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EFFICIENCY OF K AND IRRIGATION ON NUTRIENT AVAILABILITY AND UPTAKE OF NUTRIENTS IN ASH GOURD

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Abstract: A field experiment was designed to assess the effect of K on available nutrient status of the soil and uptake of nutrients by plants at different irrigation levels. The available nutrient contents of N, K and exchangeable Ca were found to be increased by the application of K while available P and exchangeable Mg content remained unaffected. Available P was more when IW/CPE ratio was 0.50. The uptake of N was significantly influenced by the application of K only at the full vegetative phase. P and K uptakes were significant both at the full vegetative phase and harvesting stage. The uptake of Ca and Mg decreased as the level of K increased except at the full vegetative phase.

INTRODUCTION

Crops in the field hardly find optimal growing conditions throughout the period from planting to harvest. Usually, their growth is impaired by one or several adverse factors, and moisture fluctuation is one among those which are very common especially under rainfed condition. Numerous experiments on growing plants in complete nutrient solutions had shown that increasing concentration of K^+ in the outer solution depresses the uptake of other cations. Similarly water stress influences the availability and mobility of many cations. Miller *et al.* (1961) reported that moderate to high levels of K generally decreased the P content and increased K content. Fong (1973) observed that the uptake of Ca and Mg was not affected by K nutrition. A typical case of K-Ca and K-Mg antagonism was reported by Monard (1976). Hence it was felt that studies with graded levels of potassium will be of some use under prolonged water stress conditions to assess the available nutrient status of the soil and uptake of nutrients.

MATERIALS AND METHODS

A field experiment was conducted to assess the effect of K under different levels of irrigation on available nutrient status of the soil and uptake of nutrients in summer vegetable, ash gourd at Vellanikkara, Trichur during the year 198-89. The experiment consisted of four levels of potassium viz., K_0, K_1, K_2 and K_3 representing 0, 75, 150 and 225 per cent of KAU package of practices recommendation (25 kg K_2O/ha) and three irrigation levels viz. I_1, I_2 and I_3 representing IW/CPE ratios 0.75, 0.50 and 0.25. The experiment was laid out in RBD and replicated thrice. N and P at the rate of 70 and 25 kg/ha respectively were also applied as urea and superphosphate. K was applied in the form of muriate of potash as per the treatments. Soil samples were collected at the full vegetative growth (S1) i.e., 35 days after planting and flowering stage (S2), i.e., 50 days after planting. Two pits from each plot were used for destructive sampling. The plant samples were collected from both stages (S1 and S2) and at the final harvest (S3).

The dried and ground plant and fruit samples were used to analyse nutrient content. The available nutrient content of the soil and N, P, K, Ca and Mg content of the plant samples were determined by standard procedures described by Jackson (1958), and Hesse (1971).

RESULTS AND DISCUSSION

Available nutrient status of the soil

Application of K showed a significant influence on the available N content of the soil during the stage2 (Table 1). Values for K, K_2 and K_3 were on par and significantly superior to K_0. The availability of N in soil decreased as the quantity of water decreased. The main effect of irrigation influenced the available P content during both stages, while the K treatments were not significant. I_2 was the superior treatment, recorded the value of 45.3 ppm and 30.6 ppm during the stage 1 and 2 respectively.

Available K content was found to progressively increasing with increase in K application during both stages. But during stage 1, K_3 which recorded an available K status of416.1 ppm, was on par with other levels of K. At stage 2, K_3 level recorded maximum value of 380.6 ppm and was significantly higher than other K levels. Effect of irrigation was significant only during stage 1. Maximum value for available K status was recorded at I_1 level (348.9 ppm K).

K had a significant influence on the exchangeable Ca content of the soil during both the stages. K_1 level was on par with K_2 at stage 1. The Ca status at K_3 (1.72 me/100g) was the lowest. During stage 2, Kj recorded the maximum value (2.57 mg/100g) followed by K_0, K_2 and K_3. Mg content of the soil increased up to K_2 level of application of K and then decreased at both stages.

Available nutrient contents of N, K and Ca were found to be increased by K application. The reports of Baker (1981) and Deb *et al.* (1976) agreed with the above findings. Irrigation at I_1 resulted in the maximum available K status. Mengel and Braunscheveig (1972) stressed the role of moisture for maximum K diffusion in soil.

Total uptake of dements

The uptake of N was not significantly influenced by any treatment at any stage except for the main effect of K during stage 1 (Table 2). Potassium applied at K_3 showed N uptake value of 26.97 and was superior to all other K levels. The available N status of the soil also increased by the application of K which in turn increased the uptake of N by the plants. The main effect of K on P uptake was significant during stage 1 and 3. Highest uptake value during stage 1 was recorded at K_3 while K application at *KQ* showed the lowest value. At harvest stage, application of K tended to reduce the P uptake and *KQ* recorded the highest value (10.42 kg/ha). Hanaway and Webber (1971) concluded that K application had no consistent effects on P accumulation. But Miller *et al.*(1961) found that K application tended to reduce the P content.

Significant difference in K uptake was observed with K levels during stage 1

Table 1. Effect of K and irrigation on soil characters

Treatment	Levels of K				Levels of irrigation		
	K_0	K_1	K_2	K_3	I_1	h	I_3
			Available N (ppm)				
S1	159	206	124	180	186	172	144
S2	143	248	252	221	256	207	186
			Available P (ppm)				
S1	42	38	25	36	32	45	29
S2	20	27	26	26	15	30	29
			Available K (ppm)				
S1	169	241	293	416	348	202	289
S2	160	189	259	380	277	226	238
			Exchangeable Ca (me/100 g)				
S1	2.17	2.86	2.50	1.72	2.48	2.10	2.35
S2	2.03	2.57	2.03	1.20	2.04	1.91	1.92
			Exchangeable Mg (me/100 g)				
S1	0.37	0.58	0.68	0.47	0.61	0.57	0.40
S2	0.36	0.49	0.50	0.34	0.48	0.42	0.36

	N		P		K		Ca		Mg	
	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
SEm	45	42	7	5	77	47	0.29	0 27	0.15	0.12
CD (0.05) K	NS	71	NS	NS	131	79	0.51	0.45	NS	NS
CD (0.05) I	NS	NS	11	8	114	NS	NS	NS	NS	NS
CD (0.05) KxI	NS	123	NS	NS	NS	137	NS	NS	NS	NS

NS = Not significant

Table 2. Effect of K and irrigation on nutrient uptake (kg/ha)

Treatment	Levels of K				Levels of irrigation		
	K_0	K_1	K_2	K_3	I_1	I_2	I_3
				N uptake			
S1	16.1	14.7	16.5	26.9	19.0	22.3	14.3
S2	17.3	21.1	24.0	18.5	22.5	18.9	19.2
S3	79.4	68.7	67.1	62.3	71.2	72.8	64.1
				P uptake			
S1	1.5	1.5	1.8	2.7	2.0	2.2	1.5
S2	2.2	2.4	2.8	2.4	2.7	2.4	2.2
S3	10.4	7.7	6.7	7.6	8.1	8.0	8.1
				K uptake			
S1	9.3	12.7	13.2	20.5	15.3	16.0	10.4
S2	13.2	17.4	19.8	17.1	18.0	16.9	15.8
S3	71.5	88.3	103.1	99.7	95.0	92.7	84.3

	N			P			K		
	S1	S2	S3	S1	S2	S3	S1	S2	S3
SEm	5.4	3.6	13.8	0.4	0.3	0.8	3.5	2.9	12.7
CD (0.05) K	9.1	NS	NS	0.7	NS	1.4	6.0	NS	21.5
CD (0.05) I	NS	NS	NS	NS	NS	NS	NS	NS	NS
CD (0.05) KxI	NS	NS	NS	NS	NS	2.5	NS	NS	NS

Treatment	K_0	K_1	K_2	K_3	I_1	I_2	I_3
				Ca uptake			
S1	11.3	12.1	13.5	19.8	12.3	19.4	10.8
S2	20.1	19.0	20.0	17.0	20.9	19.4	16.5
S3	88.4	82.7	68.3	69.2	68.8	80.9	81.8
				Mg uptake			
S1	2.2	2.9	2.1	3.8	3.0	3.2	2.1
S2	5.5	5.0	5.0	4.1	4.9	5.0	4.8
S3	27.8	19.8	15.8	11.7	18.4	18.0	20.0

	Ca			Mg		
	S1	S2	S3	S1	S2	S3
SEm±	3,4	3.6	12.2	0.84	1.1	2.9
CD (0.05) K	3.8	NS	NS	NS	NS	5.05
CD (0.05) I	5.0	NS	NS	NS	NS	NS
CD (0.05) KxI	NS	NS	36.0	2.4	NS	8.7

NS = Not significant

and stage 3. Main effect of irrigation was not significant during any stage. K_3 recorded the maximum of 20.21 kg/ha in stage 1, while the main effects at K_0, K_1 and K_2 were statistically similar. But K_2 was the superior treatment during stage 3. Thus K uptake increased up to K_3 level at the initial stage and K_2 level at later stages. Effect of irrigation on K uptake was not significant at any stage.

Ca uptake increased when K levels increased from K_0 to K_3 at stage 1. With regard to mean effect of irrigation, I_2 recorded the highest value of 19.43 kg/ha. Response of Mg to main effect was shown only during the final stage. Magnesium uptake lowered from 27.87 kg/ha at K_0 to 11.75 kg/ha at K_3. Effect of K_1 was on par with K_2 which in turn was on par with K_3. Convincing evidences of K-Ca and K-Mg antagonistic effects have been given by many scientists. Yadav and Swami (1988) reported that Ca and Mg uptake decreased as the applied K level increased. But in the present study undertaken, Ca uptake during stage 1 was found to significantly higher at K_3. This can be attributed to the high dry matter production at K_3 level as compared to K_0.

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