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Effect of Phosphorus and Sulphur on Yield and Economics of Summer Greengram (*Vigna radiata*)

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A field experiment was conducted at Krishi Vigyan Kendra, Dungarpur (Rajasthan) during summer, 2010 and 2011 on sandy clay loam soil to investigate the effect of phosphorus (0, 20, 40 and 60 kg P_2O_5 ha^{-1}) and sulphur (0, 15, 30 and 45 kg S ha^{-1}) on yield and economics of summer green gram [*Vigna radiata* (L) Wilczek]. Application of phosphorus upto 60 kg P_2O_5 ha^{-1} resulted in significantly higher grain (745 kg ha^{-1}), stover yield (1244 kg ha^{-1}), net returns (Rs 16370 ha^{-1}) and B:C ratio (2.13) over their respective preceding levels (0, 20, 40 kg P_2O_5 ha^{-1}) but it was on par with 40 kg P_2O_5 ha^{-1} in respect to B:C ratio on pooled basis. Among different levels of sulphur 45 kg S ha^{-1} gave significantly higher grain (743 kg ha^{-1}), stover yield (1225 kg ha^{-1}), net returns (Rs 16446 ha^{-1}) and B:C ratio (2.18) over their respective preceding levels (0, 15 and 30 kg S ha^{-1}) on pooled basis. Interaction effect was found significant in respect to net returns and B:C ratio. On pooled basis, combined application of 60 kg P_2O_5 ha^{-1} along with 45 kg S ha^{-1} resulted in higher net returns (18869) and B:C (2.29) ratio than of the treatment combinations.

Key words: Greengram, phosphorus, sulphur, interaction, yield, net return and B:C ratio.

Pulses are the major source of dietary protein in the vegetarian diet of our country. Besides being the source of protein, they maintain soil fertility through biological nitrogen fixation and thus play a vital role in furthering sustainable agriculture (Kannaiyan, 1999). Pulses are also an important component of cropping systems in marginal and sub -marginal areas of dry land farms as 92 per cent of the pulse production in India is realized from dry lands or the areas depending on rains. India is the largest producer of pulses in the world, the per capita consumption over the years has come down from 61 g day^{-1} in 1951 to 30 g day^{-1} in 2008 (Reddy, 2009). In India, pulses are grown in nearly 23.28 million hectare area with production status of nearly 14.66 million tonnes at an average productivity level of 630 kg ha^{-1} (Economic Survey, 2010-11). Green gram is the third most important pulse crop after chickpea and pigeon pea. At the national level it is grown on 3.10 m ha area and produces nearly 0.94 m t with an average productivity of 304 kg ha^{-1} (Govt. of India, 2010). In Rajasthan, greengram is cultivated on 1.06 m ha land mass with 0.41 m t production at a yield status of 390 kg ha^{-1} (Govt. of Rajasthan, 2010).

Greengram is generally grown as a rainfed crop during rainy season in Rajasthan either as sole crop or mixed crop with cereals. However, with the enhanced irrigation facility in southern Rajasthan, the cropping intensity has increased to quite an extent. In the canal command areas, this crop is now raised in summer season in between two main seasons *i.e.* winter and rainy. This has opened avenues of intensifying crop production in the tribal dominated belt. Perhaps, because of these distinct features and higher economic returns, farmers have shown renewed interest towards this pulse crop (Chadha, 2010).

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Materials and Methods

A field experiment was conducted during summer 2010 and 2011 at Krishi Vigyan Kendra, Dungarpur. The soils were sandy clay loam in texture and alkaline in reaction (pH 8.1 and 7.9), low in organic carbon (0.48 g kg^{-1} soil), available nitrogen (247 kg ha^{-1}), medium in available phosphorus (17.9 kg ha^{-1}), high in available potassium (282 kg ha^{-1}) and low in available sulphur (8.8 ppm). The treatments comprised four levels of phosphorus (0, 20, 40 and 60 kg P_2O_5 ha^{-1}) and four levels of sulphur (0, 15, 30 and 45 kg S ha^{-1}) thereby, making sixteen treatment combinations and were replicated four times in factorial randomized block design. The crop was sown in the same field on March 18, 2010 and March 15, 2011. As per the treatment combinations, phosphorus and sulphur were applied manually through DAP and mineral gypsum at the time of sowing in furrow at 5 cm below the seeding depth, respectively. A recommended dose of 25 kg nitrogen ha^{-1} was ensured through urea in each treatment. The seed of greengram variety SML-668 was treated with bavistin at 2 g kg^{-1}. It was followed by bacterial culture (*Rhizobium phseoli* and PSB) treatment. Furrows were opened manually at 25 cm apart and seeds were placed at a depth of 3 to 4 cm, using seed rate 15 kg ha^{-1} .Weed control, irrigation and plant protection measure were followed as per zonal package. The observations were recorded for the traits *viz.*, grain yield (kg ha^{-1}) and stover yield (kg ha^{-1}). The net return (Rs. ha^{-1}) was calculated by deducting the cost of cultivation from gross realization for each treatment. The benefit cost ratio (B C ratio) was calculated by gross returns (Rs. ha^{-1}) divided by cost of cultivation (Rs. ha^{-1}). The data were subjected to statistical analysis by adopting appropriate method of analysis of variance as described by Cocharan and Cox (1967). Assuming homogenicity in data over two years of experimentation, pooled analysis was also carried out as per Gomez and Gomez (1984).

Results and Discussion

Effect of phosphorus

Application of phosphorus upto 60 kg P_2O_5 ha^{-1} resulted in significantly higher grain and stover yield of summer greengram. On pooled basis, application of phosphorus at 60 kg P_2O_5 ha^{-1} was responsible for producing 14.39 and 14.08 per cent higher grain and stover yield over control (648 and 1091 kg ha^{-1}), respectively (Table 1). It is an established fact that photosynthesis together with availability of assimilates (source) and storage organs (sink) exert an important regulative function on the complex process of yield formation. The regulatory functions of phosphorus in photosynthesis and carbohydrate metabolism of leaves can be considered to be one of the major factors limiting plant growth particularly during reproductive phase. The level of phosphorus during this period regulates starch/sucrose ratio in the source leaves and reproductive organs (Giaquinta and Quebedeaux, 1980). In many legumes (greengram being not exception to it) poor sink capacity is attributed to low retention of flower to form pods. Three possible explanation have been postulated, first being traditional favorite hormones, the second assumes that other organs compete with flower for want of metabolites, nutrients and last being modification of seconds refer to limitation of vascular system for rapid supply of growth inputs (metabolites and nutrients) from source of sink (Jeswani, 1986). Improvement in yield of summer greengram due to P fertilization was also observed by Bhuiyan *et al*. (2008) and Ali *et al*. (2010).

Table 1. Effect of phosphorus and sulphur on yield, net return and B:C ratio of summer greengram

Treatment	Grain (kg ha^{-1})			Stover (kg ha^{-1})			Net returns (kg ha^{-1})			B:C ratio		
	2010	2011	Pooled	2010	2011	Pooled	2010	2011	Pooled	2010	2011	Pooled
Phosphorus (P_2O_5 kg ha^{-1})												
0	616	680	648	988	1194	1091	12301	15212	13756	1.94	2.16	2.05
20	624	694	659	1002	1214	1108	12210	15284	13747	1.90	2.13	2.01
40	664	740	702	1066	1316	1191	13394	16792	15093	1.96	2.20	2.08
60	714	775	745	1139	1350	1244	15003	17736	16370	2.04	2.23	2.13
S.Em.±	15	17	11	25	26							
CD (P= 0.05)	42	49	32	73	76							
Sulphur (S kg ha^{-1})												
0	617	682	649	987	1181	1084	11792	14661	13226	1.86	2.07	1.97
15	644	715	680	1021	1264	1143	12816	16015	14415	1.93	2.17	2.05
30	666	718	692	1074	1291	1183	13651	16106	14879	1.99	2.16	2.07
5	692	775	743	1113	1338	1225	14650	18242	16446	2.05	2.31	2.18
S.Em.±	15	17	11	25	26	17						
C D (P= 0.05)	42	49	32	73	76	49						

Significantly greater net returns and B:C ratio were obtained with the application of 60 kg P_2O_5 ha^{-1} except during second year which was on par with 40 kg P_2O_5 ha^{-1} in respect to net return. On pooled basis significantly higher net returns (Rs.16370.03 ha^{-1}) and B:C ratio (2.13) were registered by applying 60 kg P_2O_5 ha^{-1} but on par with 40 kg P_2O_5 ha^{-1} in respect to B:C ratio.

Effect of sulphur

Progressive application of sulphur upto 45 kg ha^{-1} significantly increased the grain and stover yield of summer greengram by 14.41 and 13.07 per cent over control (649 and 1084 kg ha^{-1}), respectively (Table 1). Wareing and Patrick (1975) reported that improvement in yield was attributed to diversion of greater proportion of assimilates to the developing pods of groundnut due to increased sink strength reflected through its larger demand for photosynthesis. Finding of Kaisher *et al.* (2010) and Patel *et al.* (2010) are provided support to the findings of the present investigation

Across the years of study and on pooled basis, an application of 45 kg S ha^{-1} resulted in significantly higher net returns and B:C ratio but on par with 30 kg S ha^{-1} in case of B:C ratio during first year of investigation. Pooled data (Table 1) indicate that application of 45 kg S ha^{-1} registered 24.34 and 10.66 per cent increase in net returns and B:C ratio over control, respectively.

Interaction effect

Though the effect of phosphorus and sulphur was significant individually the interaction effect was not significant with respect to grain and stover yield.

Net returns: The interaction effect between the two nutrient elements under study positive trend on pooled basis in respect to net returns. At each level of phosphorus, application of sulphur showed variable response. While at 20 and 60 kg P_2O_5 ha^{-1}, application of S to the tune of 45 kg ha^{-1} gave higher net returns. However, under the influence of no phosphorus and 40 kg P_2O_5 ha^{-1}, not return increased by the appreciation sulphur upto 30 kg ha^{-1}. Also variability in significance of phosphorus under different S levels was evident. Under no sulphur application, response of phosphorus was higher only upto 40 kg ha^{-1} of P_2O_5 .While the response was higher upto 60 kg P_2O_5 ha $^{-1}$ when sulphur was applied at the rate of 15 to 45 kg ha^{-1}. The highest net returns (Rs.18869 ha^{-1}) were registered by conjoint application of 60 kg P_2O_5 ha^{-1} and 45 kg S ha^{-1} which was higher over rest of the treatment combinations (Table 2).

Table 2. Interaction effect of phosphorus and sulphur on net returns (Rs ha^{-1})

Phosphorus (P_2O_5 kg ha^{-1})	Net returns (Rs. ha^{-1})			
	Pooled			
	Sulphur (S kg ha^{-1})			
	0	15	30	45
0	11908	13407	14579	15133.25
20	12748	13885	12844	15512.50
40	14330	14601	15172	16270.50
60	13920	15770	16919	18869.75

B C ratio: A perusal of data (Table 3) showed that the interaction was seen on pooled basis with respect to B C ratio of summer greengram. Pooled analysis show that combined application of 60 kg P_2O_5 ha^{-1} and 45 kg S ha^{-1} proved to be best economic treatment (2.29) showing 19.27 per cent higher in

Table 3. Interaction effect of phosphorus and sulphur on B:C ratio

Phosphorus (P_2O_5 kg ha^{-1})	B:C ratio			
	Pooled			
	Sulphur (S kg ha^{-1})			
	0	15	30	45
0	1.92	2.03	2.11	2.14
20	1.95	2.03	1.94	2.26
40	2.03	2.05	2.08	2.15
60	1.97	2.09	2.17	2.29
S.Em.±			0.029	
C.D. (P = 0.05)			0.083	

B:C ratio over the control (1.92). It was concluded that application of phosphorus at 60 kg P_2O_5 ha^{-1} and sulphur at 45 kg S ha^{-1} alone resulted in significantly higher grain and stover yield of summer greengram. While combined application of 60 kg P_2O_5 ha^{-1} and sulphur at 45 kg S ha^{-1} gave higher net returns and B:C ratio. There is improvement in yield and economics of greengram over the existing general recommended dose of phosphorus.

References

Ali, M.A., Abbas, G., Mohy-ud-Din, Q., Ullah, K., Abbas, G. and Ashan, M. 2010. Response of mungbean (*Vigna radiata*) to phosphatic fertilizers under arid climate. *The J. Animal and Plant Sci.,* **20** : 83-86

Bhuiyan, M.M.H., Rahaman, M.M., Afrose, F., Sutradha, G.W.C. and Bhuiyan, M.S.I. 2008. Effect of phosphorus and molybdenum and *Rhizobium* inoculation on growth and nodulation of mungbean. *J. Soil and Nature* **2**: 25-30

Chadha, M.L.2010.Short duration mungbean: A new success in South Asia. Asia-Pacific o/o FAO Regional office for Asia and Pacific, Bangok.p. 10-11.

Cocharan, W.G. and Cox, G.M. 1967. Experimental Design, 2nd Edn, John Wiley & Sons Inc., New York.

Economic Survey. 2010-11. Ministry of Finance, Department of Economic Affairs, Economics Division Government of India, New Delhi, p.190.

Gianquinta, R.T. and Quebedeaux, B. 1980. Phosphate induced changes in assimilate partitioning in soybean leaves during pod filling. *Plant Physiology,* **65**:119.

Gomez, K.A. and Gomez, A.A. 1984. Statistical Procedure for Agricultural Research, 2nd Edn, John Wiley & Sons, Singapore.

Govt. of Rajasthan. 2010. Districtwise area, production and yield under moong crop. (http://rajasthankrishi.gov.in Retrieved on 30 March, 2010)

Govt.of India.2010. Production of food grains, oilseeds and other commercial crops. Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture. (www.dacnet.nic.in Retrieved on 30 March, 2010)

Jeswani, L.M. 1986. Reorientation of plant breeding research to achieve self sufficient in edible oil. Extension lecture In: Department of Plant Breeding and Genetics, Sukhadia University, Udaipur (Sept.2).

Kaisher, M.S., Rahman, A.M., Amin, M.H.A., Amanullah, A.S.M. and Ahsanullah, A.S.M. 2010. Effect of sulphur and boron on seed yield and protein content of mungbean. *Bangladesh Res. Publ. J.,* **3**:1181-1186.

Kannaiyan, S. 1999. Bioresources Technology for Sustainable Agriculture. Associated Publishing Company, New Delhi, 422p.

Patel, P.M., Patel, J.S., Patel, J.J. and Patel, H.K. 2010. Effect of levels and sources of sulphur on seed yield and quality of summer green gram. *Inter. J. Agric. Sci.,* **6**: 169-171.

Reddy, A.A. 2009. Pulses production technology: Status and way forward. *Economic and Political Weekly* **44**:73-80.

Wareing, P.F. and Patrick, J. 1975. Source-sink relationship and the pattern of assimilates in the plants. pp. 481-499. In: J.P. Cooper (ed.). Photosynthesis and Productivity in Different Environments. Cambridge University Press, London.

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