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## Effect of organic fertilizers on growth and economics of cluster bean (*Cyamopsis tetragonoloba* L.) Cv. Pusa Navbahar

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### Abstract

The present investigation entitled “Effect of organic fertilizers on growth and yield of cluster bean (*Cyamopsis tetragonoloba* L.) Cv. Pusa Navbahar” was conducted during year 2017 at Fruit Research Station Jambuvadi, Junagadh Agricultural University, Junagadh. The experiment was laid out in Randomized Block Design (RBD) with three replication. In all, there were eight different treatments T<sub>1</sub>: control without any treatment, T<sub>2</sub>: RDF 20:40:00 NPK kg/ha, T<sub>3</sub>: FYM @ 5 t/ha + *Rhizobium* culture @ 20 ml kg<sup>-1</sup> seed, T<sub>4</sub>: FYM @ 5 t/ha + *Rhizobium* culture @ 20 ml kg<sup>-1</sup> seed + PSB @ 20 ml kg<sup>-1</sup> seed, T<sub>5</sub>: FYM @ 5 t/ha + *Rhizobium* culture @ 20 ml kg<sup>-1</sup> seed + PSB @ 20 ml kg<sup>-1</sup> seed + KSB @ 20 ml kg<sup>-1</sup> seed, T<sub>6</sub>: Vermicompost @ 2.5 t/ha + *Rhizobium* culture @ 20 ml kg<sup>-1</sup> seed, T<sub>7</sub>: Vermicompost @ 2.5 t/ha + *Rhizobium* culture @ 20 ml kg<sup>-1</sup> seed + PSB @ 20 ml kg<sup>-1</sup> seed, T<sub>8</sub>: Vermicompost @ 2.5 t/ha + *Rhizobium* culture @ 20 ml kg<sup>-1</sup> seed + PSB @ 20 ml kg<sup>-1</sup> seed + KSB @ 20 ml kg<sup>-1</sup> seed. Different treatments were significantly affected by days taken to germination, days to fifty percent flowering, plant height (cm), number of root nodule per plant and economics of different treatments.

**Keywords:** cluster bean, bio fertilizer, growth and economics, farm yard manure, vermicompost

### Introduction

Vegetable growing is one of the major branch of Horticulture. Different vegetables have played an important role in the economy of the country and have played a pivotal role in the food and nutritional securities of growing population of our country. They are in great demand in a country like India where a majority of the population in vegetarian.

Vegetables are rich source of nourishment and are considered as protective supplementary food as they contain large quantities of minerals, vitamins and essential amino acids. The important minerals like calcium, phosphorous and iron, which are generally lacking in cereals while they are available in abundant quantities in vegetables. Leguminous vegetables are the richest source of protein.

Cluster bean (*Cyamopsis tetragonoloba* L.) belongs to the family Fabaceae (Leguminaceae) is a coarse, upright, bushy, a drought-tolerant summer annual legume and it is cultivated as a feed crop for human and livestock consumption. Cluster bean (Guvar) is usually grown kitchen garden as a summer vegetable but at present it is also being grown as commercial crop near the urban area. It is a native plant of India and Pakistan (Rahman and Shafivr, 1967). It is grown in tropical Asia, Africa and America. The major world suppliers are India, Pakistan and the United States, with smaller acreages in Australia and Africa.

In India, green and tender pods of cluster bean are used as a favorite vegetable in many parts of the country. It is also grown as a forage crop. When it grown as a green manure crop. It enriches the soil by fixing atmospheric nitrogen almost 50-150 kg per hectare (Lal, 1985). Sometimes it is used in reclamation of saline and alkaline soils (Kay, 1979) [8]. In recent years, this crop has assumed a great significance due to the presence of good quality gum in the endosperm of its seed. Due to diversified uses of cluster bean gum in textile, paper, explosive and mining industries, pharmaceuticals, cosmetic goods and food stuffs, it has ever increasing demand in the international market.

In India, it is cultivated mainly in Rajasthan, Gujarat, Punjab, Haryana, Uttar Pradesh and Maharashtra. The cultivated area under cluster bean in Gujarat during 2016 was 3.0 lakh ha with the production of 2.8 lakh tonnes. The average production of guar in Gujarat is 766 kg ha

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(Anon., 2016) <sup>[2]</sup>. Guar is mainly cultivated in Banaskantha, Mehsana, Ahmadabad, Gandhinagar, Kheda and Kachchh district of Gujarat. Cluster bean is an erect annual growing plant; grow to a height of 2 m with stiff erect branches stems are angled, leaves trifoliolate, ovate and serrate. The white or pink colored flowers are small and borne on auxiliary raceme. Pods are compressed, linear, erect and clustered, double ridge on dorsal side, single ridge below, length 4-10 cm, 5-12 seeds per pod with white to grey or black in colour with an average weight of 0.06 g. Green pods contain moisture 81.0 %, carbohydrates 10.8 g, protein 3.2 g, fat 0.49 g, vitamin C-47 mg, vitamin A- 316 IU per 100 g of pod (Parthasarathy, 2003) <sup>[15]</sup>.

Organic farming strategy is growing rapidly all over the world to conserve human health and the environment. Bio-fertilizers are formulations of beneficial microorganisms, which upon application can increase the availability of nutrients by their biological activity and help to improve the soil health for increasing soil fertility with objective of increasing the number of such micro organisms and to accelerate certain microbial processes. Bio fertilizers are low cost, effective and renewable source of plant nutrients to supplement chemical fertilizers (Boraste *et al* 2009) <sup>[3]</sup> In addition to their role in enhancing the growth of the plants, bio fertilizers can act as bio control agents in the Rhizosphere at the same time. This synergistic effect, when present, increases the role of application of bio fertilizers in the sustainable agriculture. To meet the demand of quality vegetables, some chemical fertilizers are repeatedly used during all the seasons of cropping system. Bio fertilizer is a substance which contains living micro organism when applied to seed, plant surface, or soil, colonize the rhizosphere or the interior of the plant and promotes growth by increasing the supply or availability of primary nutrients to the host plant. These are low cost, effective and renewable source of plant nutrients to supplement chemical fertilizers. Therefore, use of biological fertilizers especially in cluster bean as it is a leguminous crop will definitely give significant results. Bio fertilizers have the ability to mobilize the nutritionally important elements from non-usable to usable form through biological processes and known to increase yield in several vegetables (Kumar *et al* 2002) <sup>[10]</sup>. Bio fertilizers play a vital role in maintaining long term soil fertility and sustainability. It may increase yield of crops by 10-30 percent (khandelwala *et. al*, 2012) <sup>[9]</sup>. In recent years, several strains of Phosphate Solubilizing Bacteria and fungi are isolated. The mechanism action of these micro organisms involves secretion of organic acids which lower the pH and increase the availability of sparingly soluble phosphorus sources. Phosphate solubilizing bacteria change the unavailable phosphorus of soil in available form for crop. Inoculation of seeds with PSB and KSB culture increases nodulation, crop growth, nutrient uptake and crop yield (Srivastava and Ahlawat, 1993) <sup>[20]</sup>. A combination of chemical and biological sources of nitrogen seems to be a cheap and effective way of increasing production under limited resources.

### Materials and Methods

An experiment was conducted at Fruit Research Station, Jambuwadi, Department of Horticulture, College of Agriculture, Junagadh Agricultural University, during summer seasons of 2017. The experiment site is situated in South Saurashtra Agro-climatic region of Gujarat. The soil was medium clayey in texture and slightly alkaline in reaction with pH (7.63) and EC (0.62 dSm<sup>-1</sup>), low in available N was

carried out with Alkaline KMnO<sub>4</sub> method by Subbaiah and Asija, 1956 (239.32 kg ha<sup>-1</sup>), medium in available P (41.07 kg ha<sup>-1</sup>) and available K (234.75 kg ha<sup>-1</sup>). The available P and K were carried out with Olsen's method and Flame Photometric method by Olsen *et al.*, 1954 and Jackson, 1974. The available heat soluble sulphur (10.60 ppm) carried out with Terbidimetric method (Chaudhary and Cornfield, 1966) <sup>[4]</sup>. The available micronutrients Fe, Mn, Zn and Cu (5.70, 8.74, 0.27 and 0.71 mg kg<sup>-1</sup>) carried out with DTPA extract method (AAS). The experiment were laid out in Randomized Block Design with three replications and consisting of 8 treatment combinations, comprising control: without any treatment (T<sub>1</sub>), RDF 20:40:00 NPK kg/ha (T<sub>2</sub>), FYM @ 5 t/ha + *Rhizobium* culture @ 20 ml kg<sup>-1</sup> seed (T<sub>3</sub>), FYM @ 5 t/ha + *Rhizobium* culture @ 20 ml kg<sup>-1</sup> seed + PSB @ 20 ml kg<sup>-1</sup> seed (T<sub>4</sub>), FYM @ 5 t/ha + *Rhizobium* culture @ 20 ml kg<sup>-1</sup> seed + PSB @ 20 ml kg<sup>-1</sup> seed + KSB @ 20 ml kg<sup>-1</sup> seed (T<sub>5</sub>), Vermicompost @ 2.5 t/ha + *Rhizobium* culture @ 20 ml kg<sup>-1</sup> seed (T<sub>6</sub>), Vermicompost @ 2.5 t/ha + *Rhizobium* culture @ 20 ml kg<sup>-1</sup> seed + PSB @ 20 ml kg<sup>-1</sup> seed (T<sub>7</sub>), Vermicompost @ 2.5 t/ha + *Rhizobium* culture @ 20 ml kg<sup>-1</sup> seed + PSB @ 20 ml kg<sup>-1</sup> seed + KSB @ 20 ml kg<sup>-1</sup> seed (T<sub>8</sub>). Seeds will be treated before sowing. Manure will be applied in soil before sowing of seed. The cluster bean variety 'Pusa Navbahar' was sown at 45 cm row to row and 20 cm plant to plant spacing. The crop was raised as per the recommended package of practices.

### Results and Discussion

#### Effect on growth parameters

An assessment of data (Table 1) indicated that application of FYM @ 5 t/ha + *Rhizobium* culture @ 20 ml kg<sup>-1</sup> seed + PSB @ 20 ml kg<sup>-1</sup> seed + KSB @ 20 ml kg<sup>-1</sup> seed (T<sub>5</sub>) recorded significantly the highest earliness in germination (6.90 days), days to fifty percent flowering (37.00 days), plant height 30, 60 DAS and last picking (9.50, 46.99, 132.82 cm respectively), number of root nodule per plant (8.17) over the control (T<sub>1</sub>) but remained at par with treatment (T<sub>3</sub>) FYM @ 5 t/ha + *Rhizobium* culture @ 20 ml kg<sup>-1</sup> seed, (T<sub>4</sub>) FYM @ 5 t/ha + *Rhizobium* culture @ 20 ml kg<sup>-1</sup> seed + PSB @ 20 ml kg<sup>-1</sup> seed, (T<sub>8</sub>) Vermicompost @ 2.5 t/ha + *Rhizobium* culture @ 20 ml kg<sup>-1</sup> seed + PSB @ 20 ml kg<sup>-1</sup> seed + KSB @ 20 ml kg<sup>-1</sup> seed.

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 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, days to fifty percent flowering, plant height (cm) may be due to the supply of balanced nutrition from integrated sources of nutrients for prolonged time. These results are in line with the findings of Ramana *et al.* (2010) <sup>[19]</sup> in French bean, Rajpal *et al.* (2003) <sup>[18]</sup> in cluster bean and Datt *et al.* (2003) <sup>[5]</sup> in vegetable pea, Kalloo *et al.* (2005) <sup>[7]</sup> in pea, Pandey *et al.* (2006) <sup>[13]</sup> Patel *et al.* (2011) <sup>[16]</sup> and Amin *et al.* (2014) <sup>[1]</sup> in cowpea.

This may be due to the fact that 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) <sup>[14]</sup> in pea with respect root nodules.

### Effect on economics

Economics is the need of the hour for the farmers while taking a decision regarding the adoption of a new technique. Hence, the gross realization, net realization and cost benefit ratio was computed for combinations different organic fertilizer.

An assessment of data (Table 2) indicated that in experiment, the highest net realization Rs. 218982 /treat was recorded with

by FYM @ 5 t/ha + *Rhizobium* culture @ 20 ml kg<sup>-1</sup> seed + PSB @ 20 ml kg<sup>-1</sup> seed + KSB @ 20 ml kg<sup>-1</sup> seed, followed by FYM @ 5 t/ha + *Rhizobium* culture @ 20 ml kg<sup>-1</sup> seed + PSB @ 20 ml kg<sup>-1</sup> seed (Rs. 192674/treat). Similarly, the highest CBR (1:6.9) was obtained under the FYM @ 5 t/ha + *Rhizobium* culture @ 20 ml kg<sup>-1</sup> seed + PSB @ 20 ml kg<sup>-1</sup> seed + KSB @ 20 ml kg<sup>-1</sup> seed, followed by Absolute control (1:6.4).

**Table 1:** Effect of different organic fertilizers on growth parameters

Treatments	Days taken to germination	Days taken to fifty percent flowering	Plant height			Number of root nodules per plant
			30 DAS (cm)	60 DAS (cm)	last picking (cm)	
T <sub>1</sub>	8.07	42.00	7.67	38.93	110.37	5.83
T <sub>2</sub>	7.83	42.00	7.73	40.53	112.35	6.88
T <sub>3</sub>	7.40	39.78	8.37	41.67	119.15	7.26
T <sub>4</sub>	6.93	37.89	8.77	44.64	128.80	7.33
T <sub>5</sub>	6.90	37.00	9.50	46.99	132.82	8.17
T <sub>6</sub>	7.67	41.94	8.09	42.33	113.35	6.35
T <sub>7</sub>	7.75	40.89	8.32	40.52	115.27	6.46
T <sub>8</sub>	7.42	39.22	8.46	42.67	116.53	7.24
SEm ±	0.24	1.17	0.24	1.25	3.90	0.38
CD at 5%	0.72	3.55	0.74	3.78	11.84	1.16
CV (%)	5.28	5.06	5.07	5.11	5.70	9.58

**Table 2:** Effect of different organic fertilizers on economics of cluster bean

Treat. No.	Yield (kg/ha)	Variable cost (Rs.)	Fixed cost (Rs.)	Gross realization/ ha (Rs.)	Total cost of cultivation/ ha (Rs.)	Net return/ ha (Rs.)	BCR
T <sub>1</sub>	11333	0	21300	158662	21300	137362	1:6.4
T <sub>2</sub>	12070	2233	21300	168980	23533	145446	1:6.1
T <sub>3</sub>	14746	10012	21300	206444	31312	175131	1:5.5
T <sub>4</sub>	16000	10025	21300	224000	31325	192674	1:6.1
T <sub>5</sub>	17880	10037	21300	250320	31337	218982	1:6.9
T <sub>6</sub>	12070	12512	21300	168980	33812	135167	1:3.9
T <sub>7</sub>	14000	12525	21300	196000	33825	162174	1:4.7
T <sub>8</sub>	14910	12537	21300	208740	33837	174902	1:5.1

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