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Effect of phosphorus, FYM and bio-fertilizer on growth, yield attribute, yield and quality of summer greengram (*Vigna radiate* L.)

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Abstract
A field experiment was conducted during 2018 to study the effect of phosphorus, FYM and bio-fertilizer on yield and quality of greengram. There were twelve treatments comprising of three phosphorus levels [Control (P_0), 20 kg P_2O_5 ha^{-1} (P_1) and 40 kg P_2O_5 ha^{-1} (P_2)] combined with two FYM levels [control (F_0) and 5 t FYM ha^{-1}(F_1)] along with two levels of bio-fertilizer [control (B_0) and PSB inoculation (B_1)]. Phosphorus applied in the form of SSP and PSB as seed inoculation. The experiment was laid out in factorial RBD with three replications. The recommended dose of N was applied uniformly to all the treatments. Seed yield and stover yield of greengram was significantly increased by the phosphorus, FYM and bio-fertilizer treatments. The increased in seed yield due to P_2 and P_1 over P_0 (797.6 kg ha^{-1}) was 18.98 and 10.97 per cent, respectively. The treatment F_1 increased the seed yield by 14.55 per cent and B_1 increased 12.65 per cent, over their respective control F_0 (817.7 kg ha^{-1}) and B_0 (825.0 kg ha^{-1}).Similar trend in stover yield was noted by phosphorus, FYM and bio-fertilizer treatments. The interaction of P x F x B effect was significant on seed and stover yield indicate that nutrient use efficiency of P was higher when phosphorus was applied along with organic FYM @ 5 t ha^{-1} and PSB inoculation to the seed. Growth and yield attribute like plant height, number of nodules per plant, 100 seed weight, seeds per pod, and pods per plant were studied. Quality parameters *viz*. protein content and protein yield studied. Application of organics P_2 and P_1, as well as FYM and PSB inoculation favourably influenced quality parameters in comparison to their respective control. A synergistic interaction of P x F x B on protein content indicates improvement in quality of greengram.

Keywords: Phosphorus, FYM, PSB, yield, protein

1. Introduction
Greengram (*Vigna radiata* L.) occupies prime position among pulses by virtue of its short growth period, high tonnage capacity and outstanding nutrient value as food, feed and forage. Among the pulses, greengram is one of the most important and extensively cultivated pulse crops. In India, greengram occupies an area of about 3.51 million hectares producing 1.80 million tonnes with the productivity of 511 kg ha^{-1} (Anonymous, 2012) [3], whereas in Gujarat it is grown over 2.40 lakh hectares with production of 1.28 lakh tonnes and productivity of 525 kg ha^{-1} (Anonymous, 2012a) [2].

Phosphorus (P) is one of the most needed elements for pulse production. Phosphorus, although not required in large quantities, is critical to green gram yield because of its multiple effects on nutrition. Phosphorus plays a key role in various physiological processes like root growth and dry matter production, nodulation and nitrogen fixation and also in metabolic activities especially in protein synthesis.

Farm yard manure (FYM) application to the crop is an age old practice. The yield and nutritional quality of green gram is greatly improved by application of FYM and nutrient elements. FYM is known to play an important role in improving the fertility and productivity of soils through its positive effects on soil physical, chemical and biological properties of soils and balanced plant nutrition.

Phosphorus solubilizing microorganisms (bacteria and fungi) enable P to become available for plant uptake after solubilization. Several soil bacteria, particularly those belonging to the genera Bacillus and Pseudomonas and fungi belonging to the genera Aspergillus and Penicillium possess the ability to bring insoluble phosphates in soil into soluble forms by secreting organic acids such as formic, acetic, propionic, lactic, glycolic, fumaric, and succinic acids. These acids lower the pH and bring about the dissolution of bound forms of phosphates.

Very high cost of phosphatic fertilizer also demand the need for recycling and exploitation of fixed phosphorus to improve crop production. The availability of phosphorus to the crop can be augmented by providing appropriate strains of microbes which are known to solubilise the

fixed phosphorus and mobilize the deeply placed phosphorus to root zone by their activity. Besides increasing the availability of native P in the soil also help in enhancing the use efficiency of applied phosphorus (Thenua and Kumar, 2007) [18]. FYM additions were also found to mobilize the fixed phosphates in the soil thus increasing the available P to crops (Venkateswarlu, 2000) [20].

2. Materials and Methods

A field experiment was conducted during summer season of 2018 at the college farm, Navsari Agricultural University, Navsari to study the "Phosphorus Management in greengram (*Vigna radiate* L.) under south Gujarat condition.". The soil of the experimental field was clay in texture having medium to poor drainage, medium in available nitrogen, available phosphorus and potash. Total twelve treatment combinations comprising of all possible treatments of three levels of phosphorus *viz*., P_0 (0 kg P_2O_5 ha-^{1}), P_1 (20 kg P_2O_5 ha-^{1}) and P_2 (40 kg P_2O_5 ha-^{1}), two levels of FYM *viz*., F_0 (0 t ha^{-1}) and F_1 (5 t ha^{-1}) and two levels of bio-fertilizer *viz*., B_0 (No inoculation) and B_1 (PSB inoculation) were tested in factorial randomized block design with three replications. Greengram variety Meha was sown by opening of furrow at a distance of 30 x 10 cm. The full dose of fertilizers was applied according to the treatments manually before sowing the seeds. PSB was applied as seed inoculation. The phosphorus was SSP. All the recommended cultural practices and plant protection measures were followed throughout the experimental periods.

3. Result and Discussion

3.1 Effect of phosphorus

The seed yield of greengram was significantly influenced by the effect of phosphorus. Application of 40 kg P_2O_5 ha^{-1} (P_2) recorded significantly higher seed yield (949.0 kg ha^{-1}) over control (P_0) (797.6 kg ha^{-1}). Application of 20 kg P_2O_5 ha^{-1} (P_1) recorded significantly higher seed yield (885.1 kg ha^{-1}) over control P_0. However, seed yield recorded under P_2 and P_1 were at par. The percentage increase in seed yield due to P_2 and P_1 over P_0 was 19.0 and 11.0 respectively. In the present investigation significant increase in number of nodules per plant, protein content, N and P content was observed due to phosphorus application. The results were supported by the earlier research findings of Kumar *et al.* (2012) [10] and Patel *et al.* (2013) [13].

Data revealed that stover yield of greengram found significantly influenced by effect of phosphorus. Significantly higher stover yield was recorded under P_2 (2184.3 kg ha^{-1}) and P_1 (2033.6 kg ha^{-1}) over control (1826.9 kg ha^{-1}). However, stover yield under P_2 and P_1 were at par.The magnitude of increased in greengram stover yield was 19.56 % and 11.31 % under the treatment of P_2 and P_1 over P_0 (control). The results for stover yield have similar trends to those on seed yield. Therefore, reasoning and discussion given for seed yield earlier holds true for stover yield also.

A perusal of data indicated that protein content in greengram significantly influenced by the effect of phosphorus. Protein content was significantly with increase in each level of phosphorus. Application of 40 kg P_2O_5 ha^{-1} (P_2) recorded significantly the highest protein content in seed (20.12%) over that of P_1 and P_0 control. Treatment P_1 produced significantly higher protein content (18.95 %) in greengram then that of P_0 control. The increase in protein content with phosphorus was probably due to efficient and effective root system developed, due to P application which helps in more fixation of atmospheric N in soil. Moreover, the increased availability of phosphorus might have favorably influenced nitrogen uptake by plants and ultimately accumulated in seeds as protein. Similar type of results was also found by Kumawat *et al.* (2009) and Rathour *et al.* (2015) [11, 14].

Plant height, number of pods per plant, number of seeds per pod, number of nodules and 100 seed weight were found non-significant due to effect of phosphorus but numerically highest under P_2 (40 P_2O_5 kg ha^{-1}).

3.2 Effect of FYM

Seed yield of the greengram was significantly influenced by FYM application. Seed yield significantly increased with application of FYM @ 5 t ha^{-1} (F_1) over control (F_1). The highest seed yield (936.7 kg ha^{-1}) was recorded by F_1. The percentage increase in seed yield due to F_1 over F_0 was 14.6. In the present investigation significant increase in No. of nodules per plant, protein content, N, K, S, Fe and Zn content were observed due to FYM application. FYM application generally improves physical, chemical and biological properties of soil and thereby increases productivity. Further application of FYM helps in increasing availability of major and micro nutrient. The above findings are in complete agreement with research reported by Shete *et al.* (2011) [17] and Rekha *et al.* (2018) [15].

An appraisal of data indicated that effect of farm yard manure on stover yield was found significant. Treatment F_1 (FYM 5 t ha^{-1}) recorded significantly higher stover yield (2155.5 kg ha^{-1}) of greengram over treatment F_0 Control *i.e.*1874.4 kg ha^{-1}. Application of FYM @ 5 t ha^{-1} (F_1) produced significantly higher stover yield which was to the tune of 14.99 per cent higher as compared to control (F_0). The results for stover yield are similar to those of seed yield. The effect of FYM on seed yield was discussed earlier. The discussion holds true for the results of stover yield affected by FYM.

The protein content in greengram significantly influenced by the effect of farm yard manure. Treatment F_1 recorded significantly higher protein content (19.69%) than control F_0 (18.22%).The quality of greengram in terms of protein content was found significantly higher with the FYM applied @ 5 t ha^{-1} over control. Application of FYM increases the protein content in seed by 8.06 per cent over control. The probable reason of increase in protein content in seed because of favorable effect of FYM on microbial activity which resulted in higher supply of N throughout the crop growth period resulted in higher protein. These results are in agreement with research result of Shete *et al.* (2010) [16] and Chesti *et al.* (2012) [6].

Plant height, number of pods per plant, number of seeds per pod and 100 seed weight were found non-significant due to effect of FYM but numerically highest under F_1 (5 t FYM ha^{-1}).

Perusal of mean data revealed that number of nodules in greengram was found significantly influenced by the effect of FYM. Treatment F_1 (FYM @ 5 t ha-1) recorded significantly higher number of nodules in greengram (26.28) over F_0 (24.87). Number of nodules was recorded significantly higher with the FYM applied @ 5 t ha^{-1} over control. There was 5.66 per cent increasing in the number of nodules under the treatment F_1 over F_0. FYM application generally improves physical, chemical and biological properties of the soil and thereby increases number of nodules in greengram. Similar findings were also reported by Ghanshyam *et al.* (2010) and Jat *et al.* (2012a) [7, 9].

3.3 Effect of bio-fertilizer

Data presented in Table 1 revealed that seed yield of greengram found significantly influenced by PSB inoculation. Significantly higher seed yield was recorded under inoculation of PSB (B_1) (929.4 kg ha^{-1}) over control (B_0) (825.0 kg ha^{-1}).Percentage increasing in the seed yield under the treatment B_1 over B_0 was 12.65. This result could be attributed due to PSB solubilized the unavailable form of P leading to more uptake of nutrients and reflected in significantly higher no. of nodules per plant, protein content and N content which resulted in increase in growth and seed yield of greengram. Similar earlier research findings were also reported by Ade *et al.* (2018) and Bhavya *et al.* (2018) [1, 4].

An appraisal of data showed that stover yield were significantly influenced by PSB inoculation. Significantly higher stover yield was recorded under treatment B_1 (2138.2 kg ha^{-1}) (PSB inoculation), over treatment B_0 (1891.7 kg ha^{-1}).Treatment B_1 increase stover yield by 13.03 per cent over control B_0. The results of PSB inoculation on stover yield are similar to those of seed yield. The effect of bio-fertilizer on seed yield was discussed earlier. The discussion holds true for the results of stover yield affected by PSB inoculation.

The effect of PSB inoculation on protein content was found significant. Significantly higher protein content in greengram was obtained with the inoculation of PSB (19.46 %) over control. PSB inoculation increase protein content in seed of greengram by 5.47 per cent over control. It may be attributed due to the PSB inoculation significantly increase the number of root nodule which helps into N fixation capacity and provide more N to the root system of greengram and as a result significantly increase in N content in greengram. Similar results were also reported by Meena *et al.* (2014) and Chaudhari *et al.* (2016) [12, 5],

Plant height, number of pods per plant, number of seeds per pod and 100 seed weight were found non-significant due to effect of bio-fertilizer but numerically highest under B_1 (PSB inoculation).

Data presented in Table 1 revealed that number of nodules in greengram found significantly influenced by PSB inoculation. The number of nodules recorded under B_1 (inoculation of PSB) (26.37) were significantly higher than that recorded under B_0 control (24.77). There was 6.46 per cent increasing in the number of nodules under the treatment B_1 over B_0. Similar findings were also reported by Hussain *et al.* (2011) and Venkatarao *et al.* (2017) [8, 19].

Table 1: Growth, yield attributes, yield and quality as influenced by phosphorus, FYM and bio-fertilizer

Treatments	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Protein content (%)	Plant height (cm)	Number of pods/plant	Number of seeds/pod	Number of nodules/plant	100 seed weight
Phosphorus (P)								
P_0 – 0 P_2O_5 kg ha^{-1}	797.6	1826.9	17.79	42.56	17.70	9.55	24.92	3.84
P_1 – 20 P_2O_5 kg ha^{-1}	885.1	2033.6	18.95	43.66	18.12	9.88	25.78	3.93
P_2 – 40 P_2O_5 kg ha^{-1}	949.0	2184.3	20.12	45.29	19.02	10.08	26.02	4.09
S.Em ±	22.91	54.15	0.26	0.76	0.37	0.16	0.54	0.07
CD at 5%	67.22	158.8	0.76	NS	NS	NS	NS	NS
FYM (F)								
F_0- 0 t ha^{-1}	817.7	1874.4	18.22	43.11	17.95	9.67	24.87	3.89
F_1- 5 t ha^{-1}	936.7	2155.5	19.69	44.56	18.60	10.00	26.28	4.02
S.Em ±	18.70	44.21	0.21	0.62	0.30	0.13	0.44	0.06
CD at 5%	54.91	129.6	0.62	NS	NS	NS	1.30	NS
Bio-fertilizer (B)								
B_0 – No inoculation	825.0	1891.7	18.45	43.13	17.99	9.72	24.77	3.89
B_1 – PSB inoculation	929.4	2138.2	19.46	44.54	18.57	9.95	26.37	4.02
S.Em ±	18.70	44.21	0.21	0.62	0.30	0.13	0.44	0.06
CD at 5%	54.91	129.7	0.62	NS	NS	NS	1.30	NS
Interaction								
P×F S.Em ±	32.40	76.58	0.37	1.07	0.52	0.22	0.77	0.10
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS
P×B S.Em ±	32.40	76.58	0.37	1.07	0.52	0.22	0.77	0.10
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS
F×B S.Em ±	26.45	62.52	0.30	0.88	0.43	0.18	0.63	0.08
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS
P×F×B S.Em ±	45.82	108.3	0.52	1.52	0.74	0.32	1.08	0.15
CD at 5%	134.4	317.6	1.52	NS	NS	NS	NS	NS
CV (%)	9.05	9.31	4.75	6.00	7.05	5.65	7.33	6.33

3.4 Interaction effect

Data presented in Table 2 revealed that the treatment combination of $P_2F_1B_1$ (40 kg P_2O_5 ha^{-1}, 5 t ha^{-1} FYM along with PSB inoculation) recorded significantly the higher seed yield (1103.3 kg ha^{-1}) as compared to rest of the treatment combinations but it was at par with $P_1F_1B_1$ (1073.8 kg ha^{-1}). Treatment $P_2F_1B_1$ recorded 35.1 per cent higher seed yield over $P_2F_0B_0$ similarly $P_1F_1B_1$ recorded 31.8 per cent higher seed yield than $P_1F_0B_0$. In the present investigation, the effect of phosphorus significantly increased in the presence of FYM and PSB inoculation. These results revealed a distinct synergistic interaction between phosphorus, FYM and PSB inoculation. Decomposition of FYM is known to supply numerous chelating agents that aid in maintaining the solubility of nutrients. Chelation can help in increasing the solubility, in exchange and release of ions and slow release of ions to the crop (Rekha *et al.*, 2018) [15]. Phosphorus fertilizer application increases the root development of greengram and increase the availability of macro and micronutrient to the crop (Kumar *et al.* 2012 [10] and Patel *et al.* 2013) [13]. PSB help in the solubilization activity of phosphorus which bound with Ca, Fe and Al in the soil and get available to the greengram (Rathour *et al.* 2015) [14]. The concentration of nutrients, particularly of P and N in solution and quantity

transported to the root by mass flow and diffusion could have greatly increased through complexation of phosphatic fertilizer with FYM as a chelating compound and PSB in the soil.

Data presented in Table 2 revealed that the treatment combination of $P_2F_1B_1$ was recorded significantly higher stover yield (2548 kg ha^{-1}) as compared to rest of the treatment combination but it was at par with $P_1F_1B_1$ (2479 kg ha^{-1}). Whereas, the lowest stover yield (1619 kg ha^{-1}) was recorded under the $P_0F_0B_0$. These results may be due to the synergetic effect of phosphatic fertilizer with FYM and PSB.

The result of interaction P x F x B on stover yield were similar to those of seed yield. There for reasoning and discussion given for seed yield holds true for stover yield also.

$P_2F_1B_1$ combination recorded significantly higher protein content (21.44 %) but it was at par with protein content recorded by treatment combination $P_1F_1B_1$, $P_1F_1B_0$ and $P_2F_0B_1$. Treatment combination $P_0F_0B_0$ recorded significantly lowest protein content (16.62 %) in seed of greengram. This result could be attributed by synergetic effect of FYM and PSB inoculation with phosphorus.

Table 2: P x F x B interaction effect on seed yield, stover yield and protein content of green gram

Treatments	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Protein content (%)
$P_0F_0B_0$	709.6	1619.1	16.62
$P_0F_0B_1$	816.9	1872.7	17.76
$P_0F_1B_0$	829.5	1902.5	18.16
$P_0F_1B_1$	834.2	1913.4	18.65
$P_1F_0B_0$	814.7	1867.5	16.60
$P_1F_0B_1$	820.1	1880.1	19.04
$P_1F_1B_0$	831.8	1970.7	19.96
$P_1F_1B_1$	1073.8	2479.3	20.20
$P_2F_0B_0$	816.7	1872.2	19.61
$P_2F_0B_1$	928.1	2135.0	19.96
$P_2F_1B_0$	947.8	2181.6	19.76
$P_2F_1B_1$	1103.3	2548.7	21.44
S.Em ±	45.82	108.3	0.51
CD at 5%	134.4	317.6	1.52

4. Conclusion

From the result of experimentation, it can be concluded that greengram (Var. Meha) should be fertilized with application of P2O5 @ 20 kg ha-1 along with FYM @ 5 t ha-1 and seed inoculation 10 ml kg-1 seed with PSB in summer season under south Gujarat condition for getting higher yield, profit and maintenance the soil fertility.

5. References

1. Ade UK, Dambale AS, Jadhav DB. Growth and Yield of Pigeonpea (*Cajanus cajan* L. Millsp) as Influenced by Phosphorus and Bio fertilizer. Int. J Curr. Microbiol. App. Sci. 2018; 6:1427-1434
2. Anonymous. Ministry of Agriculture and Co-operation, GOI. Agriculture Statistics at a glance, 2012a.
3. Anonymous, Economic Survey. Government of India, 2012.
4. Bhavya G, Shaker KC, Jayasree G, Reddy MM. Effect of Integrate Use of Phosphorus, PSB and Vermicompost on Acid and Alkaline Phosphatase Activity and Yield of Greengram (*Vigna radiata* L.). Int. J Curr. Microbiol. App. Sci. 2018; 7(1):1465-1468.
5. Chaudhari S, Thanki JD, Chaudhari V, Verma C. Yield attributes, yield and quality of black greengram (*Vigna radiata* L.) as influenced by organic manures, biofertilizer and phosphorus fertilization. The Bio Scan. 2016; 11(1):431-433.
6. Chesti MH, Tahir Ali, Bhat MA. Effect of organic and inorganic phosphorus sources on quality of greengram (*Vigna radiata*) under temperate condition of Jammu and Kashmir. Legume Research. 2012; 35(1):47-49.
7. Ghanshyam, Kumar R, Jat RK. Productivity and soil fertility as affected by organic manures and inorganic fertilizers in greengram (*Vigna radiata* L.) - wheat (*Triticum aestivum* L.) system. Indian Journal of Agronomy. 2010; 55(1):1621.
8. Hussain N, Hassan B, Habib R, Chand L, Ali A, Hussain A. Research article response of biofertilizers on growth and yield attributes of Black gram. International Journal of Current Research. 2011; 2(1):148-150.
9. Jat A, Arvadia MK, Tandel B, Patel TU, Mehta RS. Response of saline water irrigated greengram to land configuration, fertilizers and farm yard manure in Tapi command area of South Gujarat. Indian Journal of Agronomy. 2012a; 57(3):270-274.
10. Kumar R, Singh YV, Singh S, Latare AM, Mishra PK, Supriya. Effect of phosphorus and sulphur nutrition on yield attributes, yield of mungbean (*Vigna radiata* L. Wilczek). Journal of Chemical and Pharmaceutical Research. 2012; 4(5):2571-2573.
11. Kumawat N, Kumar R, Sharma OP. Nutrient uptake and yield of mungbean (*Vigna radiata* (L.) Wilczek) as influenced by organic manures, PSB and phosphorus fertilization. Environment and Ecology. 2009; 27(4B):2002-2005.
12. Meena JS, Verma HP, Pancholi P. Effect of fertility levels and biofertilizers on yield, quality and economic of cowpea. Agriculture for Sustainable Development. 2014; 2(2):162-164.
13. Patel HR, Patel HF, Maheriya VD, Dodia IN. Response of kharif greengram (*Vigna radiata* L. Wilczek) to sulphur and phosphorus fertilization with and without bio fertilizer application. The Bio scan. 2013; 8(1):149-152.
14. Rathour DK, Gupta AK, Choudhary RR, Sadhu AC. Effect of integrated phosphorus management on growth, yield attributes and yield of summer greengram (*Vigna radiata* L.). The Bio Scan. 2015; 10(1):05-07.
15. Rekha K, Pavaya RP, Malav JK, Chaudhary N, Patel IM, Patel JK. Effect of FYM, phosphorus and PSB on yield, nutrient content and uptake by greengram (*Vigna radiata* (L.) Wilckzek) on loamy sand. Indian Journal of Chemical Studies. 2018; 6(2):1026-1029.

16. Shete PG, Thanki JD, Baviskar VS, Adhav SL. Effect of land configuration, fertilizers and FYM levels on quality and nutrient status of rabi green gram. Green farming. 2010; 1(4):409-410.
17. Shete PG, Thanki JD, Baviskar VS, Bhoye KP. Yield, nutrient uptake and economics of green gram as influenced by land configuration, inorganic fertilizers and FYM levels. Green Farming. 2011; 2(4):425-427.
18. Thenua OVS, Kumar P. Effect of intercropping, phosphorus levels and bio-fertilizers on the performance of black gram. Annals Agricultural Research (New Series). 2007; 28(3 and 4):213-218.
19. Venkatarao CV, Naga SR, Yadav BL, Koli DK, Rao IJ. Effect of Phosphorus and Biofertilizers on Growth and Yield of Mungbean [*Vigna radiata* (L.) Wilczek]. Int. J. Curr. Microbiol. App. Sci. 2017; 6(7):3992-3997.
20. Venkateswarlu B. Land configurations and fertilizer management for sustainable groundnut production. Ph. D. thesis. Gujarat Agricultural University, Sardar Krishi Nagar, Gujarat, 2000.