Impact of bio fertilizers on soybean production – a review

Gurpreet Singh, and Sandeep Menon

School of Agriculture, Lovely Professional University, Jalandhar

Abstract

In the present scenario of modern agriculture, our dependence on the synthetic fertilizers has made our soils unproductive and unfertile. These alarming conditions has forced the humans to find out the alternatives for crop cultivation. An attempt has been made to find the impact of soybean cultivation by the use of biofertilizers. The variables studied were plant height, stem diameter, root length, nodule diameter, nodule number, effective nodules number, fresh nodule weight, wet effective nodules weight, dry nodule weight and dry effective nodule weight. the benefits of bio fertilizers can be best exploited if they are applied with right combination of soil amendments.

Key words: Soybean, Bio fertilizers, Rhizobium and PSB inoculation, Yield, Quality.

Introduction

Soybean (*Glycine max* L. Merrill) is an important protein and oil seed crop belongs to family Leguminosae. It contains 40-42 % high quality protein, 18-20% oil. It is also rich in polyunsaturated fatty acids like linoleic and oleic acid. It is a good source of is flavones and therefore it helps in preventing heart diseases, cancer and HIVs. Soybean oil is the leading vegetable oil in the world and is used in many industrial applications including biodiesel. Because of its high nutritional value, it is recognized as 'Golden Bean'. The annual soybean production in India was 11.64 mt with an area of 10.02 m ha and productivity of 1062 kg ha^{-1}. Soybean [*Glycine max* (L.) Merril] is an important rainy season crop in northern plains zone of India; however, cropping systems involving soybean have been confined to only soybean–wheat and soybean–mustard in small pockets. On the other hand use of rhizobium based bio-fertilizer would be hampered because it is very sensitive to soil acidity. Further, addition of small amounts of inorganic N fertilizer is not only spurs the growth of soybean plant but also increase the legumes nitrogen fixation Integrated management of land, crop, organic and inorganic fertilizer along with microbial community is very important for sustainable agriculture under acidic soil conditions.

Review

Ngoc Son et al. 2001 reported that application of organic and bio-fertilizer could be substantiated for the N inorganic fertilizer to an extent of 40 kg N ha^{-1}. The quality nutrient contents and uptake of soybean with reference to N, P, and K and soil available P and K were significantly improved by the application of composted paddy straw and inoculants viz., SB 83 (Rhizobium fredii) and SB 177 (*Bradyhrizobium* sp).

Dadhich and Somani 2007 resulted that dual inoculation with phosphate-solubilising bacteria (PSB) + vesicular arbuscular mycorrhiza (VAM) gave significantly improved the Zn and Fe uptake of soybean. The highest Zn and Fe uptake (125.77 mg kg^{-1} and 562.03 mg kg^{-1}, respectively) was recorded with the combined use of 40 kg P_2O_5 ha^{-1} + dual inoculation.

Wasule et al. 2007 Studied that half fertilizer dose + Rhizobium + PSB gave highest yield (10.67 q/ha) which was equivalent to yield recorded with full fertilizer dose + Rhizobium + PSB (10.66 q/ha) and Rhizobium + PSB (10.63 q/ha).

Dhage and Kachhave 2008 revealed that highest grain yield was recorded due to inoculation of rhizobium + PSB with 100% RDF. The highest grain yield of 15.46 q ha^{-1} recorded in 100% RDF + rhizobium + PSB was significantly superior over the other treatments.

Javaid, and Mahmood (2010) concluded that soybean yield can be significantly enhanced by the application of *B. japonicum* and EM in farmyard manure amendment.
Nandini Devi et al. 2012 revealed that application of SSP+PSB produced significantly higher number of nodules per plant, dry weight of nodules per plant, number of pods per plant and 100-seed weight as compared to other treatments. Maximum grain yield and total phosphorus uptake were also recorded when using SSP+PSB.

Munda et al. 2013 observed that maximum yield (1.56 t/ha) was obtained with RP application at recommended dose along with biofertilizers. Yield attributes and yield were at par when full dose of P was applied in conjunction with biofertilizers.

Singh et al. 2015 revealed that highest grain yield of 2296 kg per hectare was recorded with *B. japonicum* inoculation + 60 kg P_2O_5 per hectare which was 9.4 and 5.1 per cent more than *B. japonicum* inoculation alone and 60 kg P_2O_5 per hectare.

Arma 2016 revealed that plant height, stem diameter, root length, nodule diameter, nodule number, effective nodules number, fresh nodule weight, wet effective nodules weight, dry nodule weight and dry effective nodule weight significantly higher with M-bio fertilizer at concentration of 12 ml per liter of water.

Tarekegn et al. 2017 resulted that Nodule number, nodule fresh and dry weights, plant height, number of pods and seeds per plant, 100 seeds weight and grain yield responded significantly to the interaction effects of *B. japonicum* inoculation and application of N and P fertilizers but nodule volume, seed and biomass yields, and harvest index were significantly affected by the main effects of any one or more of the factors.

Venkatarao et al. 2017 indicated that seed inoculation with the PSB and *Aspergillus awamori* significantly increased highest number of total and effective number of nodules per plant, plant height, leaf area index, total chlorophyll content, grain yield (1260 kg ha^{-1}) and straw yield (3140 kg ha^{-1}) over the rest of the treatments.

Munda et al. 2018 resulted that the application of bio-fertilizers alone increased the energy use efficiency over no bio-fertilizer application. Irrespective of source (DAP or rock phosphate) treatments with bio-fertilizers had improved P use indices and apparent soil P balance even.

Sharma et al. 2018 resulted that maximum plant height (30.34 cm) was measured in Th-14 and seed yield and other contributing characters were improved by PSB bio-primed seed. PSB proved to be the best bio-agent for enhancing the growth than other tested bio-agents.

Sharma et al 2018 reported that vermicompost 1.5 t ha^{-1} Enriched with PSB & Rhizobium+ Remaining of RDF through chemical fertilizer resulted in higher grain and straw yield, maximum number of root nodule formation $plant^{-1}$ as well as their dry weight at every stage of plant growth.

Nagar et al 2018 reported that microbial inoculation significantly increased the growth attributes viz., plant height, dry matter accumulation, LAI, primary branches plant-1, number of pods $plant^{-1}$ and yield attributes number seeds pod^{-1}, seed index, grain and haulm yield over the control.

Geetha et al 2018 revealed that integration of 80 kg P_2O_5/ha curing with FYM + PSB + VAM produced significant higher plant height, dry matter, number of nodules/plant, dry weight of nodule/plant, pods/plant, higher grain and stover yield were obtained than the other treatments.

Raja and Takankhar (2018) indicated that nitrogen content in plant was significantly increased by seed inoculation with liquid 10ml of *Bradyrhizobium* (A2) at maturity 7.93% and at harvest 3.62% over control. Phosphorus content was significantly improved (at maturity 28.57% and at harvest 31.25%) by seed inoculation with liquid 10ml of PSB (B2) over control.

Conclusion

Application of biofertilizers improves P availability to soybean crops. Biofertilizer application improves the resilience of the cropping system by maintaining proper P balance and with increased use efficiencies. Biofertilizers both rhizobium and PSB exhibited spectacular performance in seed and straw yield, nutrient content in seed and nutrient availability in soil after harvest of crop as well as improved quality parameter i.e. crude protein and oil content in grain in absence as well as presence of chemical fertilizers.

Reference

Arma, M. J. (2016). Effect of biological fertilizer on the growth and nodules formation to soya bean (*Glicine max* (L.) Merrill) in Ultisol under net house conditions. *Journal of Experimental Biology and Agricultural Sciences*, *4*(6), 617-624.

Dadhich, S., & Somani, L. (2007). Effect of integrated nutrient management in a soybean-wheat crop sequence on the yield, micronutrient uptake and post-harvest availability of micronutrients on typic ustochrepts soil. *Acta Agronomica Hungarica*, *55*(2), 205-216.

Devi, K. N. L., Singh, T. N. K., Devi, H S., Devi, T. N., Singh K. B., Singh, W. K. Singh, M. (2012). Response of Soybean [*Glycine max* (L.) Merrill] to Sources and Levels of Phosphorus. *Journal of Agricultural Science*; Vol. 4, No. 6; 44-53.

Dhage S.J. and. Kachhave, K.G 2008. Effect of dual inoculation of rhizobium and PSB on yield, nutrient content, availability of nutrient contents and quality of soybean[*Glycine max (L.) Merrilli*]. *The Asian J.of Hort.* Ve,3l .(13) N : o(2.) : 272-276.

Geetha, G.P., Radder, B.M. and Pati, P.L. 2018Influence of phosphorus level cured with FYM and application of PSB, VAM on nodulation and yield of soybean (*Glycin max* L.) and soil properties. *International Journal of Chemical Studies*; 6(4): 2743-2746.

Javaid, A. R. S. H. A. D., & Mahmood, N. (2010). Growth, nodulation and yield response of soybean to biofertilizers and organic manures. *Pakistan Journal of Botany*, *42*(2), 863-871.

Munda, S., Shivakumar, B. G., Gangaiah, B., Rana, D. S., Manjaiah, K. M., & Layek, J. (2013). Response of soybean (*Glycine max*) to phosphorus with or without biofertilizers. *Indian Journal of Agronomy*, *58*(1), 86-90.

Munda, S., Shivakumar, B. G., Rana, D. S., Gangaiah, B., Manjaiah, K. M., Dass, A., & Lakshman, K. (2018). Inorganic phosphorus along with biofertilizers improves profitability and sustainability in soybean (*Glycine max*)–potato (*Solanum tuberosum*) cropping system. *Journal of the Saudi Society of Agricultural Sciences*, *17*(2), 107-113.

Nagar, G. K., Dashora, L. N., Suman, C. S., Meena, R. K., Choudhary, G.L. and Teli, S.K. 2018.Effect of Microbial Inoculation and Sulphur on Soybean Growth and Yield. *Int. J. Pure App. Biosci*. 6 (1): 1083-1087.

Ngoc Son, T. T., Thu, V. V., Man, L. H., & Hiraoka, H. (2001). Effect of organic and bio-fertilizer on quality, grain yield and soil properties of soybean under rice based cropping system. *Omonrice*, *9*, 55-61.

Raja, D., & Takankhar, V. G. (2018). Response of Liquid Biofertilizers (*Bradyrhizobium* and PSB) on Nutrient Content in Soybean (*Glycine max* L.). *Int. J. Curr. Microbiol. App. Sci*, *7*(5), 3701-3706.

Sharma, A., Sirothiya, P., Agrawal. S.B., Mishra, U.S. and Shrivastava, P. 2018. Effect of integrated nutrient management on nodulation and yield of soybean. *International Journal of Chemical Studies* 6(5): 607-612.

Sharma, P., Bhatt, A., & Jyoti, B. (2018). Effect of seed Bio-priming with microbial inoculants on plant growth, yield and yield contributing characters in soybean [*Glycine max* (L.) merril]. *International Journal of Economic Plants*, *5*(2), 53-58.

Singh, M., Kumar, N., Kumar, S., & Lal, M. (2015). *Effect of co-inoculation of b. Japonicum, psb and an fungi on microbial biomass carbon, nutrient uptake and yield of soybean (Glycine max L. Merril)* (Vol. 3, No. 1, pp. 14-18). Agriways.

Tarekegn, M. A., & Kibret, K. (2017). Effects of rhizobium, nitrogen and phosphorus fertilizers on growth, nodulation, yield and yield attributes of soybean at Pawe Northwestern Ethiopia. *World Scientific News*, *67*(2), 201-218.

Venkatarao, C. V., Naga, S. R., Yadav, B. L., Koli, D. K., & Jagga-Rao, I. (2017). Effect of Phosphorus and Biofertilizers on Growth and Yield of Mungbean [*Vigna radiata* (L.) Wilczek]. *Int. J. Curr. Microbiol. App. Sci*, *6*(7), 3992-3997.

Wasule, D. L., Wadyalkar, S. R., & Buldeo, A. N. (2007). Effect of phosphate solubilizing bacteria on role of Rhizobium on nodulation by soybean. In *First international meeting on microbial phosphate solubilization* (pp. 139-142). Springer, Dordrecht.