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Effect of Organic Sources of Nutrient on Quality Traits, Soil Nutrient Status and Economics of Cluster Bean (*Cyamopsis tetragonoloba* L.)

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ABSTRACT: A field experiment was carried out on Pusa Navbahar variety of cluster bean during summer season of 2019 at College farm, College of Horticulture, Sardarkrushinagar Dantiwada Agricultural University, Jagudan, Dist. Mehsana, Gujarat, India. Chemical based farming is very common practice among growers which has very serious effect on human health. Overcome the ill effect of hazardous farming, present experiment has been under taken with sixteen treatments having the various combinations of organic sources of nutrients (FYM, vermicompost and neem cake) along with RDF (20:40: 00 kg/ha NPK) as a control. Treatments were replicated thrice in a randomized block design. Analysis of variance showed differences among different treatments for quality traits and significant variations for soil nutrient status (available N, P_2O_5 & K_2O) as well as economics of the treatments. However, treatment T_6 [75% N (15 kg/ha) through FYM + *Rhizobium* + PSB + KSM] has significant influences on available nitrogen, P_2O_5 and K_2O in soil. It is concluded that the application of organic sources of nutrient in cluster bean with the application of 75% N (15 kg/ha) through FYM + biofertilizers (*Rhizobium* + PSB + KSM) @ 2.5 kg/ha each has beneficial effect for obtaining higher pod length, quality traits, soil nutrient status and economic return (₹ 329170), net profit (₹ 252680) and B: C ratio of 4.30.

Keywords: Organic sources, *Cyamopsis tetragonoloba* L., Soil nutrient status, economics, B:C ratio *etc.*

INTRODUCTION

Cluster bean is a valuable legume vegetable. They posses great importance as far as nutraceutical property is concern and play vital role in human health. *Cyamopsis tetragonoloba* L. is an important vegetable having the chromosome number 2n=14, a member of Fabaceae family and originated from Hindustan centre particularly India and Pakistan. It is mainly grown in tropical Asia, Africa and America. The major cluster bean producers are India, Pakistan and the United States, with smaller acreages in Australia and Africa (Patel *et al.*, 2018). Major cluster bean growing states in India are 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.

Cluster bean is mainly cultivated in entire state of Gujarat. Area under cultivation of in the district of Mehsana is 3060 ha with the production of 33,201 MT (Anonymous, 2019). It is an important *kharif* and summer season vegetable crop, ideally suited for semi-arid and arid regions. It is an erect annual growing plant, grow up to a height of 2 m with stiff erect branches, stems are angled, leaves trifoliate, ovate and serrate. The white or pink coloured flowers are small and borne on axillary raceme. Pods are compressed, linear, erect and clustered, double ridge on dorsal side, single ridge on ventral side, length 4-10 cm, 5-12 seeds per pod with white to grey or black in colour (Patel *et al.*, 2018). Due to diversified uses of cluster bean pod as fresh, processed, dried and canned, 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 (3.2g), fat (1.4g), carbohydrate (10.8g), vitamin A (65.31 IU), vitamin C (49mg), calcium (57mg) and iron (4.5mg) 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).

Organic sources of nutrients not only add the nutrients into the soil but also enhance the sustainability. Synergistic effect of bio fertilizers 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).

MATERIAL AND METHODS

The field experiment was carried out at College farm, College of Horticulture, S. D. Agricultural University, Jagudan, Distt. Mehsana (Gujarat), India during summer 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 and T_{16}:50% N through Neem cake + *Rhizobium* + PSB + KSM.

Seeds of cluster bean variety Pusa Navbahar were procured from Seed Spices Research Station, SDAU, Jagudan and sown with a spacing of 60 cm ×20 cm having plot dimensions of 3.0 m × 2.0 m. The experiment was laid out in a randomized block design (RBD) and replicated thrice. Other cultural practices and plant protection measures were followed as per the standard package of practices. The data on quality parameters like, green pod length (cm), crude protein content (%) in green pod, chlorophyll content (a, b and total) in leaves (mg/100g), crude fibre content (%) in green pod and TSS (°Brix) were recorded from randomly selected plants of a treatment and available soil N, P_2O_5 & K_2O before the commencement of experiment as a composite sample and after harvesting individual plot sample were analysed. The data were subjected to statistically analysis by adopting the standard procedures described by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Quality parameters. Results presented in Table 1 indicated that crude protein content (%) in green pod, chlorophyll A content in leaves (mg/100g), chlorophyll B content in leaves (mg/100g), total chlorophyll content in leaves (mg/100g), crude fibre content (%) in green pod and TSS (°Brix) haven't affected by the application of treatments. However, significantly maximum length (11.69 cm) of pod was recorded with the application of 75% N through FYM + *Rhizobium* + PSB + KSM which was at par with T_2, T_{10}, T_3 and T_8 treatments.

Table 1: Effect of organic nutrient management on quality parameters.

Tr. No.	Length of pod (cm)	Crude protein (%)	Chlorophyll A content (mg/100g)	Chlorophyll B content (mg/100g)	Total chlorophyll content (mg/100g)	Crude fibre (%)	TSS(°Brix)
T_1	9.97	8.19	48.00	33.57	99.00	2.25	9.14
T_2	11.47	8.38	48.55	34.81	102.17	2.36	9.25
T_3	10.79	8.59	50.09	35.53	103.47	2.25	9.20
T_4	11.28	8.53	49.69	35.36	103.13	2.27	9.24
T_5	10.32	8.28	48.35	34.54	100.13	2.25	9.16
T_6	11.69	8.33	48.53	34.71	100.33	2.39	9.32
T_7	10.07	8.19	48.08	33.60	99.87	2.25	9.16
T_8	10.58	8.65	52.48	35.72	104.37	2.24	9.16
T_9	10.20	8.28	48.17	34.28	100.00	2.25	9.15
T_{10}	11.13	8.45	49.56	34.88	102.80	2.26	9.21
T_{11}	9.53	7.72	43.86	28.68	90.67	2.26	8.91
T_{12}	9.93	8.06	47.81	33.08	98.10	2.25	9.06
T_{13}	9.07	8.00	46.56	32.80	93.23	2.21	8.82
T_{14}	9.74	8.04	47.55	32.82	95.17	2.26	8.96
T_{15}	9.46	7.89	45.70	32.28	91.47	2.25	8.89
T_{16}	9.87	8.05	47.65	32.96	96.47	2.26	9.01
S.Em. ±	0.44	0.20	1.69	1.22	3.77	0.04	0.13
C.D. 0.05	1.28	NS	NS	NS	NS	NS	NS
C.V. %	7.46	4.25	6.09	6.25	6.61	2.92	2.46

Application of various organic manures and biofertilizer significantly affects the pod length. This might be due to the use of FYM create the favourable micro environment for micro fauna which increase plant growth and yield. Good moisture condition and higher efficiency of PSB influence the nutrient availability of phosphorus. These conditions reflected significant improvements in pod length which directly increased yield. Similar results were also reported by Patel *et al.,* (2018), Chaudhari (2018) and Patel *et al.,* (2010) in cluster bean, Nasab *et*

al., (2015) in maize and Ramana *et al.,* (2011) in french bean.

Soil status. Available soil N, P_2O_5 & K_2O before the commencement of experiment as a composite sample and available N, P_2O_5 & K_2O after harvesting were analysed from individual plot. Among all the treatments, significantly maximum available nitrogen (217.82 kg/ha), P_2O_5 (47.22 kg/ha) and K_2O (292.31 kg/ha) in the soil were found with the application of T_6 (75% N through FYM + *Rhizobium* + PSB + KSM).

Improvement in available N, P_2O_5 and K_2O status in the soil was observed in the organic nutrient management practices, which have higher proportion of organic manures along with biofertilizers. Organic manures may be attributed to delayed mineralization and slow release of nutrients through biological fixation of nitrogen by *Rhizobium* and enhanced mobilization of phosphorous by PSB in the soil. Organic manures, during the process of decomposition release a large number of organic acids which react with insoluble iron, aluminium, calcium phosphates which make it available to the crop plants. The higher available K_2O status might be attributed to the beneficial effect of organic manures which release K_2O in the soil (Prabhavathi, 2014). Moreover, organic manures are known to increase the soil physical properties, improve the soil aeration, provide ideal conditions for the proliferation of microorganisms in rhizosphere and might have increased soil fertility status even after the crop harvest in the field. These results are in conformity with the finding of Patel *et al.,* (2010), Patel and Patel (2018) in cluster bean and Datt *et al.,* (2003) and Parmar *et al.,* (1998) in vegetable pea.

Economics. Data (Table 3) pertaining to the economics of treatments shows that maximum gross income (₹ 329170) was recorded in treatment T_6 (75% N through FYM + *Rhizobium* + PSB + KSM) followed by T_2 (100% N through FYM) and minimum (₹ 212150) in T_{13} (50% N through Vermicompost). Similarly, maximum net income (₹252680) in the treatment T_6 (75% N through FYM + *Rhizobium* + PSB + KSM) and minimum (₹ 135462) in T_{13} (50% N through Vermicompost). On the other hand, highest benefit: cost ratio (4.30) was worked out in the treatment T_6. Therefore, the treatment T_6 (75% N through FYM + *Rhizobium* + PSB + KSM), rated as most effective treatment which also recorded maximum yield per hectare (10972.33 kg).

Table 2: Effect of organic nutrient management on available N, P_2O_5 and K_2O in soil.

Tr. No	Available N (kg/ha)	Available P_2O_5 (kg/ha)	Available K_2O (kg/ha)
T_1	208.12	39.47	279.61
T_2	214.55	45.59	287.87
T_3	211.77	42.83	285.30
T_4	213.20	44.39	287.61
T_5	208.74	41.16	283.13
T_6	217.82	47.22	292.31
T_7	208.26	40.13	280.67
T_8	209.14	42.41	284.29
T_9	208.26	40.45	281.63
T_{10}	212.80	43.41	286.56
T_{11}	201.54	38.27	272.75
T_{12}	207.80	39.46	278.62
T_{13}	197.77	37.59	271.32
T_{14}	205.42	38.32	276.60
T_{15}	198.78	38.20	272.36
T_{16}	206.75	39.08	277.98
S.Em. ±	2.72	0.64	3.33
C.D. (P = 0.05)	7.84	1.86	9.61
C.V. %	2.26	2.71	2.05

Table 3: Effect of organic nutrient management on economics and benefit cost ratio.

Treatments	Total cost of cultivation (₹ha^{-1})	Yield per hectare (kg)	Gross income (₹ha^{-1})	Net income (₹ha^{-1})	Benefit Cost Ratio
T_1	74996	8727.00	261810	186814	3.49
T_2	76740	10405.00	312150	235410	4.07
T_3	80634	10046.33	301390	220756	3.74
T_4	85882	10625.00	318750	232868	3.71
T_5	75740	9641.67	289250	213510	3.82
T_6	76490	10972.33	329170	252680	4.30
T_7	78661	9028.00	270840	192179	3.44
T_8	79411	9826.33	294790	215379	3.71
T_9	82596	9386.67	281600	199004	3.41
T_{10}	83346	10266.33	307990	224644	3.70
T_{11}	74740	7731.33	231940	157200	3.10
T_{12}	75490	8460.67	253820	178330	3.36
T_{13}	76688	7071.67	212150	135462	2.77
T_{14}	77438	8044.00	241320	163882	3.12
T_{15}	79311	7419.00	222570	143259	2.81
T_{16}	80061	8206.00	246180	166119	3.07

CONCLUSION

It could be concluded that for harnessing maximum green pod length, quality traits, soil nutrient status (N, P_2O_5 & K_2O) and economic return as well as benefit cost ratio of cluster bean with the application of 75% N through FYM (15 kg per ha) and *Rhizobium*, PSB & KSM each @ 2.5 litre/hectare is beneficial.

FUTURE SCOPE

There is a vast scope to do research with such type of issues on biotic and abiotic stresses hardy vegetables to fulfill the growing demands of organic vegetables.

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Conflict of Interest. The authors declare that they have no conflict of interests.

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