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Effect of spacing and organic manures on growth and yield of Greengram (*Vigna radiata* L.)

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Abstract
The Experiment was conducted during Zaid, 2021 at Crop Research Farm, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P) to study the Effect of Plant population and Organic manures on Growth and Yield of Greengram (*Vigna radiata* L.) The treatment consists of three different spacing (20cm x10cm, 30cm x10cm and 40cm x10cm) and three different Organic manures (FYM-10t/ha, Goatmanure-5t/ha, Poultry manure-2t/ha). The experiment was conducted by following a randomized block design with nine treatments and were replicated thrice. The results showed that significantly higher with the Variety of Greengram i.e., Jawahar-45 with treatment combination of Spacing 30cm x 10cm with Poultry manure @ 2t/ha at 90DAS showed the Growth parameters vig, Plant height (38.5cm), No. of branches/plant (5.81), No. of nodules/plant (25.60), Dry weight (6.86g), Crop Growth Rate (5.99g/m2/day), and Relative Growth Rate (0.06g/g/day). The Yield parameters vig, Pods per plant (39.7), Grain per pod (12.3), Test weight (38.40g), Grain yield (970.35 kg/ha), stover yield (1597.65 kg/ha), harvest index (38.29%), Gross return (119637.3 INR/ha), Net return (79062.30 INR/ha) and B:C ratio (1.94) were recorded superior with the application of Spacing 30x10cm + Poultry manure @ 2t/ha.

Keywords: Spacing, organic, manures, Greengram, *Vigna radiata* L.

Introduction
Greengram (*Vigna radiata* L.,) is one of the important pulse crops grown in India. Green gram also known as mung, mungo, golden gram, Chickasaw pea and Orengo pea. It contains about 25% protein, 1.3%fat, 3.5% minerals, and 4.1% fiber and 56.7% carbohydrates and also rich source of calcium and iron. The origin of cultivated green gram is India and Central Asia.
Greengram is a short duration, drought tolerant pulse crop. It seed contain 24.7% protein as well as sufficient quantity of calcium, phosphorous and important vitamins. Due to its supply of cheaper protein source it is designated as "poor man's meat". Green gram is considered as substitute of animal protein and forms the balance diet when used with cereals. It checks the soil erosion. It also forms good silage and green manure crop. Greengram is also used as green manuring crop. Being leguminous crop, it has the capacity to fix the 42 kg N ha-1 from atomospheric nitrogen. (Pandey *et al*., 2019) [25]. Erosion. It also forms good silage and green manure crop. Greengram is also used as green manuring crop. Being leguminous crop, it has the capacity to fix the 42 kg N ha-1 from atomospheric nitrogen. (Pandey *et al*., 2019) [25]. Protein and forms the balance diet when used with cereals. It checks the soil erosion. It also forms good silage and green manure crop. Greengram is also used as green manuring crop. Being leguminous crop, it has the capacity to fix the 42 kg N ha^{-1} from atomospheric nitrogen. (Pandey *et al*., 2019) [25].
Greengram (*Vigna radiata* L. Wilczek) is a self- pollinated leguminous crop which is grown during Zaid as Kharif season in arid and semiarid regions of India. It is miserable that average turnout of greengram is very low (763.5 kg/ha) as compared to its potential yield of 2 to 4 t/ha. Numbers of factors have been responsible for low yield of Greengram in our country. Improper nutrient management have been witnessed to be most important factors for such set back in yield of greengram. The efficiency of manure has been found enhancing yield if it in mixed with phosphorous. Crop spacing and organic manures are the most important, which produce more seed yield in greengram. Spacing plays an important role in supply 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 output. Due to this reason normal population will also reduce the output. Advantage of optimum spacing under irrigated condition is due to reduce 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) [11].

- Organic manures helps to increase the plant population of soil micro-organisms which have some influence in protect in plant against pathogens nematodes an soil born insects and also helps to improve physical condition of soil and provides required plant nutrients. It enhances cation exchange capacity and acts as buffering agent against undesirable soil pH fluctuations. Organic manures provide a good substrates for the growth micro-organisms and maintain a favorable nutritional balance for productive soil ecosystem. (Shariff *et al*., 2017) [30].

Farmyard manure is known to play an important role in improving the fertility and capacity of soils through its positive effects on soil physical, volatility and biological properties and level of plant nutrition.

Goat manure which is rich in nutrients like nitrogen (N), phosphorus (P) and potassium (K) rather than obtaining from farm yard manure. The goat manure is expected to add nutrients to soil and it also makes a change in the physical properties of the soil.

Poultry manure can be efficiently used for the crops after composting the same to save the nutrients (Amanullah *et al*., 2003) [2]. Plants that collect poultry manure grew taller than other plants possibly more concentrated nutrients or minerals were made readily available and easily absorbable by the receiving plants leading to faster growth and development (Enujeke, 2013). Keeping above points in mind present investigation was conducted over evaluation of various manure of growth and yield parameters of greengram.

Greengram crop have direct of spacing due to availability of moisture and nutrient depend on spacing. Greengram gives low seed yield and poor growth performance mainly due to poor management and low soil fertility. Spacing is non-monetary input, optimum spacing provides enough space for easy inter culturing, weeding, application of fertilizers and other after care operations. Optimum row spacing plays an important role in contribute into the high yield because thick plant population will not get proper light for photosynthesis and can easily be attacked by diseases. Uniform spacing generally gives a grater yield than hill groupings under favorable moisture conditions. The advantage of uniform spacing under irrigated conditions is due to reduced competitions for light because when the moisture is lacking, light is no longer the limiting factor and the advantage of uniform spacing is lost.

Use of organic manures alone, as a substitute to chemical fertilizers is not profitable and will not be enough to maintain the present levels of crop productivity of high yielding varieties. Use of organic manures along with inorganic fertilizers leads to increase in productivity and also sustain the soil health for a longer period (Gawai and Pawar, 2006). Organic manures although not useful as sole sources of nutrients, however, acts as good complementary nutrient sources with inorganic fertilizers (Chaudhary *et al*., 2004), which have carryover effect on succeeding crops. About less than 30% of N and small fraction of P and K in organic manures may become available to immediate crop and rest to subsequent crops (Sharma and Vyas, 2001).

Keeping the views like inter-plant competition for optimum plant nutrients, sunlight, moisture and aeration in wind it is required to find out a fair combination of plant geometry and levels of organic manure to achieve the maximum yield.

Materials and Methods

The experiment was carried out during *Zaid*, 2021 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.) which is located at 25^0 57' N latitude, 81^0 50'E longitude and 98 m altitude above the mean sea-level. The experiment consists of nine treatments which were replicated thrice in a randomized block design with three different spacing vig.,(20cm x 10cm, 30cm x 10cm and 40cm x 10cm) and three different levels of organic manures like i. FYM– FYM 10t/ha, ii. Goat manure 5t/ha iii. Poultry manure 2t/h. Treatment combinations are 1. Spacing 20cm x10cm + FYM @10t/ha 2. Spacing 20cm x10cm + Goat manure @5t/ha 3. Spacing 20cm x10cm + Poultry manure @ 2t/ha 4. Spacing 30cm x10cm + FYM @ 10t/ha 5. Spacing 30cm x10cm + Goat manure @5t/ha 6. Spacing 30cm x10cm + Poultry manure @ 2t/ha 7. Spacing 40cm x10cm + FYM @10t/ha 8. Spacing 40cm x10cm + Goat manure @5t/ha 9. Spacing 40cm x10cm + Poultry manure @ 2t/ha. Irrigation was based on the necessity and at the time of sowing. Growth attributes vig., Plant height(cm), No. of branches/plant, No.of nodules/plant, Plant dry weight (g/plant), Crop growth rate (g/m^2/day), Relative growth rate (g/g/day) and Yield attributes *viz*., pods/plant, grain/pod, Test weight (g) Yield parameters *viz*. Grain yield (t/ha), stover yield (t/ha) and harvest index (%) were recorded with standard basis of observation. The data was analysed statistically by using analysis of variance as applicable in Randomized Block Design (Gomez and Gomez, 1984) [10].

Results and Discussion

Growth attributes

Data in Table 1 revealed plant height at harvest recorded a significant difference among treatment combinations. At harvest, significantly highest plant height (38.5cm) was observed in treatment Spacing 30cm x 10cm + poultry manure @ 2t/ha which was superior over the treatment which was followed by treatment combination Spacing 40cm x 10cm + Goat manure @ 5 t/ha (37.9cm) and Spacing 30cm x 10cm + FYM @ 10 t/ha (37.8cm), respectively.

Plant height of Greengram tended to increase progressively with the advance in the age of the crop. At all the stages of growth, the tallest plants were recorded with poultry manure applicated plots which was at par with those of goat manure applied plots. Taller plants produced in treatment with application of poultry manure might be due to the stimulated activities of microorganisms and synchronized release of nitrogen, which might have stimulated the cellular activity, useful for the process of cell division. The plant height was remarkably accelerated at optimum spacing of 30cm × 10cm which might be due to the tendency of plant to elongate toward light, when insufficient incidental solar radiation is intercepted in the plant canopy particularly lower one. Similar findings were reported by Rao *et al*. (2013) [27] and Singh *et al*. (2015) [31].

Further, No. of branches At Harvest (5.81/plant) was recorded significantly higher in Spacing 30cm x 10cm + Poultry manure @ 2t/ha Which was followed by the treatment combination of in Spacing 30cm x 10cm + Goat manure @ 5 t/ha (5.73) and Spacing 40cm x 10cm + Goat manure @ 5 t/ha (5.67) respectively.

Maximum No. of branches was recorded with the Spacing 30cm x 10cm + Poultry manure which was significantly superior over all other treatments might be due to better

aeration, adequate interception of light and suppression of apical dominance resulted in to increasing branching in case of Spacing 30cm×10cm.Such differential number of branches was also observed by Rao *et al*. (2003) [27] and Subrahmaniyan *et al*. (2001).

Further, Plant dry weight At Harvest (6.86/plant) was recorded significantly higher in Spacing 30cm x 10cm + Poultry manure @ 2t/ha which was followed by the treatment combination of Spacing 40cm x 10 cm + Poultry manure @ 2t/ha (6.82g) and Spacing 30cm x10 cm + Goat manure @ 5t/ha (6.76g) in Spacing 30cm x 10cm + Goat manure @ 5 t/ha, respectively.

Similarly, No. of Nodules At Harvest harvest stage was found non-significant effect among treatments. However maximum number of nodules (25.60/plant) was recorded in Spacing 30cm x 10cm + Poultry manure @ 2t/ha while Minimum No. of Nodules (21.40) was recorded with application of Spacing 20cm x 10cm + FYM @ 10t/ha.

Further, Plant dry weight At Harvest (6.86/plant) was recorded significantly higher in Spacing 30cm x 10cm + Poultry manure @ 2t/ha which was followed by the treatment combination of Spacing 40cm x 10 cm + Poultry manure @ 2t/ha (6.82g) and Spacing 30cm x10 cm + Goat manure @ 5t/ha (6.76g) in Spacing 30cm x 10cm + Goat manure @ 5 t/ha, respectively.

Dry weight of Greengram tended to increase progressively with advance in the age of crop. Total dry weight of with the treatment applicated with poultry manure and spacing 30cm x 10cm was significantly superior over all the treatments. This could be mainly attributed to increased plant height maintained throughout the crop period resulting in enhanced carbohydrate synthesis, which ultimately led to higher dry weight production. These findings were in agreement with Rao *et al*. (2013) [27] and Singh *et al*. (2015) [31].

Similarly, Crop growth rate recorded at 45DAS-At harvest (5.99/m^2/day) recorded significantly higher in Spacing 30cm x 10cm + Poultry manure @ 2t/ha which was followed by Spacing 20cm x 10cm + Poultry manure @ 2t/ha (5.82g/m2 /day) and Spacing 30cm x10 cm + FYM @ 2t/ha (5.57g/m^2/day) repectively.

Data decipted in table 1 shows that Relative growth rate recorded 45 DAS to at harvest stage was found non-significant effect among treatments. However, highest relative growth rate (0.06g/g/day) were recorded with Spacing 30cm x 10cm + Poultry manure @2t/ha. While lowest relative growth rate (0.01g/g/day) was observed in Spacing 30cm x10cm + FYM @ 10t/ha, respectively.

Yield attributes and yield

As given in Table 2 pods per plant recorded a significant difference among treatment combinations. However, pods/plant (39.7/plant) recorded significantly higher in Spacing 30 x 10cm + Poultry manure @ 2t/ha which was followed by the treatment combinations of Spacing 40 x 10cm + Goat manure @5t/ha (38.3/plant) respectively.

Higher number of pods/plants were noticed in the treatment with application of poultry manure with spacing 30cm x 10cm. This might be due to more vigorous and luxuriant vegetative growth, which in turn favoured a better partitioning of assimilates from source to sink. Similar results were obtained by Yadav *et al*. (2007) [34] and Rao *et al*. (2013) [27].

Further Grain per pod was noticed maximum (12.3grain/pod) in Spacing 30 x 10cm + Poultry manure @ 2t/ha which was significantly superior over all other treatments however, Spacing 40 x 10cm + Goat manure @ 5 t/ha (11.7) followed by treatment combination, Spacing 40 x 10cm + Goat manure @ 5 t/ha (11.7grain/pod) respectively.

Higher grain yield was recorded in poultry manure incorporated treatment. The higher grain yield might be accounted to the increased supply of almost all plants essential nutrients by translocation of photosynthates accumulated under the influence of the source of organic nutrients. Further, the translocation and accumulation of photosynthates in the economic sinks thus increased yield attributes, chlorophyll content and nitrate reductase activity resulted in grain yield. The same was obvious through the findings of Yadav *et al.* (2007) [34], Rao *et al.* (2013) [27] and Singh *et al*. (2015) [31].

Data decipted in table 2 shows that Test weight recorded at At harvest, was a significant effect among treatments. Significantly higher Test weight (38.40g) were recorded in Spacing 30cm x 10cm + Poultry manure @ 2t/ha, which was followed by Spacing 40cm x 10cm + Goat manure @ 5t/ha (38.17g) and (Spacing 30cm x 10cm + FYM @ 10t/ha (38.00g), respectively.

Higher test weight of Greengram was recorded in poultry manure incorporated plots and with spacing 30cm x 10cm. This might due to better growth of crop, efficient dry matter partitioning and better translocation to the sink, leading to the formation of large sized grains. This ultimately resulted in higher test weight this is in conformity with the results obtained by Rao *et al.* (2013) [27] and Singh *et al*. (2015) [31].

Similarly, Grain yield recorded a significant difference among treatment combinations. However, Grain yield (970.33kg/ha) recorded significantly higher in Spacing 30cm x 10cm + Poultry manure @ 2t/ha. Whereas, Spacing 40cm x 10cm +Goat manure @ 5t/ha of (900.54kg/ha) is statistically at par to Spacing 30cm x 10cm + Poultry manure @ 2t/ha.

Higher Grain yield was recorded in poultry manure incorporated plots with spacing of 30cm x 10cm which was higher than the remaining treatments. Higher grain yield might be accounted to the increased supply of almost all plants essential nutrients by translocation of photosynthates accumulates under the influence of the source of organic nutrients. Further the translocation and accumulation of photosynthates in the economic sinks thus increased yield attributes, chlorophyll content and nitrate reductase activity resulted in increased grain yield the same was obvious through the findings of Yadav *et al.* (2007) [34], Rao *et al.* (2013) [27] and Singh *et al.* (2015) [31].

Data presented in table 2 shows that Significantly higher stover yield was recorded in Spacing 30cm x 10cm + poultry manure @ 2t/ha was recorded maximum stover yield (1597.66 kg/ha) which was significantly superior over all the treatment which is followed by Spacing 40cm x 10 cm + FYM @ 10t/ha respectively.

Among the organic manures tired, incorporation of poultry manure with spacing of 300cm x 10cm recorded the higher straw yield. The increased stover yield might be because of better vegetative growth and higher dry matter production due to availability of all plant nutrients and better physical properties of soil these finding confirms Rao *et al.* (2013) [27] and Singh *et al*. (2015) [31].

Data in Table 2. revealed that Harvest index with Spacing 30x10 cm + poultry manure @ 2t/ha was recorded maximum harvest index (38.29%) which is followed by Spacing 40cm x 10cm + Poultry manure @ 2t/ha (37.78%) and Spacing 20cm x10cm + Goat manure @ 5t/ha (37.15%) respectively.

Table 1: Effect of Spacing and Levels of Organic manure on Growth Attributes of Greengram.

Treatments	Plant height (cm) at harvest	Number of branches/ Plant at Harvest	No. of Nodules/plant at harvest	Dry weight (g/plant) at Harvest	Crop Growth Rate (g/m^2/plant) 45DAS -Harvest	Relative Growth Rate (g/g/plant) 45DAS- harvest
1. Spacing 20cm x 10cm + FYM @ 10t/ha	36.9	5.13	22.40	6.54	4.70	0.03
2. Spacing 20cm x 10cm + goat manure @ 5t/ha	36.9	5.20	24.20	6.61	4.77	0.04
3. Spacing 20cm x 10cm + poultry manure @2t/ha	36.8	5.27	24.58	6.64	5.82	0.03
4. Spacing 30cm x 10cm + FYM @ 10t/ha	37.8	5.40	22.90	6.72	5.07	0.01
5. Spacing 30cm x 10cm +goat manure @ 5t/ha	37.0	5.73	24.10	6.76	5.28	0.03
6. Spacing 30cm x 10cm + poultry manure @2t/ha	38.5	5.81	25.60	6.86	5.99	0.06
7. Spacing 40cm x 10cm + FYM @ 10t/ha	37.4	5.60	22.67	6.83	5.57	0.04
8. Spacing 40cm x 10cm + Goat manure @ 5t/ha	37.9	5.67	22.93	6.73	5.56	0.03
9. Spacing 40cm x 10cm + poultry manure @ 2t/ha	36.8	5.52	23.47	6.82	5.46	0.03
F test	S	S	NS	S	S	NS
S.Em (±)	0.15	0.06	0.40	0.04	0.23	0.01
C. D (5%)	0.64	0.17	-	0.12	0.46	-

Table 2: Effect of Spacing and Levels of Organic manure on Yield Attributes of Greengram

Treatments	Pods/plant at harvest	Grain /pod	Test weight (g)	Grain/yield (kg/ha)	Stover yield (kg/ha)	Harvest index (%)
1. Spacing 20cm x 10cm + FYM @ 10t/ha	32.7	6.2	36.96	716.33	1301.33	35.43
2. Spacing 20cm x 10cm + Goat manure @ 5t/ha	32.3	7.7	37.23	799.35	1350.00	37.15
3. Spacing 20cm x 10cm + Poultry manure @ 2t/ha	35.3	8.7	36.38	815.64	1470.35	35.67
4. Spacing 30cm x 10cm + FYM @ 10t/ha	36.3	9.3	38.00	760.80	1434.33	34.65
5. Spacing 30cm x 10cm + Goat manure @ 5t/ha	34.0	8.5	36.73	807.56	1475.45	35.67
6. Spacing 30cm x 10cm + Poultry manure 2t/ha	39.7	12.3	38.40	970.35	1597.65	38.29
7. Spacing 40cm x 10cm + FYM @ 10t/ha	36.7	9.3	36.71	798.86	1481.00	35.05
8. Spacing 40cm x 10cm + Goat manure @ 5t/ha	38.3	11.7	38.17	900.54	1469.45	36.61
9.Spacing 40cm x 10cm + Poultry manure @ 2t/ha	36.3	7.4	37.25	890.34	1442.35	37.78
F-Test	S	S	S	S	S	S
S.Em (±)	0.91	2.07	0.36	19.04	33.50	0.72
C. D (5%)	2.73	0.68	1.09	72.11	118.44	1.64

Fig 1: Greengram crop at SHUATS Model Organic Farm (SMOF)

Fig 2: Spraying of Neem Oil for insect control in organic Greengram field.

Conclusion

Based on the findings of experimentation in one season in a year, it is concluded that Greengram crop has higher with application of Spacing 30cm x10cm + Poultry manure @ 2t/ha was found more productive of Grain yield (970.33 kg/ha) as well as economically viable with maximum B:C ratio (1.92) and is more helpful for attaining better growth and yields in Sesame under Eastern U.P. climatic condition.

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