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EFFECT OF PHOSPHORUS AND BIO-ORGANICS ON GROWTH, YIELD ATTRIBUTES AND YIELD OF SUMMER GREENGRAM

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ABSTRACT

Field experiment was conducted during two consecutive summer seasons of 2018 and 2019 at Agronomy Research Area, JNKVV, College of Agriculture, Tikamgarh (Madhya Pradesh) to study the effect of phosphorus levels and different bio-organics on growth, yield attributes yield of summer greengram. The results indicated that increasing levels of phosphorus enhanced the growth parameters, yield attributes and yield of summer greengram. Significantly greater plant height at harvest (55.7 cm), number of branches (5.10), total plant dry weight (11.3 g plant^{-1}), number of nodules plant^{-1} at 45 DAS (11.9), total nodules dry weight (36.9 mg plant^{-1}), number of pods plant^{-1} (41.7), number of seeds pod^{-1} (9.52), 1000-seed weight (39.9 g), Seed yield (1140 kg ha^{-1}) and straw yield (2005 kg ha^{-1}) were recorded with the application of 60 kg P_2O_5 ha^{-1} over rest of the treatments. Application of phosphorous @ 60 kg P_2O_5 ha^{-1} resulted into an increase of seed yield over control, 20 and 40 kg P_2O_5 ha^{-1} by 144.1, 91.3 and 47.3 per cent, respectively. Application of vermicompost @ 2 t ha^{-1} + VAM significantly increased the plant height (49.4 cm), number of branches (4.56), total plant dry weight (10.0 g plant^{-1}), number of nodules plant^{-1} at 45 DAS (10.6), total nodules dry weight (33.0 mg plant^{-1}), number of pods plant^{-1} (37.9), number of seeds pod^{-1} (8.52), 1000-seed weight (36.3 g), Seed yield (852 kg ha^{-1}) and straw yield (1613 kg ha^{-1}) over control and increased the seed yield by 40.6, 19.0, 11.4 and 17.7 per cent over B_0, B_1, B_2 and B_3, respectively.

Key words *: Bio-organics, phosphorus, PSB, summer greengram, VAM.*

Greengram (*Vigna radiata* L. Wilczek) belongs to the family leguminaceae and sub-family Papilionaceae, also known as mungbean is a self pollinated leguminous crop which is grown during *kharif* as well as summer seasons in arid and semi-arid regions of India. The centre of origin of greengram is India, may be used as a good quality green or dry fodder or green manure. It is an excellent source of protein (24.5%) with high quality lysine (460 mg/g N) and tryptophan (60 mg/g N). It is consumed as whole grain as well as dal in variety of ways for table purposes. It is fairly tolerant to drought and can be grown successfully on well drained loamy to sandy loam soil in areas of erratic rainfall. It is primarily a rainy season crop but with the development of early maturing varieties, it has also proved an ideal crop of spring and summer seasons. It is one of the major *kharif*pulse crops in India covering 4.30 million hectare of area in the country with total production of 2.07 million tonnes and productivity of 481 kg ha^{-1}. The important greengram growing states are Rajasthan, Madhya Pradesh, Uttar Pradesh, Odisha, Maharashtra, Karnataka and Bihar. In Madhya Pradesh it is grown in 1.49 lakh hectare of area with total production of 0.67 lakh tonnes and productivity of 448 kg ha^{-1}. The area production and productivity of greengram in Tikamgarh district is 6000 hectare, 1000 tonnes and 170 kg ha^{-1}, respectively (Source: www.dacnet.nic.in).

Phosphorus is an important nutrient next to nitrogen. Indian soils are poor to medium in available phosphorus. Only about 30 per cent of the applied phosphorus is available for crops and remaining part converted into insoluble phosphorus (1). Its deficiency is the most important single factor, which is responsible for poor yield of greengram on all types of soil. It has beneficial effects on nodule stimulation, root development, growth and also hastens maturity as well as improves quality of crop produce. Thus, the use of phosphorus to legumes is more important than that of nitrogen as later is being fixed by symbiosis with *Rhizobium* bacteria. Use of bio-organics can also have a greater importance in increasing fertilizer use efficiency. Indian soils are poor to medium status in available nitrogen and available phosphorus. The seed of pulses is inoculated with *Rhizobium* with an objective of increasing their number in the rhizosphere, so that there is substantial increase in the microbial fixation of nitrogen for the plant growth. The inoculation of seeds with suitable PSB culture increased the green pod yield over uninoculated control. The association of PSB and pulse plants helps in improving fertility of soil and is a cost effective method of phosphate fertilization in legumes (2). Symbiosis between plant roots and certain soil fungi *e.g.*, vesicular arbuscularmycorrhiza (VAM) plays an important role in phosphorus cycling and its uptake by plants (3). Vermicompost is also valuable and suitable cost-effective organic manure which have a special place as a best alternative in the sustainable agriculture and organic cultivation (4). Keeping in view the above consideration, the present investigation was undertaken during two consecutive summer seasons of 2018 and 2019 to study the effect of phosphorus levels and different bio-organics on growth, yield attributes yield of summer greengram in

Tikamgarh district under Bundelkhand region of Madhya Pradesh.

MATERIALS AND METHODS

Field experiment was conducted at Agronomy Research Area, JNKVV, College of Agriculture, Tikamgarh (24° 43'N latitude, 78° 49' E longitude at an altitude of 358 m abovemean sea level), Madhya Pradesh (India) during twoconsecutive *summer* seasons of 2018 and 2019. The experimental site is of sub-tropical climate characterized by hot dry summers and cool dry winter lies in the Bundelkhand Zone (Agro-climatic Zone-VIII). The soil of experimentalfield was medium to deep black and clayey loam in texturehaving pH 7.1, EC 0.12 dS m^{-1}, organic carbon 0.5%, available N 266 kg ha^{-1}, available P_2O_5 26 kg ha^{-1} and available $K_2O_2$55 kg ha^{-1}, respectively. The average annual rainfall ofthis region is about 1000 mm, which is mostly receivedbetween June to September and a little rainfall of 90 mm isalso obtained during October to May. The averagetemperature ranges between 4.5°C to 45°C. The weatherparameters during experiment were recorded at theMeteorological Observatory located at Research Farm, College of Agriculture, Tikamgarh. The experiment was conducted in factorial randomized block design (FRBD) with three replications and comprised of four phosphorus levels (P_0: Control, P_1: 20kg ha^{-1}, P_2: 40 kg ha^{-1} and P_3: 60 kg ha^{-1}) and five bio-organics (B_0: Control, B_1: Phosphorus soluble bacteria (PSB) @ 5 g per kg seed, B_2: Vascular arbuscularmycorrhiza (VAM) @ 10 kg ha^{-1} B_3: Vermicompost @ 2 t ha^{-1} and B_4: Vermicompost @ 2 t ha^{-1} + VAM. The greengram variety TMB-37was sown in lines 30 cm apart using a seedrate of 20 kg ha^{-1}. The full recommended doses of nitrogen (20 kg N ha^{-1}), potassium(20 kg K_2O ha^{-1}) and phosphorus (as per treatments) were applied as basal. These nutrients were applied through urea (46% N), SSP (16% P_2O_5) and MOP (60% K_2O). Bio-organics were applied as per treatments as basal. The crop was irrigated at different stages according to need.All otheragronomic and plant protection measures were applied asper recommendations. Growth parameters, yield attributes and yields recorded were plant height, number of branches $plant^{-1}$, total plant dry weight (g $plant^{-1}$), number of nodules $plant^{-1}$, dry weight of nodules (mg $plant^{-1}$), number of pods $plant^{-1}$, number of seeds pod^{-1}, 1000-seed weight (g), seed yield (kg ha^{-1}) and straw yield (kg ha^{-1}). The results were analyzed statistically to draw suitable inference as per standard ANOVA technique (5).

RESULTS AND DISCUSSION

Effect of phosphorous and bio-organics on growth : The findings depicted in Table-1 reveals that increasing level of phosphorus significantly influenced the different growth parameters. Application of 60 kg P_2O_5 ha^{-1} recorded significantly greater plant height (55.7 cm), number of branches $plant^{-1}$ (5.0), total plant dry weight (11.3 g $plant^{-1}$), number of nodules $plant^{-1}$ (11.9) and dry weight of nodules (36.9 mg $plant^{-1}$) followed by 40 kg P_2O_5 ha^{-1}, 20 kg P_2O_5 ha^{-1} and these growth parameters were the lowest in control (40.3cm, 3.74, 8.29 g $plant^{-1}$, 8.73 and 27.0 mg $plant^{-1}$, respectively). The enhanced growth parameters with application of 60 kg P_2O_5 ha^{-1} could be due to adequate supply of phosphorus during early stage of growth, which is considered important in promoting vegetative growth *viz*., plant height, branches, dry matter production, number and dry weight of root nodules. The beneficial effects of phosphorus on plant growth and nodulation, root development was also advocated by (6). Increased nodulation under increased phosphorus levels might have supplied sufficient nitrogen by nitrogen fixation bacteria and finally enhance productivity of greengram (7, 8). Besides, improvement in nodulation, the larger canopy development under the influence of increased P levels seems to have increased absorption and utilization of radiant energy resulting in higher effective and total nodules. Above findings are in accordance with (9, 10).

Similarly, incorporation of different bio-organics also influenced all the growth parameters significantly (Table-2). Application of vermicompost @ 2 t ha^{-1} + VAM resulted in significantly greater plant height (49.4 cm), number of branches $plant^{-1}$ (4.56), total plant dry weight (10.0 g $plant^{-1}$), number of nodules $plant^{-1}$ (10.6) and dry weight of nodules (33.0 mg $plant^{-1}$) over rest of the bio-organic treatments. Bio-organic source, vermicompost @ 2 t ha^{-1} + VAM resulted into enhanced supply of macro as well as micronutrients during entire growing season which led to enhanced plant height, branches and higher assimilation of food, which subsequently increased the dry weight of plant. The results of the present investigation are supported by the findings of (7, 11). The lowest values of growth attributes *viz*., plant height (44.1 cm), number of branches $plant^{-1}$ (4.05), total plant dry weight (9.03 g $plant^{-1}$), number of nodules $plant^{-1}$ (9.50) and dry weight of nodules (29.4 mg $plant^{-1}$). These results are in agreement with the findings of (12).

Effect of phosphorous and bio-organics on yield attributes and yield : The yield attributing characters namely number of pods $plant^{-1}$, number of seeds pod^{-1} and 1000-seed weight were significantly influenced by different levels of phosphorus (Table-2). Application of 60 kg P_2O_5 ha^{-1} registered significantly the maximum number of pods $plant^{-1}$ (41.7), number of seeds pod^{-1} (9.52), 1000-seed weight (39.9 g), Seed yield (1140 kg ha^{-1}) and straw yield (2005 kg ha^{-1}) followed by application of phosphorous @ 40 and 20 kg P_2O_5 ha^{-1}, whereas the lowest values for all these yield attributes (29.1, 6.98, 31.4g, 467 kg ha^{-1} and 1260 kg ha^{-1}, respectively) were reported under control. Application of phosphorous @ 60

Table-1 : Effect of different phosphorus levels and bio-organics on growth and development of summer greengram (Pooled over two years).

Treatments	Plant height (cm)	Number of branches (plant^{-1})	Total dry weight (g plant^{-1})	Number of nodules (plant^{-1})	Dry weight of nodules (mg plant^{-1})
Phosphorus levels (P_2O_5 kg/ha)					
P_0 : Control	40.3	3.74	8.29	8.73	27.0
P_1 : 20	44.3	4.09	9.11	9.59	29.7
P_2 : 40	49.0	4.61	10.0	10.5	32.8
P_3 : 60	55.7	5.10	11.3	11.9	36.9
S.Em	0.73	0.07	0.15	0.16	0.55
CD (P=0.05)	2.20	0.22	0.46	0.48	1.66
Bio-organics					
B_0 : Control	44.1	4.05	9.03	9.50	29.4
B_1 : PSB	47.2	4.44	9.66	10.1	31.5
B_2 : VAM	48.2	4.46	10.1	10.4	32.2
B_3 : Vermicompost @ 2 t/ha	47.7	4.41	9.77	10.2	31.8
B_4 : Vermicompost @ 2 t/ha + VA M	49.4	4.56	10.0	10.6	33.0
S.Em	0.82	0.08	0.17	0.18	0.61
CD (P=0.05)	2.47	0.23	0.52	1.06	1.84

Table-2 : Effect of different phosphorus levels and bio-organics on yield attributes and yield of summer greengram (Pooled over two years)

Treatments	Number of pods (plant^{-1})	Number of seeds (pod^{-1})	1000-seed weight (g)	Seed yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Straw yield (kg ha^{-1})
Phosphorus levels (P_2O_5 kg/ha)						
P_0 : Control	29.1	6.98	31.4	467	1727	1260
P_1 : 20	32.0	7.67	32.2	596	1962	1385
P_2 : 40	35.6	8.47	35.6	774	2303	1529
P_3 : 60	41.7	9.52	39.9	1140	3105	2005
S.Em	1.06	0.14	0.55	22.4	44.5	26.3
CD (P=0.05)	3.18	0.41	1.65	67.3	133.7	79.0
Bio-organics						
B_0 : Control	31.7	7.6	32.4	606	2038	1440
B_1 : PSB	34.0	8.14	34.7	716	2256	1545
B_2 : VAM	34.8	8.32	35.5	765	2339	1574
B_3 : Vermicompost @ 2 t/ha	34.7	8.23	35.1	724	2298	1552
B_4 : Vermicompost @ 2 t/ha + VA M	37.9	8.52	36.3	852	2440	1613
S.Em	1.18	0.15	0.61	25.0	49.8	29.4
CD (P=0.05)	3.54	0.46	1.84	75.2	149.5	88.3

kg P_2O_5 ha^{-1} resulted into an increase of seed yield over control, 20 and 40 kg P_2O_5 ha^{-1} by 144.1, 91.3 and 47.3 per cent, respectively. The enhanced yield attributes and yield could be due to adequate supply of phosphorus during early stage of growth which resulted into improved vegetative growth, thereby increasing the sink in terms of flowering and grain setting. Better development of the plants in term of plant height, number of branches and dry biomass production leading to increased bearing capacity of greengram. The higher seed yield with phosphorus @ 60 kg P_2O_5 ha^{-1} might be due to strong sink components *viz.*, more number of pods plant^{-1} and more number of seeds pod^{-1} as well as test weight in comparison to control and other phosphorus levels. The differences in yield attributes and seed yield of different treatments had been well documented by (12, 13). The lowest value of yield attributes and seed yield (kg ha^{-1}) with control might be due to poor vegetative growth which reflected into reduced sink components *i.e.*, yield attributes resulting in poor seed yield.

The perusal of data in Table-2 also indicates that application of bio-organics significantly increased the yield attributes and yield of greengram. Application of vermicompost @ 2 t ha^{-1} + VAM resulted into significantly

the maximum number of pods plant^{-1} (37.9), number of seeds pod^{-1} (8.52), 1000-seed weight (36.3 g), Seed yield (852 kg ha^{-1}) and straw yield (1613 kg ha^{-1}) followed by B_2 (34.8, 8.32, 35.5g, 765 kg ha^{-1} and 1574 kg ha^{-1}), B_3 (34.7, 8.23, 35.1g, 724 kg ha^{-1} and 1552 kg ha^{-1}), B_1 (34.0, 8.14, 34.7g, 716 kg ha^{-1} and 1545 kg ha^{-1}), whereas the lowest values for all these parameters (31.7, 7.60, 32.4g, 606 kg ha^{-1} and 1440 kg ha^{-1}, respectively) were observed under control. Application of vermicompost @ 2 t ha^{-1} + VAM increased the seed yield by 40.6, 19.0, 11.4 and 17.7 per cent over B_0, B_1, B_2 and B_3, respectively. The higher yield attributes and yield was due to improved vegetative growth which provided more sites for the translocation of photosynthates and ultimately resulted into significant enhancement in yield attributes and yield. Apart from this the application of vermicompost @ 2 t ha^{-1} + VAM created improved nutritional environment in rhizosphere as well as utilization in plant system leading to enhanced translocation to reproductive structures *viz*., pods, grains and other plant parts. Results of the present study are supported by the findings of (6, 11).

CONCLUSIONS

Thus, two years field study concluded that application of 60 kg P_2O_5 ha^{-1}exhibited superiority over other levels of phosphorous and resulted into an increase of seed yield by 91.3 and 47.3 per centover 20 and 40 kg P_2O_5 ha^{-1}, respectively. Similarly, combined application of vermicompost @ 2 t ha^{-1} + VAM increased the seed yield by 19.0, 11.4 and 17.7 per cent over application of PSB alone, VAM alone and vermicompost alone, respectively.

REFERENCES

1. Awomi T.A., Singh A.K., Kumar M. and Bordoloi L.J. (2012). Effect of phosphorus, molybdenum and cobalt nutrition on yield and quality of Mungbean [*Vignaradiata* (L) Wilczek] in acidic soil of North–East India.*Indian J. Hill Farming, 25(2):* 22-26.
2. Singh K., Manohar R.S., Choudhary R., Yadav A.K. and Sangwan A. (2015). Response of different sources and level of phosphorus on yield, nutrient uptake and net return on mungbean under rainfedcondition.*Indian J. Agri. Res., 35:* 263-268.
2. Mohammad I., Yadav B.L. and Ahamad A. (2017). Effect of phosphorus and bio-organics on yield and soil fertility status of mungbean [*Vignaradiata* (L.) Wilczek under semi-arid condition of Rajasthan, India. *International J. Current Microb.and Appl. Sci., 6(3):* 1545-1553.
3. Singh S.R., Bhat M.I., Wani J.A. and Najar G.R. (2009). Role of *rhizobium* and VAM fungi for improvement in fertility and yield of greengram under temperature conditions. *J. Indian Society of Soil Sci., 57:* 45-52.
4. Marko G.S., Kushwaha H.S., Singh S., Namdeo K.N. and Sharma R.D. (2013). Effect of sulphur and biofertilizers on growth, yield and quality of blackgram. *Crop Res., 45(1-3):* 175-178.
5. Gomez K.A. and Gomez A.A. (1984).Statistical Procedures for Agricultural Research. John Wiely and Sons, New York, pp. 139-264.
6. Singh R., Singh P., Singh V. and Yadav R.A. (2018). Effect of phosphorus and PSB on growth parameters, yield, quality and economics of summer greengram (*Vignaradiata* L.) *International J. Chem. Studies, 6(4):* 2798-2803.
7. Choudary R., Sadhu A.C. and Gegiya K.M. (2010). Effect of fertility levels and biofertilizers on yield and quality of *kharif*greengram (*Vignaradiata* (L.) Wilczek). *Haryana J. Agron. 26:* 41-44.
8. Kumari S., Yadav B.L., Verma H.P., Meena J.S. and Pancholi P. (2015). Effect of bio-fertilizer and phosphorus on properties of soil, yield attributes and yield of mungbean.*Annals Agril. Res.36:* 394-399.
9. Kumar S. and Yadav S.S. (2018). Effect of phosphorus fertilization and bio-organics on growth, yield and nutrient content of mungbean(*Vignaradiata (*L.).*Res. J. Agril. Sci., 9(6):* 1252-1257.
10. Rathore D.S., Purohit H.S. and Yadav B.L. (2010). Integrated phosphorus management on yield and nutrient uptake of urdbean under rainfed conditions of southern Rajasthan. *J. Food Legumes, 23(2):* 128-137.
11. Meena R.S. and Sharma S.K. (2013). Effect of organic and inorganic sources of nutrients on yield attributes, yield and economics of greengram [*Vignaradiata* (L) Wilczek]. *Annals Agri-Bio Res.,18(3):* 306-308.
12. Kumawat P.K., Tiwari R.C., Golada S.L., Garhwal R.K. and Choudhary R. (2013). Effect of phosphorus sources, levels and biofertilizers on yield attributes, yield and economics of black gram [*Phaseolusmungo* (L.)], *Legume Res., 36 :* 70-73.
13. Gajendra R.J., Khafi H.R., Raj A.D., Yadav V. and Lad A.N. (2014). Effect of phosphorus and bio-fertilizers on growth yield and economics of summer greengram (*Vignaradiata* L.*). Agriculture Update, 9(1):* 98-102.

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