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Effect of Organic Nutrient Management on Growth and Yield of Cluster Bean (*Cyamopsis tetragonoloba* L.)

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ABSTRACT

Background: Organic production of cluster bean is to contribute to the enhancement of production sustainability along with ecology. Sustainability in organic farming must therefore be seen in a holistic sense, which includes ecological, economic and social aspects. A synergistic effectof bio fertilizer with crop increases the crop productivity and sustainability also. Bio fertilizers are low cost, effective and renewable sources of plant nutrients to supplement chemical fertilizers. Therfore to overcome the ill effect of chemical based farming, organic system is becoming the emerging need of the society.

Methods: A field experiment was carried out in Pusa Navbahar variety of clusterbean during summer season (February to May) of 2019 at College farm, College of Horticulture, Sardarkrushinagar Dantiwada Agricultural University, Jagudan, Dist. Mehsana, Gujarat, India. Sixteen treatments having various combinations of organic sources of nutrients (FYM, vermicompost and neem cake), bio fertilizers (*Rhizobium* + PSB + KSM) along with RDF (20/40/0 kg/ha) as a control. They were replicated thrice in a randomized block design having a plot size of 3.0 m × 2.0 m with a spacing of 60 cm × 20 cm. Standard practices were followed during the entire course of the investigation.

Result: It showed highly significant differences among different treatments for majority of the growth and yield attributing traits, but treatment T_6 (75% N through FYM + *Rhizobium* + PSB + KSM) was rated as the best treatment for characters like days taken for germination, number of root nodules per plant, plant height at 60 DAS (cm), number of pod per cluster, number of cluster per plant, green pod yield per plant (g), green pod yield per plot (kg) and green pod yield per hectare (kg) as compared to other treatment. It can be concluded that the organic nutrient management in cluster bean with the application of 75% N through FYM + *Rhizobium* + PSB + KSM is beneficial for obtaining a higher yield.

Key words: Bean, Cluster, FYM, Management, Organic, Vermicompost.

INTRODUCTION

The growing of vegetable is the most intensive, profitable and remunerative business which may be adopted to small holders with profitable cultivation. Apart from this, vegetables are considered as 'protective supplementary food' as they contain large quantities of minerals and vitamins which are required for normal functioning of human metabolic processes. The important minerals like calcium, phosphorus and iron, which are generally lacking in cereals, are available in abundant quantities in vegetables (Shanmugavelu, 1989). Among all the vegetable crops, the crops belong to 'leguminaceae' family are rich source of vegetable protein than others.

Clusterbean [*Cyamopsis tetragonoloba* (L.)] is an important legume vegetable having the chromosome number 2n=14, a member of Fabaceae family and which is originated from Hindustan centre particularly India and Pakistan. Clusterbean is mainly grown in tropical Asia, Africa and America. The major clusterbean producers are India, Pakistan and the United States, with smaller acreages in Australia and Africa (Patel *et al.,* 2018). In India, it is mainly cultivated in Rajasthan, Gujarat, Punjab, Haryana, Uttar Pradesh and Maharashtra. The cultivated area under beans in India during 2018-19 was 229 (000'ha) with the production of 2324 (000'MT). The cultivated area of *guar* in Gujarat is 35.82 thousand ha with a production 365.11 thousand MT. Clusterbean is mainly cultivated in entire state of Gujarat.

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Area under cultivation of clusterbean in the district of Mehsana is 3060 ha with the production of 33,201 MT (Anonymous, 2019). It has ever increasing demand in the national as well as international market. Green and tender pods are nutritionally rich in energy (16 Kcal), moisture (81%), protein (3.2 g), fat (1.4 g), carbohydrate (10.8 g), vitamin A (65.31 IU), vitamin C (49 mg), calcium (57 mg) and iron (4.5 mg) in 100 g of edible portion (Kumar and Singh, 2002).

Cyamopsis tetragonoloba L. is a well known traditional plant used in folk medicine. It acts as an appetizer, cooling

agent, digestive, laxative, dyspepsia, anorexia, antiulcer, antisecretory, cytoprotective,hypoglycaemic, hypolipidemic and antihyperglycaemic effects (Mukhtar *et al*., 2006). A synergistic effectof bio fertilizer with crop increases the crop productivity and sustainability also. Bio fertilizers are low cost, effective and renewable sources of plant nutrients to supplement chemical fertilizers (Boraste *et al.,* 2009).

In recent years, several strains of phosphate solubilizing bacteria and fungi are isolated. The mechanism of these microorganisms involves in secretion of organic acids which lower the pH and increase the availability of sparingly soluble phosphorus sources. Phosphate solubilizing bacteria convert the unavailable phosphorus of soil into available form to the crop plant. Inoculation of seeds with PSB and KSB culture increases nodulation, crop growth, nutrient uptake and crop yield (Patel *et al.,* 2018).

MATERIALS AND METHODS

The field experiment entitledwas carried out at College farm, College of Horticulture, S.D. Agricultural University, Jagudan, Distt. Mehsana (Gujarat), India during summer (February to May, 2019) season of 2019. There were sixteen treatments having the various combinations of organic sources (FYM, vermicompost and neem cake) of nutrients, biofertilizers along with RDF (Recommended dose of fertilizers) as a control *viz*.,T_1:Control (RDF); T_2: 100% N through FYM; T_3: 100% N through Vermicompost; T_4: 100% N through Neem cake; T_5: 75% N through FYM; T_6: 75% N through FYM + *Rhizobium* + PSB + KSM; T_7: 75% N through Vermicompost; T_8: 75% N through Vermicompost + *Rhizobium* + PSB + KSM; T_9: 75% N through Neem cake; T_{10}: 75% N through Neem cake + *Rhizobium* + PSB + KSM; T_{11}: 50% N through FYM; T_{12}: 50% N through FYM + *Rhizobium* + PSB + KSM; T_{13}: 50% N through Vermicompost; T_{14}: 50% N through Vermicompost + *Rhizobium* + PSB + KSM; T_{15}: 50% N through Neem cake; T_{16}: 50% N through Neem cake + *Rhizobium* + PSB + KSM.

Seeds of variety Pusa Navbahar were sown at a spacing of 60 cm × 20 cm in a plot having dimensions of 3.0 m × 2.0 m. The experiment was laid out in a randomized block design (RBD) with three replications. Other cultural practices and plant protection measures were taken as per recommendations. The data on the number of days taken for germination, germination percentage (%), number of root nodules per plant, leaf area at 30 and 60 DAS (cm^2), plant height at 60 DAS (cm), days taken for first picking, days taken for the last picking, days taken for initiation of flowering, number of pod per cluster, number of cluster per plant, green pod yield per plant (g), green pod yield per plot (kg), green pod yield per hectare (kg) and number of pickings were recorded from randomly selected ten plants in each plot. The data were analyzed statistically by adopting the standard procedures described by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Effect on growth parameters

An assessment of data (Table 1) indicated that application of 75% N through FYM + *Rhizobium* + PSB + KSM recorded significantly minimum days taken for highest earliness in germination (6.00 days), the number of root nodules (9.00),

Table 1: Effect of organic nutrient management on growth parameter.

Tr. no.	Days taken for germination	Germination percentage (%)	Number of root nodules per plant	Leaf area at 30 DAS (cm^2)	Leaf area at 60 DAS (cm^2)	Plant height at 60 DAS (cm)	Days taken for first picking	Days taken for last picking	Days taken for initiation of flowering
T_1	7.33	75.33	7.00	15.22	25.66	59.67	55.67	101.00	41.67
T_2	6.33	80.00	8.33	16.06	27.10	70.49	49.00	100.00	39.00
T_3	6.67	78.67	7.33	15.48	26.96	64.38	54.00	101.00	40.00
T_4	6.33	79.33	8.00	15.92	27.10	67.35	53.67	99.67	40.33
T_5	7.00	76.67	6.67	15.29	26.62	61.27	55.33	100.67	41.33
T_6	6.00	82.00	9.00	16.74	27.19	72.32	48.67	103.33	39.00
T_7	7.33	76.00	7.00	15.07	26.02	60.53	55.67	101.33	41.67
T_8	6.67	78.00	7.33	15.55	26.65	63.55	54.67	100.67	41.33
T_9	7.00	76.00	6.67	15.08	26.38	60.68	55.33	101.00	42.00
T_{10}	6.33	79.33	7.33	16.37	26.94	65.29	53.67	100.67	40.67
T_{11}	8.00	69.33	6.33	14.42	23.65	56.45	57.00	101.33	43.00
T_{12}	7.33	74.00	6.67	14.79	25.85	57.43	56.00	101.33	42.00
T_{13}	8.33	66.67	5.67	14.32	21.85	53.67	58.33	100.00	44.33
T_{14}	7.67	70.00	6.00	14.46	24.03	56.55	56.67	101.00	43.00
T_{15}	8.00	67.33	6.00	14.08	23.24	54.87	57.00	101.33	43.67
T_{16}	7.67	70.67	6.67	14.54	24.51	57.04	56.00	103.00	42.67
S.Em. ±	0.45	3.41	0.37	0.73	1.37	2.95	1.92	4.56	1.57
C.D. (P = 0.05)	1.29	NS	1.06	NS	NS	8.51	NS	NS	NS
C.V. %	10.82	7.88	9.05	8.32	9.30	8.32	6.08	7.81	6.55

and plant height at 60 DAS (72.32 cm). It might be due to the synergistic effect of *Rhizobium,* PSB and KSB in enhancing the growth of plant. It might have increased nitrogenous activity and the available P status of the soil. It may be due to the biosynthesis of growth-promoting substances like vitamin-B12 and auxin. The increase in days taken to germination may be due to the supply of balanced nutrition from organic sources of nutrients for a prolonged time. These results are in line with the findings of Ramana *et al.* (2011) in French bean and Datt *et al.* (2003) in vegetable pea.

This may be because farm yard manure increases the adsorptive power of soil for cation and anion these adsorbed ions are released slowly for the entire crop growth period resulted in better nutrient availability at active crop growth. Therefore, number of root nodules is increased and were reflected on overall improvement in plant performance. Similar findings were reported by Parmar *et al.* (1998). in pea with respect root nodules.

Plant height is a nutrient (major and minor) responsive trait. It might be due to the synergistic effect of organic manures and biofertilizers. It may fix atmospheric nitrogen, convert nutrient from insoluble to soluble form, scavenge phosphorus from soil, help in mineralization process and improve yield by 10-20% (Roychowdhury *et al.,* 2014). It may be due to the biosynthesis of growth-promoting substances like vitamin B12 andauxin (Patel *et al.,* 2018). These results are in close conformity with the findings of Patel *et al.* (2010) and Prajapati *et al.* (2017) in clusterbean; Ramana *et al.* (2011) in french bean and Meena *et al.* (2016). in green gram.

Effect on yield parameters

An assessment of data (Table 2 and Fig 1) indicated that application of 75% N through FYM + *Rhizobium* + PSB + KSM(T_6) recorded significantly the highest number of pod per cluster (8.22), number of cluster per plant (14.93), green pod yield per plant (141.80 g), green pod yield per plot (3.16 kg) and green pod yield per hectare (10972.33 kg) which was at par with different treatments following the different yield parameters over the control (T_1). The application of soil + mine spoil + coir pith vermicompost (1:1:1) + RDF significantly enhanced plant height, number of leaves and yield per plant in onion (Thanunathan *et al*., 1997).

Number of pod per cluster and number of cluster are directly proportional to the yield. More the number of pod and cluster, yield will be more, hence more return to the grower. Maximum number of pod per cluster was obtained when the application of T_6 (75% N through FYM + *Rhizobium* + PSB + KSM) which might be due to the combined effect of biofertilizers (*Rhizobium,* PSB and KSM) with organic manure increased the availability of nutrients to the plant from different organic sources. Biofertilizers may fix atmospheric nitrogen, convert nutrients from insoluble to soluble form, scavenge phosphorus from soil, help in mineralization process and improve yield by 10-20% (Roychowdhury *et al.,* 2014). It plays important role in increases the solubility of micro nutrients in the rhizosphere, essentially required for the formation and development of the pods. Thus, it increased the number of pods. It influenced the rate of photosynthesis, protein synthesis and more absorbance capacity of nutrients from root zone. It may be mentioned that no single source of nutrient supply by bio-fertilizer is in position to meet the increasing nutrient demand and yield (Patel *et al.,* 2018). Increased yield by the application of PSB could be due to the greater availability

Table 2: Effect of organic nutrient management on yield parameter.

Tr no.	Number of pod per cluster	Number of cluster per plant	Yield per plant (g)	Yield per plot (kg)	Yield per ha (kg)	Number of picking
T_1	7.07	12.13	113.80	2.51	8727.00	9.67
T_2	7.85	14.67	137.60	3.00	10405.00	10.33
T_3	7.47	13.77	131.53	2.89	10046.33	10.67
T_4	7.76	14.23	136.73	3.06	10625.00	10.33
T_5	7.26	13.03	126.20	2.78	9641.67	10.33
T_6	8.22	14.93	141.80	3.16	10972.33	11.00
T_7	7.13	12.47	119.30	2.60	9028.00	10.00
T_8	7.31	13.40	128.67	2.83	9826.33	10.67
T_9	7.22	12.80	122.53	2.70	9386.67	10.00
T_{10}	7.61	13.83	134.47	2.96	10266.33	10.67
T_{11}	6.47	10.17	102.97	2.23	7731.33	8.67
T_{12}	7.03	11.83	112.67	2.44	8460.67	9.33
T_{13}	6.15	9.00	95.70	2.04	7071.67	8.67
T_{14}	6.61	10.57	106.87	2.32	8044.00	9.00
T_{15}	6.40	9.53	99.53	2.14	7419.00	8.67
T_{16}	6.93	11.47	109.50	2.36	8206.00	9.33
S.Em. ±	0.33	0.60	7.40	0.16	547.05	0.57
C.D. (P = 0.05)	0.95	1.73	21.36	0.45	1579.77	NS
C.V. %	7.93	8.42	10.68	10.39	10.39	10.08

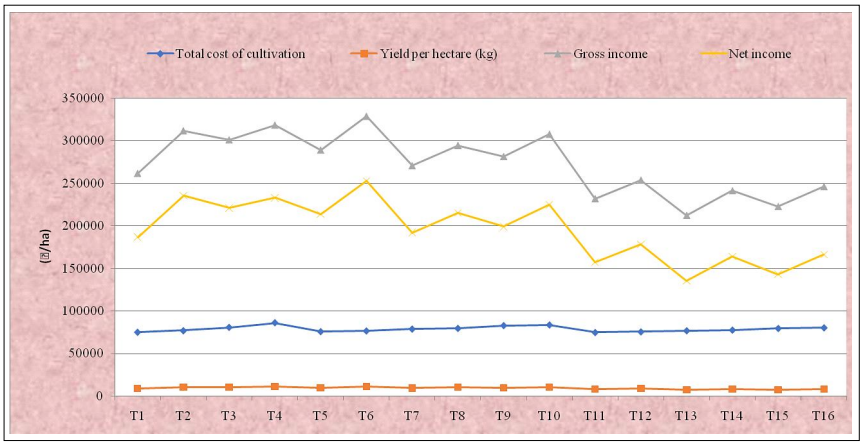

Fig 1: Effect of organic nutrient management on cost of cultivation, gross income, net income and yield.

of nutrients in the soil and better nodulation under the influence of inoculation resulted better growth and development which might be attributed to better mobilization of phosphorus and increased allocation of photosynthates towards the economic parts and also hormonal balance on the plant system (Ramana *et al.,* 2011). These results are in close conformity with the finding of Meena *et al.* (2016) in green gram. Similar results were also obtained by Chaudhari (2018) and Sammauria *et al.* (2009) in clusterbean; Sharma *et al.* (2015) in garden pea; Datt *et al.* (2003) in vegetable pea. Kagne *et al.* (2008) observed that application of vermicompost @ 2.5 t/ha along with seed treatment of Azospirillum and PSB enhanced the growth and quality of sorghum and produced highest seed yield (21.7 q/ha).

CONCLUSION

The application of 15 kg per hectare nitrogen (75% RDF) through FYM along with 2.5 litre/hectare of *Rhizobium,* PSB and KSM each resulted in significantly better growth and higher yield. Thus, application of 15 kg per hectare nitrogen (75% RDF) through FYM along with 2.5 litre/hectare of *Rhizobium,* PSB and KSM each could be a promising nutrient source particularly in organic cultivation of cluster bean through improving soil properties.

Conflicts of interest

There is no conflicts of interest among the authors.

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