Eco. Env. & Cons. 30 (January Suppl. Issue) : 2024; pp. (S341-S344)
Copyright@ EM International
ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2024.v30i01s.069

Effect of integrated nutrient management on growth, yield and economics of Soybean (*Glycine max* L.)

Putaka Pravalika, Satish Kumar, Jai Dev Sharma and Abhinandan Singh*

Department of Agronomy, School of Agriculture, ITM University, Gwalior 475 001, M.P, India

(Received 10 June, 2023; Accepted 14 August, 2023)

ABSTRACT

The field experiment was conducted during the *kharif* season of 2022 at the crop research center, school of agriculture, ITM University, Gwalior (M.P) to find out the effect of integrated nutrient management on yield and economics. The field experiment was laid out in a Random block design with ten treatments and three replications viz., T_1-100% RDF, T_2-100% RDF + Rhizobium + PSB, T_3-75% RDF + 25%N through FYM, T_4-75% RDF+ 25%N through FYM + Rhizobium + PSB, T_5-75% RDF + 25%N through Vermicompost, T_6-75% RDF + 25%N through Vermicompost + Rhizobium + PSB, T_7-50% RDF + 50% N through FYM, T_8-50% RDF + 50%N through FYM + Rhizobium + PSB, T_9-50% RDF + 50%N through Vermicompost, T_{10}-50% RDF + 50%N through Vermicompost + Rhizobium + PSB. The recommended dose of fertilizer was applied as per treatments. The sowing was done by dibbling. The sowing of soybean under application of T_6-75% RDF + 25%N through Vermicompost + Rhizobium + PSB significantly increased important grain, stover yield and quality character i.e. oil content as well as oil yield as significantly increased with T_6-75% RDF + 25%N through Vermicompost + Rhizobium + PSB. The gross returns (92354.17 Rs ha^{-1}) and net monetary returns (60278.85 $Rs.ha^{-1}$) and B:C ratio (1.88) was more under application of T_6-75% RDF + 25%N through Vermicompost + Rhizobium + PSB. Data pertaining to various parameters were tabulated and subjected to statistical analysis for interpretation of results. After the investigation T_6- 75% RDF + 25%N through Vermicompost + Rhizobium + PSB was found superior. All the yield attributing characters and economics of soybean were found significantly superior under 75% RDF + 25%N through Vermicompost + Rhizobium + PSB, While, minimum under T1.

Key words: *Soybean, Integrated nutrient management, Vermicompost, FYM, Rhizobium & PSB.*

Introduction

One of the major oilseed crops in India is the soybean (*Glycine max* (L.) Merrill). It is the world's top-ranked edible oil and India's third-largest oilseed crop, after rapeseed mustard and peanut. Due to its superior quality, soybeans are a miracle crop since they are high in vitamins, minerals, salts, and other vital amino acids. They also contain 40–42% protein and 18–20% oil. Furthermore, lysine, which is lacking in most cereals, is present in soybean protein at a rate of 5%, which enriches the nutritional quality of cereal flour (Raghuveer and Keerti, 2017). The productivity of soybeans in India is substantially lower despite their great producing potential. Low recycling of organic resources and an imbalanced use of fertilizers are two variables that contribute to low productivity (Chaturvedi *et al*., 2010). Another reason is the formation of multiple-nutrient deficits. Due to the high energy content of soybeans, a high level of main nutrients, including secondary and micronutrients, are needed (Singh *et al.*, 2006). INM offers several opportunities to enhance resource efficiency and plant performance while also facilitat-

ing environmental and resource quality preservation. It could also come from other forms of sustainable agriculture, such as vermicompost, farmyard manure, green manure, and others.Vermicompost is a very effective organic fertilizer created from farm waste that has the potential to boost production and enhance the quality of agricultural output. Vermicompost raises the NPK content, water retention capacity, and productivity of the land, enhancing its value. Another source of nutrients is farmyard manure, which also contributes to preserving soil fertility and boosting the soil's productivity and water-holding ability. The most sensible idea for regulating long-term soil fertility and production is the integrated nutrient supply system (Ramesh *et al*., 2010).

Materials and Method

The field experiment was conducted during the *kharif* season of 2022 at the Crop Research Center, School of agriculture, ITM University, Gwalior, (M.P). Total Ten treatments were included in the randomized block design and replicated three times. the treatment details are T_1-100% RDF, T_2-100% RDF + Rhizobium + PSB, T_3-75% RDF + 25%N through FYM, T_4-75% RDF+ 25%N through FYM + Rhizobium + PSB, T_5-75% RDF + 25%N through Vermicompost, T_6-75% RDF + 25%N through Vermicompost + Rhizobium + PSB, T_7-50% RDF + 50%N through FYM, T_8-50% RDF + 50%N through FYM + Rhizobium + PSB, T_9-50% RDF + 50%N through Vermicompost, T_{10}-50% RDF + 50%N through Vermicompost + Rhizobium + PSB. Soybean variety "JS—9560. Soybean seeds were first treated with biofertilizers prior to seeding. It was seeded at a rate of 75 kg ha-1. The seeds were manually sown in rows that were 45 cm apart, 3–4 cm deep, and 10 cm away from one another. For consistent germination, fertilizers were put under the seed before it was planted in furrows and covered with dirt. One week before planting, vermicompost (1.25% N, 0.85% P_2O_5, and 1.00% K_2O) and farmyard manure (0.5 N, 0.24% P_2O_5, and 0.45% K_2O) were treated. At harvest, growth and yield data (leaf area index, dry matter gm plant^{-1}, number of pod plant^{-1}, number of seeds pod^{-1}, seed index (%) as well as grain, straw yield, and harvest index were recorded. Furthermore, gross return, net return, cost of cultivation, benefit-cost ratio (B:C), production efficiency, and monetary efficiency were all examined. The data were statistically evaluated using conventional ANOVA techniques at the 5% level of significance.

Results and Discussion

Growth parameter

A perusal of data (Table 1) revealed that the growth parameters viz., leaf area index (5.21) and dry matter (19.32) were significantly increased due toT_6-75% RDF + 25%N through Vermicompost + Rhizobium + PSB. This might be because nitrogen helps to increase photosynthetic activity, which leads to increased dry matter production. The LAI is the consequence of the plant's leaf growth. Better nutrition of plants due to N, P, and K fertilizers and biofertilizers may have resulted in improved leaf size, which may have resulted in a large rise in LAI in the current research. The application of diverse organic manures boosted soil enzyme activity, soil microbial activity, and plant development. The higher availability of nutrients from organic sources may have led to more nucleic acid and amino acid synthesis, amide substances in the growing region, and meristematic tissue, ultimately enhancing cell division and increasing all growth attributes in these treatments, as evidenced by the increase in leaf area index and accumulation of dry matter at harvest of soybean. These findings on the Leaf Area Index and Dry Matters concur with those of Kannan *et al*., (2013) who studied soybean.

Yield attributes and yield

The application of organic manures and fertilizers significantly increased the yield and yield attributes viz., number of pod plant^{-1}, number of seed pod^{-1}, seed index(%), Grain yield (kgha^{-1}), straw yield (kgha^{-1}) and harvest index (Table 1). Application of T_6-75% RDF + 25%N through Vermicompost + Rhizobium + PSB recorded significantly higher yield attributes viz., number of pod plant^{-1} (42.6), number of seed pod-1, (3.42), seed index (12.42 g) grain (1912.0 kgha^{-1}), straw (4700.0 kgha^{-1}) and harvest index (28.9%) as compared to other treatments. The benefit of applying organic manures and fertilizer together is evident since they both give a consistent stream of nutrients that promote greater plant development. Additionally, it's possible that the enhanced availability of P and K as well as the other plant nutrients produced by the organic manures

helped to improve the production qualities. Cell division, cell wall expansion, meristematic activity, photosynthetic efficiency, and regulation of water uptake into the cells may have all been stimulated by the availability of specific plant nutrients and humic substances from manure and balanced nitrogen supplements from inorganic fertilizers, improving yield parameters. The findings support the conclusions made by Konthoujam *et al*. (2013). Increase in yield attributes and yield might be due to the favourable effect of vermicompost availability of nutrients to the crop, which enhanced the yield attributes and yield of soybean. These results are closely conformity to the findings of Singh *et al.* (2007).

Economics

Data (Table 1) indicate that soybean crop fertilized with T_6 -75% RDF + 25%N through Vermicompost + Rhizobium + PSB fetched highest gross returns (92354.17 Rs.ha^{-1}) and net monetary returns (60278.85 Rs.ha^{-1}) and B:C ratio (1.88) closely followed by 50% RDF + 50%N through Vermicompost + Rhizobium + PSB(T_{10}). Both these nutrient management practices significantly enhanced the gross returns, net returns and BC: ratio over rest of the treatments. The lowest value of the net returns (36355 ha^{-1}) and B: C ratio (1.56) were recorded with T10 (50% RDF + 50%N through Vermicompost + Rhizobium + PSB) treatment. The increasing cost and treatment impact on the soybean grain and straw yield are the key causes of this trend in economic return. The increasing cost and treatment impact on the soybean seed and harvest yield are the key causes of this trend in economic return. Similar findings were respected by Ramesh *et al*. (2010), Chaturvedi *et al*., (2010), Konthoujam *et al*. (2013) and Gharpinde *et al.* (2014)

According to the study's findings, the combined use of chemical fertilizers, organic manures, and biofertilizers significantly improved growth, yield characteristics, and economics. The harvest index, grain, straw, net returns, and B:C ratio reached their highest level with 75% NPK +

Table 1. Effect of various treatments on growth, yield attributes , yield and economics of soybean.Conclusion

Treatments	Growth attributes		Yield attributes			Yield (kg ha^{-1})			Economics		
	Leaf area index	Dry matter (g plant^{-1})	No. of pods plant^{-1}	No. of Seeds pod^{-1}	Seed index (%)	Grain (kgha^{-1})	Straw (kgha^{-1})	Harvest index (%)	Gross returns (Rsha^{-1})	Net returns (Rsha^{-1})	B:C ratio
T_1: 100% RDF	3.80	15.82	30.27	2.50	11.50	1475.0	2475.0	37.26	71354.17	40435.73	1.30
T_2: 100% RDF + Rhizobium + PSB	4.25	16.58	31.60	2.66	11.88	1575.0	2575.0	37.93	76031.25	44992.81	1.44
T_3: 75% RDF + 25%N through FYM	4.31	16.80	34.27	2.70	11.66	1591.6	2591.6	38.03	76822.92	46117.60	1.50
T_4: 75% RDF+ 25%N through FYM + Rhizobium + PSB	4.70	18.51	39.93	2.95	12.02	1658.3	2658.3	38.41	79916.67	49091.35	1.59
T_5: 75% RDF + 25%N through Vermicompost	4.60	17.74	38.27	2.90	11.97	1608.3	2608.3	38.12	77625.00	45669.68	1.42
T_6:75% RDF + 25%N through Vermicompost + Rhizobium + PSB	5.21	19.32	44.92	3.41	12.41	1912.0	2912.0	39.63	92354.17	60278.85	1.87
T_7: 50% RDF + 50%N through FYM	4.38	17.73	37.60	2.75	12.03	1600.0	2600.0	38.08	77196.92	45454.70	1.43
T_8: 50% RDF + 50%N through FYM + Rhizobium + PSB	4.81	18.89	39.93	3.08	12.06	1658.3	2658.3	38.41	79958.33	48096.11	1.50
T_9: 50% RDF + 50%N through Vermicompost	4.62	18.29	38.93	2.91	12.25	1650.0	2650.0	38.36	79510.83	46518.61	1.40
T_{10}: 50% RDF + 50%N through Vermicompost + Rhizobium + PSB	5.10	19.19	41.60	3.34	12.00	1733.3	2766.6	38.50	83552.08	50439.86	1.52
S.Em±	0.251	0.209	1.743	0.136	0.586	59.23	62.84	——	——	——	——
C.D at 5%	0.747	0.621	5.179	0.403	NS	175.98	186.73	——	——	——	——

25% N through vermicompost + Rhizobium + PSB(T6). In order to achieve optimal output, an appropriate balance of inorganic fertilizer, biofertilizer, and organic manure should be used.

References

Chaturvedi, S., Chandel, A.S., Dhyani, V.C. and Singh, A.P. 2010. Productivity, profitability and quality of soybean (*Glycine max*) and residual soil fertility as influenced by integrated nutrient management. *Indian J. Agron.* 55(2): 133-137.

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). *Journal of Agricultural Science*. 27(3): 303-307.

Jackson, M.L. 1967. *Soil Chemical Analysis.* Prentice Hall of India Pvt. Ltd., New Delhi: 38- 226.

Konthoujam, N. D., Singh, T. B., Athokpam, H. S., Singh, N. B. and Diana, S. 2013. Influence of inorganic, biological and organic manures on nodulation and yield of soybean [*Glycine max* (L.) Merril] and soil properties. *Agricultural Journal of Crop Science.* 7(9): 1407-1415.

Kannan, R. L., Dhivya, M., Abinaya, D., Krishna, R.L. and Kumar, S. 2013. Effect of integrated nutrient management on soil fertility and productivity in Maize. *Bulletin of Environment, Pharmacology and Life Sciences.* 2(8): 61-67.

Kadam, S.R., Amrutsagar, V.M., Patil, S.R. and Bagwan, I.R. 2008. Effect of organic nitrogen sources and fulvic acid spray on growth and yield of soybean in inceptisol. *Asian Journal of Soil Science*. 3(2): 214-216.

Mandal, K.G., Hati, K.M. and Mishra, A.K. 2009. Biomass yield and energy analysis of soybean production in relation to fertilizer NPK and organic manure. *Biomass and Bioenergy*. 33(12): 1670-1679.

Ramana, S., Ramesh, P., Panwar, N.R. and Singh, A.B. 2008. Physiological and biochemical changes in soybean as affected by organic, chemical and integrated nutrient management practices. *Indian Journal of Plant Physiology*. 13(2): 130-136.

Raghuveer and Keeerti 2017. Nutrient management in soybean: A review. *Journal of Pharmacognosy and Phytochemistry.* (1): 137-142.

Ramesh, P., Panwar, N.R. and Singh, A.B. 2010. Crop productivity, soil fertility and economics of soybean (*Glycine max*), chickpea (*Cicer arietinum*) and blond psyllium (*Plantago ovata*) under organic nutrient management practices. *Indian Journal of Agricultural Sciences.* 80(11): 965-969.

Singh, R. and Sinsinwar, B.S. 2006. Effect of integrated nutrient management on growth, yield, oil content and nutrient uptake of Indian mustard (*Brassica juncea*) on eastern part of Rajasthan. *Indian Journal of Agricultural Science.* 76: 322-324.

Thenua Shyam Veer, O.V.S. 2011. Effect of inorganic and organic sources of nutrients on growth, root nodulation and physiological parameters of soybean [*Glycine max* (L.) Merill]. *Environment and Ecology.* 29(3A): 1367- 1371.