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Effect of integrated nutrient management on growth and yield of soybean [*Glycine max*. (L.) Merril.]

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ABSTRACT : An agronomic investigation entitled integrated nutrient management in soybean was conducted at experimental farm, Department of Agronomy, College of Agriculture, Marathwada Krishi Vidyapeeth, Parbhani, during the *Kharif*, 2011. The highest seed, straw and biological yields was recorded with the treatment of 100 % RDF + *Rhizobium* + PSB + sulphur @ 25 kg ha^{-1} + vermicompost @ 3t ha^{-1} (T_7) and it was at par with 100 % RDF + *Rhizobium* + PSB + sulphur @ 25kg ha^{-1} + FYM @ 5t ha^{-1} (T_4) treatments and produced significantly higher seed, straw yield and biological yield than rest of the treatments.

Key Words : Integrated nutrient management, Growth, Yield, Soybean, *Rhizobium*

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Soybean is finding its place in policy agenda of industrial, medicinal and food sector of India due to wide spectrum of its chemical composition. The dry seed of soybean is rich source of phosphorus, potassium, sulphur, iron and vitamin A, B, D and oil in unsaturated fatty acid with the anticholesterol principle. While its sprout contains appreciable amount of vitamin C which is generally obtained from fresh fruits and vegetables. Therefore, soybean is frequently referred as poor man's meat to vegetarians due to its high protein content (Singh, 2005).

The legumes are known to increase the soil fertility particularly the soil nitrogen and consequently enhance the soil productivity of succeeding cereal crop (Nelson, 1989). Adequate fertilization is most to increase the soybean productivity.

Integrated fertility management using chemical fertilizer and bio-fertilizers along with manures will facilitate restoration, enhancement and maintenance of soil productivity at high level which in turn will ensure profitable and intensive agriculture (Kumaraswamy, 2003). In light of above a field experiment on integrated nutrient management in soybean was conducted at department of agronomy, Marathwada Krishi Vidyapeeth, Parbhani , with the an objective to study the nutrient requirement of soybean for increasing productivity and to study the economics of integrated nutrient management in soybean.

RESEARCH PROCEDURE

The field experiment was conducted during *Kharif*, 2011 at the Experimental Farm, Department of Agronomy, College of Agriculture, Marathwada Krishi Vidyapeeth, Parbhani. The average annual precipitation is 900 mm with 70 rainy days. The present experiment was laid out in Randomized Block Design (RBD) with seven treatments replicated three times.The treatments were T_1 : RDF, T_2 : 50 % RDF + *Rhizobium* + PSB + sulphur @ 25kg ha^{-1}+FYM @ 5t ha^{-1} , T_3 : 75 % RDF + *Rhizobium* + PSB + sulphur @ 25 kg ha^{-1} + FYM @ 5t ha^{-1}, T_4 : 100 % RDF + *Rhizobium* + PSB + sulphur @ 25kg ha^{-1} + FYM @ 5t ha^{-1}, T_5 : 50 % RDF + *Rhizobium* + PSB+ sulphur @ 25 kg ha^{-1} + vermicompost @ 3t ha^{-1}, T_6 : 75 % RDF + *Rhizobium* + PSB+ sulphur @ 25 kg ha^{-1} + vermicompost @3t ha^{-1}, T_7 : 100 % RDF + *Rhizobium* + PSB + sulphur @ 25 kg ha^{-1} + vermicompost @ 3t ha^{-1}. The variety of sobean used for this trial was MAUS-71, sowing was done at spacing of 45 x 05cm^2. The gross and net plot size was 5.4 x 4.5m^2 and 4.5 x 3.6 m^2 , respectively. Sowing of the experiment was done on 10th July, 2011. The recommended plant protection measures were followed.

RESEARCH ANALYSIS AND REASONING

The results of the present study as well as relevant discussions have been presented under following sub heads:

Seed yield (kg ha^{-1}) :

Data on seed yield revealed that the application of 100% RDF+*Rhizobium*+PSB+sulphur@25 kgha^{-1}+ vermicompost@3t ha^{-1}(T_7) to soybean crop produced significantly the highest seed yield (2806 kg ha^{-1}) which was found at par with the application of 100% RDF + *Rhizobium* + PSB + sulphur @25kg ha^{-1} + FYM @ 5t ha^{-1} (T_4) treatment than rest of the treatments (Table 1). Higher yield due to combined application of 100% RDF and vermicompost or FYM with biofertilizer, might have attributed to sustained nutrients supply and better utilization through improved micro environmental conditions. Similar finding was reported by Kumar *et al.* (2006) and Shinde *et al.* (2009).

Straw yield (kg ha^{-1}) :

Data on straw yield indicated that the application of 100% RDF+ *Rhizobium*+PSB+sulphur@25kgha^{-1} + vermicompost@3t ha^{-1} (T_7) recorded maximum straw yield (3874 kg ha^{-1}) which was significantly superior over rest of the treatments but was found at par with the treatment 100% RDF + *Rhizobium* + PSB + sulphur @25kg ha^{-1} + FYM @ 5t ha^{-1} (T_4) (Table 1). This might be due to enhanced growth attributes. The results are in confirmation with Shinde *et al.* (2009).

Biological yield (kg ha^{-1}) :

The data presented in Table 1clearly indicated that the similar trend was observed as that of seed and straw yield. The data of biological yield revealed that treatment 100% RDF + *Rhizobium* + PSB + sulphur @ 25kg ha^{-1} + vermicompost @3t ha^{-1} (T_7) produced significantly higher biological yield (6680 kg ha^{-1}) over rest of the treatments but was at par with 100% RDF + *Rhizobium* + PSB + sulphur @25kg ha^{-1} + FYM @ 5t ha^{-1} (T_4).

Harvest index (HI) :

Data on harvest index (Table 1) showed that highest harvest index was observed in treatment when 100%RDF + *Rhizobium* + PSB + sulphur @25kg ha^{-1} + FYM @ 5t ha^{-1} (T_4) which was applied to soybean crop and lowest was recorded in treatment 75% RDF + *Rhizobium* + PSB + sulphur @25kg ha^{-1}+ FYM @ 5t ha^{-1} (T_3).

The lowest seed, straw, biological yield and harvest index was observed in 50%RDF + *Rhizobium* + PSB + sulphur @25kg

Table 1 : Seed, straw and biological yield (kg ha^{-1}) and harvest index (HI) of soybean as influenced by different treatments

Treatments	Yield (kg ha^{-1})			Harvest index
	Seed	Straw	Biological	
T_1 - RDF	2260	3210	5470	41.01
T_2 - 50%RDF + *Rhizobium* + PSB + sulphur @ 25kg ha^{-1} + FYM @ 5t ha^{-1}	1945	2702	4647	41.81
T_3 - 75% RDF + *Rhizobium*+ PSB + sulphur@25kg ha^{-1} + FYM @ 5t ha^{-1}	2238	3184	5422	40.66
T_4 - 100% RDF + *Rhizobium* + PSB + sulphur@25kg ha^{-1} + FYM @5t ha^{-1}	2786	3855	6641	43.00
T_5 - 50% RDF+*Rhizobium* + PSB+ sulphur@25kg ha^{-1}+ vermicompost@3t, ha^{-1}	2164	2888	5052	42.84
T_6 - 75% RDF+*Rhizobium* + PSB + sulphur@25kg ha^{-1}+vermicompost@3t ha^{-1}	2450	3383	5833	41.53
T_7 - 100% RDF + *Rhizobium* + PSB + sulphur@25kg ha^{-1} + vermicompost@ 3t ha^{-1}	2806	3874	6680	42.00
S.E.±	71.12	66.28	131.61	-
C.D. (P=0.05)	219.18	204.27	405.59	-
G. Mean	2378	3299	5677	41.83

Table 2: Economics of soybean production as influenced by different treatments

Treatments	Gross monetary returns (Rs ha^{-1})	Cost of cultivation	Net monetary returns (Rs ha^{-1})	B:C ratio
T_1 - RDF	54367	17700	36667	3.07
T_2 - 50%RDF + *Rhizobium* + PSB +sulphur @25kg ha^{-1} +FYM @ 5t ha^{-1}	46082	21600	24487	2.13
T_3 - 75% RDF + *Rhizobium* + PSB + sulphur@25kg ha^{-1} + FYM @ 5t ha^{-1}	53066	22050	31016	2.40
T_4 - 100% RDF + *Rhizobium* + PSB + sulphur @25kg ha^{-1}+FYM @ 5t ha^{-1}	65793	22500	43293	2.92
T_5 - 50%RDF + *Rhizobium* +PSB + sulphur@25 kg ha^{-1}vermicompost @3t ha^{-1}	51216	26600	24616	1.92
T_6 - 75% RDF + *Rhizobium* + PSB + sulphur@25kg ha^{-1} vermicompost@3t ha^{1}	58042	27050	30992	2.14
T_7 - 100% RDF + *Rhizobium* + PSB + sulphur@25kg ha^{-1}+ vermicompost@3t ha^{1}	66475	27500	38975	2.41
S.E.±	2847	-	1610	-
C.D. (P=0.05)	8761	-	4832	-
G. Mean	56434	-	32863	2.42

ha^{-1} + FYM @ 5t ha^{-1} (T_2).

Gross monetary returns (Rs ha^{-1}) :

The differences in gross monetary returns were significant due to various treatments.

The data presented in Table 2 revealed that the application of 100% RDF + *Rhizobium* + PSB + sulphur @ 25kg ha^{-1} + vermicompost @3t ha^{-1} (T_7) recorded the maximum gross monetary returns (66475 Rs ha^{-1}) and proved significantly superior over rest of the treatments but was at par with treatments 100% RDF + *Rhizobium* + PSB + sulphur @25kg ha^{-1} + FYM @ 5t ha^{-1} (T_4) and 75% RDF + *Rhizobium* + PSB + sulphur@25kg ha^{-1}+ vermicompost @ 3t ha^{-1} (T_6).

Net monetary returns (Rs ha^{-1}) :

Data (Table 2) revealed that the application of 100% RDF + *Rhizobium* + PSB + sulphur @25kg ha^{-1} + FYM @ 5t ha^{-1} (T_4) recorded higher net monetary returns (43293 Rs ha^{-1}) and which was significantly superior than rest of the treatments but it was found at par with the application of 100% RDF + *Rhizobium* + PSB + sulphur @ 25kg ha^{-1} + vermicompost@3t ha^{-1} (T_7). It was mainly affected by cost of cultivation. The results are in confirmation with Chaturvedi *et al.* (2010).

Benefit : cost ratio :

The data given in Table 2 indicated that the maximum benefit cost ratio was observed with the recommended dose of fertilizer (T_1) followed by treatment 100% RDF + *Rhizobium* + PSB + sulphur @25kg ha^{-1} + FYM @ 5t ha^{-1} (T_4). The lowest B:C ratio was noted in treatment 50 % RDF + *Rhizobium* + PSB + sulphur @ 25 kg ha^{-1} + vermicompost @ 3t ha^{-1} (T_5).

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