Int.J.Curr.Microbiol.App.Sci (2017) *6*(10): 3443-3451

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 6 Number 10 (2017) pp. 3443-3451**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2017.610.406

Response of Greengram (*Vigna radiata* L.) to Different Level of Phosphorus and Organic Liquid Fertilizer

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Keywords

Greengram, Phosphorus, Organic liquid fertilizer, Yield, Economic.

Article Info

Accepted:
28 September 2017
Available Online:
10 October 2017

A B S T R A C T

A field experiment was conducted during summer season of 2016 at college farm, Navsari Agricultural University, Navsari to study the "Response of greengram (*Vigna radiata* L.) to different level of phosphorus and organic liquid fertilizer". Total nine treatment combinations comprising of three levels of phosphorus *viz.*, P_0 (0 kg P_2O_5/ha), P_1 (20 kg P_2O_5/ha), P_2 (40 kg P_2O_5/ha) and three levels of organic liquid fertilizer *viz.*, O_1 (Spraying of Novel liquid fertilizer @10 ml/liter of water at branching), O_2 (Spraying of Novel liquid fertilizer @10 ml/liter of water at flowering) and O_3 (Spraying of Novel liquid fertilizer @10 ml/liter of water at branching and flowering) were evaluated in factorial randomized block design with four replications. Phosphorus applied @ 40 kg/ha recorded significantly higher plant height at 60 DAS and at harvest, number of branches per plant, dry matter production per plant, number of pods per plant, number of seeds per pod and length of pod over control. Significantly the higher seed and haulm yields of 1168 and 2475 kg/ha as well as protein content (19.34%) and protein yield (226.20 kg/ha) of green gram were produced with the 40 kg P_2O_5/ha over control, respectively. The maximum gross realization Rs.76268/ha, net realization Rs. 55302/ha and the BCR value of 3.64 were also observed higher under the application of 40 kg P_2O_5/ha. Number of pods per plant, seeds per pod, pod length and seed yield (1139 kg/ha) of green gram were found remarkably higher under the spraying of Novel liquid fertilizer @10 ml/liter of water at branching and flowering stage as compared to the control, The haulm yield, harvest index and protein content were not affected significantly by the spraying of organic liquid fertilizer. Whereas, protein yield of green gram was also found remarkably higher under the same treatment. The maximum gross realization of ₹ 74260 ha^{-1}, net realization of ₹ 52631ha^{-1} and BCR value of 3.43 were secured under the spraying of Novel liquid fertilizer @10 ml/liter of water at branching and flowering stage over rest of treatments.

Introduction

The word "pulse" is derived from the Latin word '*puls*' means pottage, *i.e.* seed boiled to make porridge or thick soup. Pulses are the important crops in our country and are the main sources of vegetable protein as far as an Indian dietary is concerned. The lysine rich

protein of pulses are considered to the supplement the deficiency of this amino acid in cereal dietaries and brings at par with milk's protein in the terms of biological efficiency. It is because of this reason that pulses have also been called the *"Poor man's meat."* Pulses are major sources of vitamins like riboflavin, thiamine, niacin and iron. Medical considerations encourage the presence of certain quantity of fibre in the human diet (Chandra and Lal, 1987). The average protein content in pulses varies from 18 to 24 per cent. Pulses also content calcium and phosphorus.

Among different production practices, fertilizer management is one of the important agronomic practices for increasing crop yield and maintaining soil fertility. Growth and development of crops depend largely on the development of root system. Phosphorus (P) is one of the most important elements among the three macronutrients that plants must require for the better growth and development. Most of the soils throughout the world are P deficient (Batjes, 1997), with the introduction of high yielding varieties, increased cropping intensity and heavy applications of N fertilizers. Hence, the effect of phosphorus on root development is well established (Hossain and Hamid, 2007). Addition of P fertilizer enhances root development, which improves the supply of other nutrients and water to the growing parts of the plants, resulting in an increased photosynthetic area and thereby more dry matter accumulation. Non-addition of P in soil leads to decreasing the yield and quality of the crop.

It has been well established that most of the plant nutrients are absorbed through the leaves and absorption would be remarkably rapid and nearly complete. Moreover, foliar feeding practice would be more useful in early maturing crops which could be combined with regular plant protection programs. If foliar nutrition is applied, it reduces the cost of cultivation which in turn reduces the amount of fertilizer thereby reducing the loss and also economizing crop production. Foliar nutrition can be adopted wherever possible except for unavailable circumstances where soil application is only feasible. Foliar application of major plant nutrients like nitrogen and potassium was found to be as good as soil application (Subramanian and Palaniappan, 1981). Deshmukh *et al.,* (2013) also reported the 40 per cent higher yield of greengram with foliar spray of 1 per cent urea and 1 per cent DAP before flowering as compared to without foliar spray. Foliar application of nutrients is one of the possible ways to avoid such loss of fertilizer.

There is little research work has been done on foliar application of nutrients on summer greengram variety Meha under south Gujarat condition. Considering the above facts and view, the present experiment has been planned to study the "Response of greengram (*Vigna radiata* L.) to different level of phosphorus and organic liquid fertilizers" during *summer* season of 2016 at College Farm N. M. College of Agriculture, Navsari Agricultural University, Navsari.

Materials and Methods

Field experiment was conducted during *summer* season of 2016 at College Farm N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat. Total nine treatment combinations comprising of three levels of phosphorus *viz.*, P_0 (0 kg P_2O_5/ha), P_1 (20 kg P_2O_5/ha), P_2 (40 kg P_2O_5/ha) and three levels of organic liquid fertilizer *viz.*, O_1 (Spraying of Novel liquid fertilizer @10 ml/liter of water at branching), O_2 (Spraying of Novel liquid fertilizer @10 ml/liter of water at flowering) and O_3

(Spraying of Novel liquid fertilizer @10 ml/liter of water at branching and flowering) were evaluated in factorial randomized block design with four replications. The soil of the experimental plots was clayey in texture having medium to poor drainage, EC 0.36 dS/m and soil pH 8.14. The soil is medium in organic carbon (0.35%), low in available nitrogen (150.23 kg/ha) and available phosphorus (46.16 kg/ha) and fairly rich in available potassium (307.81kg/ha) were determined by Kjeldahl's method, Olsen's method and Flame photometric method, respectively. Green gram variety "Meha" seeds were sown at 30 cm x 10 cm spacing. The entire dose of nitrogen and phosphorus applied at basal application just before sowing and spraying of organic liquid fertilizer were applied as per the treatments. Urea and single super phosphate were taken as fertilizer sources for N and P, respectively.

Results and Discussion

Effect on phosphorus

Growth attributes of summer green gram were significantly influenced by various levels of phosphorus. Significantly the taller plant height was registered with the application of 40 kg P_2O_5/ha at 60 DAS (41.83 cm) and at harvest (49.48 cm) over control, which was at par with application of 20 kg P_2O_5/ha. The lowest plant height at 60 DAS (37.72 cm) and at harvest (45.37 cm) was recorded under control. Increased in plant height might be due to application of phosphorus increased photosynthesis activity of plant and helps to develop a more extensive root system and thus enables the plant to extract more water and nutrient from soil depth, resulting in better development of plant growth. The number of branches per plant was also remarkably influenced by application of phosphorus. An application of 40 and 20 kg P_2O_5/ha remain at par but produced significantly higher number of branches per plant of 3.88 and 3.65 over control (3.26), respectively. This could be attributed due to application of phosphorus help in efficient utilization of nutrients, which resulted in attaining better crop canopy. Similar types of results are in accordance with the findings of Ghanshyam *et al.,* (2010), Mahetele and Kushwaha (2011), Nawange *et al.,* (2011), Bairwa *et al.,* (2012), Atik *et al.,* (2014) and Kokani *et al.,* (2015). An application of phosphorus did not exert their significant effect on days to 50% flowering. Significantly the lowest dry matter production per plant (7.39g) was observed in control, whereas the highest dry matter production per plant (7.92g) was recorded with the phosphorus applied @ 40 kg/ha. It might be due to the cumulative effect of increasing in plant height and number of branches resulted in increasing the dry matter production of plant. The present findings are within the close vicinity of those reported by Meena *et al.,* (2006), Kumar *et al.,* (2014) and Sengupta and Tamang (2015).

The significant variation in the yield attributing parameters like number of pods per plant, number of seeds per pod and length of the pod (Table 1) were found due to different levels of phosphorus. Phosphorus applied @ 40 & 20 kg P_2O_5/ha were at par, but fond remarkably higher number of pods per plant, number of seed per pod and length of pod as compared to control. Test weight of greengram did not influenced significantly by any level of phosphorus. The percentage increasing in the yield attributes are 18.31, 11.30, 9.66 and 2.33 per cent found in number of pods per plant, number of seeds per pod, length of pod and test weight over control.

In general, overall improvement in yield attributing character because of phosphorus increased the photosynthesis activity of plant and helps to develop a more extensive root system and thus enables the plant to extract more water and nutrients from soil depth,

resulting in better development of plant growth and yield attributes. Positive responses in terms of yield attributes due to application of phosphorus have also been reported by Gupta *et al.,* (2006), Gangaiah and Ahlawat (2008), Patil *et al.,* (2011), Kumar *et al.,* (2012), Patel *et al.,* (2013).

The seed and haulm yields of green gram showed significant differences due to an application of graded dose of phosphorus (Table 2). An application of 40 kg P_2O_5/ha was produced significantly the highest seed (1168 kg/ha) and haulm yields (2475 kg/ha) as compared to control, but it was at par with 20 kg P_2O_5/ha in case of seed yield (1081kg/ha). The magnitude of increased in green gram seed yield of 30.80 per cent and haulm yield of 17.68 per cent under the application of 40 kg P_2O_5/ha over control. The increase in seed yield with increased in the levels of phosphorus was mainly due to cumulative effect of significant increased in the yield attributing component like number of pods per plant, number of seeds per pod and length of pod. Similarly, the haulm yield was remarkably increased due to the significant improvement in the growth and yield attributing characters *viz.,* plant height, number of branches per plant and dry matter production per plant. The results were supported by the findings of Gupta *et al.,* (2006), Ghanshyam *et al.,* (2010), Mahetele and Kushwaha (2011), Nawange *et al.,* (2011), Patil *et al.,* (2011), Kumar *et al.,* (2012), Patel *et al.,* (2013), Bairwa *et al.,* (2014). Phosphorus applied @ 40 & 20 kg/ha were produced significantly the highest protein content of 19.34 & 19.17 per cent and protein yield of 226.20 & 207.59 kg/ha over control (18.29 % and 163.02 kg/ha), respectively. The increase in protein content with increased phosphorus levels was probably due to efficient and effective root system develop, 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. The increase in protein yield was mainly due to higher protein content in greengram seed and higher seed yield under same treatments. Similar type of results was also found by Meena *et al.,* (2006), Gangaihah and Ahlawat (2008), Kumawat *et al.,* (2009), Wagadre *et al.,* (2010), Chesti *et al.,* (2012), Patel *et al.,* (2013), Yadav *et al.,* (2013), Nyekha *et al.,* (2015) and Rathour *et al.,* (2015).

An appraisal of data given in Table 2 revealed that the maximum gross realization of 76268 ₹ /ha, net realization of 55302 ₹ /ha and BCR of 3.64 was secured with phosphorus application @ 40 kg P_2O_5/ha. The lowest gross realization of 58838 ₹ /ha, net realization of ₹ 38819 ha^{-1} and BCR of 2.94 was obtained under control treatment. This might be due to the highest grain and haulm yields were recorded under same treatment (P_2) as compared rest of treatments. The results confirm the findings of Bairwa *et al.,* (2012), Kumawat *et al.,* (2013), Gajera *et al.,* (2014) and Rathour *et al.,* (2015).

Effect of organic liquid fertilizer

Effect of various treatments of spraying of organic liquid fertilizer did not manifest their significant variation on growth parameters like plant height at 60 DAS and at harvest, as well as number of branches per plant, days to 50 % flowering and dry matter production per plant. Non-significantly but numerically higher value of plant height of 40.78 and 49.38 cm at 60 DAS and at harvest, respectively, number of branches (3.84), days to 50 % flowering (42.42) and dry matter production per plant (7.76 g) were recorded under the spraying of novel liquid fertilizer @ 10 ml/liter of water at branching and flowering stage (O_3) Venkatesh and Basu (2011) found similar type of results for plant height.

Table.1 Effects of phosphorus and organic liquid fertilizer on growth and yield attributes of greengram

Treatment	Plant height (cm) 60 DAS	At harvest	Days to 50% flowering	Dry matter production/plant (g)	Number of branches /plant	Number of pods/ plant	Number of seed/ Pod	Length of pod (cm)	Test weight (g)
Phosphorus (kg/ha)									
P_0 – 0	37.72	45.37	41.00	7.39	3.26	26.43	8.58	6.11	38.94
P_1 – 20	39.80	48.17	41.92	7.57	3.65	29.17	9.02	6.40	39.33
P_2 – 40	41.83	49.48	42.42	7.92	3.88	31.27	9.55	6.70	39.81
S. Em. ±	1.05	1.06	1.02	0.14	0.14	0.98	0.21	0.15	0.73
C.D. (P=0.05)	3.06	3.09	NS	0.40	0.42	2.87	0.61	0.44	NS
Organic liquid fertilizer (ml/lit.)									
O_1 – Spraying of Novel liquid fertilizer @ 10 ml/liter of water at branching	38.62	45.65	41.00	7.42	3.39	26.47	8.69	6.06	38.85
O_2 – Spraying of Novel liquid fertilizer @ 10 ml/liter of water at flowering	39.95	47.98	41.92	7.70	3.55	29.72	9.00	6.45	39.45
O_3 – Spraying of Novel liquid fertilizer @ 10 ml/liter of water at branching and flowering	40.78	49.38	42.42	7.76	3.84	30.68	9.47	6.71	39.80
S. Em. ±	1.05	1.06	1.02	0.14	0.14	0.98	0.21	0.15	0.73
C.D. (P=0.05)	NS	NS	NS	NS	NS	2.87	0.61	0.44	NS

Table.2 Effects of phosphorus and organic liquid fertilizer on yield, quality parameters and economics of greengram

Treatment	Seed yield (kg/ha)	Haulm yield (kg/ha)	Protein content (%)	Protein yield (kg/ha)	Cost of production ((₹ /ha)	Gross return (₹ /ha)	Net return (₹ /ha)	BCR
Phosphorus (kg/ha)								
P_0 – 0	893	2103	18.29	163.02	20019	58838	38819	2.94
P_1 – 20	1081	2210	19.17	207.59	20492	70385	49893	3.43
P_2 – 40	1168	2475	19.34	226.20	20965	76268	55302	3.64
S. Em. ±	37.39	60.75	0.26	7.59				
C.D. (P=0.05)	109.13	177.34	0.77	22.16				
Organic liquid fertilizer (ml/lit.)								
O_1 – Spraying of Novel liquid fertilizer @ 10 ml/liter of water at branching	975	2163	18.63	182.10	20985	63908	42923	3.05
O_2 – Spraying of Novel liquid fertilizer @ 10 ml/liter of water at flowering	1028	2256	18.96	195.40	20985	67320	46335	3.21
O_3 – Spraying of Novel liquid fertilizer @ 10 ml/liter of water at branching and flowering	1139	2368	19.20	219.30	21629	74260	52631	3.43
S. Em. ±	37.39	60.75	0.26	7.59				
C.D. (P=0.05)	109.13	NS	NS	22.16				

All most all the yield attributes such as number of pods per plant, number of seeds per pod and pod length were influenced remarkably by different treatments of spraying of organic liquid fertilizer, except the test weight. Significantly higher number of pods per plant (30.68), number of seeds per pod (9.47) and pod length (6.71cm) were produced due to spraying of novel liquid fertilizer @ 10 ml/liter of water at branching and flowering stage over treatment O_1, which was statistically at par with treatment of spraying of novel liquid fertilizer @ 10 ml/liter of water at flowering stage of plant. None significantly but numerically higher test weight of greengram (39.80 g) was found under the same treatment (O_3). The increase in yield attributes might have been on account of the overall improvement in vegetative growth of the plant due to application of nutrients in adequate quantity and easily available form to plant through foliar spray which favorably influenced on yield attributes. Moreover, accumulation of more photosynthesis provided better pod and seed development in *summer* greengram. These finding were in agreement with Ganiger *et al.,* (2003), Verma *et al.,* (2011) and Yadav and Choudhary (2012).

The variation in seed yield was significantly differed due to various treatments of spraying of organic liquid fertilizer whereas, haulm yield did not differed significantly by the spraying of organic liquid fertilizer (Table 2). Significantly the highest seed yield (1139 kg/ha) was obtained under treatment O_3 over treatment O_1 (975 kg/ha), but it was at par with treatment O_2 (Spraying of novel liquid fertilizer @ 10 ml/liter of water at flowering stage). Haulm yield (2368 kg/ha) of green gram was found numerically higher under the same treatment of O_3. The percent increasing in the seed yield of 16.82 % and haulm yield of 9.48 % were noticed due to the spraying of novel liquid fertilizer @ 10 ml/liter of water at branching and flowering stage over treatment O_1. The increases in seed yield might be due to adequate supply of nutrients with easy availability to plant at most critical growth period stages resulted into better growth and yield attributing charters.

The better growth of crop ultimately diverted more energy under sink source relationship which helped in providing more yield. Similar types of results were also reported by Ganiger *et al.,* (2003), Titare *et al.,* (2005), Choudary and Yadav (2011), Verma *et al.,* (2011), Kumar *et al.,* (2013) and Sengupta and Tamang (2015).

Spraying of organic liquid fertilizer did not exert any significant effect on protein content but, it had remarkable variation on protein yield. Significantly the highest protein yield (219.30 kg/ha) was recorded due to spraying of novel liquid fertilizer @ 10 ml/liter of water at branching and flowering stage (O_3) over the treatments O_1 and O_2. Similarly, protein content was found higher under the treatments O_3. The improvement in protein yield might be due to higher seed yield of greengram couple with protein content under the treatments of spraying of novel liquid fertilizer @ 10 ml/liter of water at branching and flowering stage. These finding are in agreement with the experimental results reported by Verma *et al.,* (2011), Doss *et al.,* (2013) and Tahir *et al.,* (2014).

Spraying of novel liquid fertilizer @10 ml/liter of water at branching and flowering stage recorded maximum gross realization of ₹ 74260 ha^{-1}, net realization of ₹ 52631 ha^{-1} with BCR of 3.43, which was followed by gross realization of ₹ 67320 ha^{-1}, net realization of ₹ 46335 ha^{-1} with BCR of 3.21 under the treatment O_2. Similar findings were in close vicinity of Ganiger *et al.,* (2003), Chandrasekhar and Bangarusamy (2003) and Behera and Elamathi (2007).

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How to cite this article:

Himani B. Patel, K.A. Shah, M.M. Barvaliya and Patel, S.A. 2017. Response of Greengram (*Vigna radiata* L.) To Different Level of Phosphorus and Organic Liquid Fertilizer. *Int.J.Curr.Microbiol.App.Sci.* 6(10): 3443-3451. doi: https://doi.org/10.20546/ijcmas.2017.610.406