International Journal of Enhanced Research in Educational Development (IJERED)
ISSN: 2320-8708, Vol. 6 Issue 2, March-April-2018

Response of Variable Levels of Phosphorus on Nodulation, Yield and Nutrient Status of Promising Varieties of Soybean (Glycine Max L.)

Kamalesh Kumar[1], Edwin Luikham[2]

[1]General Shivdev Singh Diwan Gurbachan Singh Khalsa College, Patiala, 147001
[2]College of Agriculture, Central Agricultural University, Imphal, Manipur, 795 004

ABSTRACT

The experiment was conducted during the kharif season of 2010-11. At the research farm of Agronomy, College of Agriculture, Central Agricultural University, Imphal, Manipur. The experiment was laid out in factorial randomized block design with 3 replications. The treatment consisted of four levels of phosphorus (P_o- control, P_1-30kg P_2O_5/ha, P_2-60kg P_2O_5/ha, P_3-90kg P_2O_5/ha) and three varieties (V_1-Bragg, V_2- JS-335 and V_3-Local). Application of phosphorus significantly influenced the plant height, number of branches per plant, fresh weight of plant, dry weight of plant, seed yield and stover. The highest seed yield was recorded with the application of phosphorus at 60 kgP_2O_5/ha which remained at par with 90 kg P_2O_5/ha, but significantly higher stover yield was observed at 90 kg P_2O_5/ha. Better growth characters like plant height, fresh weight, and number of branches were obtained in both Local and Bragg varieties. Though comparable seed yield was recorded in Local and Bragg varieties, significantly higher stover yield was observed in Local variety.

Keyword: Soybean, miracle bean, phospholipids

INTRODUCTION

Soybean is one of the most important oil containing legume crop in the world. It is almost an ideal pulse crop because of quick growing, high yielding and nutritious quality. It has also been termed as miracle bean because it contains about 20 per cent oil and 40 per cent high quality protein. The productivity of soybean in the state can be improved by adopting suitable agronomic practices. Among the agro techniques selection of suitable variety and application of adequate quantity of phosphorus are the two important factors for increasing plant height, fresh weight, dry weight of plant and nodules as well as production of this crop. Phosphorus has a great role in energy storage and transfer and is a constituent of nucleic acid, phospholipids and phytene. Various works done at different part of the country indicated increased growth parameter, fresh, dry weight and also on yield attributes & yields of soybean with the addition of phosphorus in different variety.

Growing of suitable variety well adapted to climatic condition of the area is one of the means to increase the plant height, fresh weight, dry weight of plant and nodules as well as production of this crop. There are many reports from different parts of the country about the use of phosphorous for better crop performance and seed yield of soybean.

MATERIALS AND METHODS

The experiment was conducted during the kharif season of 2010-11 at the research farm of Agronomy, Central Agricultural University, Imphal, Manipur. The experiment was laid out in factorial randomized block design with 3 replications. The treatment consisted of four levels of phosphorus (P_o- control, P_1-30kg P_2O_5/ha, P_2-60kg P_2O_5/ha, P_3-90kg P_2O_5/ha) and three varieties (V_1-Bragg, V_2- JS-335 and V_3- Local.

From the five randomly selected plants the numbers of nodules were counted from the sample plants and the values of these were averaged. To study the fresh and dry weight of five plants were collected from the sampling rows of each plot at 30 days interval from sowing till harvest of the crop.

These fresh samples were air dried and then dried in an oven at 60 ^{0}C till a constant weight was obtained and weighed to record the average dry weight of the plant nodules. The weight of the sun dried harvested crop was recorded from net plot area and expressed in quintal per hectare after subtracting the seed yield. Seed yield of each plot excluding the border and sampling row was weighed in kilo gram and converted into quintal per hectare.

RESULT AND DISCUSSION

Application of phosphorous showed significant increased in number of nodules upto 60 kg P_2O_5/ha (60 and 120 DAS) and 60 kg P_2O_5/ha (90DAS). Phosphorus plays an important role in the development of roots nodules by enhancing the micronutrient availability like Zn, Bo, and Mo which are responsible for nodules development. This finding is also supported by Yadav et al. (2013).

Among the varieties the maximum number of nodules was recorded in Bragg and minimum in Local and they were significantly different. This finding is also supported by Yadav et al. (2013) and Kamara et al. (2008) in soybean.

Marked improvements in fresh and dry weight of nodules were recorded with the application of phosphorus. Fresh and dry weight of the nodules increased with increasing levels of phosphorus up to 90 kg P_2O_5/ha at 60 DAS and 60 kg P_2O_5/ha, at 90 and 120 DAS. However, application of different level of phosphorus could not significantly influence the dry weight of nodules at 120 DAS. Phosphorus increases the fresh and dry weight of the plant nodules compared to the control such beneficial effect of phosphorus on nodule and dry weight. This finding is also supported by Yadav et al. (2013). in soybean.

Significant differences in fresh and dry weight were observed in different. The Local variety showed significant superiority in fresh and dry weight of nodules over Bragg and JS-335. This finding is also supported by Luo et al. (2005).

The seed and stover yield was significantly affected by phosphorus application. Application of 60 kg P_2O_5/ha showed a significant superiority over that of control and 30 kg P_2O_5/ha and was at par to 90 kg P_2O_5/ha in respect of seed yield.

Application of phosphatic fertilizer therefore provides better nutrition to soybean which resulted in higher seed yield.

Increased in seed yield with the application of phosphorus may be due to better growth of the plant as expressed in term of plant height, fresh and dry weight of plant and nodulation which were favourably affected by phosphate fertilization. This finding is also supported by Malik et al.(2006).

The highest seed and stover yield was recorded with the Local variety which remained at par to Bragg but significant superior to JS-335. The higher seed yield in Local variety may be attributed to higher test weight which was significantly superior to the other two varieties. On the other hand the variety Bragg recorded more number of pods per plant and number of seeds per pod which ultimately contributed to obtain higher seed yield (Table: 5 and fig:1a,b). This finding is also supported by Hasan et al.(2011).

The available nitrogen content in soil after harvest of the crop was significantly increased with the application of phosphorus 60 kg P_2O_5/ha which remain at par to 30 and 90 kg P_2O_5/ha higher residual available nitrogen in soil with the application of phosphorus may be attributed to better activity of micro organism which influence the nodules development resulting in greater atmospheric nitrogen fixation similar benefit of phosphorus on residual available nitrogen is also reported by Kuntyastuti et al. (2015).

The residual available nitrogen in soil was recorded highest in variety Bragg which remained at par to JS-335 but significantly superior to Local. Again JS-335 did not differ significantly as compared to Local in respect of available nitrogen. The variation in residual available nitrogen in soil with different cultivars is also supported by Kuntyastuti et al. (2015).

The residual available phosphorus in soil after the harvest of the crop increase significantly with every increase in the level of phosphorus upto 90 kg P_2O_5/ha. Such beneficial effect of phosphorus application on residual available phosphorus in soil is also supported by Dalshad et al. (2013)

Different varieties could not significantly influence on the residual available phosphorus in soil. This finding is also supported by Slaton et al. (2001)

Table No. 1 Effect of phosphorus and varieties on number of plant nodules at 60 DAS, 90 and 120 DAS

	Number of plant nodules at 60 DAS				**Number of plant nodules at 90 DAS**				**Number of plant nodules at 120 DAS**			
	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean	V_1	V_2	V_3	**Mean**
P_0	30.73	29.80	15.85	**25.46**	54.33	51.60	46.60	**50.84**	53.47	51.27	44.00	**49.58**
P_1	34.01	35.60	33.53	**34.38**	57.00	53.60	48.53	**53.04**	57.00	53.60	46.64	**52.41**
P_2	37.55	35.73	34.13	**35.81**	60.47	56.33	51.27	**56.02**	60.47	56.33	51.27	**56.02**
P_3	41.77	36.80	34.60	**37.72**	62.73	58.67	53.73	**58.38**	62.07	57.53	53.73	**57.78**
Mean	**36.02**	**34.48**	**29.53**		**58.63**	**55.05**	**50.03**		**58.25**	**54.68**	**48.91**	

	SE (d) ±	CD 0.05	SE (d) ±	CD 0.05	SE (d) ±	CD 0.05
Variety	2.42	5.02	0.17	0.35	0.41	0.84
Phosphorus	2.80	5.80	0.20	0.41	0.47	0.97
V*P	4.84	10.05	0.34	0.71	0.81	1.68

Table No. 2 Effect of phosphorus and varieties on fresh weight of plant nodules (g) at 60 DAS, 90 and 120 DAS

					Fresh weight of plant nodules in (g) at							
	60 DAS				**90 DAS**				**120 DAS**			
	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean	V_1	V_2	V_3	**Mean**
P_0	1.83	1.08	1.80	**1.57**	3.11	2.54	2.86	**2.84**	2.91	2.33	2.67	**2.64**
P_1	1.85	1.15	2.50	**1.83**	3.17	2.67	3.84	**3.23**	2.78	2.53	3.41	**2.91**
P_2	1.91	1.19	2.51	**1.87**	3.24	2.69	3.98	**3.31**	3.24	2.69	3.98	**3.31**
P_3	1.92	1.30	2.63	**1.95**	3.37	2.73	4.00	**3.37**	3.36	2.73	4.00	**3.37**
Mean	**1.88**	**1.18**	**2.36**		**3.22**	**2.66**	**3.67**		**3.07**	**2.57**	**3.52**	

	SE (d) ±	CD 0.05	SE (d) ±	CD 0.05	SE (d) ±	CD 0.05
Variety	0.02	0.040	0.04	0.07	0.11	0.24
Phosphorus	0.02	0.05	0.04	0.09	0.13	0.27
V*P	0.04	0.08	0.07	0.15	0.23	0.48

Table No. 3 Effect of phosphorus and varieties on dry weight of plant nodules (g) at 60 DAS, 90 and 120 DAS

					dry weight of plant nodules (g) at							
	60 DAS				**90 DAS**				**120 DAS**			
	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean	V_1	V_2	V_3	**Mean**
P_0	0.34	0.28	0.37	**0.33**	0.43	0.42	0.49	**0.45**	0.42	0.39	0.46	**0.42**
P_1	0.34	0.29	0.39	**0.34**	0.48	0.44	0.52	**0.48**	0.44	0.41	0.48	**0.45**
P_2	0.344	0.29	0.39	**0.34**	0.49	0.46	0.52	**0.49**	0.49	0.46	0.45	**0.46**
P_3	0.35	0.30	0.41	**0.35**	0.51	0.48	0.53	**0.50**	0.49	0.44	0.53	**0.48**
Mean	**0.34**	**0.29**	**0.39**		**0.47**	**0.45**	**0.52**		**0.46**	**0.42**	**0.48**	

	SE (d) ±	CD 0.05	SE (d) ±	CD 0.05	SE (d) ±	CD 0.05
Variety	0.003	0.01	0.01	0.03	0.02	0.06
Phosphorus	0.003	0.01	0.01	0.03	0.03	NS
V*P	0.006	0.01	0.03	NS	0.05	NS

Table No 4 Effect of phosphorus and varieties on available nitrogen in soil kg/ha

	Available nitrogen in soil kg/ha				Available phosphorus in soil (kg/ha)			
	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean
P_0	386.74	384.09	368.85	**379.89**	15.71	14.63	13.91	**14.75**
P_1	387.87	387.69	390.38	**388.65**	16.07	17.95	19.81	**17.94**
P_2	395.10	390.88	391.52	**392.50**	19.89	19.23	20.72	**19.94**
P_3	399.60	393.33	392.70	**395.21**	23.51	22.48	22.13	**22.71**
Mean	**392.33**	**389.00**	**385.86**		**18.80**	**18.57**	**19.14**	

	SE (d) ±	CD 0.05	SE (d) ±	CD 0.05
Variety	1.73	3.60	0.57	NS
Phosphorus	2.00	4.15	0.66	1.37
V*P	3.47	7.19	1.14	2.37

Table No 5. Effect of phosphorus and varieties on seed and stover yield (q/ha)

	Grain yield (q/ha)				Stover (q/ha)			
	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean
P_0	14.28	13.46	13.27	13.67	45.38	48.60	49.33	47.77
P_1	17.20	17.87	18.41	17.83	53.81	54.98	55.89	54.89
P_2	22.55	21.21	23.15	22.30	60.38	60.44	62.29	61.04
P_3	22.99	21.54	23.70	22.74	65.25	66.29	67.89	66.47
Mean	19.25	18.52	19.63		56.20	57.58	58.85	

	SE (d) ±	CD 0.05	SE (d) ±	CD 0.05
Variety	0.25	0.52	0.17	0.34
Phosphorus	0.29	0.60	0.19	0.40
V*P	0.50	1.04	0.33	0.69

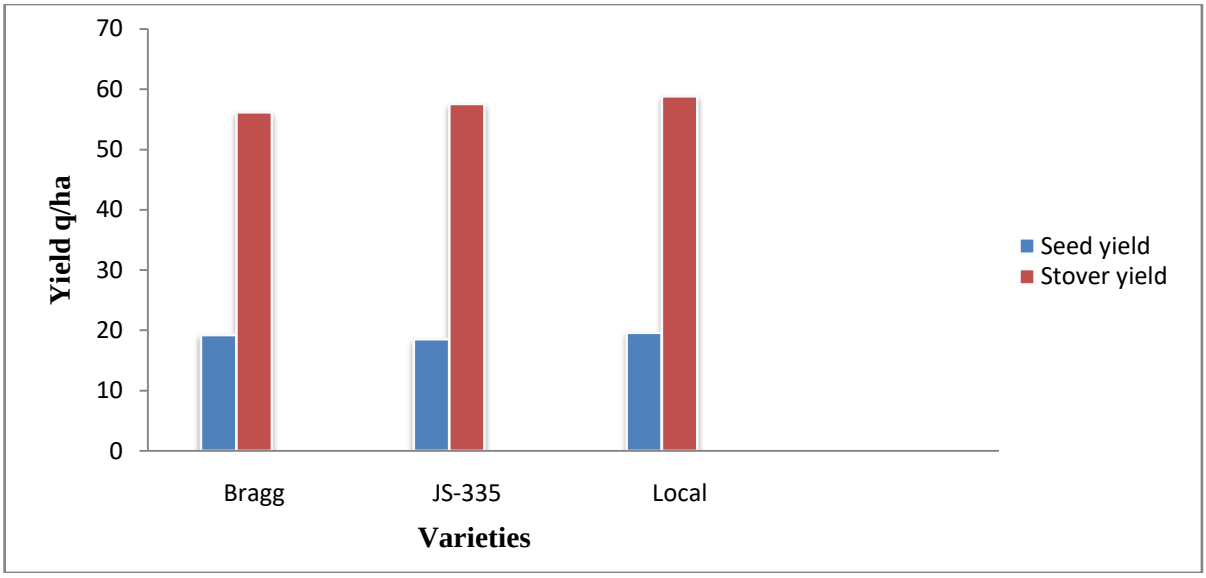

Fig. 1(a) Effect of varieties on seed and stover yield q/ha

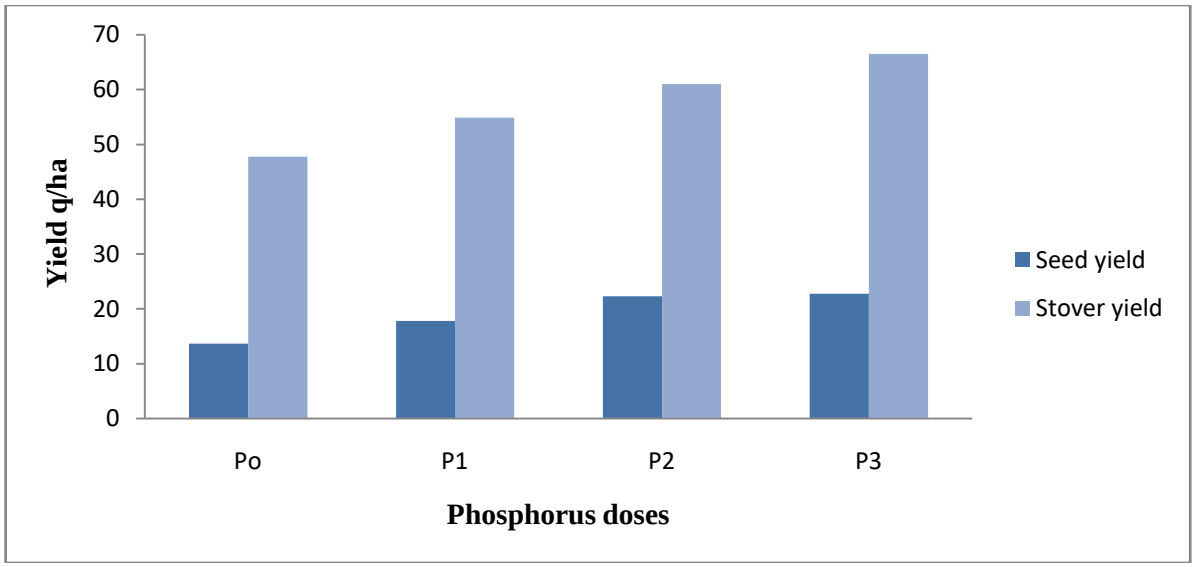

Fig.1.(b) Effect of phosphorus on seed and stover yield q/ha

Acknowledgements
Authors are thankful to the Department of Agronomy and University authority for providing facilities to conduct the experiment.

REFERENCES

[1]. Dalshad, A; Darwesh Pakhshan, M; Maulood and Shireen A; Amin 2013. Effect of Phosphorus Fertilizers on Growth and Physiological Phosphorus Use Efficiency of Three Soy Bean Cultivars. IOSR Journal of Agriculture and Veterinary Science. **3** Issue 6 PP 32-36.

[2]. Hasan, N; Thenua OVS, Bisht CP 2011. Response of soybean varieties to various rates of nutrients along with bio-organic spray on growth and yield. Environ and Eco 29(4):1789-1793.

[3]. Kamara, A.;Ywari, J. K.; Ekeleme, F.; Omoigui, L. and Abaidoo, R. (2008). Effect of Phosphorus Application and Soybean Cultivar on Grain and Dry Matter Yield of Subsequent Maize in the Tropical Savannas of north-eastern Nigeria African J. of Biotec. **7** (15) 2593-2599.

[4]. Kuntyastuti, Henny and Suryantini 2015. Effect of phosphorus fertilization on soil phosphrous level, growth and yield of soybean (Glycin max L.) in paddy soil. Journal of Experimental Biology and Agricultural Sciences Volume **3** (1)

[5]. Luo CH, Zeng LB, Yong MZ (2005) Effects of phosphorus on the physiological and biochemical properties of soybean under cadmium stress. J of Hunan Agril Uni **31**(4):431-433

[6]. Malik MA, Cheema MA, Khan HZ, Wahid MA (2006) Growth and the yield response of soyabean (Glycine max L.) to seed inoculation and varying phosphorous levels. J. of Agri Res. 44 (1): 47-53.

[7]. Matusso, Jossias Mateus Materusse and Cabo, Francelina Grandet Daniel 2015 Response of Soybean [Glycine max (L.) Merrill] to Phosphorus Fertilizer Rates in Ferralsols. Academic Research Journal of Agricultural Science and Research Vol. **3**(10), pp. 281-288.

[8]. Shyam Veer, Thenua OVS (2011) Effect of inorganic and organic sources of nutrients on growth, root nodulation and physiological parameters of soybean (Glycine max L. Merrill.). Environ and Eco 29(3A):1367-1371.

[9]. Slaton, N.A.; DeLong, R.E.; Ntamatungiro, S.; Clark, S.D. and Boothe, D.L. (2001). Phosphorus fertilizer rate and application time effect on soybean yield. Res. Series Arkansas Agric. Experiment Station. No. (480) 54-58.

[10]. Yadav, Heeralal M.A; Shekh, S.S; Takar, B.S; Kherawat , Ashish Shivran And M.C; Agarwal 2013.Effect of phosphorus and sulphur on growth and yield of summer soybean. International Journal of Agricultural Sciences, Volume **9** 168-171.