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Mirza IAB
Assistant Professor, Dept. of Agronomy, Latur
Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

Sirsath MK
M. Sc Dept. of Agronomy, Latur
Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

Khazi GS
Ph.D Dept. of Agronomy, Latur
Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

Correspondence
Mirza IAB
Assistant Professor, Dept. of Agronomy, Latur
Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

Production and productivity of soybean as influenced by integrated sulphur management

Mirza IAB, Sirsath MK and Khazi GS

Abstract
The field investigation entitled “Production and Productivity of Soybean as influenced by Integrated Sulphur management was conducted at farm, Department of Agronomy, College of Agriculture, Latur. The experiment was laid out in a randomized block design with nine treatments. Each experimental unit was repeated three times. Sowing was done on 5th July, 2013 by dibbling the seeds at spacing 45 cm X 5 cm. Application of RDF + sulphur enriched FYM (on the basis of S @ 20 kg ha^{-1}) + *Thiobacillus* (T_6) recorded significantly higher growth, yield and quality contributing characters followed by application of RDF + sulphur enriched FYM (on the basis of S @ 20 kg ha^{-1}) (T_3).

Keywords: Growth, FYM, *Thiobacillus*, Soybean, Yield.

Introduction
Soybean is important crop in human and animal nutrition, because it is a major source of edible vegetable oil and high protein feed as well as food in the world. It is an excellent health food and contains 40% quality protein, 23% carbohydrates and 20% cholesterol free oil. Soybean protein is rich in valuable amino acid viz., lysine (5%) which is deficient in most of the cereals. It also contains 60% poly unsaturated fatty acid (52.8% linoleic acid +7.2% linoleic acid). It has high calorific value releasing 432 calories from 100 gm edible protein as compared to 350 calories from cereal of same quantity (Dixit *et al*., 2011).

Good yield of soybean can be achieved by balanced nutrient. In addition to N, P and K application of sulphur is gaining importance because of it being deficient in soil of growing areas. Sulphur is now being recognized as the fourth major nutrient in addition to nitrogen, phosphorus and potassium. The deficiency of sulphur in soil and plant are being reported from several parts of the country and also in Maharashtra. Crop generally requires as much sulphur as they need phosphorus.

Sulphur is important nutrient for optimum production of high yielding soybean. It is component of several amino acids, the building blocks of proteins. This element is therefore, very important with respect to quality. It is also essential for formation of nodules on the roots of legumes. Soybean grown on soil that are low or deficient in sulphur are poorly nodulated and therefore nitrogen fixation is suppressed. It is also involved in the formation of oils.

Material and Methods
The field investigation entitled “Production and Productivity of Soybean as influenced by Integrated Sulphur management was conducted at farm, Department of Agronomy, College of Agriculture, Latur. The experimental field was leveled and well drained. The soil was clayey in texture, low in nitrogen, medium in phosphorus and alkaline in reaction. The environmental conditions prevailed during experimental period was favorable for normal growth and maturity of soybean crop. The experiment was laid out in a randomized block design with nine treatments. Each experimental unit was repeated three times. The treatments are T1: RDF, T2:RDF + Sulphur 20 kg ha^{-1}, T3:RDF+ Sulphur enriched FYM (on the basis of S @ 20 kg ha^{-1}), T4: RDF + FYM @ 5 t ha^{-1} + Sulphur 20 kg ha^{-1}, T5: RDF + *Thiobacillus* + Sulphur @ 20 kg ha^{-1}, T6: RDF + Sulphur enriched FYM (on the basis of S @ 20 kg ha^{-1}) + *Thiobacillus*, T7: RDF + Vermi compost @ 2 t ha^{-1} + S @ 20 kg ha^{-1}, T8: RDF + Vermi compost @ 2 t ha^{-1} + S @ 20 kg ha^{-1} + *Thiobacillus,* T9:*Thiobacillus.*Sowing was done on 5th July, 2013 by dibbling the seeds at spacing 45 cm X 5 cm. The recommended cultural practices and plant protection measures were taken. The recommended dose of fertilizer (30:60:30 kg NPK ha^{-1}) was applied at the time of sowing through Urea, DAP and MOP. The crop was harvested on 13th October, 2012. Data obtained on various variables were analysed by "analysis of variance method" (Panse and Sukhatme, 1967).

Results and discussion

The beneficial effect of different treatment on plant height, number of functional leaves, leaf area, and number of branches, number of pods per plant, total dry matter and root nodules of soybean were evident during active growth and maturity.

The application of RDF + sulphur enriched FYM (on the basis of S @ 20 kg ha^{-1}) + *Thiobacillus* (T_6) produced more vegetative growth in early period of crop growth. It was observed from the data that the plant height was found to be increased progressively at every stage of crop growth. The increase in height was rapid during 30-60 DAS and thereafter it increases marginally till maturity. The effect of different treatments on plant height was found to be significant and the higher plant height was recorded by the application of RDF + sulphur enriched FYM (on the basis of S @ 20 kg ha^{-1}) + *Thiobacillus* (T_6) (29.33 cm) as compared to other treatments. The increase in growth attributes may be due to better uptake and translocation of plant nutrients to growing plants, but it was found to be at par with application of RDF + sulphur enriched FYM (on the basis of S @ 20 kg ha^{-1}) (T_3). Similar kind of observations were recorded by Gupta *et al.*, (2003)

Data on mean number of trifoliate functional leaves per plant and leaf area per plant revealed that these increased rapidly up to 45 DAS and between 60-75 DAS and decreased thereafter towards maturity due to senescence of leaves. The application of RDF + sulphur enriched FYM (on the basis of S @ 20 kg ha^{-1}) + *Thiobacillus* (T_6) recorded higher mean number of functional leaves (22.13) and it was at par with the application of RDF+ sulphur enriched FYM (on the basis of S @ 20 kg ha^{-1}) (T_3) (21.43), RDF + FYM @ 5 t ha^{-1} + sulphur 20 kg ha^{-1} (T4) (20.50) and RDF + Vermi compost @ 2 t ha^{-1} + S @ 20 kg ha^{-1} +*Thiobacillus* (T8) (20.00)

The application of RDF + sulphur enriched FYM (on the basis of S @ 20 kg ha^{-1}) + *Thiobacillus* (T_6) recorded higher mean number of leaf area per plant (19.17 dm^2) and it was at par with the application of RDF+ sulphur enriched FYM (on the basis of S @ 20 kg ha^{-1}) (T_3) (18.50 dm^2) and RDF + FYM @ 5 t ha^{-1} + sulphur 20 kg ha^{-1} (T4) (17.97) at every stage of the crop growth. Thus might be due to more available of sulphur to plant which resulted in vigorous growth, resulted in higher number of leaves and leaf area. Trivedi *et al.*, (2011) also reported similar results.

From the data of mean number of branches it was revealed that the number of branches increased up to 90 DAS and remains constant at harvest. The rate of increase was high up to 30-60 days, moderate from 60-90 days and was remain same thereafter at harvest. Mean number of branches were influenced significantly by various treatments under study and application of RDF + sulphur enriched FYM (on the basis of S @ 20 kg ha^{-1}) + *Thiobacillus* (T_6) recorded higher mean number of branches (6.75) and it was at par with the application of RDF+ sulphur enriched FYM (on the basis of S @ 20 kg ha^{-1}) (T_3) (6.52). The maximum number of nodules $plant^{-1}$ were observed with the application of RDF + sulphur enriched FYM (on the basis of S @ 20 kg ha^{-1}) + *Thiobacillus* (T_6) (85.00) and it was at par with the application of RDF+ sulphur enriched FYM (on the basis of S @ 20 kg ha^{-1}) (T_3) (79.67). Jadhav *et al.*, (2009) also reported similar results.

Total dry matter accumulation per plant was found to be increased continuously with advancement in age of the crop till at harvest. The rate of increase in dry matter accumulation was faster between 30 to 90 DAS and remains constant at harvest. The application of RDF + sulphur enriched FYM (on the basis of S @ 20 kg ha^{-1}) + *Thiobacillus* (T_6) recorded the higher dry matter accumulation at 75 DAS (26.10 g) along with application of RDF+ sulphur enriched FYM (on the basis of S @ 20 kg ha^{-1}) (T_3) (25.03 g). Least dry matter $plant^{-1}$ was recorded by application of *Thiobacillus* (T_9) (14.43) at all the crop growth stages. Similar kind of results was reported by Hussain *et al.*, (2011)).

It was observed from the data on mean number of pods per plant increased progressively from 60 days onwards till maturity. The application of RDF + sulphur enriched FYM (on the basis of S @ 20 kg ha^{-1}) + *Thiobacillus* (T_6) recorded higher mean number of pods per plant (21.64) followed by the application of RDF+ sulphur enriched FYM (on the basis of S @ 20 kg ha^{-1}) (T_3) (20.69), RDF + FYM @ 5 t ha^{-1} + sulphur 20 kg ha^{-1} (T_4) (20.70) and RDF + Vermi compost @ 2 t ha^{-1} + S @ 20 kg ha^{-1} +*Thiobacillus* (T_8) (19.12) and *Thiobacillus* (T_9) (14.70). This might be due to enhanced uptake of sulphur nutrient due to more availability of sulphur which resulted in more growth of plant hence more pod bearing capacity. Also reported the beneficial effect of sulphur on number of pods Trivedi *et al.*, (2011).

Seed yield q ha^{-1} as influenced by different treatments was found to be significant. The application of RDF + sulphur enriched FYM (on the basis of S @ 20 kg ha^{-1}) + *Thiobacillus* (T_6) recorded higher mean seed yield (26.00 q ha^{-1}) and it was at par with the application of RDF+ sulphur enriched FYM (on the basis of S @ 20 kg ha^{-1}) (T_3) (25.00 q ha^{-1}). This might because of the cumulative effect in increasing growth contributing characters which have been clearly exhibited on the final produce i.e. seed and straw yield ha^{-1}. Also found similar result Gokhale *et al*., (2005).

Straw yield kg ha^{-1} as influenced by different treatments was found to be significant. The application of RDF + sulphur enriched FYM (on the basis of S @ 20 kg ha^{-1}) + *Thiobacillus* (T_6) recorded significantly higher mean straw yield (33.41 q ha^{-1}) followed by the application of RDF+ sulphur enriched FYM (on the basis of S @ 20 kg ha^{-1}) (T_3) (33.31 q ha^{-1}).

Data on biological yield kg ha^{-1} as influenced by different treatments was found to be significant. The application of RDF + sulphur enriched FYM (on the basis of S @ 20 kg ha^{-1}) + *Thiobacillus* (T_6) recorded significantly higher mean biological yield (59.41 q ha^{-1}) followed by the application of RDF+ sulphur enriched FYM (on the basis of S @ 20 kg ha^{-1}) (T_3) (58.31 q ha^{-1}). Least biological yield was recorded in treatment (T_9) where only *Thiobacillus* was applied.

Data on harvest index showed that the highest harvest index was recorded (44.30) by the application of sulphur RDF + Vermi compost @ 2 t ha^{-1} + S @ 20 kg ha^{-1} followed by the application of RDF + sulphur 20 kg ha^{-1} (43.97), RDF + sulphur enriched FYM (on the basis of S @ 20 kg ha^{-1}) + *Thiobacillus* (T_6) (43.76) and only *Thiobaciillus* (T_9) (43.73).

Table 1: Mean Growth attributes of soybean as influenced by different treatments at 90 DAS

	Treatments	Plant height	No. of leaves	No. of Branches	Leaf Area	Dry matter	Root Nodules
T_1	RDF	21.00	13.33	2.69	0.70	17.70	16.00
T_2	RDF + Sulphur 20 kg ha^{-1}	23.67	16.17	4.18	0.90	20.38	19.00
T_3	RDF+ Sulphur enriched FYM (S @ 20kg ha^{-1})	28.47	20.93	6.52	1.33	25.03	26.07
T_4	RDF + FYM@ 5 t ha^{-1} +Sulphur 20 kg ha^{-1}	27.67	20.00	6.25	1.30	24.88	24.77
T_5	RDF + *Thiobacillus* + Sulphur @ 20 kg ha^{-1}	26.33	18.97	6.07	1.23	23.70	22.67
T_6	RDF + Sulphur enriched FYM (S @ 20 kg ha^{-1}) + *Thiobacillus*	29.33	21.47	6.75	1.50	26.10	31.33
T_7	RDF + Vermicompost @ 2t ha^{-1} + S @ 20 kg ha^{-1}	25.03	17.93	5.20	1.20	22.23	21.00
T_8	RDF + Vermicompost @ 2 t ha^{-1} + S @ 20 kg ha^{-1} + *Thiobacillus*	27.33	19.50	5.93	1.27	24.02	23.67
T_9	*Thiobacillus*	17.67	10.33	1.63	0.43	14.43	13.00
	S.E.±	0.95	0.63	0.27	0.07	0.86	0.55
	C.D. at 5%	2.84	1.90	0.81	0.20	2.60	1.65
	G.M.	25.17	17.63	5.03	1.10	22.05	21.94

Table 2: Seed yield (q ha^{-1}), Straw yield (q ha^{-1}), Biological yield (q ha^{-1}) and Harvest Index (%) as influenced by different treatments.

	Treatments	Seed yield (q ha^{-1})	Straw Yield (q ha^{-1})	Biological Yield (q ha^{-1})	Harvest Index (%)
T_1	RDF	19.47	26.00	45.47	42.82
T_2	RDF + Sulphur 20 kg ha^{-1}	20.67	26.33	47.00	43.97
T_3	RDF+ Sulphur enriched FYM (S @ 20kg ha^{-1})	25.00	33.31	58.31	42.88
T_4	RDF + FYM@ 5 t ha^{-1} +Sulphur 20 kg ha^{-1}	24.03	31.68	55.71	43.14
T_5	RDF + *Thiobacillus* +Sulphur @ 20 kg ha^{-1}	22.17	31.00	53.17	41.69
T_6	RDF + Sulphur enriched FYM (S @ 20 kg ha^{-1}) + *Thiobacillus*	26.00	33.41	59.41	43.76
T_7	RDF + Vermicompost @ 2t ha^{-1} + S @ 20 kg ha^{-1}	21.47	27.00	48.47	44.30
T_8	RDF + Vermicompost @ 2 t ha^{-1} + S @ 20 kg ha^{-1} + *Thiobacillus*	23.00	31.49	54.49	42.21
T_9	*Thiobacillus*	17.33	22.30	39.63	43.73
	S.E.±	0.37	0.66	1.04	-
	C.D. at 5%	1.12	2.00	3.13	-
	G.M.	22.13	29.15	51.18	43.16

References

1. Dixit AK, Antony JIX, Navin K, Sharma Tiwari RK. Bio-sciences, ITC R&D Center, peenya industrial area, peenya, Bangalore -560058, India, 2011.
2. Panse VG, Sukhatme PV. Statistical methods for Agricultural Workers. ICAR, New Delhi, 1967.
3. Gupta V, Sharma GL, Sonkiya VA, Tiwari G. Impact of differant levels of FYM and sulphur on morph physiological indices and productivity of soybean genotypes. JNKVV Res. J. 2003; 37:76-78.
4. Trivedi AK, Hemantaranjan A, Pandey SK. Iron and Sulphur application may improve growth and yield of soybean. Indian Journal of Plant Physiology. 2011; 16 (3&4):309-313.
5. Jadhav AS, Andhale RP, Patil PA. Effect of integrated nutrient management on yield attributes and yields of soybean. J. Maharashtra Agric. Univ. 2009; 34(1):86-88.
6. Hussain Khadim, Muhammad Islam, Muhammad Tariq Siddique, Rifat Hayat and SaleemMohsan. Soybean growth and nitrogen fixation as affected by sulfur fertilization and inoculation under rainfed conditions in Pakistan. International J of Agriculture & Biology. 2011; 13(6):951-955.
7. Gokhale DN, Kanade AG, Karanjikar PN, Patil VD. Effect of sources and levels of sulphur on seed yield, quality and sulphur uptake by soybean, (*Glycine max* (*L.*)) Merrill. J of Oilseeds Research. 2005; 22(1):192-193.