Biological Forum – An International Journal **13(2): 408-412(2021)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Influence of Spacing and Phosphorus on Growth and Yield of Green Gram (*Vigna radiata* L.) in Prayagraj Condition

Vikramjeet Singh[1] and Vikram Singh[2]*
[1]M.Sc. Scholar, Department of Agronomy, NAI, SHUATS, Prayagraj, (Uttar Pradesh), India.
[2]Associate Professor, Department of Agronomy, NAI, SHUATS, Prayagraj, (Uttar Pradesh), India.

(Corresponding author: Vikramjeet Singh)*
(Received 15 April 2021, Accepted 16 June, 2021)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: A field experiment was conducted at Central Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj, (U.P.) during *Zaid*-2020 by adopting two important factor of crop production spacing and phosphorus levels, it seems necessary factors for achieving the higher yield of green gram. The seed rate with unmanaged spacing which increases intra species competition and yield decrease. Besides, P also plays a significant role for the growth of green gram, phosphorus (P) required for energy transformation in nodules which contribute yield, hence green gram cultivation need more attention as it is important pulse crop in India. Spacing and phosphorus levels necessary factors for achieving the higher yield and economics of green gram. The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.7), low high carbon (0.44%), low available N (171.48 kg/ha), low available P (9.27kg/ha) and high available K (291.2 kg/ha). The experiment was laid out in randomized block design and having nine treatment consisted of spacing *viz.*, S_1 (20 × 10 cm), S_2 (30 × 10 cm), S_3 (40 × 10 cm) and Phosphorus *viz.*, P_1 (20 Kg/ha), P_2 (40 Kg/ha) and P_3 (60 Kg/ha) which were replicated thrice and effect was observed on summer Green gram. The result shown significantly higher plant height (42.47cm), Dry weight (8.12g), Leaf area (166.05cm^2), number of leaves/plant (8.20), nodules/plant (16.00), Pods/plant (29.70), Seeds/pod (11.73), test weight (36.31g), Seed yield (1222.30 kg/ha), Stover yield (2948.86 kg/ha) and Biological yield (4171.16 kg/ha)was recorded with Spacing 30 × 10 cm along with the application of 60 kg/ha Phosphorus compared to the rest of the treatments. Which is beneficial for the green gram production.

Keywords: Spacing, Phosphorus, Green Gram, Yield.

INTRODUCTION

The mung bean (*Vigna radiata* L.) is under cultivation since pre-historic time in India. The green gram (*Vigna radiata* L. is very important pulse crop of India. This belongs to family “Leguminosae” and genus ‘Vigna’. Pulses occupy a unique position in cropping system as a main, catch, cover, green manure and as intercrop.In India during 2019-20, about 31.15 lakh ha (76.97 lakh acres) area was covered under green gram. The states of Rajasthan 18.30 lakh ha (45.22 lakh acres), Karnataka 2.69 lakh ha (6.65 lakh acres), Maharashtra 3.28 lakh ha (8.11 lakh acres), Madhya Pradesh 1.82 lakh ha (4.50 lakh acres), Odisha 1.63 lakh ha (4.03 lakh acres) and Telangana 0.66 lakh ha (1.64 lakh acres) are the major producers of green gram in India (*Directorate of Economics & Statistics, 2019*). In 2018-19, green gram production has increased from 19.25 to 20.26 lakh tonnes due to higher crop area by 7.41% to 34.36 lakh ha. With the import remaining same at 1.5 lakh tonnes, the total green gram supply has increased from 28.96 to 29.02 lakh tonnes including carryout stock of 7.26 lakh tonnes (Anonymous, 2020). It is a native of India and Central Asia. It occupies prime position among pulses by virtue of its short growth period, high biomass and outstanding nutrient value as food, feed and forage. Green gram contains 24.7 % protein, 0.6 % fat, 0.9 % fibre and 3.7 % ash as well as sufficient quantity of calcium, phosphorus and important vitamins. The food legumes, particularly the grain or pulses are important food stuff in all tropical and subtropical countries (Mohbe *et al.*, 2015).

Spacing plays an important role in contributing to the high yield because thick plant population will not get proper light for photosynthesis and high infestation of diseases. On the other hand, very low plant population will also reduce the yield. Due to this reason normal population is necessary for high yield. Advantage of optimum spacing under irrigated conditions is due to reduced competition for light because when the moisture is lacking, light is no longer limiting factor and the advantage of uniform spacing is lost (Ihsanullah *et al*., 2002). Spacing by maintaining plant population to an optimum level, play an important role in growth and development by affecting plant density and inturn moisture, nutrients and space availability (Panwar and Sharma, 2004). The increase in plant height may be due to 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 (Swami *et al.,* 2020).

Phosphorus is most critical nutrient in pulse crop important role in root proliferation and there by atmospheric nitrogen fixation, also Phosphorous play a vital role in production of pulses (Nair, 1985). Phosphorous stimulates the symbiotic nitrogen fixation of bacterial cell to root hair for nodulation (Charel, 2006). 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. As the concentration of available P in the soil solution is normally insufficient to support the plant growth, continual replacement of soluble P from inorganic and organic sources is necessary to meet the P requirements of crop. P is added extra dose in recommended dose of phosphorus which increase nitrogen fixation and finally improve productivity of green gram. It plays an important role in virtually all main metabolic processes in plant including photosynthesis, energy transfer, signal transduction, macromolecular biosynthesis and respiration **(**Rashmitha *et al.,* 2021). In view of these investigations, the experiment was under taken to find out suitable spacing and phosphorus levels on the application for maximizing the yield of Green gram under Prayagraj condition in UP.

MATERIALS AND METHODS

The experiment was conducted during the *Zaid* season 2020, at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higgin bottom University of agriculture, Technology and Sciences (SHUATS), Prayagraj (U.P.) which is located at 25^o 39' 42''N latitude, 81^{o}67'56" E longitude and 98 m altitude above the mean sea level (MSL). This area is situated on the right side of the Yamuna River by the side of Prayagraj - Rewa road about 12 km from the city. The experiment was laid out in Randomized block design, replicated thrice. The treatment comprised of three different Spacing noted as S_1 (20 × 10 cm), S_2 (30 × 10 cm), S_3 (40 × 10 cm) and three Phosphorus levels P_1 (20 Kg/ha), P_2 (40 Kg/ha) and P_3 (60 Kg/ha) through basal application and the possible combination is presented in Table 1. During the growing season, the mean weekly maximum and minimum temperature, relative humidity and rainfall were 36.60^{o}C, 24.90^{o}C, 76.40 %, 48.48 % and 4.72 mm, respectively. The field was uniformly irrigated one day before sowing on each of the treatment combinations. The soil of experimental plot was sandy loam in texture, neatly neutral in soil reaction (pH 7.7), low organic carbon (0.44%), low available N (171.48 kg/ha), low available P (9.27 kg/ha) and high available K (291.2 kg/ha). The RDF i.e., Nitrogen (20 kg ha^{-1}) was applied through Urea in basal dose, whereas dose of Phosphorous was given according to the treatment combinations in basal dose through SSP and full dose of Potassium (20 kg ha^{-1}) were applied through MOP. Observations on growth parameters *viz.* plant height (cm), Dry weight (g), Leaf area (cm^2), Leaf Area Index (LAI), number of leaves/plant and nodules/plant, yield attributes *viz.* Pods/plants, Seeds/pods and test weight (g) and yield of Green Gram *viz.* Seed yield (kg/ha), Stover yield (kg/ha) and Biological yield (kg/ha), was recorded and their significance was tested by the variance ratio and F-value at 5% level of significance (Gomez and Gomez, 1984).

Table 1: Treatment combination.

Treatments	Treatment combination
T_1	20cm × 10cm + 20 kg/ha phosphorus.
T_2	20cm × 10cm + 40 kg/ha phosphorus.
T_3	20cm × 10cm + 60 kg/ha phosphorus.
T_4	30cm ×10cm + 20 kg/ha phosphorus.
T_5	30cm ×10cm + 40 kg/ha phosphorus.
T_6	30cm ×10cm + 60 kg/ha phosphorus.
T_7	40cm × 10cm + 20 kg/ha Phosphorus.
T_8	40cm × 10cm + 40 kg/ha phosphorus.
T_9	40cm × 10cm + 60 kg/ha phosphorus.

RESULTS AND DISCUSSION

A. Growth parameter

Growth parameters of Green Gram, *viz.* plant height (cm), Dry weight (g), Leaf area (cm^2), Leaf Area Index (LAI), number of leaves/plant and nodules/plant varied due to different Spacing and Phosphorus level are presented in Table 2. The treatment in which Spacing 30cm × 10cm along with the application of 60 kg/ha Phosphorus resulted in significantly higher plant height (42.47cm), Dry weight (8.12g), Leaf area (166.05 cm^2), number of leaves/plant (8.20) and nodules/plant (16.00). In growth parameters like plant height spacing 40cm× 10cm + 60 kg/ha phosphorus and spacing 30cm × 10cm + 40 kg/ha phosphorus (42.47cm) was found statistically at par with Spacing 30cm × 10cm + 60 kg/ha phosphorus. In growth parameters like Dry weight, Leaf area and nodules/plant spacing 20cm× 10cm + 40 kg/ha phosphorus, spacing 20cm × 10cm + 60 kg/ha phosphorus, spacing 30cm × 10cm + 40 kg/ha phosphorus, spacing 40cm × 10cm + 40 kg/ha phosphorus and spacing 40cm × 10cm + 60 kg/ha phosphorus was found statistically at par with Spacing 30cm × 10cm + 60 kg/ha phosphorus. In growth parameters like number of leaves/plant spacing 20cm × 10cm + 60 kg/ha phosphorus, spacing 30cm × 10cm + 40 kg/ha phosphorus, spacing 40cm×10cm + 40 kg/ha phosphorus and spacing 40cm×10cm + 60 kg/ha phosphorus was found statistically at par with Spacing 30cm × 10cm + 60 kg/ha phosphorus. While, the treatment in which Spacing 20cm × 10 cm along with the application of 60 kg/ha Phosphorus resulted in significantly higher Leaf Area Index (5.40). In growth parameter Leaf Area Index spacing 20cm × 10cm + 40 kg/ha phosphorus, spacing 30cm × 10cm + 40 kg/ha phosphorus and spacing 30cm × 10cm + 60 kg/ha phosphorus was found statistically at par with Spacing 20cm × 10 cm along with the application of 60 kg/ha Phosphorus. The Spacing had significant effects on growth, However, an increasing trend with closer geometry level could be noticed. This may be due to the competition between the inter and intra plants for sun light, water, nutrients and space at closer spacing which encouraged self thinning of branches and enhanced vertical growth rather than horizontal growth (Bahadur and Singh, 2005). The plants attained more vigour with phosphorus as compared to control, due to adequate supply and availability of nitrogen, phosphorus, potassium and spacing in balanced combination, resulting in increased dry weight of the plant. Better photosynthetic activity due to greater exposure to light and increased availability of nutrients to plants might have also resulted in higher growth of the plant. When P supply is limited, the availability of P and N to chloroplast became limited ultimately affect the photosynthetic processes as well as photosynthates supply to nodules. The effect of P could be related to the finding by that it stimulates root growth and activity and nodule formation (Swami *et al.,* 2020).

Table 2: Effect of Spacing and Phosphorus levels on Growth attributes of summer Green Gram.

	At harvest					
Treatment	**Plant Height (cm)**	**Dry weight (g plant^{-1})**	**No. of leaves/ Plant**	**Leaf area (cm^2)**	**Leaf area index**	**Nodules/plant**
T_1: 20cm × 10cm + 20 kg/ha phosphorus.	25.90	4.98	4.87	99.44	2.45	9.60
T_2: 20cm × 10cm + 40 kg/ha phosphorus.	34.28	6.66	6.33	135.07	4.27	13.00
T_3: 20cm × 10cm + 60 kg/ha phosphorus.	36.47	7.07	7.07	143.70	5.40	13.87
T_4: 30cm ×10cm + 20 kg/ha phosphorus.	32.39	6.31	6.27	127.62	2.67	11.93
T_5:30cm ×10cm + 40 kg/ha phosphorus.	38.25	7.34	7.33	149.43	3.66	14.33
T_6: 30cm ×10cm + 60 kg/ha phosphorus.	42.47	8.12	8.20	166.05	4.54	16.00
T_7: 40cm × 10cm + 20 kg/ha Phosphorus.	29.73	5.81	5.73	117.14	1.68	11.27
T_8: 40cm × 10cm + 40 kg/ha phosphorus.	35.54	6.83	6.87	138.74	2.39	13.27
T_9: 40cm × 10cm + 60 kg/ha phosphorus.	38.94	7.53	7.53	153.42	2.94	14.87
S.E.m($\pm$)	1.97	0.49	0.50	10.38	0.65	1.01
CD.(5%)	5.92	1.47	1.51	31.12	1.95	3.04

B. Yield attributes

Yield attributes such as number of effective Pods/plants, Seeds/pods and test weight (g) exhibited significant variation during the experimental period due to different Spacing and Phosphorus level (Table 3). The yield attributing character number of effective Pods/plant (29.70) and Seeds/pod (11.73) showed significant result for the Spacing 30cm × 10 cm along with the application of 60 kg/ha Phosphorus. In yield attribute like Pods/plant W spacing 20cm × 10cm + 40 kg/ha phosphorus, spacing 20cm× 10cm + 60 kg/ha phosphorus, spacing 30cm × 10cm + 40 kg/ha phosphorus, spacing 40cm × 10cm + 40 kg/ha phosphorus and spacing 40cm×10cm + 60 kg/ha phosphorus was found statistically at par with Spacing 30cm × 10 cm along with the application of 60 kg/ha Phosphorus. In yield attribute like Seeds/pod With spacing 20cm × 10cm + 60 kg/ha phosphorus, spacing 30cm×10cm + 40 kg/ha phosphorus, spacing 40cm × 10cm + 40 kg/ha phosphorus and spacing 40cm × 10cm + 60 kg/ha phosphorus was found statistically at par with Spacing 30cm × 10 cm along with the application of 60 kg/ha Phosphorus. While yield attribute test weight does not show any significant result but the highest test weight (36.31g) was showed in Spacing 30cm × 10 cm along with the application of 60 kg/ha Phosphorus. Higher yield attributes might have been possible due to more vigour and strength attained by the plants as a result of better photosynthetic activities with sufficient availability of light, and supply of nutrients in balanced quantity of the plants at growing stages which resulted into a higher length of the pod, similar result also reported by Nadeem *et al.* (2003). The increase in yield attributes might also have been due to application of nutrients in adequate quantity and easily available form to plant through foliar spray which favourably influenced on yield attributes. The combined application of different level of phosphorus along with zinc also enhanced the protein content of green gram **(**Rashmitha *et al.,* 2021).

C. Yield

Seed yield (kg/ha), Stover yield(kg/ha) and Biological yield (kg/ha) varied considerably significant due to different Spacing and Phosphorus level (Table 3). The treatment in which Spacing 30 × 10 cm along with the application of 60 kg/ha Phosphorus resulted in significantly higher Seed yield (1222.30 kg/ha), Stover yield (2948.86 kg/ha) and Biological yield (4171.16 kg/ha). In yield parameter like Seed yield (1222.30 kg/ha), Stover yield (2948.86 kg/ha) and Biological yield (4171.16 kg/ha) spacing 20cm × 10cm + 40 kg/ha phosphorus, spacing 20cm × 10cm + 60 kg/ha phosphorus, spacing 30cm × 10cm + 40 kg/ha phosphorus, spacing 40cm × 10cm + 40 kg/ha phosphorus and spacing 40cm × 10cm + 60 kg/ha phosphorus was found statistically at par with Spacing 30cm × 10 cm along with the application of 60 kg/ha Phosphorus. The increase in seed yield due to phosphorus application is attributed to source and sink relationship. It appears that greater translocation of photosynthates from source to sink might have increased seed yield (Balai *et al.,* 2017). Phosphorus increases yield due to its well-developed root system, increased N fixation and its availability to the plants and favourable environments in the rhizosphere. Phosphorus increases yield due to its well-developed root system, increased N fixation and its availability to the plants and favourable environments in the rhizosphere (Lokhande *et al*., 2018). Phosphorus resulted in higher rate of dry matter accumulation which might be due to the increase in vegetative development and reproductive attributes under proper availability of phosphorus and better physical condition of soil. Positive responses in terms of yield attributes due to application of phosphorus (Mashi *et al.,* 2020).

Table 3: Effect of Spacing and Phosphorus levels on yield attributes and yield of summer Green Gram.

Treatment	Yield attributes and yield					
	Pods/plant (No.)	Seeds/pod(No.)	Test weight(g)	Seed yield(kg/ha)	Stover yield(kg/ha)	Biological yield(kg/ha)
T_1: 20cm × 10cm + 20 kg/ha phosphorus.	21.80	7.07	31.74	731.95	1765.86	2497.81
T_2: 20cm × 10cm + 40 kg/ha phosphorus.	26.00	9.53	32.53	994.21	2398.58	3392.80
T_3: 20cm × 10cm + 60 kg/ha phosphorus.	27.10	10.47	33.75	1057.79	2551.97	3609.76
T_4: 30cm × 10cm + 20 kg/ha phosphorus.	25.20	9.07	31.24	939.37	2266.29	3205.66
T_5:30cm × 10cm + 40 kg/ha phosphorus.	27.30	10.80	34.00	1099.91	2653.59	3753.50
T_6: 30cm × 10cm + 60 kg/ha phosphorus.	29.70	11.73	36.31	1222.30	2948.86	4171.16
T_7: 40cm × 10cm + 20 kg/ha Phosphorus.	23.50	8.60	32.28	862.29	2080.31	2942.59
T_8: 40cm × 10cm + 40 kg/ha phosphorus.	26.50	10.00	30.00	1021.23	2463.77	3485.01
T_9: 40cm × 10cm + 60 kg/ha phosphorus.	28.20	10.85	35.21	1129.32	2724.53	3853.85
S.E.m($\pm$)	1.24	0.62	2.45	76.41	184.34	260.75
CD. (5%)	3.72	1.86	-	229.07	552.65	781.72

Plate 1

Plate 2

CONCLUSION

In the light of above study, it may conclude that under Eastern UP condition Green gram raised yield at T6 (30 × 10 cm + 60 kg/ha phosphorus) is fitting practice has proved to be a better option for getting higher productivity under irrigated condition.

Acknowledgment. I express gratitude to my advisor Dr. Vikram Singh and all the faculty members of Department of Agronomy for constant support and guidance to carry out the whole experimental research study.

Conflict of Interest: Nil.

REFERENCES

Anonymous (2020). https://pjtsau.edu.in/files/AgriMkt/2019/KPSF_Greengram_May_2019.pdf.

Bahadur, A., & Singh, K. P. (2005). Optimization of spacing and drip irrigation scheduling in indeterminate tomato. *The Indian Journal of Agricultural Sciences, 75*: 563-565.

Balai, K., Jajoria, M., Verma, R., Deewan, P., & Barwa, S. K. (2017). Nutrient content, uptake, quality of chickpea and fertility status of soil influenced by fertilization of phosphorus and zinc JPP, *6* (1): 392-398.

Charel, J. D. (2006). Response of green gram [*vigna radiata* (L) Wilczek] to phosphorus and Sulphur with and without PSB inoculation. M.Sc. thesis, Aaanand Agicultural University, Aanand.

Directorate of Economics & Statistics., Annual report 2019.

Escalante E. J. A. S., Barrios A. P., Gonzalez, R. M. T., Chavez G., M., C., & Barrios, A. M. (2014). Analysis of Cowpea Growth and Production in Maize Trellis with Nitrogen and Phosphorus. *International Journal of Agriculture Sciences*, *4*: 102-108.

Gomez, K. A., & Gomez, A. A. (1984). Statistical Procedures for Agricultural Research.

Ihsanullah; Taj, F. H., Akbar, H., Basir, A., & Ulaah, N. (2002). Effect of row spacing on agronomic traits and yield of mung bean (*Vigna radiata* L.). *Asian Journal of Plant Sciences, 1* (4); 328-329.

Lokhande, P. B., Indulkar, B. S., Vaidya, P. H., Padghan, A. D., Wagh, C. B., Ingole, A. J., Patil, N. M., & Aundhkar, A. (2018). Effect of phosphorus and zinc on yield and quality of Green gram (*Vigna radiata* L.) in Inceptisol. *International Jounal of Engineering Science and Computing*, *8*(7): 18647-18649.

Masih, A., Joy dawson & richaevelyn singh (2020). Effect of Levels of Phosphorus and Zinc on Growth and Yield of Green gram (*Vigna radiata* L.). *International Journal of Current Microbiology and Applied Sciences, 9*(10): 3106-3112.

Nadeem Akhtar, Muhammad Amjad & Muhammad Akbar Anjum (2003). Growth and Yield Response of Pea (*Pisumsativum* L.) Crop to Phosphorus and Potassium Application. *Pakisthan Journal of Agriculture Sciences*, *40*(3-4).

Nair, P. K. R. (1985). An introduction to Agroforestry. The Netherlands: Kluwer Academic Publisher.

Panwar, G., & Sharma, B. B. (2004). Effect of planting date, seed rate and row spacing on yield and yield attributes of bold seeded mung bean during summer season. *Indian Journal of Pulses Research, 17*(1): 45-46.

Rashmitha B., Umesha C., & Meshram, M. R. (2021). Influence of Spacing and Phosphorus Levels on Growth and Yield of Blackgram (*Vignamungo* L.). *Biological Forum, 13*(1): 82-85

Sandeepmohbe, Mishra, U. S., & Pandey, R. C. (2015). A study on Organic manure on green gram (*Phaseolus radiate* (L.) under rainfed condition of Chitrakoot area. *Trends in Biosciences, 8* (23): 6551-6554.

Swamy B. M. V., Vikram Singh, Dhananjay Tiwari & Indu Thakur (2020). Study of System of Crop Intensification (SCI) and Phosphorus Management on Growth, Yield and Economics of Green gram (*Vigna radiata* L.). *International Journal of Current Microbiology and Applied Sciences, 9*(8): 1950-1958.

How to cite this article: Singh, V. and Singh, V. (2021). Influence of Spacing and Phosphorus on Growth and Yield of Green Gram (*Vigna radiata* L.) in Prayagraj Condition. *Biological Forum – An International Journal*, *13*(2): 408-412.