

Original Research Article

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Study of System of Crop Intensification (SCI) and Phosphorus Management on Growth, Yield and Economics of Greengram (*Vigna radiata* L.)

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ABSTRACT

A field experiment was conducted during Zaid 2019 at Central Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). To study the “System of Crop Intensification (SCI) and Phosphorus management on growth, yield and economics of Greengram (*Vigna radiata*)”. There were 10 treatments each replicated thrice. The treatment consists of 4 different spacing levels of (20cm×20cm), (25cm×25cm), (30cm×30cm), (35cm×35cm) and 2 different sources of application of phosphorus, 100% RDP through Inorganic, 50% RDP Inorganic + 50% Organic.. The experiment was laid out in Randomized Block Design. The results revealed that maximum growth attributes such as plant height (24.87cm), number of nodules (6.80 /plant) and dry weight (4.52 g/ plant) was obtained by application of T₁:(100%RDP through Inorganic + 20cm × 20 cm) at 60 days after sowing. However maximum Crop growth rate (2.21 g/m²/day) at 15-30DAS were recorded with the application of T₉ (100% RDP through Inorganic (Control) 30cm × 10cm). As well as significantly maximum yield attributes viz, pods per plant (16.80), grains per pod (10.37), Grain yield (1113.67 kg/ ha), Stover yield (2556 kg/ha) were recorded under 100%RDP through Inorganic + 20cm × 20 cm. However gross return (101778 ₹ ha), Net return (63444 ₹ ha) and B:C ratio (2.70) were showed their superiority with application T₂ (100%RDP through Inorganic +25cm× 25cm) as compared to other treatments.

Keywords

Green gram,
Plant geometry,
Phosphorus

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Introduction

The mung bean (*Vigna radiata* L.) is under cultivation since pre-historic time in India. It is also known as green gram and serve are a major source of dietary protein for the vast majority of people. Pulses are considered as lifeblood of Agriculture. Pulses occupy a

unique position in every farming system viz., main, catch, cover, green manure, intercrop and mix crop. Their inclusion in rotation kept the soil alive and productive. Pulse crops enrich the soil fertility by means of addition of organic matter and fixation of atmospheric nitrogen mediated by root nodule of Rhizobium bacteria. They are the cheapest

source of quality protein for the human being. It is well known that paucity of protein diet results in malnutrition. In general, pulses have two to three times more protein than the cereals or any other group of plants besides supply of micronutrients, low fat, high dietary fiber and complex carbohydrates.

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 in turn moisture, nutrients and space availability Panwar and Sharma, (2004). 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.

Phosphorus is essential constituent of majority of enzyme which is of great importance in the transformation of energy in carbohydrates metabolism and also in respiration. P is closely related to cell division and development. Fertilizers play key role for obtaining higher crop production. Phosphorus is one of the major plant nutrients for pulses production. Green gram requires relatively higher quantity of phosphorus and is also sensitive to phosphorus deficiency. Keeping these points in view, a field experiment was conducted to assess the effect of System of

Crop Intensification (SCI) and Phosphorus management on growth, yield and economics of Greengram (*Vigna radiata* L).

Materials and Methods

The experiment was conducted during the *Zaid* season 2019, at the Crop Research Farm, Department of Agronomy, (SHUATS), Prayagraj (U.P.) The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.3), low in organic carbon (0.57%), available N (230 kg/ha), available P (32.10 kg/ha) and available K (235 kg/ha). The treatment consists of 4 different spacing levels of (20cm×20cm), (25cm×25cm), (30cm×30cm), (35cm×35cm) and 2 different sources of application of phosphorus, 100% RDP through Inorganic, 50% RDP Inorganic + 50% Organic. Whose effect was observed on Greengram. There were 10 treatments each replicated thrice. The experiment was laid out in Randomized Block Design. The crop was sown on 11th April 2019 using a variety Samrat (PDM-84-139) with a seed rate of 20 kg/ha. The recommended dose of 20 kg N, 40 kg P & 20 kg K₂O per ha was applied according to the treatment details through DAP, MOP and Vermicompost. Whole quantity of nitrogen and phosphorus was applied as basal at the time of sowing. Five random plants were selected from each plot to record observations on nodulation and plant growth parameters. Similarly, 5 random plant samples were collected from each plot at the time of harvest for recording observations on plant yield attributing characters. The economics viz., cost of cultivation, gross income, net income and B:C ratio was worked out at the prevailing market prices of the inputs and outputs at the time of harvest. Experimental data collected was subjected to statistical analysis by adopting Fishers method of Analysis of Variance (ANOVA) as outlined by Gomez and Gomez (2010). Critical Difference (CD) value was calculated

whenever the 'F' test was found significant at 5 % level.

Results and Discussion

Growth attributes

The growth parameters like plant height, number of nodules and dry weight was significantly affected by the application of different levels and sources of phosphorus along with different spacing.

Plant height (cm)

Table 1 revealed that green gram crop fertilized with 100%RDP through Inorganic and with spacing of 20cm × 20 cm, significantly resulted maximum plant height (24.87 cm) which was statistically at par with 100 % RDF through inorganic + 25 cm x 25 cm (24.33 cm) and 100 % RDF through inorganic (Control) 30 x 10 (23.87 cm) at 60 days after sowing.

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 Kumar *et al.*, (2017). The SCI practices had significant effects on plant height (cm). 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 (Siddharaju *et al.*, 2010).

Number of nodule per plant

In the present investigation, number of nodules per plant was increased with increasing crop age upto 45 DAS, thereafter

they were decreased to 60 DAS (Table 1) showed that significantly maximum number of nodules per plant (6.80) was recorded in T₁ (100% RDP through inorganic + 20cm × 20 cm) which was statistically at par with T₂ (100% RDP through Inorganic + 25cm × 25 cm) (6.37), 100% RDP through Inorganic + 30 cm × 30 cm (5.61), 50% RDP through Inorganic + 50% vermicompost + 20cm × 20cm (5.88) and 100% RDP through Inorganic (Control) 30cm × 10cm (6.13).

Such increase in nodulation, root and growth might be due to increase in number of nodules which might have supplied sufficient nitrogen by nitrogen fixation and finally enhance productivity of green gram. Similar results also obtained by Prasad *et al.*, (2014).

Dry weight (g) per plant

The analysed data presented in (Table 1) shown significant variation among all treatments. At 60 DAS significantly maximum plant dry weight (4.52) was recorded in T₁ (100% RDP through inorganic + 20cm × 20 cm), which was significantly superior over rest of the treatments except with T₂ (100%RDP through Inorganic + 25cm × 25cm) (4.43) and T₉ (100% RDP through Inorganic (Control) 30cm × 10cm) (4.17).

The plants attained more vigour with phosphorus application 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 dry weight of the plant. These results are close conformity with Erman *et al.*, (2009) and Pandya *et al.*, (2009).

Yield and yield attributes

Yield attributes and yield were also significantly affected by application of different levels and sources of phosphorus along with different spacing.

Number of pods/ plant

Successive increase in the number of pods per plant of Greengram was observed at harvest showing significant impact of System of crop Intensification (SCI) and phosphorus management respectively (Table 2) represent that significantly superior number of pods per plant (16.80) was recorded in T₁ (100%RDP through Inorganic + 20cm × 20 cm). And none of the treatments recorded at par value except T₉(100% RDP through Inorganic (Control) 30cm × 10cm) (15.90). Higher number of pods/plant 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 resulted into a higher length of the pod. The result is confirmed by Nadeem *et al.*, 2003.

Number of seeds per plant

Significantly superior number of pods per plant (10.37) table 2 was recorded in T₁ (100% RDP through Inorganic + 20cm × 20 cm) which statistically at par with 100%RDP through Inorganic + 25cm × 25cm (10.17), 100%RDP through Inorganic + 30cm × 30cm (10.30), 100%R DP through Inorganic + 35cm × 35cm (10.03), 100% RDP through Inorganic (Control) 30cm × 10cm (10.07). Increase in Number of seeds per plant due sufficient availability of nutrients (nitrogen, phosphorus, potassium and spacing) and their absorption by the plants, together with better photosynthetic activity due to proper light and spacing between the plants increased the

vigour and plant growth thereby resulting in greater number of seed plant. Similar results also reported by Khan *et al.*, (2017).

Test weight (g)

Data of test weight showed that significantly maximum test weight was recorded under 100%RDP through Inorganic + 20cm × 20 cm (36.78) (Table 2) which was significantly superior over all other treatments except 100%RDP through Inorganic + 25cm × 25cm (36.67), 100%RDP through Inorganic + 35cm × 35cm (36.20), 50% RDP through Inorganic + 50% vermicompost + 25cm × 25cm (36.10), 100% RDP through Inorganic (Control) 30cm × 10cm (36.23). Higher vigour and growth attained by the plants due to sufficient absorption of nutrients might have resulted in higher test weight. Similar results also reported by Sundara *et al.*, (2004) and Aga *et al.*, (2004).

Grain yield (Kg/ha)

Table 2 represented that significantly superior grain yield (1113.67) was recorded in T₁ (100%RDP through Inorganic + 20cm × 20 cm) which was statistically at par with 100% RDP through Inorganic + 25cm × 25cm (1054) and 100% RDP through Inorganic (Control) 30cm × 10cm (1060.67). This might be due to that greater translocation of photosynthates from source to sink might have increased seed yield. Similar conformity has by Balai *et al.*, (2017). Phosphorus increases yield due to its well-developed root system, increased N fixation and its availability to the plants and favorable environments in the rhizosphere. Also Lokhande *et al.*, (2018) also reported similar results.

Stover yield (Kg/ha)

Stover yield data showing that significant variation among all treatments.

Table.1

Treatments	Plant height (cm)	Nodules/plant	Dry weight (g)
1. 100%RDP through Inorganic + 20cm × 20 cm	24.87	6.80	4.52
2. 100%RDP through Inorganic + 25cm × 25cm	24.33	6.37	4.43
3. 100%RDP through Inorganic + 30cm × 30cm	17.95	5.61	3.51
4. 100%RDP through Inorganic + 35cm × 35cm	18.85	5.27	3.43
5. 50% RDP through Inorganic + 50% vermicompost + 20cm × 20cm	19.89	5.88	3.60
6. 50% RDP through Inorganic + 50% vermicompost + 25cm × 25cm	20.86	5.70	3.78
7. 50% RDP through Inorganic + 50% vermicompost + 30cm × 30cm	18.60	4.99	3.68
8. 50%RDP through Inorganic + 50% vermicompost + 35cm × 35cm	21.42	4.78	3.77
9. 100% RDP through Inorganic (Control) 30cm × 10cm	23.87	6.13	4.17
10. 50% RDP through Inorganic + 50% vermicompost (Control) 30cm × 10cm	17.27	4.13	3.43
F test	S	S	S
SEm±	0.89	0.47	0.21
CD (P = 0.05)	2.65	1.41	0.62

Table.2

Treatments	No. of pods plant ⁻¹	No. of grains pod ⁻¹	Test weight (g)	Grain yield (kg ha ⁻¹)	Stover yield (kg ha ⁻¹)
1. 100%RDP through Inorganic + 20cm × 20 cm	16.80	10.37	36.78	1113.67	2556
2. 100%RDP through Inorganic + 25cm × 25cm	15.77	10.17	36.67	1054	2251
3. 100%RDP through Inorganic + 30cm × 30cm	15.00	10.30	35.60	786	1650
4. 100%RDP through Inorganic + 35cm × 35cm	15.40	10.03	36.20	781	1606
5. 50% RDP through Inorganic + 50% vermicompost + 20cm × 20cm	13.63	9.87	35.67	821.33	1808
6. 50% RDP through Inorganic + 50% vermicompost + 25cm × 25cm	13.87	9.93	36.10	776	1637
7. 50% RDP through Inorganic + 50% vermicompost + 30cm × 30cm	13.53	9.77	35.94	705	1564
8. 50%RDP through Inorganic + 50% vermicompost + 35cm × 35cm	13.03	9.57	35.87	700	1531.67
9. 100% RDP through Inorganic (Control) 30cm × 10cm	15.90	10.07	36.23	1060.67	2424
10. 50% RDP through Inorganic + 50% vermicompost (Control) 30cm × 10cm	13.07	9.63	35.70	854	1926
F test	S	S	S	S	S
SEm±	0.33	0.14	0.24	28.89	43.18
CD (P = 0.05)	0.98	0.40	0.72	85.83	128.28

Table.3

Treatments	Gross return (Rs ha⁻¹)	Net return (Rs ha⁻¹)	B:C Ratio
1. 100%RDP through Inorganic + 20cm × 20 cm	101778	63444	2.66
2. 100%RDP through Inorganic + 25cm × 25cm	95985	60497.1	2.70
3. 100%RDP through Inorganic + 30cm × 30cm	71625.1	34247.1	1.92
4. 100%RDP through Inorganic + 35cm × 35cm	71093	31775	1.81
5. 50% RDP through Inorganic + 50% vermicompost + 20cm × 20cm	74824.3	40271.33	2.17
6. 50% RDP through Inorganic + 50% vermicompost + 25cm × 25cm	70658.5	35150.50	1.99
7. 50% RDP through Inorganic + 50% vermicompost + 30cm × 30cm	64232	20178	1.46
8. 50%RDP through Inorganic + 50% vermicompost + 35cm × 35cm	63795.3	27702	1.77
9. 100% RDP through Inorganic (Control) 30cm × 10cm	96672	58084	2.51
10. 50% RDP through Inorganic + 50% vermicompost (Control) 30cm × 10cm	77823.17	44225.17	2.32

Maximum (Table 2) stover yield was obtained under 100% RDP through Inorganic + 20cm × 20 cm (2556 kg/ha) and none of treatments recorded at par value. The increase in stover 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 yield. Balai *et al.*, (2017) also reported similar findings.

Economics

The highest gross (₹ 101778/ha) and net returns (₹ 63444/ha) were obtained in Green gram fertilized with 100%RDP through Inorganic and with spacing of 20cm × 20 cm. Where, as the higher B:C ratio (2.70) were obtained in Green gram fertilized with 100% RDP through Inorganic and with spacing of 25cm × 25 cm (Table 3). The increase in gross returns and net returns of Green gram crop in the same unit area obtained from 100%RDP through Inorganic and with spacing of 20cm × 20 cm because of optimum fertilizer doses are along with huge plant population available for the crop and moreover, the increase in spacing results in higher B:C ratio when fertilized with 100% RDP through Inorganic along with spacing of 25cm × 25 cm, because of lesser competition for available nutrients between the plants with lesser plant population

It is concluded, on the basis of one year experiment, application of 100%RDP through Inorganic along with a spacing of 20cm × 20 cm is more productive whereas 100%RDP through Inorganic along with a spacing of 25cm × 25 cm was economically effective.

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