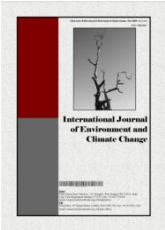

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Influence of Organic Nutrient Sources on Yield and Economics of Vegetable Cluster Bean (*Cyamopsis tetragonoloba* (L.) Taub.) Variety – MDU1

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Authors' contributions

This work was carried out in collaboration among all authors. Author ATK designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors ES and NT managed the analyses of the study and managed the literature search. All authors read and approved the final manuscript.

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ABSTRACT

Cluster bean is one of the important industrial legume crop, favoured semi-arid and arid farmers by its drought tolerance and nitrogen fixation capacity. A investigation was carried out to study the impact of various organic nutrient sources on the yield and economics of the vegetable cluster bean. The experiment was conducted in randomized complete block design with 12 treatments and three replications at wetland farms, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, during *Kharif* season, 2018. The yield parameters were recorded after each picking from five tagged plants and averaged for statistical analysis. The yield of vegetable cluster bean from the net plot area at each picking was noted. The harvest index, gross returns, net returns and the benefit-cost ratio was calculated for each of the treatment. Significantly higher pod length, pod weight, yield, harvest index and gross returns (11.6 cm, 2.4 g, 11084 kg/ha, 2.4, Rs. 1,66,254/ha, respectively) were recorded under recommended dose of fertilizer (50:50:40-N:P:K) in addition to the foliar spray of TNAU pulse wonder. However, all

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these parameters were statistically on par with treatments such as organic farmer's practice and 25 t/ha of Farm yard manure (FYM) along with a foliar spray of 3% *Panchagavya*. But economics net returns and benefit-cost ratio were higher with humic acid @ 6 l/ha along with banana pseudostem sap @ 2% followed by Humic acid @ 6 l/ha along with *Panchagavya* @ 3% and organic farmers practice. Considering the safer environment, human health and economic feasibility the farmer's practice of applying FYM @ 10 t/ha in addition with *Jeevamruth* @ 500l/ha and foliar spray of *Panchagavya* @ 3% is found to provide higher yields and profits in vegetable cluster bean.

Keywords: Economics; organic manures; vegetable cluster bean; yield and RDF.

1. INTRODUCTION

Today, the world has been facing problems headed by food and agriculture, mainly due to the indiscriminate use of synthetic chemicals for food production and their consequences on the health of humans and the environment [1]. Organic farming is one of the best alternative food production systems for safer and sustainable life, as it promotes and enhances agro-ecosystem health by following principles of health, ecology, fairness and care for all including soil [2]. With a land area of 10.2 million hectares, India ranks second in vegetable output behind China (175 million tonnes). However, in comparison to worldwide production, we continue to trail behind in the output of numerous vegetables [3]. As a result, there is a pressing need to boost vegetables yield in a long-term manner.

Cluster bean [*Cyamopsis tetragonoloba* (L.) Taub.] is a fabaceae plant that is native to the Indian subcontinent [4]. It is popularly known as 'Guar', and it is a very good social and commercially important legume crop in India's arid and semiarid regions, valued for its high yield and drought tolerance. Tender pods are vegetables that are high in protein (3.2 g), vitamin C (49 mg), vitamin A (65.31 IU), energy (16 KCal), iron (4.5 mg), calcium (57 mg), fat (1.4 g), carbohydrate (10.8 g) and moisture (8.1 g) per 100 g edible piece [5]. It also treats a variety of ailments, including stomach ulcers, high blood pressure, obesity, plague, arthritis, inflammation, sprains and liver enlargement [5].

Vegetable cluster bean requires an abundant supply of nutrients for good growth and development. Organic substances like vermicompost, farm yard manure, *Panchagavya* and humic acid can be used as substitutes for inorganic fertilizers in cluster bean to maintain soil productivity and environmental quality [6]. Organic manures not only enhance the soil's chemical properties by providing macro and micronutrients, but they also reduce the chances of crop failure by providing growth-promoting substances and also improve the soil's physical properties like structure and soil moisture retention capacity [7].

2. MATERIALS AND METHODS

A fields experiment was conducted for one season during *Kharif*, 2018 on irrigated wetland farms of Tamil Nadu Agricultural University, Coimbatore to evaluate the influence of organic manures on yield parameters and economics of vegetable cluster bean. The experimental site has clay loamy soil with alkaline p*H* (8.6), low EC (0.28 dS/m), medium in organic carbon (0.62%), low in nitrogen (252 kg/ha), medium in phosphorous (18.2 kg/ha) and high in potassium (402 kg/ha). The experiment was carried out in randomized complete block design with twelve treatments and three replications. The following are the treatment details: T_1: Organic farmer's practice (farm yard manure (FYM) @10 t/ha + *Jeevamruth* @ 500 l/ha along with irrigation on 3rd days after sowing (DAS), 30 DAS and 60DAS + *Panchagavya* @ 3% as foliar spray (FS) on 30, 45 and 60 days after sowing (DAS), T_2: FYM @ 25 t/ha + *Panchagavya* @ 3% as FS on 30, 45 and 60 DAS, T_3: FYM @ 12.5 t/ha + *Panchagavya* @ 3% as FS on 30, 45 and 60 DAS, T_4: FYM @ 12.5 t/ha + banana pseudostem sap @ 2% as FS on 30, 45 and 60 DAS, T_5: Vermicompost @ 5 t/ha + *Panchagavya* @ 3% as FS on 30, 45 and 60 DAS, T_6: Vermicompost @ 5 t/ha + banana pseudostem sap @ 2% as FS on 30, 45 and 60 DAS, T_7: *Ganajeevamruth* @ 500 kg/ha + *Panchagavya* @ 3% as FS on 30, 45 and 60 DAS, T_8: *Ganajeevamruth* @ 500 kg/ha + banana pseudostem sap @ 2% as FS on 30, 45 and 60 DAS, T_9: Humic acid @ 6 l/ha+ *Panchagavya* @ 3% as FS on 30, 45 and 60 DAS, T_{10}: Humic acid @ 6 l/ha + banana pseudostem sap @ 2% as FS on 30,45 and 60 DAS, T_{11}: RDF of NPK fertilizers

(50:50:25) + TNAU pulse wonder @ 1% as FS, T12: Absolute control.

The FYM, vermicompost, *Ganajeevamruth*, and humic acid were applied as basal, whereas *Panchagavya*, banana pseudostem sap were given as foliar spray on 30, 45, and 60 DAS. *Jeevamruth* was given along with irrigation water on the 3rd day after sowing (DAS), 30th and 60th DAS. Banana pseudostem sap was extracted from banana standing 8 year old tree, by making incision on stem with a sharp knife. The collected sap was applied as foliar spray by diluting 2ml of sap in one liter of water.

To achieve good tilth, the field was ploughed twice with a cultivator and once with a rotovator. Using a bullock-drawn ridge former, 45 cm width ridges were created. The dimension of the plots was 6.75 m x 3.15 m. Prior to sowing, organic manures were applied to the soil and irrigated. Cluster bean MDU 1 of TNAU was utilized in this experiment. Seeds were treated with *Rhizobium* at a concentration of 80 g/kg and then dried in the shade for 12 hours. Seeds were sown at 15 cm apart on one side of the ridge. The first irrigation was given on the day of sowing, the second on the third DAS, and then further irrigations were scheduled based on available soil moisture content. As per the treatments, organic liquid manures were administered as a foliar spray on 30, 45 and 60 DAS. Except for the use of synthetic chemicals, all other cultural practices were followed as recommended by the TNAU agro site.
(http://agritech.tnau.ac.in/horticulture/horti vegetables cluste.html).

Length of a pod (cm) was measured from the calyx base to pod tip, width of a pod in (mm) was measured on broadside of the pod with help of Vernier calipers, the weight of individual single green tender pods was noted. Mean values were recorded for each picking from five pods in each tagged plant. Vegetable green tender pods/plant were weighed using an electronic weighing balance after each picking and pooled. Yield of vegetable cluster bean from net plot area of each treatment, leaving border lines and sampling rows were recorded at each picking. The final yield was attained by summing up all the pickings and expressed in kilograms. The dry weight of the shoot portion/net plot at harvest was weighed after sun drying the plants. The straw yield is the dry weight of shoot portion without pod weight in a net plot and expressed in kg/ha. The harvest index was calculated using the formula was given by Watson in 1952 [8].

$$\text{Harvest index (HI)} = \frac{\text{Economic yield (Kg/ha)}}{\text{Biological yield (Kg/ha)}}$$

The experimental yield parameters data were statistically analyzed by analysis of variance using Agres software. The level of significance was kept at 5% (P =0.05). The cost of cultivation was worked out for all 12 treatments individually. The cost of all the operations from the land preparation to the final picking of green pods along with the input costs were taken into consideration. The prevailing market prices of vegetable cluster bean at the harvest time in Coimbatore market was taken into consideration for computing profit amount. The gross returns (Rs./ha) were calculated by taking into account the green pod yield of each treatment. The net returns (Rs./ha) was calculated by deducting the total cost of cultivation from gross returns per hectare for each of the treatment. The BC ratio was also computed by dividing gross return with cost of cultivation for each treatment.

3. RESULTS AND DISCUSSION

3.1 Effect of organic nutrient source on yield parameters and yield of vegetable cluster bean

The recommended dose of fertilizer (RDF) with TNAU pulse wonder registered 56% higher yield than absolute control. Whereas, organic farmers' practice (T_1) and FYM @ 25 t/ha in addition to the foliar spray of 3% *Panchagavya* (T_2) scored 43% and 42% higher yield, respectively than absolute control (T_{12}).

Yield parameters are the ultimate output in nutrient experiments to be observed in order to attain food security [9]. Table 1 shown statistically evaluated mean data on yield parameters of vegetable cluster bean, such as pod length, pod breadth, single pod weight, and pod yield. A review of the data revealed that RDF in addition to TNAU pulse wonder (T_{11}) produced significantly longer pods (11.6 cm) higher single pod weight (2.4 g) and pod yield (11084 kg/ha) among the treatments, which was comparable to organic farmers' practice (T_1) and FYM @ 25 t/ha in addition to foliar spray of 3 percent *Panchagavya* (T_2).

Table 1. Effect of organic manures on yield parameters and economic of vegetable cluster bean

Treatments	Pod length (cm)	Pod width (mm)	Pod weight (g)	Pod yield (kg ha-1)	Stover yield (kg/h)	Harvest index	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	B:C ratio
T1	10.7	7.7	2.2	10215	2284	0.47	70277	153231	82954	1.18
T2	10.6	8.0	2.2	10145	2443	0.45	96597	152172	55575	0.58
T3	9.6	7.6	2.0	9190	2167	0.46	74097	137846	63749	0.86
T4	9.7	8.0	2.0	9283	2344	0.44	72647	139251	66604	0.92
T5	9.5	7.2	1.9	9125	2192	0.45	101597	136870	35273	0.35
T6	9.7	7.7	2.0	9256	2360	0.44	100147	138833	38686	0.39
T7	8.4	7.9	1.7	8042	1890	0.46	72797	120631	47834	0.66
T8	8.5	7.7	1.7	8115	2013	0.45	71347	121730	50383	0.71
T9	8.5	7.6	1.7	8164	1907	0.46	53757	122462	68705	1.28
T10	9.5	7.8	1.9	9055	2076	0.47	52307	135832	83525	1.60
T11	11.6	7.7	2.4	11084	2351	0.49	55019	166254	111235	2.02
T12	7.4	6.5	1.5	7102	1859	0.43	50097	106529	56432	1.13
SEd	**0.6**	**0.4**	**0.1**	**498**	**117**	**0.02**				
CD (P = .05)	**1.2**	**NS**	**0.2**	**1033**	**242**	**NS**				

**FYM: Farm yard manure*

The faster accessible form of nutrients from inorganic fertilizers was responsible for the better production value [10-12].

The yield attributes and yield obtained from organic farmers' practice treatment and FYM @ 25 t/ha along with *Panchagavya* foliar spray was because of farm yard manure application. FYM adds great value to soil by changing the bulk density, improving soil aeration, enriching soil microbial life along with supply of plant nutrients. In addition to this, *Jeevamruth* act like biofertilizer, as it has N fixers and P solubilize [13-16]. As a composite result, vegetable cluster bean had higher uptake of nutrients from the soil. Besides this, *Panchagavya* and FYM application also might had boosted plant vegetative growth with this higher photosynthate production and good partitioning of food material and translocation might have contributed to increase in yield attributes and yield [17,18], the composite effect of all above discussed parameters had made organic treatments statically on par with inorganic treatment [19-21].

3.2 Effect of Organic Manures on Economics of Vegetable Cluster Bean

Any technology developed by scientists or farmers will be adopted based on economic viability and feasibility [9]. The economics in terms of net return and benefit-cost ratio of a crop cultivation technology will have a greater impact on practical utility and acceptance by farmers. The economics of different organic manures application in vegetable cluster bean had been computed and exhibited in Table 1. Net returns (Rs. 1,11,235/ha) and benefit cost ratio (2.02) were higher with RDF in addition with TNAU pulse wonder (T_{11}), followed by humic acid @ 6 l/ha with banana pseudo stem sap foliar spray (T_{10}) and organic farmers' practice (T_1) due to better crop growth, physiological activity, nutrient uptake and higher yield [22]. Lower net returns (Rs. 35,273/ha) and benefit cost ratio (0.3) were obtained with vermicompost @ 5 t/ha in addition *Panchagavya* foliar spray (T_5) followed by vermicompost @ 5 t/ha with 2% banana pseudostem sap as a foliar spray (T_6) and FYM @ 25 t/ha along with 3% *Panchagavya* as a foliar spray (T2) because of higher cost incurred to FYM and vermicompost. The results are in conformity with [23-28].

4. CONCLUSION

It is concluded that application of RDF along with TNAU pulse wonder provide better yield in vegetable cluster bean, along with food security, it is also necessary to consider the safety of the environment, human health and economic feasibility in agriculture and food production systems. So, it is recommended that the farmer's practice of applying FYM @ 10 t/ha in addition along with *Jeevamruth* @ 500l/ha and foliar spray of *Panchagavya* @ 3% is found to provide higher yields and better profits in vegetable cluster bean for organic farmers.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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