Crop productivity and economics of soybean (Glycine max L) as influenced by bio fertilizers and phosphorus levels cured with FYM in Vetisols

[1]Geetha G P, [2]Rajashekhar L, [3]Veerendra Patel G M.
[1]*Research Associate-UAS,GKVK,* [2]*Student Shivmogga Agriculture University,* [3]*Research Associate - UAS, GKVK.*
A World bank funded project - KWDP-II Sujala-III under Watershed Dept GoK, University of Agricultural Sciences, GKVK, Bangalore, India.

Abstract A field experiment was conducted during *kharif* season of 2013-14 at main agriculture research station (MARS), Dharwad, Karnataka, India to study the levels of phosphorus with or without curing (with FYM) and biofertilizers. Application of 80 kg P_2O_5/ha cured with FYM + PSB + VAM recorded significantly higher grain yield of 30.80 q/ha and straw yield of 45.40 q/ha. However, this treatment is closely followed by treatments RPP and 60 kg P_2O_5/ha cured with FYM +PSB + VAM with grain yield 29.17 and 28.27 q/ha and straw yield 43.30 and 41.97 q/ha. The application of 80 kg P_2O_5/ha cured with FYM + PSB + VAM resulted in the highest net returns of 63995 Rs/ha and benefit cost ratio of 3.30.

Keywords— Soybean, FYM cured DAP, yield, economics and biofertilizers.

---

1. INTRODUCTION

Soybean is a grain legume is considered as a wonder crop due to its dual qualities Viz., high protein (40-43 %) and oil content (20 %). It was introduced in India during 1960s and is gaining rapid recognition as a highly desirable pulse and oil seed crop. In the world, it is grown in an area of 108.75 m. ha. with annual production of 268.00 m.t and productivity of about 2464 kg /ha. In India, it is grown in an area of 12.03 m. ha. with production of 12.23 m.t. and productivity of about 1017 kg/ha. In Karnataka, it is grown in an area of 12.47 lakh ha with a production of 3.00 lakh mt and productivity of about 1215 kg/ha.

Phosphorus (P) is one of the indispensable plant nutrient required for plant growth and development because of its role in life processes such as photosynthesis, energy transformation, breakdown of sugar and starches, nutrient transport within the plant and the transfer of genetic character from one generation to next. It also has a significant role in sustaining crop productivity particularly under intensive agriculture system. In present days, costly and ultimately availability of chemical fertilizers, there is a strong need to adopt integrated nutrient supply system by judicious combination of organic, biological and chemical fertilizers to improve soil health and crop productivity. Biofertilizers mainly rhizobium, phosphate solubilizing bacteria (PSB) and vesicular arbuscular mycorrhizae (VAM) are commonly used for soybean production and they have an enormous potential to fix atmospheric nitrogen and also have capacity to solubize and mobilize phosphorus and micronutrients present in nonavailabile form in the soil. The productivity of soybean can be increased by inoculation of biocultures and which have shown encouraging results in sustaining the crop productivity of soybean and improving soil fertility (Dubey, 1997).

2. MATERIALS AND METHODOLOGY

Field experiment was conducted during kharif season 2013-14 at MARS, Dharwad. The experimental site is located at 15^0 26′N latitude and 75^0 07′ E longitude and at an altitude of 678 m above mean sea level. The soil of the experimental area was clay with alkaline pH (7.7), medium in available nitrogen (350 kg/ha), available phosphorus (32 kg/ha), potassium (380 kg/ha) and sulphur (19 kg/ha). Soybean cv. DSb-21 was choosen for the study. The experiment was laid out in RCBD design comprising of 9 treatments in three replications. Soybean seeds were treated with PSB and rhizobium. VAM is applied just below the seeds at

the time of sowing. The inoculated seeds were dried under shade and sown immediately after drying. All the agronomic practices were carried out uniformly to raise the crop.

4. RESULTS AND DISCUSSIONS

4.1 Growth parameters

The data in table 1 revealed that the levels of phosphorus with biofertilizers influenced significantly plant height. Maximum plant height (66.27 cm) was recorded from the treatment 80 kg P_2O_5/ha cured with FYM + PSB + VAM (T9) followed by RPP (64.53 cm) (T3) and 60 kg P_2O_5/ha cured with FYM + PSB + VAM (62.53 cm) (T7) and lowest from the absolute control 48.33 cm (T1). Number of branches per plant were recorded highest in the treatment T_9 recorded highest number of branches (9.0) followed by treatment T_3 (8.3) and T_7 (8.3). Similarly, at harvest, the treatment T_9 (80 kg P_2O_5/ha cured with FYM + PSB + VAM) recorded highest dry matter of 27.49 g/plant and it was on par with T_3 (RPP) (24.85 g/plant) and T_7 (60 kg P_2O_5/ha cured with FYM + PSB + VAM) (22.56 g/plant). These treatments differed markedly over rest of the treatments. The treatment T_1 (Absolute control) recorded lowest dry matter 12.58 g/plant.

The increased plant height was mainly due to the improvement of phosphorus in several energy transformations and biochemical reactions including nitrogen fixation. Root development, stalk and stem strength and nitrogen fixation in legumes are the attributes associated with phosphorus nutrition. It shows that phosphorus is needed in relatively large amounts by legumes for growth and nitrogen fixation and it has been reported to promote biomass yield. Further, Sharma *et al*. (2002), reported that positive improvement in growth parameters under increased phosphorus application might be due to increased metabolic process in plants resulting into greater meristematic activities and apical growth there by improving plant height, branches per plant and ultimately resulted in improved dry matter accumulation.

Table 1: Effect of different levels of phosphorus cured or uncured and biofertilizers on plant height (cm), number of branches/plant and dry matter (g/plant)

Treatments	**Plant height (cm)**	**No branches/ plant**	**Dry matter (g/plant)**
T_1= Absolute control (No P)	48.33	7.33	12.58
T_2 = Absolute control with biofertilizer	50.60	7.33	13.57
T_3 = RPP	64.53	9.33	24.85
T_4= 40 kg P_2O_5 /ha + PSB + VAM	54.10	8.00	15.33
T_5= 40 kg P_2O_5/ha cured with FYM + PSB +VAM	56.40	8.00	16.40
T_6= 60 kg P_2O_5 /ha + PSB + VAM	57.53	7.67	18.27
T_7= 60 kg P_2O_5/ha cured with FYM+ PSB + VAM	62.53	8.33	22.56
T_8= 80 kg P_2O_5/ha + PSB + VAM	59.13	8.00	20.21
T_9= 80 kg P_2O_5/ha cured with FYM + PSB + VAM	66.27	9.00	27.49
SE m±	**0.99**	**0.62**	**0.86**
CD @ 5%	**2.98**	**NS**	**2.59**

4.2 Yield and yield attributes

Significant differences among the treatments were noticed with respect to number of pods per plant, seed yield per plant, test weight, number of seeds per pod, grain and straw yield (Table 2 and 3). Application of 80 kg P_2O_5/ha curing with FYM + PSB + VAM (T_9) produced maximum number of pods/plant (87.00), number of seeds per pod (3.9), seed yield (27.13 g/plant) and hundred seed weight (22.57 g/plant) and the lowest was in the control. However, it was on par with RPP (T_3) and 60kg P_2O_5/ha curing with FYM + PSB + VAM (T_7) but significantly superior over rest of the treatments. It might be due to better

growth and development of crop due to supply of phosphorus and nitrogen by curing and application of biofertilizers thereby increase in the supply of assimilates to seed, which ultimately gained more weight. Similar observations on hundred seed weight with phosphorus nutrition were reported by Singh and Hiremath (1990), Chauhan *et al.* (1992) and Anchal *et al.* (1997). The increase in seed yield might be due to better yield parameters. The higher value of stover yield at higher levels of P is owing to significantly higher value of dry matter per plant. These findings are in conformity with the results of Sarkar *et al.* (1997) and Nandini Devi *et al.* (2012) in Soybean, Tauseef *et al.* (2013) in Field pea.

Table 2: Yield attributes of soybean as influenced by application of levels of phosphorus cured or uncured and biofertilizers

Treatments	No of pods/ plant	Test weight (g/plant)	Seed yield (g/plant)	No of seeds/ pod
T_1= Absolute control (No P)	50.00	7.70	11.77	2.00
T_2 = Absolute control with biofertilizer	60.67	9.60	13.48	2.37
T_3 = RPP	84.00	20.27	24.97	3.33
T_4= 40 kg P_2O_5 /ha + PSB + VAM	66.67	11.93	16.13	2.33
T_5= 40 kg P_2O_5/ha cured with FYM + PSB +VAM	70.67	13.67	17.07	2.53
T_6= 60 kg P_2O_5 /ha + PSB + VAM	73.33	14.40	18.53	2.67
T_7= 60 kg P_2O_5/ha cured with FYM+ PSB + VAM	81.33	18.77	23.10	3.23
T_8= 80 kg P_2O_5/ha + PSB + VAM	78.67	16.27	20.40	3.00
T_9= 80 kg P_2O_5/ha cured with FYM + PSB + VAM	87.00	22.57	27.13	3.97
SE m±	**8.98**	**0.84**	**1.23**	**0.14**
CD @ 5%	**26.93**	**2.52**	**3.69**	**0.42**

4.3 Economics

The data on economics of soybean cultivation as influenced by various treatments are presented in Table 3.

The treatment T_9 (80 kg P_2O_5/ha cured with FYM + PSB + VAM) registered the highest gross return (Rs 92400/-) followed by T_3 (RPP) (Rs 87600/-) and T_7 (60 kg P_2O_5/ha cured with FYM + PSB + VAM) (Rs 84900/-). While, the highest net return of Rs 63995/- T_9 (80 kg P_2O_5/ha cured with FYM + PSB + VAM) registered the highest net return followed by T_3 (RPP) (Rs 59525 /-) and T_7 (60 kg P_2O_5/ha cured with FYM + PSB + VAM) (Rs 57015/-). Similarly, the highest benefit cost ratio (3.3) was recorded in T_9 (80 kg P_2O_5/ha cured with FYM + PSB + VAM) followed by T_3 (RPP) and T_7 (60 kg P_2O_5/ha cured with FYM + PSB + VAM) with 3.1 and 3.0 respectively. The lowest benefit cost ratio was observed in the treatment T_1 (absolute control) (1.9).

Table 3: Yield attributes and economics of soybean as influenced by application of different levels of phosphorus and biofertilizer

Treatments	Grain yield (q/ha)	Straw yield (q/ha)	GR (₹/ha)	NR (₹ /ha)	B:C
T_1= Absolute control (No P)	15.64	23.47	46800	21555	1:9
T_2 = Absolute control with biofertilizer	18.77	27.10	56400	30765	2:2
T_3 = RPP	29.17	43.30	87600	59525	3:1
T_4= 40 kg P_2O_5 /ha + PSB + VAM	22.77	34.50	68400	41485	2:5
T_5= 40 kg P_2O_5/ha cured with FYM + PSB +VAM	25.04	37.03	74790	47875	2:8
T_6= 60 kg P_2O_5 /ha + PSB + VAM	26.10	39.10	78300	50415	2:8
T_7= 60 kg P_2O_5/ha cured with FYM+ PSB + VAM	28.27	41.97	84900	57015	3:0
T_8= 80 kg P_2O_5/ha + PSB + VAM	26.25	40.10	78750	50345	2:8
T_9= 80 kg P_2O_5/ha cured with FYM + PSB + VAM	30.80	45.40	92400	63995	3:3
SE m±	**1.00**	**1.38**			
CD @ 5%	**3.00**	**4.14**			

Conclusion

It can be concluded that there was significant improvement in soil biological indicators due to dual inoculation of PSB and VAM. The soybean yield was on par with T_3 (RPP) and T_7 (60 kg P_2O_5/ha curing with FYM + PSB + VAM). Therefore, it can be concluded that integrated use of P, FYM with dual inoculation of biofertilizers can supplyment P requirement to the extent of 20 kg/ha.

ACKNOWLEDGMENT

The first author Geetha acknowledges to Department of SoilScience and Agriculture Chemistry, UAS Dharwad for providing the necessary infrastructures to carry out the work.

REFERENCES

[1] Anchal, D., Kharwara, P. C., Rana, S. S. and Dass, A., 1997, Response of gram varieties to sowing dates and phosphorus levels under on farm condition. *Himachal J. Agric. Res*., 23:112-5.

[2] 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.

[3] Dadhich, S. K., Somani, L. L. and Shilpkar, D., 2011, Effect of integrated use of fertilizer P, FYM and biofertilizers on the soil properties and productivity of Soybean-Wheat crop sequence. *J. Adv. Dev. Res*., 2(1): 42-46.

[4] Dubey, S.K., 1997, Coinoculation of phosphate solubilizing bacteria with Brady rhizobium Japonicum to increase phosphate availability to rainfed soybean on vertisols. *J. Indian Soc. Soil Sci*., 46(3):474-476.

[5] Jain, P. C. and Thrivedi, S. K., 2005, response of soybean to phosphorus and biofertilisers, *Leg. Res*., 28 (1); 32 33.

[6] Nandini Devi, K., 2012, Response of soybean to sources and levels of phosphorus. *J. Agic. Sci*., 4(6): 44-53.

[7] Pattar, P. S., Mansur, C. P., Alagundagi, S. C., Salimath, P. M. and Manjunath Hebbara., 2013, Effect of different phosphorus sources and seed priming on growth, yield parameters and yield of chickpea. *J. Crop improvement*.

[8] Sarkar, R. K., Shit, D. and Chakraborty, A., 1997, Effects of levels and sources of phosphorus with and without farmyard manure on pigeon (*Cajanuscajan*) under rainfed condition. *Indian J. Agro*., 42(1):120-123.

[9] Sharma, S. C., Vyas, A. K. and Shaktwat, M. S., 2002, Effect of levels and sources of phosphorus under the influence of FYM on growth detreminantts and productivity of soybean. *Indian J. Agric. Res*., 36(2): 123-127.

[10]Singh, B. G. and Hiremath, S. M., 1990, Effect of phosphate fertilization on physiological aspects of mungbean. *J. Maharashtra Agric. Univ*., 15(2): 176-78.

[11] Tauseef Bhat, A., Meenakshi Gupta, Manzoor Ganai, A., Rayees Ahanger, A., Hilal Bhat, A., 2013, Yield, soil health and nutrient utilization of field pea (*Pisum sativum* L.) as affected by phosphorus and bio-fertilizers under subtropical conditions of jammu. *Int. J. Modern Plant and animal Science*, 1(1): 1-8.

[12] Tomar, R. K. S., 2011, Effect of integration of bio fertilizers and farmyard manure with inorganic fertilizers on productivity of soybean (*Glycine max* L.) in farmer's field. *J. Oilseed Res*., 28(2): 112-114.

. [13] Umale, S. M., Thosar, V. R., Anita, B., Chorey, and Chimote, A. N., 2002, Growth response of Soybean to P solubilising bacteria and phosphorus levels. *J. Soils and Crops*, 12(2) 258-261.