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Influence of plant geometry and integrated nutrient management on growth and yield of cluster bean (*Cyamopsis tetragonoloba* L. Taub) cv. Pusa Navbahar

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Abstract

A field experiment was conducted during *Kharif-Rabi* season of 2018 at Horticulture Research Farm, Department of Horticulture, B. A. College of Agriculture, Anand Agricultural University, Anand to study the "Influence of plant geometry and integrated nutrient management on growth and yield of cluster bean (*Cyamopsis tetragonoloba* L. Taub) cv. Pusa Navbahar". The experiment was laid out in Randomized Block Design (Factorial) with 3 replications and fourteen treatments combination comprising of two levels of plant geometry *viz.*, S_1: 45 × 15 cm and S_1: 30 × 15 cm and seven level of integrated nutrient management *viz.*, F_1 - 25:50:00 NPK kg/ha (Control), F_2 - 30:60:00 NPK kg/ha, F_3 - 50 % RDN through inorganic fertilizer + 50 % RDN through FYM + seed treatment of *Rhizobium* and Phosphate solubilizing bacteria (each 5 ml/kg of seed), F_4 - 50 % RDN through inorganic fertilizer + 50 % RDN through vermicompost + seed treatment of *Rhizobium* and Phosphate solubilizing bacteria (each 5 ml/kg of seed), F_5 - 20:40:00 NPK kg/ha + seed treatment of *Rhizobium* (5 ml/kg of seed), F_6 - 20:40:00 NPK kg/ha + seed treatment of Phosphate solubilizing bacteria (5 ml/kg of seed), F_7 – 20 : 40 : 00 NPK kg/ha + seed treatment of *Rhizobium* and Phosphate solubilizing bacteria (each 5 ml/kg of seed). Plant geometry had significant effect on yield parameters while, it did not manifest its significant effect on growth parameters and green pod weight. Plant geometry 45 × 15 cm (S_1) recorded significantly, maximum number of cluster/plant, number of pods/cluster, green pod length (cm) and green pod yield (g/plant) whereas, green pod yield (t/ha) was found significantly, maximum in plant geometry 30 × 15 cm (S_2). Integrated nutrient management had significant effect on yield parameters while, it did not manifest its significant effect on growth parameters and green pod weight (g). Maximum number of cluster/plant, number of pods/cluster, green pod yield (g/plant) and green pod yield (t/ha) was recorded with treatment F_4. While, maximum green pod length (cm) was observed in treatment F_3.

Keywords: Cluster bean, FYM, vermicompost, *Rhizobium*, phosphate solublising bacteria

Introduction

Cluster bean (*Cyamopsis tetragonoloba* L. Taub.) belongs to family Fabaceae is an important drought resistant leguminous vegetable crop. It is a short duration crop mainly grown in arid and semi-arid regions of tropical India. It has deep penetrating root system enables the plant to utilize available moisture more efficiently and thus offers better scope for rainfed cropping.

India is one of the major cluster bean producing countries of the world contributing around 75 to 80 % of the world's total production. In India Rajasthan, Gujarat, Haryana, Utter Pradesh and Punjab are known to be leading states for cultivation of this crop. Pods of cluster bean are rich in food value and each 100 g contains 10.8 g carbohydrate, 3.2 g protein, 1.4 g minerals, 316 IU vitamin-A and 47 mg Vitamin-C. It is also used as a nutritious fodder for livestock.

Cluster bean is used for human consumption, cattle feed, medicinal and industrial purposes as well as for soil improvement.

It has assumed great significance in recent years mainly because of its good quality gum content, although it has grown earlier for years as vegetables, feed and fodder crop, which is in great demand. Mucilaginous seed flour is used for making guar gum (galactomannan).

The plant to plant and row to row distance ensure proper utilization of different natural inputs, *viz*. nutrition, moisture, sunlight and minimize competition for growth. The optimum plant spacing increased plant population which boosts up yield directly by increasing the plant number and indirectly by smothering the weeds.

Use of inorganic fertilizers alone it may not sustain the productivity in long run and affects soil health. On the other hand, organic sources of nutrients are cheaper, ecofriendly, improve soil properties and can substitute nutrient requirement of crops partially.

Hence, integrated use of inorganic fertilizers, organic manures and low-cost nutrient sources such as bio fertilizers is the better option for sustainable production and to maintain soil health.

Materials and methods

An experiment was conducted during *Kharif –Rabi* season of the year 2018 at Horticulture Research Farm, Department of Horticulture, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat. The soil of the experimental site was sandy loam. It is well drained, porous with good moisture retention capacity. The experiment was laid out in Randomized Block Design (Factorial) with 3 replications and fourteen treatments combination comprising of two levels of plant geometry (S_1: 45 × 15 cm and S_1: 30 × 15 cm) and seven level of integrated nutrient management *viz.*, F_1 - 25:50:00 NPK kg/ha (Control), F_2 - 30:60:00 NPK kg/ha, F_3 - 50 % RDN through inorganic fertilizer + 50 % RDN through FYM + seed treatment of *Rhizobium* and Phosphate solubilizing bacteria (each 5 ml/kg of seed), F_4 - 50 % RDN through inorganic fertilizer + 50 % RDN through vermicompost + seed treatment of *Rhizobium* and Phosphate solubilizing bacteria (each 5 ml/kg of seed), F_5 - 20:40:00 NPK kg/ha + seed treatment of *Rhizobium* (5 ml/kg of seed), F_6 - 20:40:00 NPK kg/ha + seed treatment of Phosphate solubilizing bacteria (5 ml/kg of seed), F_7 – 20 : 40 : 00 NPK kg/ha + seed treatment of *Rhizobium* and Phosphate solubilizing bacteria (each 5 ml/kg of seed). Biofertilizers were applied as a seed treatment before sowing. Blanket application of FYM 10 t/ha was given at the time of field preparation. Organic manures were given on the basis of its nutrient content. Observations of growth and yield were recorded during investigation.

Results and discussion

Growth parameters

Effect of plant geometry

A perusal of data revealed that (Table 1) plant geometry did not manifest its significant influence on any growth parameters *viz.*, days to 50 % flowering, plant height (cm) at 30 and 60 DAS.

Effect of integrated nutrient management

Integrated nutrient management did not show significant difference among the treatments for days to 50 % flowering and plant height (cm) at 30 and 60 DAS. (Table 1)

Interaction effect

A perusal of data revealed that an interaction effect due to plant geometry and integrated nutrient management (S × F) on days to 50 % flowering and plant height (cm) at 30 DAS and 60 DAS were found non-significant.

Yield

Effect of plant geometry

An assessment of data (Table 1) indicated that 45 × 15 cm spacing recorded significantly, the highest number of clusters plant (14.70), number of pods/cluster (6.86), green pod length (11.65 cm) and green pod yield/plant (99.21 g). It might be due to in wider row spacing have better growth and development of individual plant. While, in closer spacing, there might have been competition between roots of the neighboring plants for uptake of nutrition, water and for utilization of sunlight, which would have restricted the growth of plants. Similar, results were also reported by Meena *et al.* (2016) [2] in cluster bean. Whereas, green pod yield/ha (14.41 t/ha) was maximum in spacing 30 × 15 cm. It might be due to more number of plants per unit area and their cumulative effect on yield resulted higher yield. Therefore, higher yield potential of plants under wider row spacing could not compensate the total yield obtained from closer row spacing. Similar, results were also reported by Reddy *et al.* (2014) [7], Patel *et al.* (2018) [4], Yadav *et al.* (2014) [10] in cluster bean, Naik (1989) [3] and Uddin *et al*. (2001) [9] in garden pea. However, there was no found any significant effect of plant geometry on green pod weight.

Effect of integrated nutrient management

Data presented in Table 1 indicated that number of clusters/plant influenced significantly by the effect of integrated nutrient management. The highest number of clusters/plant (16.25), number of pods/cluster (7.44) and number of pod/plant (113.06) were recorded in treatment F_4 but, it was remained at par with treatment F_3 for number of clusters per plant (14.91) and number of pods/plant (103.68) whereas, same treatment was at par with F_3 and F_7 for number of pods/cluster (7.00 and 6.82). Whereas, green pod length was found maximum in treatment F_3 (13.01 cm). It might be due to integrated use of inorganic and organic fertilizers along with biofertilizers increased nutrient availability in rhizosphere by soil biological activity which supplied the required nutrients constantly at all stages of crop growth along with better assimilation of photosynthates. Similar, findings were also reported by Reddy *et al.* (2014) [7], Prabhavathi (2014) [5], Choudhary *et al.* (2011) [1] and Patel *et al.* (2018) [4] in cluster bean. There was no any significant effect of integrated nutrient management on green pod weight.

Interaction effect

Interaction effect of plant geometry and integrated nutrient management on number of clusters/plant was found significant (Table 2). Maximum number of clusters/plant (16.68) was recorded under treatment combination S_1F_1 [45 x 15 cm spacing along with the 25:50:00 NPK kg/ha (Control)] which, was at par with treatment S_1F_4 (16.62), S_2F_4 (15.88), S_1F_3 (15.02), S_2F_3 (14.79), S_2F_6 (14.78) and S_1F_5 (14.23). It might be due to in wider spacing plants utilized the fully available natural resources resulting in improvements in the yield components as compared to narrow spacing and application of integrated nutrient made available nutrient in rhizosphere and proper utilization of photosynthets by plants. Similar, results were also reported by Rajput (2002) [6] and Sharma (2007) [8] in cluster bean.

Table 1: Effect of plant geometry and integrated nutrient management on growth and yield

Treatments	Plant height (cm)		Days to 50 % flowering	No. of clusters/plant	No. of pods/cluster	Green pod weight (g)	Green pod length (cm)	Green pod yield (g/plant)	Green pod yield (t/ha)
	At 30 DAS	At 60 DAS							
Factor A : Plant geometry									
S_1	28.17	99.94	26.88	14.70	6.86	1.09	11.65	99.21	13.50
S_2	27.07	96.63	27.21	13.73	6.37	1.08	10.48	72.34	14.41
S. Em.±	0.44	1.69	0.36	0.32	0.16	0.02	0.20	1.97	0.30
C. D. at 5 %	NS	NS	NS	0.94	0.45	NS	0.57	5.73	0.89
Factor B : Integrated Nutrient Management									
F_1	26.35	101.87	28.00	14.09	5.59	1.07	9.97	82.75	13.62
F_2	27.11	97.73	27.40	13.13	6.50	1.11	10.68	78.33	13.02
F_3	28.25	95.63	26.59	14.91	7.00	1.17	13.01	90.33	14.25
F_4	29.68	105.27	25.44	16.25	7.44	1.05	11.93	98.21	15.88
F_5	26.94	96.23	27.50	13.61	6.53	1.07	10.28	80.44	13.07
F_6	26.89	94.67	27.69	14.10	6.43	1.09	10.64	82.48	13.64
F_7	28.12	96.60	26.68	13.40	6.82	1.04	10.93	87.86	14.23
S. Em.±	0.82	3.16	0.68	0.60	0.29	0.04	0.37	3.69	0.57
C. D. at 5 %	NS	NS	NS	1.76	0.85	NS	1.06	10.72	1.66
Interaction									
S × F	NS	NS	NS	Sig.	NS	NS	NS	NS	NS
C. V. %	7.26	7.87	6.18	10.42	10.84	9.88	8.09	10.53	10.01

Table 2: Interaction effect of plant geometry and integrated nutrient management on number of clusters/plant.

Plant geometry	Integrated nutrient management						
	F_1	F_2	F_3	F_4	F_5	F_6	F_7
S_1	16.68	13.64	15.02	16.62	14.23	13.42	13.26
S_2	14.09	12.62	14.79	15.88	12.98	14.78	13.54
S. Em.±	0.85						
C. D. at 5 %	2.48						
C. V. %	10.42						

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