0.30	0.38
54.47	44.57	49.52	17.43	15.42	16.43	22.74	17.89	20.31	3.39	3.04	3.21	0.95	0.69	0.82
71.25	42.42	56.84	18.68	16.64	17.66	22.64	20.12	21.38	3.53	3.22	3.37	1.33	0.71	1.02
75.50	50.15	62.83	19.38	17.30	18.34	23.40	20.84	22.12	3.69	3.39	3.54	1.46	0.87	1.17
77.50	54.08	65.79	20.22	18.36	19.29	24.45	21.68	23.07	3.72	3.42	3.57	1.57	0.99	1.28
26.25	20.83	23.54	14.88	12.18	13.53	15.45	12.49	13.97	2.53	2.39	2.46	0.31	0.25	0.28
55.54	39.13		17.83	15.56		21.22	18.09		3.30	3.02		1.01	0.64	

F-test	S.Ed	CD (0.05)	F-test	S.Ed	CD (0.05)	F-test	S.Ed	CD (0.05)	F-test	S.Ed	CD (0.05)	F-test	S.Ed	CD (0.05)
*	0.273	0.557	*	0.216	0.441	*	0.631	1.288	*	0.062	0.127	*	0.04	0.08
*	0.472	0.965	*	0. 374	0.765	*	1.093	2.231	*	0.107	0.219	*	0.07	0.15
*	0.668	1.365	*	0.529	1.081	NS	1.545	3.155	NS	0.152	0.310	*	0.11	0.22

* = Significant at 5% level of significance NS - Non-significant

and 60N:40P:45K Kg/ha (21.38). The fruit size was also higher at 2 x 1 m (3.30cm) spacing than at 1 x 1 m spacing (3.02cm) (Table). Among fertilizer levels, it ranged from 2.46cm with control to 3.57cm with 240N:160P:75K Kg/ha which was on par with120N:80P:60K Kg/ha (3.54cm) and 60N:40P:45K Kg/ha (3.37cm). As the levels of spacing and plant nutrients increased the number of seeds and fruit size also increased. The increase in fruit size at wider spacing and higher fertilizer level could be attributed to the availability of carbohydrates in plenty and translocation of carbohydrates from source to sink. Sharma (2001) in paprika reported increased fruit size at wider spacing and higher fertilizer levels than at narrow and lower fertilizer levels.

Yield per plant (kg/plant) was significantly affected due to different spacings and fertilizers. Between two spacings, 2 x 1 m (1.01kg/plant) recorded significantly higher yield over 1 x 1 m (0.64kg/plant) (Table). Among fertilizer levels, yield per plant ranged from 0.28kg/plant with control to 1.28kg/plant with 240N:160P:75K Kg/ha. Among interactions, 2 x 1 m + 240N:160P:75K Kg/ha (1.57kg/plant) recorded higher yield which was on par with 2x1m+ 120N:80P:60K Kg/ha (1.46kg/plant). This could be explained that presence of one element modifying the presence of others, although they may not show their effects individually. These results indicated that the efficiency of nitrogen increased considerably by a simultaneous application of phosphorus and potassium. Improvement of vegetative growth and fruiting could be due to combined application of nitrogen, phosphorus and potassium. The fruit yield per plant in terms of number and total weight of fruits was more in wider spaced plants compared to narrow spaced plants could be due to more number of branches, leaf area, availability of nutrients, light, water and less competition from adjacent plants as also reported by Umamaheswarappa *et al.* (2002) in bottlegourd and Choudhary *et al.* (2007) in capsicum.

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