Indian Journal of Agronomy **46** (2) : 273–276 (June 2001)

Performance of chickpea (*Cicer arietinum*) varieties as influenced by sulphur with and without phosphorus

B.G. SHIVAKUMAR

Division of Agronomy, Indian Agricultural Research Institute, New Delhi 110 012

Received : February 1999

ABSTRACT

A 2-year field experiment was conducted at New Delhi during 1993–95 with 3 varieties of chickpea (*Cicer arietinum* L.) ('Biogreen', 'BG 256' and 'BG 209') and 5 levels of S and P (0, 40, 80 kg S/ha, 40 kg S + 40 kg P_2O_5 and 80 kg S+40 kg P_2O_5/ha). 'Biogreen' recorded significantly higher seed yield than the other varieties, while 'BG 209' recorded the least seed yield. Application of S with or without P recorded significantly higher seed yield up to 40 kg S/ha only. Addition of P with S showed significantly higher seed yield than S alone. Most of the growth and yield attributes too showed similar trend except seeds/pod, test weight and harvest index.

Key words : Chickpea, Varieties, Sulphur, Phosphorus

Chickpea (*Cicer arietinum)* is the major winter pulse crop in India. After phosphorus, sulphur nutrition has been found to be major limiting factor in chickpea production (Saraf, 1988). Among the different sulphur sources, iron pyrite is found quite effective in legumes (Tiwari *et al.*, 1984) including chickpea. Further, phosphorus and sulphur are reported to have synergistic effect on the productivity of crops. Hence an attempt was made to study the differential response of varieties to sulphur nutrition as iron pyrite in the absence and presence of phosphorus on the growth and yield of 3 promising varieties of chickpea or gram.

MATERIALS AND METHODS

A field experiment was carried out at New Delhi during the winter seasons of 1993–94 and 1994–95. The soil of the experimental site was alluvial sandy loam in texture with slightly alkaline reaction (pH 7.68) and analysed low in available N (organic carbon 0.43%), P (7.92 kg/ha) and medium in available K (173 kg/ha). The available S status of the soil was 11.4 ppm. The 3 varieties of chickpea, viz. recently developed green-seeded 'Biogreen' a cross between *desi* and *kabuli* types 'BG 256' and *desi* 'BG 209' were grown with 0, 40, 80 kg S/ha; 40 kg S + 40 kg P_2O_5 and 80 kg S+ 40 kg P_2O_5/ha given as iron pyrites

(22.5% S) and diammonium phosphate (DAP). The N in diammonium phosphate treatments was made up by using urea in non-P treatments. The experiment was laid out in split-plot design with varieties in the main plots and S levels with and without P in subplots and replicated thrice. The S and P as per treatment were applied before sowing and mixed in the soil. Seeds were treated with appropriate strains of rhizobium and phosphate-solubilizing bacteria culture prior to sowing. Sowing was done by using bullock-drawn *desi* plough in 30 cm rows at the seed rate of 75 kg/ha during the second fortnight of October. Recommended plant-protection measures and other agnonomic practices were followed as and when required. Observations on growth and yield parameters were recorded at harvest from the plants drawn randomly. Test weight of grain and harvest index were computed after the harvest. The data recorded on growth and yield attributes and yield were analysed as per analyses of variance (ANOVA) technique for split-plot design. The economics of different treatments was calculated on the basis of prevailing market prices for both inputs and produce from the experiment.

RESULTS AND DISCUSSION

Growth attributes

Among the varieties 'Biogreen' recorded significantly higher plant height and dry-matter accumulation than 'BG 256' and 'BG 209' which were at par with each other. While the number of branches/plant were significantly higher in 'BG 256', followed by 'BG 209' and the least were in 'Biogreen' variety of gram.

Among the sulphur treatments, application of sulphur alone @ 80 kg/ha recorded significantly higher plant height than the control. Addition of 40 kg P_2O_5 to sulphur increased the plant height significantly over sulphur alone. Highest dry-matter accumulation was noticed under 80 kg P_2O_5/ha treatment and was significantly superior to all other treatments. Addition of 40 kg P_2O_5 increased the dry-matter accumulation compared with sulphur levels alone. The number of branches also exhibited the similar trend (Table 1).

Yield attributes

Variety 'Biogreen' recorded significantly higher pods and pod weight/plant, while 'BG 256' recorded the least number of pods and 'BG 209' recorded the least pod weight/plant. The small-seeded 'BG 209' recorded significantly higher seeds/pod, followed by 'BG 256' and 'Biogreen'.

Application of sulphur alone @ 80 kg/ha recorded significantly higher pods and pod weight/plant over the control. Inclusion of 40 kg P_2O_5/ha at both the sulphur levels recorded significant increase in these attributes over sulphur alone. Further 80 kg S + 40 kg P_2O_5/ha was significantly superior to all other treatments. Seeds/pod were not influenced by sulphur treatments indicating that it is genetically controlled and varietal character. Among the varieties, 'BG 256' recorded significantly higher 100-seed weight, followed by 'Biogreen' and the least 100-seed weight was observed in 'BG 209'. Further 'BG 256' also recorded the highest harvest index and it was followed by 'BG 209'. 'Biogreen' recorded the lowest harvest index.

Table 1. Growth and yield attributes of chickpea at harvest as influenced by varieties and sulphur levels with and without phosphorus (mean data of 2 years)

Treatment	Plant height (cm)	Dry matter (g/plant)	Branches/ plant	Pods/ plant	Pod weight (g/plant)	Seeds/ pod
Variety						
'Biogreen'	56.88	15.53	4.88	29.63	7.36	0.88
'BG 256'	47.25	11.68	5.55	21.63	6.12	1.09
'BG 209'	46.05	11.66	5.23	26.30	5.85	1.23
CD (P=0.05)	1.57	1.67	0.37	2.49	0.53	0.09
S + P level (kg/ha)						
0	47.11	10.32	4.44	20.89	5.28	1.12
40	48.83	11.06	4.75	23.27	5.47	1.05
80	50.14	12.87	5.14	26.02	6.27	1.04
40 + 40 kg P_2O_5	51.41	14.05	5.52	28.19	6.98	1.06
80 + 40 kg P_2O_5	52.80	16.49	6.25	31.97	8.21	1.08
CD (P=0.05)	2.03	2.15	0.48	3.21	0.69	NS

Sulphur treatments did not show any clear trend for 100-seed weight and harvest index. There was no significant difference among treatments during the first year, while 80 kg S + 40 kg P_2O_5/ha recorded significantly higher 100-seed weight and harvest index during the second year. The pooled analysis showed non-significant difference among the treatments (Table 2).

Seed yield

The green-seeded variety 'Biogreen' recorded significantly higher seed yield over 'BG 256' and 'BG 209'. There was significant difference in the yield of 'BG 256' and 'BG 209' during the second year. However, these varieties were at par during the first year. The pooled analysis also showed the similar trend. The highest seed yield in 'Biogreen' may be attributed to higher dry-matter production and subsequent higher pods and pod weight/plant.

There was no significant increase in seed yield due to sulphur application alone during the first year, but application of sulphur at both 40 and 80 kg/ha recorded significant increase in seed yield during the second year. Such variable response to chickpea to sulphur nutrition was also observed by Saraf *et al.* (1997). The pooled analysis showed significant increase in seed yield at 80 kg S/ha over the control. Although addition of phosphorus to sulphur @ 80 kg/ha along with phosphorus found statistically significant compared with the control during the first year, while addition of phosphorus recorded significantly higher yield compared to sulphur alone at all levels during the second year. The pooled analysis also showed significant increase in seed yield because of addition of phosphorus compared to sulphur treatments alone. The highest net return and benefit : cost ratio were with 'Biogreen' variety, followed by 'BG 256' and 'BG 209'. The application of 40 kg S + 40 kg P_2O_5/ha

Table 2. Effect of varieties and sulphur levels with and without phosphorus on 100-seed weight, harvest index and seed yield of chickpea (mean data of 2 years)

Treatment	100-seed weight (g)	Harvest index (%)	Seed yield (q/ha)			Net return (Rs/ha)	Benefit : cost ratio (Re/Re)
			1993–94	1994–95	Mean		
Variety							
'Biogreen'	19.70	35.06	15.71	17.23	16.44	8,432	1.78
'BG 256'	22.74	43.99	12.30	13.49	12.89	5,592	1.18
'BG 209'	11.82	42.66	11.66	12.13	11.90	4,800	1.02
CD (P=0.05)	0.81	2.68	2.08	0.55	1.13		
S + P level (kg/ha)							
0	18.22	39.92	11.62	11.97	11.79	5,432	1.35
40	17.76	40.02	11.99	12.97	12.48	5,504	1.23
80	17.73	40.09	13.36	13.85	13.56	5,888	1.19
40 + 40 kg P_2O_5	18.02	41.13	14.11	15.86	14.99	7,112	1.46
80 + 40 kg P_2O_5	18.71	41.69	15.04	16.76	15.90	7,440	1.41
CD (P=0.05)	NS	NS	2.68	0.70	1.46		

recorded the highest benefit : cost ratio while application of 80 kg S + 40 kg P_2O_5/ha recorded the highest net returns. However, the difference between the two was very small. The lowest net return was with no sulphur and phosphorus treatment, while the lowest benefit : cost ratio with 80 kg S/ha alone (Table 2).

It may be concluded that green-seeded chickpea variety 'Biogreen' is superior to 'BG 256' and 'BG 209'. Application of 40 kg S along with 40 kg P_2O_5/ha results in higher grain yield than sulphur alone both at 40 and 80 kg S/ha and is at par with 80 kg S + 40 kg P_2O_5/ha, hence it may be considered optimum for chickpea.

REFERENCES

Saraf, C.S. 1988. Sulphur fertilization on pulses for yield and quality. (In) *Proceedings of the TSI-FAI Symposium on Sulphur in Indian Agriculture,* held during 9–11 March 1988 at New Delhi. SII/2 : 2–7.

Saraf, C.S., Shivakumar, B.G. and Patil, R.R. 1997. Effect of phosphorus, sulphur and seed inoculation on performance of chickpea (*Cicer arietinum). Indian Journal of Agronomy* **42** (2) : 323–328.

Tiwari, K.N., Dwivedi, B.S. and Pathank, A.N. 1984. Evaluation of iron pyrites as sulphur fertilizer. *Fertilizer Research* **5** : 235–243.