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Response of Vermicompost and Phosphorus with and without PSB Inoculation on Summer Green Gram

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An experiment was conducted at the College Agronomy farm, Anand Agricultural University, Anand to study the response of summer green gram (V*igna radiat* L.Wiczek) to vermicompost and phosphorus with and without PSB inoculation. Significantly highest seed and stover yield as well as protein content were recorded under the application of vermicompost @ 2t/ha. Application of phosphorus @ 40 kg P_2O_5/ha recorded significantly higher seed and stover yields over the control and significantly increased the protein content of green gram seed. Inoculation with PSB culture (strain PBA-22) significantly influenced the seed and stover yields as well as protein content of green gram seed.

Key words: Vermicompost, Green Gram, Phosphorus.

Pulse production is very low and become challenging problem against the requirement of increasing population of our country. Pulses are considered as lifeblood of agricultural because they occupy a unique position in every known system of farming as main, catch, cover, green manure, intercrop and mix crop. Green gram is one of the important and extensive cultivated pulse crop in the India since ancient times. Green gram is drought resistant crop and suitable for dryland farming predominantly grown as an intercrop with other crops. Green gram is rich in protein content as it contains about 25 percent protein. It supplies protein requirements of vegetarian population of the country.

The nutritive values improves greatly, because of the complementary relationship of the essential amino acids. It is particularly rich in lucien, phenylalanine, lysine, valinelsoleucine etc.

Pulse plays important role in maintaining the soil. It is a drought resistant crop suitable for dry land farming and predominantly used as an intercrop with other crops. It is also grown during summer season. Green gram is thermo sensitive, low input requiring and short duration crop. It adds about 40 kg N ha^{-1} in the soil by fixing the atmospheric nitrogen, which in subsequently beneficial to succeeding crops (Yadav, 1992).

Among the various factors of crop production, proper management of nutrients plays vital role in increasing the green gram production next to variety and irrigation management. Optimum application of nutrients either in form of organic or inorganic is one of the well-established techniques for increasing crop production.

Organic manure play a vital role in increasing the productivity of pulses by several means for example organic not only supplied all the major and minor nutrients, but also act as a soil conditioner and increase productivity (Kamd *et al*., 2014). Vermicomposting is an eco-friendly and effective way of recycling recycle agricultural waste. Vermicompost is a potential source due to presence of readily available plant nutrients, growth enhancing substances such as auxins and gibberellins and number of beneficial micro-organisms like N-fixing, P- solubilizing and cellulose decomposing organism.

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Phosphorus stimulates the synthesis of nitrogen fixation because in presence of phosphorus, bacterial cell become mobile which is pre-requisite of bacterial cell to root hairs for nodulation. It is important component of genetic materials. It is involved in energy transfer in plants and all living organisms.

The microbial inoculations are becoming popular in India. It has capacity to render insoluble form of phosphorus more available to plant. Metabolic products of soil microbes such as organic acid and humic acid substance from complexes with Fe and Al compounds, thereby reducing further fixation.

MATERIALS AND METHODS

The experiment was conducted at the College Farm, Anand Agricultural University, Anand during 2008 to study the response of summer green gram to vermicompost and phosphorus with and without PSB inoculation. The soil of experimental plot was loamy sand in texture, low organic carbon (0.40 %), total nitrogen 0.036%, medium in available phosphorus (40.28 kg/ha) and high in available potash (282 kg/ha) with neutral in reaction. Twelve treatments combinations comprising of two levels of vermicompost (0 and 2 t VC/ha), three levels of phosphorus (0, 20 and 40 kg P_2O_5/ha) and two levels of PSB inoculation (no inoculation and inoculation with PBA-22) were laid down in randomized block design factorial with four replications. All agronomical practices was carried out. In time for recording observations, tagged five plants at initial stage from net plot area.

RESULTS AND DISCUSSION

Effect of vermicompost

Perusal of data presented in Table 1 revealed that treatment V_1 (vermicompost @ 2t / ha) recorded significantly the highest number of pods/plant (22.54), pod length (8.06 cm) and number of seeds/pods. Application of vermicompost @2/ ha was significantly increasing the plant height at harvest (49.33 cm) and number of branches/plant (3.60). This might be due to prolong availability of moisture due to organic manures increased uptakes of nutrients released of phytohormones and organic acids which provide food for the beneficial bacteria (Kumar and Uppar, 2007).

Data presented in Table-1 indicated that application of vermicompost @ 2 t/ha (V_1) recorded significantly the highest seed yield (1248 kg/ha) and straw yield (2570 kg/ha). The magnitude of increased in seed yield with V_1 (2 t VC ha^{-1}) was to the tune of 42.14 % over control (no vermicompost treatment). Crop yield is the combined function of which modify anatomy and morphology of the growing plants. Judicious quantity of available nutrients is a basic requirement throughout the crop growth period for smooth running of all physiological process (Chaudhary *et al.*2013 and Shah *et al*., 2008).

Application of vermicompost had also shown its significant effect on protein content (Table 1). Treatment V_1 (2 t VC ha^{-1}) produced the higher protein content (11.61 percent). Enhancement in the protein content this might be due to the significant role of vermicompost in root enlargement, better microbial activities resulted in more availability and uptake of nitrogen and thereby increased protein content in seed (Parthasarathi *et al.,* 2008)

Effect of phosphorus

Date presented in Table-1 indicated that application of phosphorus 40 kg P_2O_5 ha^{-1} recorded significantly the highest plant height (at 30 DAS, 23.68 cm, 60 DAS 48.81 cm and at harvest 49.33 cm), number of branches $plant^{-1}$ (3.60), number of pods $plant^{-1}$ (22.81), pod length (8.25 cm) and number of seeds pod (10.31). This might be due to the effect of phosphorus which plays a vital role in plant nutrition and ultimately concerned with utilization of nitrogen and the vital function of plant. Beside that its, plays a primary role in photosynthesis by way of energy transfer and thereby increase the photosynthetic efficiency and thus increased the availability of photosynthates (Meena *et al.*,2001*)*. It could be attributed to better proliferation of roots and increased nodulation due to increased phosphorus availability. Phosphorus encourage formation of new cells, promote plant vigour and hastens leaf development, which help in harvesting more solar energy and better utilization of nitrogen, which help towards higher growth attributes. The results are in conformity with those Rathour *et al.*,2015.

Effect of phosphorus was found (Table 1) significant on seed and straw yields. Application

Table 1. Yield, yield attributing characters and protein content of summer green gram as influenced by vermicompost, phosphorus and PSB inoculation

Treatment	Plant height at harvest (cm)	No. of branches plant^{-1}	No. of pods plant^{-1}	Pod length (cm)	No. of seed pod^{-1}	Yield (kg ha^{-1}) Seed	Stover	Protein Content (%)
Levels of vermicompost								
V_0 (control)	45.91	3.33	19.87	7.36	8.91	878	1764	20.75
V_1 (2 t ha^{-1})	49.33	3.60	22.54	8.06	10.79	1248	2570	23.16
S.Em.±	0.62	0.07	0.41	0.14	0.20	15.53	23	0.25
CD (P=0.05)	1.80	0.21	1.19	0.42	0.58	44.99	65	0.73
Levels of phosphorus								
P_0 (0 kg P_2O_5 ha^{-1})	46.00	3.25	20.21	6.95	9.06	1017	2100	21.45
P_1 (20 kg P_2O_5 ha^{-1})	47.31	3.50	2068	7.95	10.18	1072	2174	21.86
P_2 (40 kg P_2O_5 ha^{-1})	49.56	3.60	22.81	8.25	10.31	1099	2227	22.57
S.Em.±	0.76	0.08	0.50	0.18	0.24	19.15	28	0.31
CD (P=0.05)	2.20	0.25	1.46	0.52	0.71	55.11	81	0.89
Levels of PSB inoculation								
I_0 (without inoculation)	46.70	3.28	19.37	7.26	9.33	1037	2133	21.47
I_1 (with inoculation)	48.54	3.61	23.04	8.16	10.37	1089	2199	22.45
S.Em.±	0.62	0.07	0.41	0.14	0.20	15.63	23	0.25
CD (P=0.05)	1.80	0.21	1.19	0.42	0.58	44.99	65	0.73
Interaction	NS	NS	NS	NS	NS	NS	NS	NS
CV %	6.44	12.82	9.61	9.43	10.07	7.20	5.14	5.68

of phosphorus @ 40 kg P_2O_5/ha (P_2) recorded significantly the higher seed yield (1099 kg/ha) and straw yield (2227 kg/ha) over other phosphorus treatment except treatment P_1 (40 kg P_2O_5/ha). The magnitude of increasing seed yield under P_2 (40 kg P_2O_5/ha) 6.08 per cent higher over treatment P_1 and P_0, respectively. Phosphorus is known to play beneficial role in legume growth by promoting extensive root development and nodulation there by ensuring proper growth and seed yield. Phosphorus play beneficial role in legume growth by the enhanced and promoting extensive root development and nodulation improve the supply of nutrient and water from the deeper soil layer for higher photosynthetic activities and translocation of photosynthetes to the sink of the site of their requirement consequently increased growth and yield parameters (Singh and Pareek, 2003). Phosphorus encourages formation of new cells, promotes plant vigour and hasten leaf development, which helps in harvesting more solar energy and better utilization of nitrogen(Choudhary *et al.*,2012). The another reason, it might be due to the increase in phosphorus availability that lead to better translocation of photosynthesis towards sink with consequent improvement in yield attributes. Similar finding also reported by Nail and Rajpur, 2003 and Prasad *et al.*,2014.

It was observed that phosphorus at increasing levels had significantly positive effect on protein content (Table-1). Treatment P_2 (40 kg P_2O_5 ha^{-1}) recorded significantly highest protein content (5.22 per cent) over treatment P_0 (0 kg P_2O_5 ha^{-1}) treatments. This might be due to the fact that phosphorus application promotes root growth and thus increase the content of nitrogen. Green gram is a legume crop and the effect of phosphorus is known to active microbial population which is responsible for nodulation and efficient nodulation owing to phosphorus application might have enhanced nitrogen fixation to be utilized by plants and ultimately increased protein content (Ram and Dixit, 2000). Second reason it might be due to phosphorus promotes root growth and thus increase the uptake of nitrogen which resulted in increased protein content. The result found similar with Patel and Patel, 2006 and Patel *et al*., 2013.

Effect of PSB inoculation

It is evident from the data (Table-1) that inoculation with PSB (I_1) had significantly increasing seed yield (1089 kg/ha) and straw yield (2199 kg/ha) over no inoculation of PSB. The magnitude of increase in seed and stover yield with PSB inoculation was to the tune of 5.00 and 3.04 per cent respectively over no PSB inoculation. The increased in seed and stover yield due to PSB inoculation might be due to the solublization of native (insoluble) or applied phosphorus in soil by bacteria and thus making it available for plant by bacteria and thus making it available for plant use (Tanwar *et al.*,2003). This was might be due to inoculation with PSB, increased availability of P and favored higher nitrogen fixation, dry matter accumulation, rapid growth, higher absorption and ultimately positive results effect on growth and yield attributes which lead to increase the value of yield attributes and yield. This results was similar with Rasal, 2007 and Patel *et al.*, 2014.

Plant height at harvest and number of branches /plant were found significantly highest with by application of PSB. This might be due to that phosphobacteria dissolved insoluble phosphorus in the soil, making it available to the crop plants for profuse root and vegetative growth and growth promoting substance produced by PSB.

Data presented in Table-1 revealed that treatment I_1 (Inoculation with PSB) significantly increase the number of pods/plant (23.04), length of pod (8.16 cm) and number of seeds/pod (10.37) compared to no-inoculation of PSB. The increase in yield attributes might be due to increased nodulation and phosphorus availability due to PSB inoculation(De N and Singh 2010).

Seeds inoculated with PSB produced significantly highest protein content (4.56 percent) over no inoculation of PSB (Table-1). The increase in protein content might be due to increase the availability and higher content of nitrogen results in of better nitrogen fixation and increased availability of phosphors due to phosphorus solubilization which ultimately increased nitrogen availability and thereby protein synthesis (Singh and Pareek, 2003).

CONCLUSION

In the light of the results obtained from present investigation, it is concluded that for obtaining higher growth, yield attributes, yield and

protein content of summer green gram cv. GM-4, it should be inoculated with PSB culture and fertilized with application of vermicompost @ 2t ha^{-1} and phosphorus @ 40 kg P_2O_5 ha^{-1}.

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