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EFFECT OF PHOSPHORUS AND SULPHUR NUTRITION ON GROWTH AND YIELD OF BLACK GRAM

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ABSTRACT

In the field trials conducted for three years, at the National Pulses Research Centre, Vamban, significant effect of phosphorus and sulphur application was observed in black gram. Phosphorus @ 60 kg/ha and 40 kg/ha increased the growth, yield attributes and yield. There was 13.9% yield increase in sulphur @ 40 kg/ha than control. A positive interaction existed between phosphorus and sulphur application. Among all the treatments, $P_{60}S_{40}$ was superior and it was on par with $P_{40}S_{40}$. The economic analysis also revealed a higher cost-benefit ratio in $P_{40}S_{40}$ treatment.

KEY WORDS : Black gram, sulphur, phosphorus, effect

Sulphur, in the form of sulphate is essential for all plants and is indispensible for the synthesis of certain aminoacids like methionine, cystine and cysteine (Ghosh 1980). Sulphur is now recognised as the foruth major nutrient, after nitrogen, phosphorus and potassium, and on an average crops absorb as much sulphur as they absorb phosphorus and field scale deficiencies of sulphur in soils and plants are becoming increasingly important (Tandon, 1991). Crop removal of sulphur is more in pulses and oilseeds (Manickam, 1985). Only in the recent years, the importance of sulphur in soil fertility was recognised. Studies on the interaction of sulphur with phosphorus in black gram is lacking. Hence, the present investigation was undertaken to findout the response of black gram to sulphur application and its interaction with phosphorus, in red latertic soils.

MATERIALS AND METHODS

Field experiments under the All India Co-ordinated Pulses Improvement Project were conducted during the *kharif* seasons of 1992, 1993 and 1994, at the National Pulses Research Centre, Vamban. The experiments were laid out in a factorial randomised block design replicated thrice. Two factors *viz.*, phosphorus (P) and sulphur (S) were tried. The P levels were 0, 20, 40 and 60 kg P_2O_5/ha while the S levels were 0, 20 and 40 kg S/ha. A common dose of 25 kg N/ha was applied through urea and P was applied as diammonium phosphate, while S was applied in the form of elemental sulphur 15 days prior to sowing and incorporated in the field by ploughing. The soil was of red-lateritic with pH of 6.6 and available N, P and K status were low, low and medium respectively. Initial available soil S was 6.1 ppm. The trial was conducted under rainfed condition and the rainfall received during the cropping period were 263, 275 and 212 mm during 1992, 1993 and 1994 respectively. The economic analysis was made by adopting the prevailing market rates of labour, inputs and produce.

RESULTS AND DISCUSSION

Effect of P and S on growth and yield attributes

Significant effect of P and S application was seen on the growth and yield attributes of black gram during all the three years (Table 1). Among the different P levels, P @ 60 kg/ha produced significantly higher growth and yield attributes. However, this was on par with P @ 40 kg/ha. for all the characters. Among the different S levels. S @ 40 kg/ha significantly increased the plant height, number of branches/plant, number of pods/plant, pod length and number of seeds/pod.

With the increasing doses of P, the response to S application also increased significantly. There was no response to different S levels when P was not applied. Hence, there existed a strong positive interaction between P and S. Similar interaction was observed in mungbean by Aulakh and Pasricha (1978) and in red gram by Arunachalam *et al.*, (1995). Among the different treatments, $P_{60}S_{40}$ was significantly superior to others in increasing the growth and yield attributes, but this was on par with $P_{40}S_{40}$. Similar trend was observed regarding all the growth and yield attributes. The significant role of S in increasing the growth and yield

Table 1. Effect of phosphorus and sulphur on growth and yield of black gram (Mean of three years)

Treatments (kg/ha)	Plant height (cm)	No. of branches/ plant	No. of pods/plant	Pod length (cm)	No. of seeds/pod	Grain yield kg/ha	Net return (Rs./ha)	Cost benefit ratio
P_0S_0	24.5	2.91	13.2	3.30	3.01	507	4070	1.67
P_0S_{20}	26.0	3.00	15.0	3.41	3.02	515	4290	1.52
P_0S_{40}	27.3	3.00	16.0	3.40	3.00	520	4550	1.41
$P_{20}S_0$	27.0	3.12	18.3	3.92	3.43	526	4850	1.78
$P_{20}S_{20}$	31.6	3.51	25.0	4.56	3.73	588	5950	1.90
$P_{20}S_{40}$	37.0	4.00	30.1	5.10	4.12	619	6770	1.92
$P_{40}S_0$	28.0	4.03	27.2	4.70	3.70	590	6330	2.09
$P_{40}S_{40}$	43.5	4.44	34.7	5.52	4.42	666	7630	2.22
$P_{40}S_{40}$	48.4	4.85	40.0	6.21	5.00	725	8990	2.35
$P_{60}S_0$	47.5	4.60	35.1	5.63	4.62	675	7210	2.17
$P_{60}S_{40}$	50.2	4.88	41.0	6.44	5.21	730	8570	2.29
$P_{60}S_{40}$	50.5	4.89	43.0	6.52	5.20	753	9170	2.22
CD (5%)	4.0	0.31	4.5	0.34	0.21	42.0	-	-

P : Phosphorus : S : Sulphur

attributes might be attributed to its role in chlorophyll synthesis.

Effect on grain yield

Differences in grain yield among levels of P and S were significant (Table 1). Among the different levels, P @ 60 kg/ha produced significantly higher yield of 719 kg/ha. However, this was on par with P @ 40 kg/ha. There was 39 per cent and 28 per cent yield increase in P @ 60 kg/ha and 40 kg/ha respectively than control.

S application significantly influenced the grain yield of black gram. Highest and significant yield was realised in S @ 40 kg/ha, which was superior to other levels. The yield response to S application was 2 kg/kg of S applied. Similar findings were reported earlier also. The interaction between P and S was positive and synergistic regarding grain yield also. Increasing P level increased the response to S application substantially. No response to S application was observed even for 40 kg S/ha when P was not applied. Among the different treatments, $P_{60}S_{40}$ produced significantly higher yield. However this was on par with $P_{40}S_{40}$.

Economics

The economic analysis of the treatments (Table 1) revealed that the highest net profit was realised in $P_{60}S_{40}$ which was closely followed by $P_{40}S_{40}$. The cost-benefit ratio worked out showed higher cost-benefit ratio of 2.35 for $P_{40}S_{40}$. Hence, $P_{40}S_{40}$ was considered as the best and economic dose for black gram.

From the studies it can be concluded that application of 40 kg S/ha in the form of elemental sulphur along with 40 kg P/ha, produced highest yield in black gram in red-lateritic soils.

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