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SOYBEAN RESPONSE TO APPLIED SULPHUR AND BRADYRHIZOBIUM INOCULATION IN CLAY LOAM SOIL

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A pot culture experiment was conducted in clayloam soil to study the effect of sulphur and Bradyrhizobium inoculation on the growth and yield of soybean. The treatments consisted of four levels of S viz., 0, 7.5, 15 and 30 kg ha in the presence and absence of Bradyrhizobium inoculation. The result revealed that soybean responded significantly in the presence of Bradyrhizobium and sulphur compared to control. Plant height, root length, shoot and root dry weight, number of pods plant, 100 seed weight and seed yield were highest with 30 kg S ha in the presence on Bradyrhizobium inoculation compared to sulphur or inoculation alone and control. The per cent increase in seed yield was 44 over control. Bradyrhizobium inoculated soil recorded higher rhizospheric microbial population compared to uninoculated soil. Sulphur application significantly increased the bacterial population, while fungal and actinomycetes population were higher in control.

INTRODUCTION

Intensive cropping with high yielding varieties has caused marked depletion of inherent nutrient reserves of soil including sulphur. Sulphur deficiency is increasingly reported in Indian soils. Sulphur is vital plant nutrient and constituent of aminoacids, which are essential in protein synthesis. Lack of sulphur affects pod formation and development in grain legumes (Singh et al., 1994). Ram et al. (1998) reported that sulphur play multirole on growth and development and improve nitrogen fixation through its involvement in many metabolic pathway. There is paucity of information regarding sulphur and Bradyzhizobium interaction on growth and yield of soybean, hence the present study was taken up.

MATERIALS AND METHODS

A pot culture experiment was conducted using clay loam soil deficient in sulphur during 2001. The experiment was conducted in FCRD. The treatments consisted of four levels of S viz., 0, 7.5, 15, 30 kg ha applied through gypsum (15%) in the presence and absence of Bradyrhizobium inoculation. The experimental soil was having pH 7.8, EC 0.50 dSm¹, organic carbon 2.5 g kg⁻¹, available NPK being 284, 14.8, 230 kg ha¹ respectively. All the pots received uniform dose of NPK 20:40:80 kg ha, respectively. The biometric observation on plant height, root length, shoot and root dry weight, number of pods plant, 100 seed weight and seed yield were recorded. The microbial viable population was determined by standard dilution plate technique using selective media (Subba Rao, 1977).

RESULTS AND DISCUSSION

Effect of sulphur and Bradyrhizobium inoculation on the growth characters of soybean has

Table 1. Effect of S levels and Bradyrhizobium on plant height, root length and shoot and root dry weights of soybean

S.levels (kg ha ⁻¹)	Plant height (cm)			Root length (cm)			Shoot dry weight (g plant ⁻¹)			Root dry weight (g plant ⁻¹)		
	Without Rhizobium	With Rhizobium	Mean	Without Rhizobium	With Rhizobium	Mean	Without Rhizobium	With Rhizobium	Mean	Without Rhizobium	With Rhizobium	Mean
0	56.3	75.6	65.9	20.7	30.1	25.4	2.10	2.70	2.40	0.61	0.81	0.71
7.5	58.4	80.1	69.3	25.2	30.7	27.9	2.87	3.10	2.98	0.71	0.85	0.78
15	60.9	85.9	73.4	30.3	34.3	32.3	2.97	3.17	3.07	0.83	0.87	0.85
30	70.2	90.7	80.5	35.8	37.9	36.8	3.23	3.40	3.32	0.91	1.11	1.01
Mean	61.5	83.1	-	27.9	33.2	-	2.79	3.09	-	0.77	0.91	-
	S	I	Sxl	S	I	Sxl	S	I	Sxl	S	I	Sxl
CD at 5%	0.13	0.09	0.18	0.14	0.09	0.19	0.18	0.13	0.26	0.02	0.01	0.03

Table 2. Effect of S levels and Bradyrhizobium on number of pods plant⁻¹, 100 seed weight and seed yield.

S.levels (kg ha ⁻¹)	Number of pods plant ⁻¹			Hundred seed weight (g)			Seed yield (g pot ⁻¹)		
	Without Rhizobium	With Rhizobium	Mean	Without Rhizobium	With Rhizobium	Mean	Without Rhizobium	With Rhizobium	Mean
0	38.0	43.0	40.5	8.87	9.70	9.28	14.02	17.76	15.89
7.5	41.0	48.0	44.5	9.80	11.82	10.81	16.08	20.81	18.44
15	42.9	55.8	49.4	11.80	14.20	13.00	19.67	23.46	21.56
30	44.9	58.4	51.7	13.67	16.20	14.93	21.3	24.63	22.95
Mean	41.7	51.3	-	11.03	12.98	-	17.76	21.66	-
	S	I	Sxl	S	I	Sxl	S	I	Sxl
CD at 5%	0.15	0.10	0.22	0.12	0.08	0.16	0.9	0.6	1.27

Table 3. Effect of S levels and *Bradyrhizobium* on microbial population at 60 DAS in the rhizosphere of soybean.

S.levels (kg ha ⁻¹)	Fungi (x 10 ⁴ g ⁻¹)			Bacterial (x 10 ⁶ g ⁻¹)			Actinomycetes (x 10 ⁵ g ⁻¹)		
	Without Rhizobium	With Rhizobium	Mean	Without Rhizobium	With Rhizobium	Mean	Without Rhizobium	With Rhizobium	Mean
0	33.6	46.6	40.1	83.6	90.0	86.8	18.0	25.3	21.7
7.5	31.6	37.7	34.7	100.6	109.6	105.1	17.6	24.1	20.9
15	29.6	35.7	32.7	105.7	113.4	109.6	16.3	23.0	19.7
30	26.4	33.6	30.0	96.4	100.2	98.3	15.7	21.4	18.6
Mean	30.3	38.4	-	96.6	103.3	-	16.9	23.5	-
	S	I	SxI	S	I	SxI	S	I	SxI
CD at 5%	0.14	0.09	0.19	0.19	0.13	0.27	0.11	0.08	0.16

been presented in Table 1. The results indicate that sulphur application in the presence of *Bradyrhizobium* increased the plant height, root length, shoot and root dry weight significantly compared to their individual application and control. The growth characters increased with increase in S levels and the maximum growth was observed at 30 kg S ha in the presence of *Bradyrhizobium*. The per cent increase due to this treatment over control was 61, 83.1, 61.9, 82 for plant height, root length, shoot and root dry weight respectively. The beneficial effect of S might be due to its low status in the initial soil and S application @ 30 kg ha¹ could be more advantageous for profused vegetative and root growth which activated higher absorption of nutrients from the soil and improved metabolic activity inside the plant as it is directly related to the cell division, enlargement and elongation. These findings endorse the results of Singh et al. (1994) in moong.

Number of pods plant, test weight and seed yield were increased significantly with increasing levels of S (Table 2) in the presence of *Bradyrhizobium* compared to control. The maximum values of 58.4, 16.2 g and 24.63 g pot for number of pods plant, test weight and seed yield respectively were recorded at 30 kg S ha in the presence of inoculation. The per cent increase due to this treatment over control was 27.7, 60.9, 44.4 for number of pods plant, test weight and seed yield respectively. This may be due to its role in protein and hormone synthesis. Sulphur is required for conversion of reduced nitrogen into protein in nitrogen fixing legumes. Ramamoorthy et al. (1996) and Raghuwanshi et al. (1997) reported that addition of 40 kg S ha¹ recorded maximum seed yield of soybean.

Increase in seed yield due to *Rhizobium* inoculation could be due to proper establishment and greater infection of *Rhizobium* strains at more number of sites as evidenced from higher number of

nodules and their weight which resulted in supply of N in larger quantity to plant. Muneshwar Singh et al. (1998) also reported increased seed yield in soybean when inoculated with rhizobium.

Influence of sulphur and Bradyrhizobium inoculation on rhizospheric microbial population at 60 DAS is presented in Table 3. Fungal, bacterial and actinomycetes population was more in inoculated soils compared to uninoculated soil. Bacterial population increased with S levels upto 15 kg S ha and population was reduced at 30 kg S ha¹. Fungal and actinomycetes population was more in control than in S treated soils. Decrease in fungal population could be due to fungicidal action of S and reduction in actinomycetes population could be due to non-compatible nature of S oxidising bacteria with actinomycetes. Similar response was noticed in moong by Jogendra Singh et al. (1997)

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