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RESPONSE OF ORGANIC NUTRIENT SOURCES AND SULPHUR LEVELS ON GROWTH, ECONOMICS AND OIL CONTENT OF SOYBEAN (*GLYCINE MAX* L. MIRRELL)

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ABSTRACT

A field experiment was conducted during the *kharif* season 2013-14 at the Crop Research Farm, Department of Agronomy Allahabad School of Agriculture, SHIATS, Allahabad (U.P.) to evaluate the response of organic nutrient sources and sulphur levels on growth, economics and oil content of soybean. The experiment was laid out in randomized block design with three replications. The soil of experiment field is low in organic carbon (0.34%), medium in available phosphorus (13.50 kg ha^{-1}) and high in available potash (257 kg ha^{-1}). The treatment consisted of three sources of solid organic nutrients (vermicompost, farmyard manure and poultry manure) and four levels of sulphur (0 kg, 30 kg ha^{-1} sulphur, 40 kg ha^{-1} sulphur and 50 kg ha^{-1} sulphur respectively). The experimental results revealed that Poultry manure + 40 kg ha^{-1} sulphur recorded highest plant height, Farmyard manure + 40 kg ha^{-1} sulphur recorded highest branches (9.0), grain yield (2112.89 kg ha^{-1}), oil content (18.66%) and B:C ratio (2.85). Among the organic sources Farmyard manure + 40 kg ha^{-1} sulphur recorded highest plants dry weight. Farm yard manure and 40 kg ha^{-1} sulphur may be recommended to soyabean for maximizing yield and quality of soyabean.

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INTRODUCTION

Soybean (*Glycine max* L. Merrill) is an important oilseed crop and food grain legume.India is the second largest producer of Soybean after U.S.A. Soybean known as the "Wonder crop". It is an excellent source of protein (44%), Cholesterol free oil (20%) and carbohydrate (Gahukar *et al.*, 1997).It is a triple beneficiary crop, a unique food, a valuable feed and an industrial raw material with considerable potential (Chavan, *et al.*, 2014).Nutrient imbalance is one of the important constraints of soybean productivity in the North Indian Plains (Tiwari, 2001).

The non-judicious and unbalanced use of fertilizers, also leads to environmental pollution Yadav *et al.*, 2005. At present soil health as well as productivity of crop affected by nutrient imbalance and quality of crop productivity decreases day by day due to using of chemical fertilizer to supply plant nutrient.Another aspect that of chemical fertilizer affect the physical, chemical and biological properties of soil as well as prices of chemical fertilizer increasing day by day. On the other hand when increased doses of chemical fertilizers are used to increase crop production it cause the environmental pollution and toxicity to soil as it kill the beneficial microorganism. It is also proved that plant remove more nutrient from the soil in modern intensive cultivation and hence needs constant replenishment. Under such condition organic manure offer good alternative technology to replenish the required crop nutrients (Chandra *et al.*, 2005). So at present organic farming is one of the most important practice to maintain long lives soil fertility as well as it is a cheaper sources to prevent soil from soil pollution by chemical fertilizers. One of the important aspects in organic farming is the soil fertility/nutrient management of crops/cropping systems to optimize crop productivity. Organic amendments helps in improving the soil physical and biological environment besides supplying nutrients for crop growth (Darwish *et al.*, 1995). Concomitantly, adoption of appropriate agronomic operations may result in acceptable phenotypical characteristics, *viz.*, dry matter production, nodulation and ultimate enhancement of productivity of the crop. The management of manures within a crop rotation can have large effects on yields and crop quality (Stein-Bachinger and Werner, 1997). Organic farming plays greater role in maintaining soil health and reducing the risk of soil erosion when compared to chemical farming (Reganold and Palmer, 1995). There is need to refining and standardized package of practice for important crop under organic farming system. Sulphur is an essential macronutrient in plant growth and development. It is increasingly being recognized as the fourth major plant nutrient after nitrogen, phosphorus and potassium. Among the fertilizer elements sulphur requirement of oilseed crops is quite high as compared to other crops (Das and Das, 1994). Sulfur deficiencies in crops have increasingly occurred due to less to no addition of S to soil because of increased use of S-free fertilizers, greater S removal from soil by crops with enhanced yield and under more intensive cropping systems (Scherer, 2001). The role of sulphur in the seed production of soybean has been reported by several investigators. Bhuiyan *et al.* (1998), Srivastava *et al.* (2000) observed that among the fertilizer elements, sulphur requirement of oilseed crops is quite high as compared to other crops. Devi *et al.* (2012) reported

that application of sulphur improved nitrogenase activity, nitrogen fixation, plant dry matterandquality of soyabean grain in sulphur deficient soil. The objective of this topic is to evaluate the effect of integrated nutrient management, organic nutrient sources and sulphur levels on growth, yield, quality and economics of soyabean.

MATERIALS AND METHODS

The soil of the experimental field was shallow in depth (30 cm) having 0.34% organic carbon, 225 kg ha^{-1} available nitrogen13.50 kg ha^{-1} available P_2O_5, 257.00 kg ha^{-1} available K_2O, pH 7.5 and EC (0.13 dS m^{-1}). These parameter analyzed by Wet Oxidation Method,Alkaline Permanganate Method,Olsen's Colorimetric Method and NH_4OAC- leaching method respectively. Farm is situated at 25° 57' N latitude, 87° 19' E longitude and 98 m altitude from the sea level. The treatment combinations in the experiment comprised of 3 sources of solid organic manures *viz*., Farmyard manure, Poultry manure and Vermicompost and three levels of sulphur (30 kg ha^{-1}, 40 kg ha^{-1} and 50 kg ha^{-1}) with control (0 kg ha^{-1} sulphur) for sulphur. Half dose of NPK was supply by organic manure and remaining dose supply by inorganic sources (equivalency based on phosphorus).The experiment was laid out in Randomized Block Design with three replication. Twelve treatment T_1- FYM + Control (0 kg ha^{-1} sulphur), T_2- FYM + 30 kg ha^{-1}sulphur, T_3- FYM + 40 kg ha^{-1}sulphur, T_4- FYM + 50 kg ha^{-1}sulphur, T_5- Vermicompost + Control (0 kg ha^{-1} sulphur), T_6- Vermicompost + 30 kg ha^{-1} sulphur, T_7- Vermicompost + 40 kg ha^{-1} sulphur,T_8- Vermicompost+ 50 kg ha^{-1} sulphur, T_9- Poultry manure +Control (0 kg ha^{-1} sulphur),T_{10}- Poultry manure + 30 kg ha^{-1} sulphur,T_{11}- Poultry manure + 40 kg ha^{-1} sulphur and T_{12}- Poultry manure + 50 kg ha^{-1} sulphur. In T_1,T_5 and $T_9$are controlled for sulphur. Seed sown at the rate of 80 kg ha^{-1} with *kera* method of sowing. Variety using in trial is JS-335. Oil content in kernels was estimated through 'Soxhlet's apparatus.

RESULTS AND DISCUSSION

Yields attributes and yield of soybean

Among the all sources of organic manure and levels of sulphur T_3 (FYM + 40 kg ha^{-1} sulphur)is best in all of treatment. Plant height are highest recorded at 75 DAS (44.90) in T_{11} (Poultry manure + 40 kg ha^{-1} sulphur) which was 20.86 % higher than lowest value (37.15) in treatment T_8 (Vermicompost + 50 kg sulphur ha^{-1}) and the number of branches are highest at 75 DAS (9.00)in T_3 (FYM + 40 kg ha^{-1}sulphur) which was 40.62 % higher than lowest value (6.40) in T_{12} (Poultry manure + 50 kg sulphur ha^{-1}). Application of farmyard manure due to increased available macro and micro nutrient thus promoting activity of beneficial micro organism (Chaturvedi *et al*., 2010). The application of organic manures decrease bulk density, improve the soil environment including physico-chemical (such as enhanced nitrogenase activity), aeration biological condition, and micro climate of photosphere resulting in maximum penetration of rhizobium in root hairs (Yawalkar*et al*., 1996). All yield attributing characters viz., plant height, branches $plant^{-1}$, pod $plant^{-1}$, grains $capsule^{-1}$, 100-seed weight (g) and seed yield of the experimental crop significantly influenced by different sulphur levels (Pratibha *et. al*.,)

Maximum seed yield highest (2112.89 kg ha^{-1}) was recorded in T_3 (FYM + 40 kg ha^{-1} sulphur) which was 202.48 % higher than lowest value (698.52 kg ha^{-1}) was observed in treatment T_6 (Vermicompost + 30 kg sulphur ha^{-1}). Nitrogen influenced the seed yield through optimum or enhanced source-sink relationship, resulting in higher production of photosynthates and their increased translocation to reproductive parts, as nitrogen being the most important essential plant nutrient is needed for growth and development of plant and known to increase the yield of soyabean(Amarnath *et al*.,1990, Edward and Daniel,1992).

Economics

The highest gross return (86403.62 Rs. ha^{-1}), net return (56113.61 Rs. ha^{-1}) and benefit cost ratio (2.85) were registered in treatment T_3 (Farmyard manure + 40 kg ha^{-1} sulphur) followed by T_7 (Vermicompost+ 40 kg ha^{-1} sulphur). The data of economics revealed that application of Farm yard manure and 40 kg ha^{-1} sulphur increased net returns and B: C ratio compared to other organic manure, being highest net return and B: C ratio.

Table 1: Effect of organic nutrient sources and sulphur levels on growth, economics and oil content of soybean

Treatment		Plant height (cm) at 75 DAS	Number of branches $plant^{-1}$ at 75 DAS	Seed yield Kg (ha^{-1})	Gross return (Rs. ha^{-1})	Cost of cultivation (ha^{-1})	Net return (ha^{-1})	B:C ratio	Oil content (%)
T1	Farmyard manure + Control (0 kg ha^{-1} sulphur)	41.55	7.73	752.27	30737.43	28290.00	2447.43	1.08	15.50
T2	Farmyard manure + 30 kg ha^{-1} sulphur	40.40	7.80	771.28	31514.73	29664.00	1850.72	1.06	16.83
T3	Farmyard manure + 40 kg ha^{-1} sulphur	39.48	9.00	2112.89	86403.62	30290.00	56113.61	2.85	18.66
T4	Farmyard manure + 50 kg ha^{-1} sulphur	38.86	6.80	789.24	32323.93	31290.00	1033.93	1.03	17.33
T5	Vermicompost + Control (0 kg ha^{-1} sulphur)	44.22	7.33	756.86	31018.07	26498.00	4520.06	1.17	16.33
T6	Vermicompost + 30 kg ha^{-1} sulphur	43.76	7.46	698.52	28574.01	27872.00	702.01	1.02	17.66
T7	Vermicompost + 40 kg ha^{-1} sulphur	37.29	6.80	1629.65	66657.46	28498.00	38159.46	2.33	17.33
T8	Vermicompost + 50 kg ha^{-1} sulphur	37.15	7.18	756.74	30957.99	29498.00	1459.98	1.04	16.33
T9	Poultry manure + Control (0 kg ha^{-1} sulphur)	38.99	7.13	737.55	30146.96	26440.00	3706.95	1.14	14.66
T10	Poultry manure + 30 kg ha^{-1} sulphur	41.76	7.00	733.79	29954.6	27814.00	2140.60	1.07	15.66
T11	Poultry manure + 40 kg ha^{-1} sulphur	44.90	6.76	769.44	31435.01	28440.00	2995.01	1.10	16.66
T12	Poultry manure + 50 kg ha^{-1} sulphur	41.25	6.40	798.68	32673.27	29440.00	3233.26	1.10	15.33
	SEd (±)	3.46	0.78	116.02					0.22
	CD (p = 0.05)	NS	1.62	240.61					0.45
	CV (%)	9.86	13.72	15.08					1.62

NS - Non significant

The optimum dose of nutrient through organic sources, which play an important role in increasing the output of soybean crop and sustain the fertility and productivity of the soil (Behera *et al.*, 2007) has shown itself to be economically promising.

Oil content

The highest oil content recorded (18.66%) in treatment T_3 (Farmyard manure + 40 kg sulphur ha^{-1}). Application of FYM and vermicompost produced maximum oil content. It may be due to higher rate of availability of sulphur from FYM and vermicompost (Behra, 2002).The increased oil content in seeds may be due to the application of organic manures, which slowly releases phosphorus that is available to plant up to the pod filling stage (Rajput *et al.*, 1991). Similar finding was reported by Vara *et al.* (1994).

Another aspect application of sulphur in oilseed crops is increasing oil content. Similar result observed by Lal *et al.* (1996), Dubey and Billore (1995), Bansal (1991), Singh and Singh (1995), Fazal and Sisodia (1989) and Aulakh *et al.* (1990).

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