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Total Drymatter Production, N and K Contents of Okra (*Abelmoschus esculentus* L.) at Harvest as Influenced by Different Levels of Nitrogen and Potassium

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ABSTRACT

A field experiment was conducted during kharif season of 2011 on a sandy loam soil (Alfisol) at Student's Farm, College of Agriculture, Rajendranagar, Hyderabad with a view to study the effect of levels of nitrogen (0, 60, 120 and 180 kg N ha^{-1}) and potassium (0, 30, 60 and 90 kg K ha^{-1}) on pod yield, total dry matter production, total nutrient content and uptake by okra at harvest (90 DAS). Randomized Block Design (RBD) with factorial concept was followed. The pod yield of okra was significantly increased with nitrogen, potassium and their interactions. Among the different interactions (N×K), the highest pod yield (126.17 q ha^{-1}) was recorded by combined application of nitrogen @ 180 kg ha^{-1} + potassium @ 90 kg ha^{-1} (N_3K_3). Similarly the highest total dry matter production (5152.9 kg ha^{-1}), highest total N (3.38%) and K (2.97%) content and highest total N (83.83 kg ha^{-1}) and K (75.19 kg ha^{-1}) uptake were recorded with combined application of 180 kg N ha^{-1} + 90 kg K_2O ha^{-1} (N_3K_3).

Key words: *Total drymatter production, total nutrient content, total nutrient uptake, yield, okra.*

INTRODUCTION

Okra is one of the most important vegetable crops grown throughout the year which is having rich diet value, medicinal and industrial importance. In India, *Okra* is cultivated in 0.43 million hectares producing 4.54 million tonnes with a productivity of 10.4 t ha^{-1} [4]. In general crop responds well to N and K application. Okra production depends on many factors, among them judicious application of N and K plays a vital role.

Nitrogen is the first limiting nutrient in okra production that greatly influences crop growth and pod yield. The Indian soils are generally deficient in organic matter thus unable to release N at a rate required to maintain adequate N supply to the growing plant. Nitrogen is an essential constituent of various metabolically active compounds like amino acids, proteins, nucleic acids, pyrimidines, flavines, purines, nucleoproteins, enzymes, alkaloids etc[6].

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Therefore, application of nitrogen in the form of fertilizers becomes indispensable to meet the N needs of the crop. Potassium is another important plant nutrient that plays a vital role in enzyme activation, water regulations, translocaton of assimilates, photosynthesis and protein synthesis. It counteracts harmful effects of excess nitrogen in plants. The response of crop to potassium increases significantly in the presence of nitrogen[9].

Hence, keeping in view the significance of N and K on productivity of okra, an experiment was conducted to study the effect of levels of nitrogen and potassium on total dry matter production and nutrient content of okra grown on an Alfisol.

MATERIALS AND METHODS

A field experiment was conducted on a sandy loam soil (*Alfisol*) at Student's Farm, College of Agriculture, Rajendranagar, Hyderabad during *kharif* season 2011. The experiment was laid out in Randomized Block Design (RBD) with factorial concept consisting of sixteen treatment combinations with four levels each of nitrogen (N_0-0, N_1-60, N_2-120 and N_3-180 kg ha^{-1}) and potassium (K_0-0, K_1-30, K_2-60 and K_3-90 kg ha^{-1}). Nitrogen and potassium were applied in the form of urea and muriate of potash in 3 splits as per treatment combinations. A basal dose of 60 kg P_2O_5 ha^{-1} was applied in the form of single super phosphate to all the treatment plots.

The experimental soil is sandy loam in texture, slightly alkaline (pH 7.8) in reaction, non saline (0.23 dS m^{-1}), low in organic carbon (0.48 per cent) and available nitrogen (226.8 kg N ha^{-1}), medium in available phosphorus (38.63 kg P_2O_5 ha^{-1}) and potassium (278.5 kg K_2O ha^{-1}). Pod yield was recorded at different pickings. The total dry matter production, nitrogen and potassium content of okra (plants + pods) were computed at harvest.

RESULTS AND DISCUSSION

Pod yield: The levels of nitrogen, potassium and their interactions had significant effect on pod yield of okra (Table 1). The pod yield increased to an extent of 24.18 (60 kg N ha^{-1}), 50.19 (120 kg N ha^{-1}) and 68.21 per cent (180 kg N ha^{-1}) as compared to control. Similarly, K application increased the pod yield by 14.55, 37.28 and 45.09 per cent at 30, 60 and 90 kg K_2O ha^{-1}, respectively over no K application. Among the interactions, N_3K_3 has recorded the higher pod yield (126.17 q ha^{-1}) but it was on par with the yield recorded at N_3K_2 (124.83 q ha^{-1}) and significantly superior over other interactions. Yield attributes like number of flowers, number of pods per plant, size and weight of pods are governed by nitrogen [1]. Potassium also influenced the yield due to the direct or indirect involvement of potassium in major plant processes such as photosynthesis, respiration, enzyme activation and metabolism of carbohydrates[5& 8] . The increase in yield by the combined application of nitrogen and potassium may be attributed due to efficient functioning of photosynthetic surface and increased accumulation of photosynthates[11].

Total dry matter production: The effect of levels of nitrogen, potassium and their interactions were found to have significant effect on total dry matter production (Table 2) of okra (plants + pods) at harvest (90 DAS). Among the different nitrogen levels, 180 kg N ha^{-1} (N_3) has recorded significantly highest total dry matter production (4882.5 kg ha^{-1}) which was significantly superior over N_2 (4145.9 kg ha^{-1}), N_1 (3515.7 kg ha^{-1}) and N_0 (2748.5 kg ha^{-1}). With regard to potassium levels, K_3 (90 kg ha^{-1}) has recorded significantly highest total dry matter production (4234.3 kg ha^{-1}) followed by K_2, K_1 and K_0. Among the interactions, application of nitrogen @ 180 kg ha^{-1} (N_3) along with potassium @ 90 kg ha^{-1} (K_3) has recorded significantly highest total dry matter production (5152.9 kg ha^{-1}). Nitrogen being a constituent of chlorophyll resulted in increased photosynthesis which ultimately accelerated the growth[3]. Similar increase in dry matter production of okra with increasing levels of nitrogen and potassium were reported by Rani *et al*[7].

Total nutrient content and nutrient uptake: Combined application of nitrogen and potassium had synergistic effect on nutrient content (Table 3) at harvest (90 DAS). There was significant increase in total N and K contents (per cent) with application of 180 kg N ha^{-1}(N_3), the values of which found to be 3.25 and 2.87 per cent, respectively. Among the potassium levels, application of 90 kg K_2O ha^{-1} (K_3) has recorded highest K content (2.86 per cent) and N content (2.95 per cent) and were significantly superior over lower levels. With regard to interaction effects, N_3K_3 has recorded significantly highest total K (2.97 per cent) content, while the lowest content was recorded under control. However N_3K_3 was on par with N_3K_2. Whereas the interaction effect of nitrogen and potassium did not show any significant effect on total N content.

The effect of levels of nitrogen and potassium found to be significant with regard to total uptake of N and K (Table 4) at harvest (90 DAS). There was significant increase in total N and K uptake (kg ha^{-1}) with application of 180 kg N ha^{-1}(N_3), the values of which found to be 76.80 and 69.04 kg ha^{-1}, respectively. Among the potassium levels, application of 90 kg K_2O ha^{-1} (K_3) has recorded highest nutrient uptake viz., 61.67 (N), and 60.12 (K) kg ha^{-1} followed by K_2, K_1 and K_0. The per cent increase in total N and K uptake at N_3 level was 138.29 and 106.64 per cent over N_0, respectively. The total N and K uptake at K_3 level increased to an extent of 34.77 and 42.84 per cent over K_0, respectively. With regard to interaction effects, N_3K_3 has recorded significantly highest K (75.19 kg ha^{-1}) uptake while the lowest uptake was recorded under control. With regard to total N uptake, interaction between nitrogen and potassium did not show any significant effect. Okra is also heavy feeder of nutrients and requires nitrogen and potassium for vegetative growth, flowering and pod formation. Increase in total N and K uptake with increase in the levels of nitrogen and potassium were also reported by Balle *et al*[2] and Sharma *et al* [10].

It can be concluded that combined application of nitrogen @ 180 kg ha^{-1} + potassium @ 90 kg ha^{-1} (N_3K_3) contributed to higher total drymatter production, total nutrient content and uptake at harvest by okra grown on light textured red sandy loam soils (alfisols) of Telangana state.

Table 1: Effect of levels of nitrogen, potassium and their interactions on pod yield (q ha^{-1}) of okra

Levels	**Pod yield (q ha^{-1})**				
	K_0	K_1	K_2	K_3	**Mean**
N_0	50.56	57.47	73.37	81.45	**65.71**
N_1	66.26	77.48	86.52	96.16	**81.60**
N_2	80.18	92.68	109.27	112.63	**98.69**
N_3	90.01	101.13	124.83	126.17	**110.53**
Mean	**71.75**	**82.19**	**98.50**	**104.10**	

	S.Ed±	CD (0.05)
N	1.48	3.02
K	1.48	3.02
N×K	2.95	6.03

Table 2: Effect of levels of nitrogen, potassium and their interactions on total dry matter production (kg ha^{-1}) of okra (plant + pods) at harvest (90 DAS)

Levels	**Total dry matter production (kg ha^{-1})**				
	K_0	K_1	K_2	K_3	**Mean**
N_0	2322.3	2544.7	2885.6	3241.2	**2748.5**
N_1	2955.2	3453.6	3642.2	4011.7	**3515.7**
N_2	3670.1	4075.8	4306.1	4531.6	**4145.9**
N_3	4514.8	4840.7	5021.5	5152.9	**4882.5**
Mean	**3365.6**	**3728.7**	**3963.9**	**4234.3**	
	S.Ed±		CD (0.05)		
N	24.82		50.71		
K	24.82		50.71		
N×K	49.64		101.41		

Table 3: Effect of levels of nitrogen, potassium and their interactions on total N and K contents (%) in okra (plant + pods) at 90 DAS

Levels	**Total nitrogen content (%)**					**Total potassium content (%)**				
	K_0	K_1	K_2	K_3	**Mean**	K_0	K_1	K_2	K_3	**Mean**
N_0	2.24	2.34	2.52	2.49	**2.40**	2.15	2.36	2.51	2.71	**2.43**
N_1	2.60	2.68	2.77	2.83	**2.72**	2.45	2.47	2.64	2.86	**2.61**
N_2	2.92	3.02	3.08	3.10	**3.03**	2.61	2.70	2.76	2.91	**2.75**
N_3	3.15	3.20	3.27	3.38	**3.25**	2.73	2.84	2.94	2.97	**2.87**
Mean	**2.73**	**2.81**	**2.91**	**2.95**		**2.49**	**2.59**	**2.71**	**2.86**	
	S.Ed±		CD (0.05)			S.Ed±		CD (0.05)		
N	0.02		0.04			0.014		0.028		
K	0.02		0.04			0.014		0.028		
N×K	0.04		N.S.			0.028		0.057		

Table 4: Effect of levels of nitrogen, potassium and their interactions on total N and K uptake (kg ha^{-1}) by okra (plant + pods) at 90 DAS

Levels	Total N uptake (kg ha^{-1})					Total K uptake (kg ha^{-1})				
	K_0	K_1	K_2	K_3	**Mean**	K_0	K_1	K_2	K_3	**Mean**
N_0	25.23	28.87	35.71	39.11	**32.23**	24.66	29.66	35.87	43.45	**33.41**
N_1	37.31	45.20	49.32	55.52	**46.84**	35.73	42.16	47.58	56.77	**45.56**
N_2	51.71	59.54	64.21	68.20	**60.92**	47.22	54.30	58.68	65.08	**56.32**
N_3	68.79	74.94	79.63	83.83	**76.80**	60.76	67.57	72.65	75.19	**69.04**
Mean	**45.76**	**52.14**	**57.22**	**61.67**		**42.09**	**48.42**	**53.70**	**60.12**	

	S.Ed±	CD (0.05)	S.Ed±	CD (0.05)
N	0.66	1.34	0.51	1.03
K	0.66	1.34	0.51	1.03
N×K	1.31	N.S	1.01	2.07

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