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Effect of sulphur and *Bradyrhizobium japonicum on the growth* and yield of Soybean

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S.Mahalakshmi, M.Vijayapriya and K.Sowmiya

Faculty of Agriculture, Annamalai University, Annamalai Nagar- 608 002.

Abstract

A pot culture experiment was conducted in clay loam soil to study the effect of Sulphur (S) and *Rhizobium* inoculation on nodulation, nitrogenase activity and yield of soybean C01. The treatments consisted of levels of S *viz.* 0, 7.5,15,30 kg ha^{-1}in the presence and absence of exogenous inoculation of *Rhizobium*. The results revealed that with increasing levels of S, there was gradual increase in nodulation, nitrogenase activity and seed yield and maximum was found with 30kg ha^{-1} . Rhizobium inoculation irrespective of S levels enhanced BNF over uninoculated control, and thus there was increase in the seed yield of soybean by 22 per cent.

Key words: Soybean, Rhizobium, Sulphur, Nitrogenase activity.

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INTRODUCTION

Soybean is one of the proteinaceous crops of the world and is cultivated in about 3 million hectares in India with an annual production of 1.9 million tones. As a legume crop, inoculation of seeds with *Rhizobium* is known to boost its BNF of crop (Pandazou *et al.,* 1990). The requirement of S to produce 1 ton of soybean seed is 3 to 8 kg S. Besides N, sulphur is also required for protein synthesis (Mengel and Kirkby, 1987). One of the main demands of sustainable agriculture is the improved management of environmental nitrogen pool as well as the reduction of N fertilizers input. Sulphur in found to increase N_2 fixation by legumes (Brogan and Murphy, 1980), and soybean is a sulphur loving plant and like other oilseed crops for proper growth and yield The response of soybean to sulphur application has been reported by several workers (Nagar *et al*., 1993; Rao and Ganeshmurthy, 1994). However, most of the Bangladesh soil are deficient in available sulphur which roughly covers about 44% of the total cropped area (Hussain, 1990). Soils in many parts of the country are becomingsulphur deficient and information on relationship between N_2 fixation by *Rhizobium* and available S is lacking The present article deals with the effect of sulphur and *Rhizobium* inoculation on BNF andseed yield of soybean.

MATERIALS AND METHODS

*Corresponding Author :
email: *menagamohan2008@gmail.com*

A bulk soil sample (0-15 cm) was collected from Experimental Farm, Annamalai University.The soil was dried, processed and sieved through 2mm sieve. Thirty kilogram processed soilsample was transferred to 1×1 m^2 cement pot. The experimental soil was clay loam with pH 8.1 EC 0.45 dSm^{-1}, organic carbon 0.49 per cent available NPKha^{-1} was 215,16, 350 kg respectively and available S was9.6ppm (low). Sulphur was applied at the rate of 0, 7.5, 15 and 30 kg ha^{-1} applied through gypsum in the presence and absence of *Bradyrhizobium japonicum* inoculation. All the pot received a common fertilizerschedule of 20:80:40 kg N, P_20_5 and K_20 kgha^{-1} respectively as basal dose. All the treatments werereplicated thrice in FCRD design. The plants were carefully uprooted and gently washed to record the number of nodules per / plant. The nodules were detached and oven dried at 60°C for 24 hr., and the nodule dry weight was recorded. The nitrogenase activity of intact nodule was determined by acetylene reduction assay (Hardy *et al.,* 1968). Number of pods per / plant, 1000 grain weight and seed yields were also recorded.

RESULTS AND DISCUSSION

Effect on root nodulation and nitrogenase activity: Addition of sulphur and *Rhizobium* inoculation significantly increased the number of nodules $plant^{-1}$, nodule dry weight, leghaemoglobin content and nitrogenase activity compared to control (Table 1). *Rhizobium* inoculation proved helpful in significantly increasing the number of nodules $plant^{-1}$ (23.6), nodule dry weight (0.63 g), leghaemoglobin content (1.37 mg g^{-1} of nodule) and nitrogenase activity (540.9

Table.1. Effect of sulphur and Rhizobium inoculations on nodule number, nodule dry weight, leghamoglobin content and nitrogenase activity in soybean Co 1.

S levels (kg ha"1)	Number of nodules			Nodules dry weight		
	Unino-culated	Inocu-lated	Mean	Unino-culated	Inocu-lated	Mean
S_0-o	17.8	20.3	19	0.42	0.46	0.44
S_1 -7.5	20	22.5	21.2	0.44	0.53	0.48
S_2-15.0	23.5	24.7	24.1	0.58	0,62	0.6
S_3 -30.0	25.1	27	26.1	0.88	0.97	0.92
Mean	21.8	23.6	-	0.58	0.65	-
	S	I	S×I	S	I	S×I
SE_D	0.88	0.62	1.24	0.05	0.04	0.08
CD (p-0.05)	1.76	1.25	2.49	0.11	0.08	0.16

Table. 2. Effect of sulphur and ***Rhizobium*** inoculations on yield components and seed yield of soybean Co 1

S levels (kg ha-1)	Number of pods			100 seed weight (g)			Seed yield (g pot^{-1})		
	Unino-culated	Inocu-lated	Mean	Unino-culated	Inocu-lated	Mean	Unino-culated	Inocu-lated	Mean
V°	38	43	40.5	8.9	9.7	9.3	14.03	17.76	15.89
S, - 7.5	41	47.9	44.5	9.8	11.8	10.8	16.08	20.81	18.45
S_2-15.0	42.9	55.8	49.4	11.8	14.2	13	19.67	23.46	21.57
S_3 -'30.0	44.9	58.4	51.7	13.7	16.2	14.9	21.28	24.63	22.96
Mean	41.7	51.3		11	13		17.77	21.67	
	S	I	Sx1	S	I	Sx1	S	I	Sxl
SED	1.35	0.96	1.97	0.06	0.04	0.08	1.2	0,08	1.5
CD (p=0.05)	2.71	1.91	3.81	0.12	0.08	0.16	2.4	1.6	3.2

nanomoles C_2H / mg of nodules) when compared to uninoculated control. Praharaj and Dhingra (1995) reported *Rhizobium* inoculation enhanced BNF. Biological nitrogen fixation progressively increased with S levels and highest number of nodules plant^{-1} (26.1), nodule dry weight (0.92 g), leghaemoglobin content (1.6 mg g^{-1} root nodule) and nitrogenase activity (579.8 nanomoles C_2H_4 / mg of nodules) was noticed with 30 kg ha^{-1}. The per cent increase of nitrogenase activity over control due to S was 25.1. Sulphur application has been reported to increase the root system of leguminous plants and also increases the rate of photosynthesis of plant causing increase in number of nodules and nitrogenase activity (Brogan and Murphy, 1980). Sriramachandrasekharan *et al* . (2004) made similar type of observations with the application of 30 kg S ha^{-1} in the presence of B*radyrhizobium* inoculation.

Effect on yield and yield traits

Rhizobium inoculation and sulphur levels had significant effect on seed yield, number of pods plant^{-1} and 1000 grain weight compared to control (Table 2). Increase in number of pods plant^{1},100 seed weight and seed yield following *Rhizobium* inoculation over inoculated was in order of 23, 18, 22 per cent, respectively. Kaur (1990) reported similar response of *Rhizobium* on seed yield and ancillary character of soybean. Yield traits and yield progressively increased with S levels and maximum number of pods per plant (51.7), 1000 grain weight (14.9g) and seed yield (22.9 g) were recorded with 30 kg ha^{-1}. Since the experimental soil was deficient in S, soybean crop responded well when the soil was addeded with 30 kg S ha^{-1}. It has been reported that sulphur plays a vital role in chlorophyll development and ultimately on photosynthesis and carbohydrate metabolism which has reflected on seed yield. Nguyenn-van Bo and Nguyen and Trong Thi (1997) reported significant increase in soybean yield over control when increased rate of sulphurwas applied.

REFERENCES

Brogan, J.C. and Murphy, M.D. 1980. Sulphur nutrition in Ireland. *Sulphur in Agric*. 4:2-4.

Hardy, R.W., Hosten, R.D., Jackson E.K. and Burns, E. 1968. *The acetylene assay for nitrogen fixation.* Laboratory and field evaluation. *Plant Physiol*. 43:1185 -1207. PMid:16656902 PMCid:PMC1086994 https://doi.org/10.1104/pp.43.8.1185

Hussain, S.G. 1990. Sulphur in Bangladesh Agriculture. *Sulphur in Agriculture* 14:25-28. https://doi.org/10.5962/p.266666

Kaur, *G.1980. Studies on Soybean Bradyrhizobium interactions in Punjab soils.* M. Sc. Thesis, PAU. Ludhiana.

Mengel, K. and Kirkby, E.A.1987. *Principles of plant nutrition,* International Potash Institute, Bern, Switzerland.

Nagar, R.P., Mai, G.C. and Lal, P. 1993. Effect of P and S on yield and chemical composition of soybean in vertisolos. *Indian Soil* 4:385-386.

Nguyen Van Bo and Nguyen Trong Thi. 1997. Efficiency of S containing fertilizer application for soybeangrown in degraded soils in Northern Vietnam. *Sulphur in Agric.,* 20:85 - 92.

Pandazou, J., Beunard, P. and Saint Macary, H. 1990. Inoculation of soybean in Congo. *Agronomic Tropica*le 45: 199 - 204.

Praharaj, C.S. and Dhingra, K.K. 1995. Effect of Pendimethalin on rhizobial efficiency in soybean. *Indian J. Weed Sci.* 27(3/4): 201 - 204.

Rao,A.S. and Ganeshmurthy, A.N. 1994. Soyean response to applied P and S on Vertic Ustochrepts in relation to available P and S. *Indian society of soil* 2:606-610.

Sriramachandrasekharan, M.V., Muthukkaruppan, S.M., 2004. Effect of sulphur and Rhizobium on biological nitrogen fixation, nutrient uptake and seed yield of soybean. *J. of Ecobiology* 16(3): 235-236.