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RESEARCH PAPER

Effect of potassium and sulphur on nutrient uptake by onion and chilli intercrops in a vertisol

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Abstract : A field experiment was conducted during *Kharif* 2006 on black clay soil to study the effect of potassium and sulphur on onion and chilli intercrops in a vertisol with four levels of potassium (0, 50, 75 and 100 kg K_2O ha^{-1}) and three levels of sulphur (0, 15 and 30 kg S ha^{-1}). The significantly higher uptake of N, P, K and S by onion plant as well as shoot and fruit portion of chilli were observed with the individual application of potassium @ 100 kg K_2O ha^{-1} and sulphur @ 30 kg S ha^{-1}.

Key Words : Nutrient uptake, Soil sodium, Soil potassium, Bulb, Vertisol, Intercrops

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INTRODUCTION

Onion and chilli are the major commercial vegetable crops grown in India and they contribute sizable foreign exchange through their export. Their average productivity in terms of sole crops is of great concern today. The low productivity levels reflect on adoption of improper management practices towards these crops. Among the major nutrients, potassium plays a vital role in plant metabolism such as photosynthesis, translocation of photosynthates, regulation of plant pores, activation of plant catalysts and resistance against pests and disease. Sulphur requirements of crops is almost similar to that of phosphorus. Sulphur is also required for the synthesis of important essential amino acids such as cystine and methionine. Intercropping system of onion plus chilli is an age old practice in India, which not only serves as insurance against natural vagaries but also assures effective utilization of land and other natural resources. Keeping these things in view, the present study was undertaken.

MATERIAL AND METHODS

An experiment was conducted during *Kharif* 2006 under rainfed situation in Main Agricultural Research Station, Dharwad. The soil of the experimental field was black clay soil with a pH of 7.54, organic carbon (5.80 g kg^{-1}), available nitrogen (303.80 kg ha^{-1}), available P (22.00 g ha^{-1}), available K (401.00 kg ha^{-1}) and available S (11.50 mg kg^{-1}). The experiment was laid out in Split Plot Design with four potassium levels (0, 50, 75 and

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100 kg K_2O ha^{-1}) and three levels of sulphur (0, 15 and 30 kg S ha^{-1}) and onion var. Bellary red and chilli as Byadagi dabbi was test crops (intercrops). The recommended dose of 100 kg N, 50 kg P_2O_5 and 50 kg K_2O ha^{-1} of onion and sulphur were supplied through factomphos a complex fertilizer (20 : 20 : 0 : 15 kg N, P_2O_5, K_2O and S) and remaining amount of N, P_2O_5 and K_2O were applied through urea, diammonium phosphate and muriate of potash, respectively. Shallow furrows at a distance of 15 cm were opened using a marker, so as to maintain a row proportion of 4: 1 (onion: chilli). Chilli were sown with a row spacing of 75 cm apart and in between the chilli rows, 4 rows of onion were sown with an inter row spacing of 15 cm. All the recommended cultural practices were followed. Based on the nutrient concentration in plants and dry matter accumulation the uptake of nitrogen, phosphorus potassium and sulphur were worked out.

RESULTS AND DISCUSSION

The uptake of N, P, K and S at harvest increased with increase in dosage of potassium. In general, the greatest uptake of N (97.57 kg ha^{-1}), P (13.51 kg ha^{-1}), K (102.0 kg ha^{-1}) and S (14.83 kg ha^{-1}) were observed when potassium was applied @ 100 kg ha^{-1} (Table 1). These results corroborate the findings of earlier worker (Nagaich *et al*., 1998).

Nitrogen uptake (85.65 kg ha^{-1}) by onion plant increased significantly with higher levels of S application upto 30 kg S ha^{-1}. Similarly phosphorus (11.91 kg ha^{-1}), potassium (71.40 kg ha^{-1}) and sulphur (14.01 kg ha^{-1}) uptake by onion plant also increased significantly with each successive increase in S application upto 30 kg ha^{-1}. These results are in conformity with the findings of Sankaran *et al*. (2005). Interaction effects of K and S was observed to be non-significant. However, the interaction of potassium (100 kg ha^{-1}) and sulphur (30

Table 1 : Effect of potassium and sulphur on uptake of nutrients by onion plant at harvest

Potassium levels	Sulphur levels															
	N (kg/ha)				P (kg/ha)				K (kg/ha)				S (kg/ha)			
	S_0	S_1	S_2	Mean	S_0	S_1	S_2	Mean	S_0	S_1	S_2	Mean	S_0	S_1	S_2	Mean
K_0	49.46	56.93	62.40	56.26	5.37	6.23	6.90	6.16	38.16	44.48	48.61	43.75	5.94	7.11	9.41	7.48
K_1	62.46	66.04	78.02	68.84	7.81	8.81	9.98	8.86	50.75	57.57	66.62	58.31	7.48	9.48	12.47	9.81
K_2	71.06	78.44	93.77	81.09	9.36	10.78	12.71	10.95	71.06	81.41	93.37	81.94	8.32	12.27	15.50	12.03
K_3	86.28	98.05	108.4	97.57	11.89	13.48	15.18	13.51	88.96	102.13	114.90	102.0	10.74	15.12	18.64	14.83
Mean	67.32	74.87	85.65	75.94	8.61	9.83	11.91	9.87	62.23	71.40	80.88	71.50	8.12	11.00	14.01	11.04
	S.E.±		C.D. (P=0.05)		S.E.±		C.D. (P=0.05)		S.E.±		C.D. (P=0.05)		S.E.±		C.D. (P=0.05)	
Potassium	1.22		4.2		0.25		0.86		2.37		8.2		0.28		0.10	
Sulphur	2.51		7.51		0.31		0.94		2.40		7.17		0.51		1.54	
Potassium x sulphur	4.27		NS		0.57		NS		4.57		NS		0.89		NS	

K_0-No potassium, K_1-50 kg K_2O/ha, K_2- 75 kg K_2O / ha, K_3- 100 kg K_2O /ha S_0 –No sulphur, S_1 -15 kg S /ha, S_2 -30 kg S /ha, NS = Non- significant

Table 2 : Effect of potassium and sulphur on nutrient uptake by shoot portion of chilli at final picking stage

Potassium levels	Sulphur levels															
	N (kg/ha)				P (kg/ha)				K (kg/ha)				S (kg/ha)			
	S_0	S_1	S_2	Mean	S_0	S_1	S_2	Mean	S_0	S_1	S_2	Mean	S_0	S_1	S_2	Mean
K_0	14.04	19.93	23.48	19.15	4.15	4.43	5.15	4.57	14.69	14.91	17.57	15.72	2.81	3.04	3.56	3.13
K_1	19.57	26.02	31.78	25.79	4.95	5.12	6.21	5.42	17.95	20.35	24.12	20.81	3.33	3.60	4.55	3.82
K_2	28.57	33.36	39.84	33.92	5.56	6.30	7.53	6.46	27.16	30.72	36.83	31.57	4.07	5.08	6.48	5.21
K_3	36.33	40.33	42.55	39.73	6.78	7.77	8.52	7.69	34.89	39.10	41.90	38.63	5.57	6.25	6.81	6.21
Mean	24.63	29.91	34.42	29.65	5.36	5.91	6.85	6.04	23.67	26.27	30.11	26.68	3.95	4.49	5.35	4.59
	S.E.±		C.D. (P=0.05)		S.E.±		C.D. (P=0.05)		S.E.±		C.D. (P=0.05)		S.E.±		C.D. (P=0.05)	
Potassium	0.79		2.74		0.07		0.25		1.24		4.30		0.24		0.82	
Sulphur	0.69		2.07		0.15		0.45		1.16		3.46		0.23		0.72	
Potassium x Sulphur	1.38		NS		0.26		NS		2.26		NS		0.47		NS	

K_0-No potassium, K_1-50 kg K_2O/ha, K_2- 75 kg K_2O / ha, K_3- 100 kg K_2O /ha, S_0 –No sulphur, S_1 -15 kg S /ha, S_2 -30 kg S /ha, NS = Non-significant

kg ha^{-1}) resulted in the greatest uptake of N, P, K and S by onion crop.

In chilli crop, potassium application significantly influenced the uptake of N, P, K and S by both shoot and fruit portion. Highest uptake of these nutrients were noticed with the application of 100 kg K_2O ha^{-1}. Similarly, the total uptake of N, P, K and S also increased significantly at increased levels of potassium application and recorded highest with the application of potassium @ 100 kg K_2O ha^{-1} (Table 2). These results are in agreement with results of Lalitha *et al*. (1997).

The higher uptake of N, P, K and S were observed with the application of 30 kg S ha^{-1} by both shoot and fruit portion (Table 3). The total uptake of N, P, K and S at final picking stage increased with the stepwise increase in sulphur application. The higher uptake of N (79.78 kg ha^{-1}), P (15.43 kg ha^{-1}), K (71.88 kg ha^{-1}) and S (14.21 kg ha^{-1}) was recorded with the application of 30 kg S ha^{-1} (Table 4). These results also corroborate the findings of Malawadi (2003). Interaction effects of K and S was found to be non-significant.

Such a higher nutritional uptake by both crops mainly by greater expansion of root system caused by increased supply of photosynthetic production and also could be attributed to increased dry matter production under balanced supply of nutrients especially potassium and sulphur.

Based on the results obtained, it may be concluded that application of potassium alone @ 100 kg ha^{-1} and sulphur alone @ 30 kg ha^{-1} were beneficial for higher uptake of nutrients by both onion and chilli intercrops.

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Table 3 : Effect of potassium and sulphur on nutrient uptake by fruit portion of chilli at final picking stage

Potassium levels	Sulphur levels															
	N (kg/ha)				P (kg/ha)				K (kg/ha)				S (kg/ha)			
	S_0	S_1	S_2	Mean	S_0	S_1	S_2	Mean	S_0	S_1	S_2	Mean	S_0	S_1	S_2	Mean
K_0	20.23	23.76	26.58	23.52	4.79	5.68	6.06	5.51	13.48	16.62	19.67	16.59	4.10	4.84	5.66	4.86
K_1	24.32	30.04	38.11	30.82	5.46	6.21	7.63	6.43	23.97	29.26	34.98	29.40	4.63	6.14	7.74	6.17
K_2	32.51	41.98	51.30	41.93	6.41	7.95	9.45	7.93	31.58	39.44	46.72	39.25	5.22	8.39	9.89	7.83
K_3	48.26	59.20	65.46	57.60	9.09	10.33	11.15	10.19	50.34	60.23	65.83	58.80	9.41	11.04	12.15	10.86
Mean	31.33	38.75	45.36	38.48	6.44	7.54	8.57	7.52	29.84	36.38	41.80	36.01	5.84	7.60	8.86	7.43
	S.E.±		C.D. (P=0.05)		S.E.±		C.D. (P=0.05)		S.E.±		C.D. (P=0.05)		S.E.±		C.D. (P=0.05)	
Potassium	1.76		6.10		0.13		0.50		0.82		8.82		0.17		0.59	
Sulphur	1.27		3.80		0.21		0.62		0.91		2.73		0.32		0.97	
Potassium x sulphur	2.71		NS		0.37		NS		1.70		NS		0.56		NS	

K_0-No potassium, K_1-50 kg K_2O/ha, K_2- 75 kg K_2O / ha, K_3- 100 kg K_2O /ha, S_0 –No sulphur, S_1 -15 kg S /ha, S_2 -30 kg S /ha, NS = Non-significant

Table 4 : Effect of potassium and sulphur on total nutrient uptake by chilli plant at final picking stage

Potassium levels	Sulphur levels															
	N (kg/ha)				P (kg/ha)				K (kg/ha)				S (kg/ha)			
	S_0	S_1	S_2	Mean	S_0	S_1	S_2	Mean	S_0	S_1	S_2	Mean	S_0	S_1	S_2	Mean
K_0	34.27	43.69	50.06	42.67	8.94	10.11	11.21	10.08	28.17	31.53	37.24	32.31	6.91	7.88	9.22	8.00
K_1	43.89	56.06	69.89	56.61	10.41	11.33	13.84	11.86	41.92	49.61	59.10	50.21	7.96	9.74	12.29	9.99
K_2	61.08	75.34	91.14	75.85	11.97	14.25	16.98	14.40	58.74	70.16	83.55	70.81	9.28	13.47	16.37	13.04
K_3	84.26	99.53	108.01	97.26	15.87	18.10	19.67	17.88	85.23	99.33	107.63	97.39	14.28	17.29	18.96	16.84
Mean	55.88	68.66	79.78	68.10	11.80	13.45	15.43	13.56	53.51	62.66	71.88	62.88	9.61	12.10	14.21	11.97
	S.E.±		C.D. (P=0.05)		S.E.±		C.D. (P=0.05)		S.E.±		C.D. (P=0.05)		S.E.±		C.D. (P=0.05)	
Potassium	1.54		5.33		0.15		0.50		1.54		5.33		0.14		0.51	
Sulphur	0.94		2.84		0.29		0.87		0.94		.2.84		0.37		1.13	
Potassium x Sulphur	2.18		NS		0.5		NS		2.18		NS		0.64		NS	

K_0-No potassium, K_1-5.33 50 kg K_2O/ha, K_2-75 kg K_2O/ha, K_3- 100 kg K_2O /ha, S_0-No sulphur, S_1 -152.84 kg S/ha, S_2 -30 kg S /ha, NS=Non-significant

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