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IMPACT OF CO-INOCULATION OF BIOFERTILIZERS ON GROWTH, YIELD AND YIELD-ATTRIBUTES OF SOYBEAN (*Glycine max* (L) Merrill) IN VERTISOL .

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ABSTRACT

A field experiment was conducted during *kharif* season of 2018 and 2019 at the Research Farm, RAK College of Agriculture, Sehore (M.P.), India to study the impact of co-inoculation of biofertilizers on growth, yield and yield-attributes of soybean. The combined application of 50% RDF + *Glomus geosporum* (AMF) + PGRS (*Paenibacillus polymyxa*) + *Rhizobium japonicum* (T_7) proved most beneficial for growth symbiotic traits, yield-attributes and productivity of soybean in vertisol. This was equally followed by 50% RDF + *Glomus geosporum* (AME) + PGPR (*Paenibacillus polymyxa*) (T_6) and then 50% RDF + *Rhizobium japonicum* (T_5). The grain yield in T_7, T_6 and T_5 treatments was 13.91, 13.44 and 12.94 q/ha, respectively.

Key words: Biofertilizers, inoculation, soybean

INTRODUCTION

Soybean (*Glycine max* L) is an important oilseed-cum-pulse crop. Soybean contains 40% protein and 20% oil. Soybean is capable of fixing atmospheric-N

upto 65-115 kg N/ha/year with a symbiosis of *Rhizobium japonicum* microorganism.

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The efficacy of co-inoculation with various strains of *Bradyrhizobium japonicum* and arbuscular mycorrhizal fungi (AMF) species on soybean development, root colonization, and supplement take-up of N, P, Zn, Fe, and Cu. Co-inoculation with different AMF species and rhizobia altogether expanded the soybean biomass production (Hemmat Jou, 2017).

Soil microbial population plays a vital role in maintaining soil and plant health and thus help sustain crop production and food security. Plant growth-promoting rhizobacteria (PGPR) are the group of bacteria that colonize in the rhizosphere, at root surfaces, in association with roots and can improve plant growth directly or indirectly. Several PGPR inoculants are being available to promote plant growth by various mechanisms viz. improved nutrient acquisition, suppression of plant disease, phytohormone production (Anonymous, 2017). The significant residual effect of PGPR in vertisol in increasing the physico-chemical properties, nutrients availability in soil, growth, nodulating traits, nutrients uptake and yield of soybean have also been reported by Jain and Dhote,2019). Looking to the above facts, the present research was taken up on growth, yield and yield-attributes of soybean.

MATERIALS AND METHODS

The field experiment was conducted during *kharif* season of 2018 and 2019 at the Research Farm, RAK College of Agriculture, Sehore (M.P.), India. The soil of the experimental field was medium black (Vertisol) having clay loam texture, low in available nitrogen (208 N kg/ha), medium in available phosphorus (13 P kg/ha), high in available potassium (420 kg K/ha) and Normal in available sulphur (8.80 S kg/ha) with pH of 7.5. The experiment consisted of 7 treatments laid out in randomized block design keeping 3 replications. The treatment included

absolute control (T_1),100% RDF (T_2), 50% RDF + *Glomus geosporum* (AMF culture) (T_3), 50% RDF + PGPR (*Paenibacillus polymyxa*) (T_4), 50% RDF + *Rhizobium japonicum* (T_5), 50% RDF + *Glomus geosporum* (AMF)+ PGPR (*Paenibacillus polymyxa*) (T_6), 50% RDF+ *Glomus geosporum* (AMF) + PGPR (*Paenibacillus polymyxa*)+ *Rhizobium japonicum* (T_7). The soybean var. RVS-24 was sown on 4th and 2nd July in 2018 and 2019, respectively. The 50 percent recommended doses of fertilizers were applied as per package of practices for soybean @ 20:60:20:20 kg/ha N, P_2O_5, K_2O and S, respectively. The crop was harvested on 3rd October, 2018 and 15th October, 2019.

RESULTS AND DISCUSSION

Growth parameters

The data indicated in Table 1 reveal that the branches per plant, root length, dry weight/plant, number and dry weight of root nodules/plant were found significantly superior under the application of 50% RDF + *Glomus geosporum* (AME) + PGPR (*Paenibacillus polymyxa*) + *Rhizobium japonicum* (T_7), followed by T_6, T_5 and then T_4 treatments. However, the plant height did not differ significantly.

The combined use of plant growth promoting rhizobacteria (PGPR) is a better alternative input to enhance the yields. They play an essential and vital role to enrich the soil fertility, plant growth promotion, and suppression of harmful phytopathogens for development of eco-friendly sustainable agriculture. These results corroborate with those of Gupta *et al*.(2015), Jain (2015), Jain and Virendra (2017), Jain and Singh (2018). The benefits could also be observed in plant–PGPR interactions with AMF to increased rhizospheric dynamics leading to better availability of nutrients, root development, shoot and root weights, leaf area, chlorophyll content, protein content, and nutrient uptake (Adesemoye *et al*.2009 and Sharma *et al*.2012).

Yield-attributes

Yield attributing characters viz., pods/plant, seed per pod, grain yield/plant, grain yield kg/ha and straw yield kg/ha were significantly influenced by the combined application of 50% RDF + *Glomus geosporum* (AMF) + PGPR (*Paenibacillus polymyxa*) + *Rhizobium japonicum* (T_7) over absolute control (T_1) followed by 50% RDF + *Glomus geosporum* (AMF) + PGPR (*Paenibacillus polymyxa*) (T_6) and then 50% RDF + *Rhizobium japniucum*. The increased yield-attributes inT_7, T_6 and T_5 treatments may be on account of significant increases in growth parameters which translocated maximum photosynthates towards reproductive arts (sink). These results support the findings of Estrade *et al*. (2013), Jain (2015), Jain and Singh (2018) and Jain and Dhote (2019).

Productivity parameters

Grain yield is a complex process which depends on the different yield attributing characters such as number of pods/plant, number of seeds/pod, seed index. The treatment T_7 (50% RDF + *Glomus geosporum* + PGPR + *Rhizobium japonicum*) exerted the maximum seed yield (13.41 q/ha) which was found at par with the treatment T_6 (13.44) and then T_5 (12.94 q/ha). The straw yield was 16.64, 16.21 and 15.70 q/ha, respectively.

Physiological phenomenon and plant growth pattern form an essential basis in crop management, sustained productivity, maintenance of proper soil moisture and reduction of crop-weed competition.

The increment and mobilization in the supply of essential elements through AM fungi colonies population and PGPR sources could be the concomitant mineralization, their availability, mobilization and influx into the plant tissues increased and thus improved growth, yield components and finally the grain yield of soybean. These results corroborate with the findings of Jain (2015), Jain and Virendra (2017), Jain and Singh (2018) and Jain and Dhote (2019).

The findings conclude that the combined application of 50% RDF + *Glomus geosporum* (AMF) + PGRS (*Paenibacillus polymyxa*) + *Rhizobium japonicum* (T_7)

proved most beneficial for growth symbiotic traits, yield-attributes and productivity of soybean in vertisol. This was equally followed by 50% RDF + *Glomus geosporum* (AME) + PGPR (*Paenibacillus polymyxa*) (T_6) and then 50% RDF + *Rhizobium japonicum* (T_5).

REFERENCES

Adesemoye, A.O.; Torbert, H.A. and Kloepper, J.W. (2009). Plant growth-promoting rhizobacteria allow reduced application rates of chemical fertilizers. *Microb. Ecol.*, **58**: 921–929.

Anonymous (2017). Report of Soybean Processors Association of India (SOPA),www.sopa org.

Estrada, G.A., Baldani, V.L.D.; Oliveira, D.M., Urquiaga, S. and Baldani, J.V. (2013). Selection of phosphate-solubilizing iazotrophic Herbaspirillum and Burkholderia strains and their effect on rice crop yield and nutrient uptake. *Plant Soil* **369**:115-129.

Gupta, G., Parihar, S.S., Ahirwar, N.K., Snehi, S.K. and Singh, V. (2015). Plant growth promoting rhizobacteria (PGPR): Current and future prospects for the development of sustainable agriculture. *J Microb Biochem Technol* , **7**(2): 096-102.

Hemmat Jou, M.H. and Besalatpour, A.A. (2017). Interactive effect of co-inoculation of *Bradyrhizobium japonicum* strains and mycorrhiza species on soybean growth and nutrient contents in plants. *J. Plant Nutrition*, **41**(1): 10-18.

Jain, R.C. (2015). The response of soybean (*Glycine max*(L.)Merrill) to lime-based integrated nutrient management and mulching on nodulation, nutrient

contents and yield in clay loam soil. *Current World Environment* **10**(2): 707-709.

Jain, R.C. and Dhote, A. (2019). Study on the Residual Effect of Arbuscular Mycorrhizal Fungi and PGPR supplemented with slacked lime on growth, nutrient uptake and yield of soybean (*Glycine max* (L.) Merrill) in black soil. M.Sc. (Ag.) *Thesis* RVSKVV Gwalior (M.P.).

Jain, R.C. and Singh (2018). Residual Effect of Arbuscular Mycorrhizal Fungi and PGPR on nodulation, growth, nutrient uptake and yield of soybean (*Glycine max* (L.) Merrill) in black soil, M.sc.(Ag) *Thesis* RVSKVV Gwalior (M.P).

Jain, R.C. and Virendra, (2017).Effect of Arbuscular Mycorrhizal Fungi and PGPR on nodulation, growth, nutrient uptake and yield of soybean (*Glycine max* (L.) Merill) in black Soil. M.Sc. (Ag) *Thesis*, RVSKVV Gwalior (M.P.).

Sharma, M.; Jaisinghani, K.; Sharma, S. and Bhatia, V.S. (2012). Effect of native soybean rhizobia and AM fungi in the improvement of nodulation, growth, soil enzymes and physiological status of soybean under microcosm conditions. *National Academy of Agricultural Sciences* **1**(4):346–351.

Table 1 Growth, nodulation, yield-attributes and yield of soybean as influenced by combined inoculation of biofertilizers (Pooled for 2 years)

Treatments	Plant height (cm)	Branches/ plant	Dry weight/ plant (g)	Root length (cm)	Root nodules/ plant (45 DAS)	Dry weight of root nodule/plant (mg)	Pods/ plant	Seeds/ pod	Seed index (g)	Grain yield/ plant (g)	Grain yield/ (q/ha)	Straw yield (q/ha)
T_1	51.40	3.62	17.66	22.07	23.13	49.72	34.37	1.98	9.59	7.89	10.07	12.56
T_2	52.97	4.01	18.88	24.50	24.88	52.98	36.82	2.20	10.00	9.41	11.5	14.21
T_3	53.82	4.42	20.00	26.47	25.88	55.42	38.35	2.39	10.11	10.19	11.76	14.96
T_4	56.73	4.69	20.48	27.43	27.50	58.29	40.57	2.52	10.66	10.95	12.18	15.17
T_5	57.69	4.96	21.88	28.21	29.21	62.59	43.73	2.71	10.94	12.29	12.94	15.70
T_6	58.63	5.38	23.01	29.96	30.94	65.71	46.03	2.89	11.45	12.53	13.44	16.21
T_7	60.19	5.89	24.02	32.13	33.21	68.63	48.04	3.19	11.88	13.71	13.91	16.64
C.D.(P=0.05)	**NS**	**0.57**	**1.87**	**2.495**	**2.99**	**NS**	**7.14**	**0.355**	**0.625**	**1.5**	**1.11**	**1.30**