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EFFECT OF PHOSPHORUS AND SULPHUR ON GROWTH, YIELD AND NUTRIENT UPTAKE OF RAINFED UPLAND COWPEA

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Abstract: A field experiment was conducted during kharif 1992-94 in a sandy loam acid laterite soil to study the effect of graded doses of phosphorus and sulphur on the yield and nutrient uptake of rainfed cowpea *(Vigna unguiculata* [L.j Walp). The different levels of phosphorus showed significant difference in the yield and nutrient uptake of cowpea. Maximum grain yield and nutrient uptake was obtained with application of 60 kg P_2O_5 ha^{-1}. The net return was also highest with this level of phosphorus nutrition. Application of sulphur did not show any remarkable influence on growth, yield and nutrient uptake of cowpea.

Key words : Nutrient uptake, P nutrition, rainfed cowpea, S nutrition.

INTRODUCTION

Rainfed upland cowpea *(Vigna unguiculata* [L.J Walp) gives low seed yield mainly due to the inadequate supply of plant nutrients and low soil fertility. Phosphorus is considered to be the kingpin nutrient in pulse growing having a direct role in better root development, flower primordia initiation, stimulation of growth and formation of seeds. Importance of phosphorus in nitrogen fixation has also been well established (Baldev *et al.*, 1988). Ahlawat *et al.* (1979), Balakumaran and Kunju (1989) and Santhakumari *et al.* (1994) have reported that cowpea responds well to phosphorus application when grown under irrigated condition in summer months. Cowpea also shows marked response to sulphur application (Aulakh *el al.*, 1977). Sulphur application has been found to improve the yield and quality of legume crops (Singh *el al.*, 1991). The present study was initiated to find out the effect of graded doses of phosphorus and sulphur on the yield and nutrient uptake of rainfed cowpea during kharif season.

MATERIALS AND METHODS

The field experiments were conducted during the kharif seasons of 1992, 1993 and 1994 at the Regional Agricultural Research Station, Pattambi. The soil was sandy loam acid laterite (Lithic Kanhaplustalf) having pH 5.6, organic carbon 1.12 per cent, available P_2O_5 20 kg ha^{-1}, available K_2O 110 kg ha^{-1} and available sulphur 44 kg ha^{-1}.

Table 1. Grain yield and economics of cowpea as influenced by P and S levels

Treatment kg ha ^{i}	Grain yield, kg ha^{-1}				Mean net income, Rs ha^{-1}	Mean benefit : cost ratio
	1992	1993	1994	Pooled		
Phosphorus						
0	344	221	541	369	704	1.14
20	410	374	561	448	1753	1.32
40	480	409	744	544	3069	1.55
60	530	542	863	645	4455	1.76
CD (0.05)	82	56	108	71		
Sulphur						
0	489	359	695	514	2894	1.53
20	397	404	685	495	2394	1.42
40	438	397	652	496	2198	1.38
CD (0.05)	NS	NS	NS	NS		
Px S	NS	NS	NS	NS		

The treatments consisted of four levels of phosphorus (0, 20, 40 and 60 kg P_2O_5 ha^{-1}) and three levels of sulphur (0, 20 and 40 kg ha^{-1}) and were tried in factorial randomised block design having three replications with

Table 2. Effect of P and S application on growth and yield attributes of cowpea (pooled mean)

Treatment kg ha^{-1}	Plant height, cm	Branches / plant	Pods / plant	100 seed weight
Phosphorus				
0	57.5	2.3	3.9	8.35
20	55.8	2.4	4.0	8.42
40	59.9	2.6	4.2	8.44
60	62.5	3.0	4.7	8.76
CD (0.05)	4.0	0.28	0.5	NS
Sulphur				
0	59.7	2.6	4.1	8.43
20	58.8	2.5	4.3	8.40
40	58.3	2.6	4.2	8.64
CD (0.05)	NS	NS	NS	NS
Px S	NS	NS	NS	NS

Kanakamoni as test variety. A uniform basal dose of 20 kg N and 10 kg K_2O ha^{-1} in the form of urea and muriate of potash was supplied to all the plots. P and S in the form of mussooriephos and elemental sulphur as per treatments were given at the time of seeding. The seeds were dibbled at a spacing 25 x 15 cm. Plant samples were collected at branching, flowering and harvest stages and were analysed for P and S as per standard chemical procedures (Chesnin and Yien, 1954; Jackson, 1958). Correlation coefficients of P levels and P uptake on yield of cowpea were worked out and models were framed according to the method suggested by Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

Yield and yield attributes

Phosphorus application had marked beneficial effect on yield and yield attributes of cowpea in all the three seasons tried (Table 1 and Table 2) Addition of phosphorus @ 70 kg ha^{-1} recorded the maximum yield which was 75 per cent higher over no phosphorus. The increase in yield was progressive with incremental levels of phosphonis application. The beneficial effect of phosphorus on cowpea yield was possibly because of its vital role in root development. Moreover, the significant effect of phosphorus application on the growth and yield attributes was reflected on the grain yield. The response in yield was found to be linear (r = 0.99) showing that the yield could be further increased by addition of phosphorus. The mean response per kg P_2O_5 was 4.6 kg grain. Linear response function had been found to be the best fit and the response equation for grain yield was Y = 362 + 4.6X. Among the growth and yield characters plant height, number of branches per plant and number of pods per plant were significantly influenced by phosphorus. The nature of response obtained was almost similar to that of grain yield. On the other hand, no significant variations were observed either in grain yield or in yield attributes in any of the seasons due to the application of different levels of sulphur. This can be attributed to the comparatively higher status of available sulphur in the soil. The interaction effect between phosphorus and sulphur was found to be nonsignificant.

Nutrient Uptake

The uptake of phosphorus increased progressively with plant growth and recorded maximum uptake at the time of harvest irrespective of treatments (Table 3). In the early stage of plant growth, different levels of phosphorus failed to record any significant influence on phosphonis uptake. This can be attributed to the slower dissolution of rockphosphate and lack of availability of sufficient nutrient in the early stages. Later the uptake showed a linear pattern as in the case of grain yield; incremental doses of the nutrient leading to

Table 3. P and S uptake by the crop as influenced by P and S application, kg ha^{-1}

Treatment kg ha^{-1}	Branching stage		Flowering stage		Harvest stage	
	P	S	P	S	P	S
Phosphorus						
0	0.70	0.46	2.0	1.3	5.5	3.0
20	0.84	0.57	2.6	1.5	6.6	3.3
40	0.81	0.46	2.6	1.6	8.1	3.4
60	0.81	0.56	3.3	2.1	9.7	3.9
CD (0.05)	NS	NS	0.53	0.5	1.9	NS
Sulphur						
0	0.77	0.49	2.7	1.4	7.6	3.4
20	0.74	0.50	2.9	1.7	7.5	3.4
40	0.86	0.57	2.5	1.7	7.3	3.5
CD (0.05)	NS	NS	NS	NS	NS	NS

successive increments in uptake. Maximum uptake was obtained in treatment receiving high phosphorus (60 kg P_2O_5 ha^{-1}). The, increased uptake of phosphorus might be due to the increased foraging capacity of the roots, which in turn was reflected in increased grain yield. Increased grain yield with increasing phosphorus uptake has been reported by Mohankumar *el al.*, (1979). Linear regression was a better fit and the response equation was y = 12.7 + 65.4x. On the other hand, no significant variations were observed for uptake of phosphorus at any stages of crop growth due to varying doses of sulphur.

Sulphur uptake increased with plant growth. The uptake at harvest stage was five times higher than that at branching stage. But the different levels of sulphur did not produce any variation in uptake at any stages of crop growth. This might be due to the availability of sufficient nutrient from the soil. Increased phosphorus application recorded progressive increase in sulphur uptake at flowering and harvest stages; the effect being significant at flowering stage. The better root development and increased dry matter accumulation consequent to higher phosphorus supply might have increased sulphur uptake.

The addition of phosphorus was greatly beneficial. Application of 60 kg P_2O_5 ha^{-1} gave the highest net income of Rs 4455 ha^{-1}. This level of phosphorus showed maximum benefit cost ratio of 1.76.

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REFERENCES

Ahiawat, I. P. S., Saraf, C. S. and Singh, A. 1979. Response of spring cowpea to irrigation and phosphorus. *Indian J. Agron.* 24 : 237-239

Aulakh, M. S., Parischa, N. S. and Dev, G. 1977. Response of different crops to sulphur fertilisation in Punjab. *Ferti. News* 22(9) : 32-36

Balakumaran, K. N. and Kunju, U. M. 1989. Response of cowpea to water management practices and phosphorus nutrition. *Agri. Res. J. Kerala* 27 : 37-40

Baldev, B., Ramanujam, S. and Jain, M. K. 1988. *Pulse Crops.* Oxford and IBH Pub Co. Pvt. Ltd. New Delhi

Chesnin, L. and Yien, C. H., 1954. Turbidometric determination of available sulphur. *Proc. Soil Sci. Soc. Am.* 15 : 149-151

Jackson, M. L. 1958. *Soil Chemical Analysis.* Prentice Hall of India Pvt. Ltd., New Delhi

Santhakumari, G., Pillai, G. R., Varughese, K. and Mathew, J. 1994. Response of cowpea to irrigation and phosphorus. *J. trop. Agric.* 32 : 30-32

Singh, S., Singh, D. P. and Singh, B. 1991. Direct and residual effect of pyrites on yield, sulphur content and quality characters of groundnut and mustard. *.7. Indian Soc. Soil Sci.* 39 : 328-331

Snedecor, G. W. and Cochran, G. W. 1967. *Statistical Methods.* Oxford and IBH Pub. Co., New Delhi