International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(4): 2390-2392

Received: 28-05-2019
Accepted: 30-06-2019

Thota Satya Santhosh Kumar
M. Sc Student, MSSSOA, Centurion University of Technology and Management Paralakhemundi, Odisha, India

Pakalpati Satyanarayana Raju
Professor Emeritus, MSSSOA, Centurion University of Technology and Management Paralakhemundi, Odisha, India

Tetakale Umamaheswari
Assistant Professor, MSSSOA, Centurion University of Technology and Management Paralakhemundi, Odisha, India

Archana Behera
Technician, MSSSOA, Centurion University of Technology and Management Paralakhemundi, Odisha, India

Correspondence
Thota Satya Santhosh Kumar
M. Sc Student, MSSSOA, Centurion University of Technology and Management Paralakhemundi, Odisha, India

Effects of plant spacing on growth attributes of greengram (*Vigna radiata* L. Wilczek)

Thota Satya Santhosh Kumar, Pakalpati Satyanarayana Raju, Tetakale Umamaheswari and Archana Behera

Abstract
Greengram (*Vigna radiata* L. Wilczek), also known as mung bean, is a major pulse crop cultivated throughout India. A field experiment was conducted during *rabi* 2018-19 on a sandy loam soil in Centurion University Farm (23º39’ N latitude, 87º42’ E longitude), R.Sitapur, Gajapati District, Odisha, to study the effects of plant spacing on the growth parameters of green gram. The experiment was laid out in a randomized complete block design with five replications and four treatments. The four treatments were within row plant spacings of 7, 9, 11, and 13 cm, corresponding to population densities of 2,37,500, 1,83,333, 1,50,000, and 1,25,000 plants per hectare, respectively. Seeds of the green gram variety Shakti (NRI G 002) were sown in rows on ridges spaced 60 cm apart. The growth attributes, plant height, branches/plant, leaves/plant, and plant dry matter were measured at 30, 50, and 65 days after sowing (DAS) and LAI, RGR, and CGR were calculated. In general, plant height and branches/plant decreased with decrease of plant spacing from 13 to 7 cm. The number of leaves/plant increased with increased plant spacing from 9 to 11 cm. When the plants were young at 30 DAS, LAI was greater in the wider plant spacing of 13 cm compared to closer spacing. The RGR was very low at 50-65 DAS in all spacing treatments and CGR increased with decreased plant spacing from 13 to 7 cm.

Keywords: Green gram, grain yield, population density, plant spacing, mung bean, stover

Introduction
Greengram (*Vigna radiata* L. Wilczek), also known as mung bean, is an important pulse crop cultivated widely in India. It is grown in several tropical and subtropical countries. India is the world’s largest producer as well as consumer of greengram. Major greengram producing States are Rajasthan, Maharashtra, AP, Gujarat, Bihar, and Karnataka. It occupies a prime position among pulses by virtue of its short growth period, high biomass, and outstanding nutrient value as food, feed, and forage. Its grain contain 24.7% protein, 0.6% fat, 0.9% fiber, and 3.7% ash, as well as sufficient quantity of calcium, phosphorus, and important vitamins. As a cheap protein-rich food, it is designated as “poor man’s meat” (Aslam *et al.*, 2010) [1].
Greengram is best suited to areas having annual rainfall of 600-800 mm. It is one of the hardiest of pulse crops and tolerates drought. It requires hot weather, optimum mean temperature being 28-32 C. It is grown in *kharif* and summer seasons in north India but in *rabi* season in south and south-west India. It can be very successively grown in drought prone areas during rainy season. Well drained loamy to sandy loam soil is best suited for greengram cultivation. It is best suited to areas having annual rainfall of 600-800 mm. It is one of the hardiest of pulse crops and tolerates drought. It requires hot weather, optimum mean temperature being 28-32 C. It is best suited to areas having annual rainfall of 600-800 mm. It is one of the hardiest of pulse crops and tolerates drought. It requires hot weather, optimum mean temperature being 28-32 C. It is grown in *kharif* and summer seasons in north India but in *rabi* season in south and south-west India. Plant population density affects water and nutrient availability to individual crop plants and thus affects crop yields. The present study was done to determine the optimum plant population density of green gram to maximize grain yield on sandy loam soils in Gajapati district of Odisha.

Materials and Methods
Experiment Site and Design
A field experiment was conducted in the *rabi* season of 2018-19, during December to February at Centurion University Farm (23°39' N latitude, 85°83' E longitude), R. Sitapur, Gajapati

district, Odisha. A composite soil sample was drawn to a depth of 30 cm from the experimental field before sowing. The soil was analysed for physical and chemical properties. The soil of the experimental plot was sandy loam in texture, where the percentages of sand, silt, and clay were 55.2, 20.4, and 18.5, respectively. The soil pH was 6.4, EC 0.20 dS m^{-1}, and organic carbon 0.53%. During the period of the experiment, the minimum and maximum temperatures ranged from 11.86 to 19.06 C and 28.22 to 30.28 C, respectively. The crop received rainfall of 16.36, 4.43, and 0.08 mm during the months of December, January, and February, respectively. Greengram seeds of the variety Shakti (NRI G 002) were sown in rows on ridges spaced 60 cm apart. The experiment was conducted in a randomozed complete block design with five replications. Within row plant spacings of 7, 9, 11, and 13 cm were the four treatments. Each plot was 19.2 m^2 in area and consisted of 8 rows, each 4 m long.

Experiment Procedure

The land was ploughed twice with a mouldboard plough and then harrowed, levelled, and ridged. Fertilizer was applied basally at the rate of 20 kg N, 40 kg P_2O_5, and 20 kg K_2O per hectare in the form of urea, single super phosphate, and muriate of potash, respectively. The greengram seeds were sown at 3 cm depth on 30th November, 2018 and the field irrigated. Irrigations were applied thereafter when needed. Two hand weedings were done at 15 and 30 DAS. To maintain plant populations in treatments, thinning was done after 15 DAS when the plants had 3-4 leaves.

Plant height was recorded on five randomly selected and tagged plants at 30 and 50 DAS and at harvest stage (65 DAS). Samples of 5 randomly selected plants each were collected at 30, 50, and 65 DAS and taken for growth analysis. Leaf area was measured by a leaf area meter. Numbers of branches/plant and leaves/plant were noted. The plant parts were dried in a forced draft oven at 80 C for two days, till a stable weight was attained, allowed to cool, and weighed. Leaf area index (LAI) was calculated as a ratio of the leaf area of the plants to the land area occupied by the plants. Crop growth rate (CGR) was calculated using the formula (Watson, 1952) [2]: CGR (g m^{-2} day^{-1}) = $(W_2 - W_1) / (t_2 - t_1)$, where W_1 and W_2 are plant dry weights per unit area at t_1 and t_2 days, respectively.

Statistical analysis of the data recorded for various plant growth characters was done using statistical procedures appropriate for the randomized complete block design and the treatment variances were tested by the “F” test. Treatment means, standard errors of means, co-efficient of variation percentages, critical differences (CDs) at 5% probability level were calculated, and obtained CD values compared with table values to test whether the various plant characters showed significant differences among treatments.

Results and Discussion

Plant height (Table 1), branches/plant (Table 2), and number of leaves/plant (Table 3) of greengram at 30, 50, and 65 DAS were significantly affected by plant spacing. Maximum plant height of 25.53 cm at 30 DAS was recorded at the widest plant spacing of 13 cm and the minimum was observed at the closest spacing of 7 cm. Maximum plant height was recorded at 65 DAS in the spacing of 13 cm and minimum at spacing of 7 cm. Plant height decreased with decrease of plant spacing from 13 to 7 cm. These findings are also in agreement with the findings of (Nimje *et al*. 2003) [3]. The plant height was less at 7 cm probably due to more plant population.

Table 1: Effects of plant spacing on plant height (cm) at different growth stages of greengram.

Plant spacing	30 DAS	50 DAS	65 DAS
7 cm	18.83	28.59	38.91
9 cm	21.74	28.90	40.91
11 cm	22.70	30.28	42.74
13 cm	25.53	32.19	44.18
SEm ±	0.65	0.30	0.45
CD($P \leq 0.05$)	1.43	0.66	0.99
CV (%)	14.8	5.1	5.5

In general, the number of branches increased with increased plant spacing from 7 to 13 cm. At 30, 50, and 65 DAS, the maximum number of branches/plant were observed at 13 cm spacing and the minimum number at 7 cm spacing. This might be due to increased plant growth at wider spacing, where plants had better opportunity to avail more space, light, and nutrients leading to maximum branches per plant. The above findings are in complete agreement with the work of Mohapatra (1998) [4].

Table 2: Effects of plant spacing on branches/plant at different growth stages of green gram.

Plant spacing	30 DAS	50 DAS	65 DAS
7 cm	2.98	2.84	2.946
9 cm	2.9	3.54	3.116
11 cm	3.3	3.68	3.266
13 cm	3.18	3.88	4.364
SEM ±	0.09	0.08	0.06
CD ($P \leq 0.05$)	0.19	0.17	0.12
CV (%)	13.9	10.9	8.3

The number of leaves/plant increased with increased plant spacing from 9 to 11 cm. At 65 DAS, the maximum number of 24.20 leaves were observed in 11 cm spacing and the minimum number of 18.80 leaves were in 9 cm spacing. (Khanda *et al*. 2001) [5] earlier found that wider plant spacing resulted in higher number of leaves per plant compared to other treatments.

Table 3: Effects of plant spacing on leaves/plant at different growth stages of green gram.

Plant spacing	30 DAS	50 DAS	65 DAS
7 cm	10.94	15.20	20
9 cm	10.7	14.21	18.80
11 cm	11.9	17.72	24.20
13 cm	11.54	16.94	21.80
SEm ±	0.26	0.23	0.34
CD ($P \leq 0.05$)	0.56	0.51	0.74
CV (%)	11.5	7.3	8

In general, plant dry matter increased with decreased within-row plant spacing, attaining maximum of 6.39 g at 50 DAS and 8.92 g at 65 DAS in 7 cm plant spacing (Table 4).

Table 4: Effects of plant spacing on plant dry matter (g) at different growth stages in green gram

Plant spacing	30 DAS	50 DAS	65 DAS
7 cm	1.12	6.39	8.92
9 cm	1.24	6.20	8.69
11 cm	1.29	6.11	7.44
13 cm	1.04	6.10	7.58
SEm ±	0.03	0.10	0.12
CD $P \leq 0.05$)	0.08	0.23	0.26
CV (%)	15.8	8.8	7.5

When the plants were young at 30 DAS, LAI was greater in the wider plant spacing of 13 cm compared closer spacing. Later, when the plants were older at 50 and 65 DAS, the differences in LAI between treatments did not show clear trends (Table 5). The younger plants in wider spacing might have had more access to light, water, and nutrients and thereby grew more luxuriently and produced greater LAI. However, the plants in later stages might have overlapped canopies and rate of leaf area increase might have slowed down, thereby reducing the earlier advantages of wider spacing on LAI. Chiezey *et al.* (1993) [6] observed that LAI was greatly enchanced by the wider spacing.

Table 5: Effects of plant spacing on leaf area index at different growth stages in green gram.

Plant spacing	30 DAS	50 DAS	65 DAS
7 cm	1.1	3.01	3.10
9 cm	2.16	3.63	2.36
11 cm	2.08	3.42	2.96
13 cm	2.23	3.2	2.91
SEm ±	0.05	0.09	0.07
CD($P \leq 0.05$)	0.11	0.20	0.16
CV (%)	13.8	14	13

The relative growth rate (RGR) at 30-50 was greater in 9 cm plant spacing compared to other spacings (Table 6). The RGR was very low at 50-65 DAS in all spacing treatments. RGR was earlier found to be significantly high at wider plant spacings (Chiezey *et al.*, 1993) [7].

Table 6: Effects of plant spacing on RGR (g m^{-2} day^{-1}) at 30-50 DAS and 50-65 DAS in green gram.

Plant spacing	30-50 DAS	50-65 DAS
7 cm	0.26	0.03
9 cm	0.27	0.03
11 cm	0.26	0.03
13 cm	0.26	0.02
SEm ±	0.01	0.00
CD($P \leq 0.05$)	0.01	0.00
CV (%)	10.7	13.5

Between 30-50 DAS, CGR was found to be significantly different amongst treatments (Table 7). CGR increased with decreased plant spacing from 13 to 7 cm, with the maximum in 7 cm spacing being 6.33 and 8.49 between 30-50 DAS and 50-65 DAS, respectively. These trends are in conformity with those found by Biswas (2002) [8].

Table 7: Effects of plant spacing on crop growth rate (g m^{-2} day^{-1}) at 30-50 DAS and 50-65 DAS in green gram.

Plant spacing	30-50 DAS	50-65 DAS
7 cm	6.33	8.49
9 cm	6.14	8.27
11 cm	6.05	7.03
13 cm	6.05	7.17
SEm ±	0.11	0.12
CD ($P \leq 0.05$)	0.24	0.27
CV (%)	8.9	8

Conclusion

In general, the plant height and branches/plant of green gram variety Shakti (NRI G 002) decreased with decrease of plant spacing from 13 to 7 cm. The number of leaves/plant increased with increased plant spacing from 9 to 11 cm. When the plants were young at 30 DAS, LAI was greater in the wider plant spacing of 13 cm compared to closer spacing. The RGR was very low at 50-65 DAS in all spacing treatments and CGR increased with decreased plant spacing from 13 to 7 cm.

References

1. Aslam M, Hussain N, Zubair M, Hussain SB, Baloch MS. Integration of organic & inorganic sources of phosphorus for increased productivity of mungbean (*Vigna radiata* L.). Pakistan Journal of Agriculture Science. 2010; 47(2):111-114.
2. Watson DJ. The physiological basis of variation in yield. Advances in Agronomy. 1952; 4:101-145.
3. Nimje PM, Agrawal V, Soni RD. Effect of plant density and improved seeding machinery on yield and economics of soybean (*Glycine max*). Indian Journal of Agronomy 2003; 48(4):301-304.
4. Mohapatra AK. Effect of time of sowing, spacing and fertility levels on growth and yield of rice bean (*Vigna umbellata*). Indian Journal of Agronomy. 1998; 43(1):118-121
5. Khanda CM, Mohapatra AK, Misra PK. Response of rice bean (*Vigna umbellata*) to row spacing and phosphorus under rainfed condition. Annals of Agricultural Research New series 2001; 22(4):481-484
6. Chezey UF, Yayock TY, Ahamed MK. Growth and development of soybean influenced by phosphorus fertilizer and plant density. Crop research 1993; 6(3):341-349.
7. Biswas DK, Haque MM, Hamid A, Ahmed JU, Rahman MA. Influence of plant population density on growth and yield of two blackgram varieties. J of Agron. 2002; 1(2):83-85.