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Influence of Organic and Inorganic Fertilizers on Growth, Yields and Nutrient Uptake of Soybean (*Glyscine max* Merril L.) under Jhabua Hills

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A B S T R A C T

Field experiments were conducted at Zonal Agricultural Research Station, Jhabua (RVSKVV, Gwalior) during *kharif* 2013, 2014 and 2015 to study the effect of organic, inorganic manures and biofertilizers on growth, yield and nutrient uptake by soybean. Results revealed that application of 50% RDF (10:30:20 kg NPK/ha) + 50% vermicompost (2.5 t/ha) recorded significantly higher growth characters *viz*., plant height (55.88 cm), number of branches (4.72), dry matter production (19.21 g/plant), no. of nodules (19.21/plant) and dry weight of nodules (65.43 mg/plant). Similarly, the maximum pods/plant (72.40), seeds/pod (3.25) and test weight (137.63 g) were also recorded with the application of 50% RDF + 50% vermicompost. The highest seed yield (2262 and 2143 kg/ha) and straw yield (2386 and 2330 kg/ha) was produced under 50% RDF + 50% vermicompost and 100% RDF (20:60:40 kg NPK/ha), respectively. The same treatment also recorded higher N, P and K uptake (190.21, 23.45 and 121.06 kg/ha, respectively) followed by 100% RDF. Therefore, for higher production and productivity of soybean should be fertilized with 50% RDF + 50% vermicompost under rainfed condition of Jhabua Hills.

Introduction

Soybean is extensively grown in all over Madhya Pradesh because of its wide adaptability to agro-climatic conditions and better market value. In India, soybean covers an area of about 11.60 Mha with production about 8.57 MT. Madhya Pradesh is the leading state in India with 5.40 Mha area and 5.51 MT and 1020 kg/ha (Anonymous, 2016). Soybean is known as natural fertilizers factory because having high nitrogen fixing capacity. Being a legume crop, it is expected improve soil health and productivity of succeeding crops (Gharpinde *et al.*, 2014). It has great nutritive value and very high protein content (42-43%) and edible oil (18-20%) with major essential fatty acids, lecithin and vitamins (A and D). It also having high carbohydrate (30%) and fibre (4%) (Sunilkumar *et al.*, 2013). Therefore it also known as "golden bean" and man-made meat. In India, the deteriorating of

productivity mainly due to low availability of nutrients in soil or imbalance nutrition to the crop. The long term use of inorganic fertilizers without organic supplements deteriorating the physical, chemical biological properties of soil and cause the environmental pollution (Devi *et al.,* 2013). Hence balanced nutrition is must to harness the productivity of the crop. Therefore, in view of escalating prices and less availability of chemical fertilizer, there is a strong need to adopt integrated nutrient management by judicious combination of chemical fertilizers, organic manures and bio-fertilizers to improve crop productivity, soil health and save money and environment. Keeping this in view, present investigation was planned to assess the influence of organic and inorganic fertilizers on growth yield and nutrient uptake of soybean.

Materials and Methods

The experiments was carried out in the field during rainy season of 2013, 2014 and 2015 under National Agricultural Research Project at Research Farm, Zonal Agricultural Research Station, Jhabua (MP) ($21^0$30' – $22^0$55' N and $73^0$30' - 75^0 01' E; altitude 428 m above sea level). The soil was sandy with shallow to medium depth with gravel developed over stony uplands with pH of 7.5, low in organic carbon (0.41%), available N (215 kg/ha) but medium in available P_2O_5 (12.3 kg/ha) and available K_2O (116.5 kg/ha). The experiment consist of 9 treatments *viz*., T_1-control, T_2- vermicompost (5t/ha), T_3-FYM (10 t/ha), T_4-recommended dose of fertilizer (RDF=20 N, 60 P and 40 K kg/ha), T_5-50% RDF + *Rhizobium* + PSB, T_6- 50% RDF + 50% vermicompost, T_7-50% RDF + 25% vermicompost + *Rhizobium* + PSB, T_8-*Rhizobium* culture + PSB and T-$_9$ 50% vermicompost + *Rhizobium* + PSB. The experiment was laid out in randomized block design (RBD) with the three replication. Recommended dose of fertilizers (RDF) i.e. nitrogen, phosphorous and potash were applied as basal in the form of urea, single superphosphate and murate of potash (MOP), respectively. *Rhizobium* and PSB was used as seed treatment (5 g/kg seed). Organic manures (FYM and vermicompost) was applied 15 days prior of sowing of the respective plots as per treatment. The nitrogen, phosphorus and potassium content in the applied FYM and vermicompost were 0.62, 0.41, 0.83% and 1.71, 1.18, and 1.95%, respectively. Growth and yield attributes were recorded as per standard procedures. The seed and straw yield per net plot was recorded after drying. The plot yield was later on converted into kg/ha by multiplying it by conversion factor. Nutrient uptake in seed and straw were calculated in kg/ha in relation to dry matter production/ha by using the formula (Kumawat, 2011). Nutrient uptake by seed and stalk was added to get the total nutrient uptake by the crop. The oil content in seeds was estimated by using Soxhlet Ether Extraction method (Sadasivam and Manickam, 1996). The data were tabulated in systematic manner and analyzed statistically by Fisher's (1958) method. The calculated "F" value was compared with tabulated "F" value at 5% level of significance. Critical difference at 5% level of probability was calculated to judge the difference between the treatment means.

Results and Discussion

Growth characters

Growth characters (plant height, no. of branches/plant, dry matter production/plant, no. of nodules/plant and dry weight of nodules/plant) were significantly influenced by the application of organic and inorganic fertilizers (Table 1). Pooled data of three years showed that plant height produced by T_6 (55.88 cm), T4 (53.95 cm), T_7 (53.40 cm), T_2 (49.60 cm) and T_3 (49.15 cm) were significantly higher than that of all other

treatments and lowest plant height (44.01 cm) was in the control plot. Similarly, higher no. of branches/plant produced by T_6 (4.72) followed by T_4 (4.50) and T_7 (4.44) were significantly higher than rest of treatments. Dry matter production also highest recorded under T_6 (19.21 g/plant), T_4 (18.90 g/plant) and T_7 (18.37 g/plant) these were statistically similar with each other and significantly superior to remaining treatments. Higher no. of nodules/plant (19.21) and dry weight of nodules/plant (65.43 mg) was recorded with the treatment of T_4. This clearly shows the need of adding organic manures with inorganic fertilizers which increased the availability of nutrient for a longer period and with available form resulting positive effects on growth characters of crop which promoted various physiological activities in plants which are considerable to be indispensable for proper growth and development. Phosphorus plays a significant role in the nodules formation, growth function in addition to its role in host plant growth. Microorganism (*Rhizobium* and PSB) with organic manures increase the availability soluble phosphate and enhanced the plant growth. The increase in the nodules dry weight might be due to higher no. of nodules/plant (Ponmurugan and Gopi, 2006). These findings are in accordance with the results of Kumawat *et al.,* (2009a), Devi *et al.,* (2013) and Sunilkumar *et al.,* (2014).

Yield attributes

The pods/plant, seeds/pod and test weight were influenced significantly by the different integrated nutrient management treatments. The maximum pods/plant (72.40) was found in the integration of T_6 which was statistically at par with T_7, T_4, T_3, T_5 and T_2 (Table 1). Similarly, the higher no. of seeds/pod also recorded under T_6 (3.25) which was comparable with T_4, T_7, T_2, T_3 and T_5. Maximum test weight was recorded with the treatment of T_6 (137.63 g) and T_4 (135.25 g), both the treatment significantly superior to rest of the treatments. This was due to continues supply of nitrogen, phosphorus and potassium the crop at early stage and through organic manures (FYM and vermicompost) at later stages of growth as slow release plant nutrients. Similar findings were reported by Chauhan *et al.,* (1992), Kumawat *et al.,* (2009b) and Sunilkumar *et al.,* (2014).

Yields

The results in respect of seed and straw yield of crop as influenced by various treatments and indicated that the seed yield significantly higher (2262 kg/ha) in treatment T_6 receiving 50% RDF and 50% vermicompost and it was found to be at par with the T_4 and T_7 (Table 2). The lowest seed yield (1099 kg/ha) was recorded in T_1 i.e. control. Similarly, straw yield was also significantly higher (2386 kg/ha) in the treatment T6 (50% RDF and 50% vermicompost) and it was comparable with the T_4. The higher yield was due to better supply of metabolites and photosynthates. In addition to supply of organic manures with inorganic fertilizers with balanced dose improved the yield attributes resulting enhanced the yield of soybean. The results in conformity with the findings of Ramesh *et al.,* (2008), Thenua *et al.,* (2010), Kumawat *et al.,* (2010) and Devi *et al.,* (2014).

Nutrient uptake, oil content and oil yield

The uptake of N, P and K by the soybean was influenced by the different integrated nutrient management treatments (Table 2). Among the different treatments, T_6 (50% RDF and 50% vermicompost) gave significantly highest uptake of N and P but it was statistically at par with T_4 (100% RDF) and significantly different from other treatments. Similarly, highest uptake of K by the crop was also recorded with the application of T6 but it was at with T4 and T7.

Table.1 Effect of organic and inorganic fertilizers on growth and yield attributes of soybean (mean data of 3 years)

Treatment	Plant height (cm)	No. of branches/plant	Dry matter production/ plant (g)	No. of nodules/plant	Dry weigh of nodules/ plant (mg)	Pods/ plant	Seeds/ pod	Test weight (g)
T_1=control	44.01	2.64	10.14	10.14	50.75	56.72	2.55	126.67
T_2= vermicompost (5 t/ha)	49.60	4.00	14.63	14.63	63.50	68.45	2.93	132.67
T_3=FYM (10 t/ha)	49.15	3.75	14.18	14.18	62.54	65.30	2.83	132.21
T_4=100% RDF (20 N:60 P:40 K kg/ha)	53.95	4.50	18.90	18.90	59.02	69.53	3.20	135.25
T_5=50% RDF + *Rhizobium* + PSB	47.46	3.51	12.46	12.46	61.80	64.89	2.91	131.40
T_6=50% RDF + 50% vermicompost	55.88	4.72	19.21	19.21	65.43	72.40	3.25	137.63
T_7=50% RDF + 25% vermicompost + *Rhizobium*+ PSB	53.40	4.44	18.37	18.37	64.30	70.23	3.05	132.20
T_8=*Rhizobium* + PSB	44.90	3.02	11.03	11.03	53.95	59.72	2.60	131.30
T_9=50% vermicompost + *Rhizobium* + PSB	48.00	3.50	11.33	11.33	58.87	65.00	2.62	131.49
SEm±	2.31	0.23	1.09	1.75	1.09	2.45	0.19	1.51
CD (P=0.05)	6.92	0.68	3.26	5.24	3.26	7.33	0.58	4.50

Table.2 Effect of organic and inorganic fertilizers on yields and nutrient uptake of soybean (mean data of 3 years)

Treatment	Seed yield (kg/ha)	Straw yield (kg/ha)	Total N uptake (kg/ha)	Total P uptake (kg/ha)	Total K uptake (kg/ha)	Oil content (%)	Oil yield (t/ha)
T_1=control	1099	1270	81.36	9.89	50.60	15.30	16.80
T_2= vermicompost (5 t/ha)	1836	2010	148.92	18.07	97.05	18.05	33.06
T_3=FYM (10 t/ha)	1797	1987	145.10	17.62	94.18	18.00	34.23
T_4=100% RDF (20:60:40:: N:P:K kg /ha)	2143	2330	174.72	22.29	116.55	18.67	40.02
T_5=50% RDF + *Rhizobium* + PSB	1684	1868	132.45	16.11	87.64	17.56	29.57
T_6=50% RDF + 50% vermicompost	2262	2386	190.21	23.45	121.06	18.73	42.68
T_7=50% RDF + 25% vermicompost + *Rhizobium*+ PSB	2013	2191	162.24	20.15	108.20	18.60	37.45
T_8=*Rhizobium* + PSB	1329	1485	99.35	12.38	62.95	16.60	21.99
T_9=50% vermicompost + *Rhizobium* + PSB	1099	1660	115.61	13.92	71.87	17.33	25.90
SEm±	99	54	7.82	1.06	5.68	0.50	2.55
CD (P=0.05)	298	162	23.45	3.18	17.03	1.51	7.65

The higher uptake of N, P and K is attributed to continuous and steady supply of available nutrient throughout crop growth period because application of organic and inorganic inputs. Similar findings were also made by Tiwari *et al.*, (2007) and Sunilkumar *et al.*, (2014).

The soil content and oil yield were significantly influenced by the various nutrient management treatments (Table 2). Among the different treatments, application of T (50% RDF and 50% vermicompost (T_6) enhanced the oil content in seeds and oil yield of soybean which was at par with 100% RDF and significantly superior to control and *Rhizobium*+ PSB (T_8). The lowest oil content and oil yield was recorded in control. This may be ascribed due to better availability of required nutrients in the rhizospher resulting increases the synthesis of amino acid i.e. cysteine, cysteine and methionine. Similar findings were also reported by Devi *et al.*, (2013)

From the above results it may be concluded that integrated use of 50% RDF (10:30:20 kg NPK/ha) + 50% vermicompost (2.5 t/ha) is beneficial for achieving sustainable production and productivity of soybean under Jhabua Hill of Madhya Pradesh.

References

Anonymous, 2016. Ministry of Agriculture Govt. of India. The Soybean Processor Association of India (SOPA).

Chauhan, Y. S., Johanson, C. and Venkataratnam, N. 1992. Effect of phosphorus deficiency on phenology and yield components of short duration pigeonpea. *Trop. Agric*., 69: 235-8.

Devi, K. N., Singh, T. B., Athokpam, H. S., Singh, N. B. and Shamurailatpam, D. 2013. Influence of inorganic, biological and organic manures on nodulation and yield of soybean (*Glycine max* Merril L.) and soil properties. *Austra. J. Crop Sci.*, 7(9):1407-1415.

Fisher, R. A. 1958. Skeleton Analysis of Variance Book "Design of Experiment".

Gharpinde, B., Gabhane, V. V., Nagdeve, M. B., Sonune, B. A. and Ganvir, M. M. 2014. Effect of integrated nutrient management on soil fertility, nutrient balance, productivity and economics of soybean in an Inceptisol of semi-arid region of Maharashtra. *Karnataka J. Agric. Sci*., 27 (3): 303-307.

Kumawat, N. 2011. Effect of pigeonpea + blackgram intercropping and integrated nutrition on growth, yield and quality of rainfed pigeonpea [*Cajanus cajan* (L.) Millsp.]. PhD. Thesis, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi (UP).

Kumawat, N., Kumar, R. and Sharma, O. P. 2009a. Nutrient uptake and yield of mungbean [*Vigna radiata* (L.) Wilczek] as influenced by organic manure, PSB and Phosphorus fertilization. Environ. Ecol., 27 (4B): 2002-2005.

Kumawat, N., Sharma, O. P. and Kumar, R. 2009b. Effect of Organic manure, PSB and Phosphorus fertilization on yield and economics of mungbean. *Environ. Ecol.*, 27(1): 5-7.

Kumawat, N., Sharma, O. P., Kumar, R. and Kumari. A. 2010. Yield and yield attributes of mungbean [*Vigna radiata* (L.) Wilczek] as affected by organic manures, PSB and phosphorus fertilization. Environ Ecol., 28(1A): 332-335.

Ponmurugan, P. and Gopi, C. 2006. Distribution pattern and screening of phosphate solubilizing bacteria isolated from different food and storage crops. *J. Agron.*, 5: 600-604.

Ramesh, P., Panwar, N. R., Singh, A. B. and Ramana, S. 2008. Effect of organic

manures on productivity, soil fertility and economics of soybean (*Glycine max*) - durum wheat (*Triticum durum*) cropping system under organic farming in Vertisols. *Indian J. Agril. Sci.*, 78(12):118-122.

Sadasivam, S. and Manickam, A. 1996. Biochemical methods, 22-23. New Age International Pvt. Ltd. Ansari Road, Daryaganj, New Delhi.

Sunilkumar, K., Gowda, A., Nagaraj, R., Veeranagappa, P. Jayaprakash, R. and Patil, S. 2013. Influence of integrated nutrient management on growth, yield, nutrient uptake and economics of vegetable soybean. *Intern. J. For. Crop Impro.*, 4(1): 24-27.

Thenua, O. V. S., Singh, K. and Shivakumar, B. G. 2010. Studies on *Rhizobium* inoculation and potassium levels on the performance of soybean (*Glycine max* L.). *Ann. Agric. Res*., 31(1):1-4.

Tiwari, D. K. Khaddar, V. K., Rajpoot, R. S. and Gupta, S. B. 2007. Effect of decomposed city waste under integrated nutrient management system on yield and nitrogen uptake by soybean. *Adv. Pl. Sci*., 20(1): 295-298.

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