Influence of organic nutrient sourceson nutrient, quality and yield parameters of vegetable clusterbean

Abstract:

The investigation “organic nutrient source and their influence on nutrient dynamics, quality and yield parameters of vegetable clusterbean” during the year 2018, was conducted at irrigated wetland farms, TNAU, Coimbatore. The RBD (randomized complete block design) design was adopted and replicated thrice. The total number of treatments were12 with various basal applications of organic manures namely farm yard manure, vermicompost, humic acid,*ghanjeevamrutham*and also foliar spray combinationsnamely panchagavyaand banana pseudo stem sap. The standard recommended cultural practices of organic farming were followed forall treatments except fertilizer application and synthetic chemical use. The data revealed that soil chemical properties *viz.*, pH, EC and organic carbon were not significantly influencedbyvarious organic nutrient sources. Significantly, higher values of N, P and K availability in soil and their uptake by clusterbean crop and crude protein content, crude fiber, ascorbic acid, moistures percentage in cluster bean pods were recorded with 100 % recommended dose of fertilizer and 2% foliar spray of TNAU pulse wonder. However, organic treatments wereon parwith inorganic treatments for all the nutrient, quality and yield parameters.So, organic treatments like organic farmers practice and FYM along with *Panchagavya*were recommended to improve nutrient use efficiency and quality of yield, eventually to benefit farmers and complete agricultural ecosystem in terms of profit and sustainability, respectively.

Key words: Clusterbean, FYM, N uptake, Organic manures, Panchagavya,

Introduction:

The clusterbean (*Cyamopsis tetragoloba*(L). Taub.) is an annual nitrogen fixing, drought tolerant legumecrop with deep root system. It is also valued as potential industrial crops, because of Gaur (galactomanan) gum content in endosperm of seed. Inorganic fertilizers has resulted in reduced crop yield, as a result of soil acidity, nutrient imbalance, poor physical properties of the soil and nutrient retention(Ballal and Kadam, 2016). Organic farming has gained importance in recent years, as a result of the of intrinsic benefits, such as lowering the hazardsof human, animal and environmental exposure to toxic chemicals. It also helps in recycling animal wastes back into the farm and therefore reducing the cost of cultivation. Therefore, the application of plant nutrients through organic sources like FYM, Vermicopmost, *Panchagavya*, bananapseudostem sap remains a preferable option for ensuring increased fruit shelf life, quality and sustainable crop production *(Alexander et al*., 2009). Considering the benefits of organic farming, the experiment was taken up to study the influence of various basal organic manures and foliar spray on soil nutrient availability and their uptake and also on quality parameters of vegetable clusterbean.

Material and Methods:

The field experiment entitled "Organic nutrient source and their influence on nutrient dynamics and quality parameters of vegetable clusterbean" was taken up at irrigated wetland farms of Tamil Nadu Agricultural University, Coimbatore during *Kharif* season from July to October, 2018. The experiment was carried out in randomized complete block design with twelve treatments and three replications. Treatment details are as follows ; 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 60 DAS + *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 @ 5t/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, T_{12}: Absolute control.

A well decomposed farm yard manure, vermicompost, *ganajeevamruth* and humic acid were administered on to clusterbean crop as basal treatments, whereas *Panchagavya*, banana pseudostem sap were foliar sprayed on 30, 45, and 60 DAS and Jeevamruth was dissolved into irrigation water on 3rd day after sowing, 30 DAS and 60 DAS. The banana pseudostem sap was collected from 8 year old banana plant, by making sharp cut on one side of a stem. Two milliliter of the extracted sap was diluted in one liter of water and applied as foliar spray.

Field was ploughed twice using a cultivator and once using rotovator to get fine tilth. A bullock-drawn ridger was used to create ridges 45 centimetres apart. The dimension of the gross plot was 6.75 m × 3.15m. The field was irrigated and basal organic manures were applied prior to seeding. The experiment employed the clusterbean MDU 1 variety released from TNAU. Rhizobium was applied to the seeds at a rate of 80 g/kg, and they were then shade-dried for 12 hours. The ridge was seeded with a 15-cm seed spacing on one side. In accordance with the soil's moisture content, irrigation was applied on the day of sowing, on the 3DAS, and subsequently as and when moisture was deficit. In accordance with treatment schedule, foliar sprays of organic liquid manures were applied at 30, 45, and 60 DAS. Except

for the use of synthetic chemicals, all other traditional methods were carried out in accordance with the TNAU recommendationspackage of practices.

The initial soil samples were collected from the experimental field in in zig zag manner at 0 to 30 cm depth before treatment imposition. Then composite samples were prepared and analyzed for physical and chemical properties. The results were presented in the Table 1.

Table 1. Initial Soil and irrigation water characteristics of the experimental field.

Particulars	Values	Methods	Reference
A. Textural composition (Moisture free basis)			
Mechanical Analysis		Robinson International pipette method	Piper (1966)
Clay (%)	47.6		
Silt (%)	22.5		
Fine sand (%)	11.7		
Coarse sand (%)	18.2		
Textural class	Clay loam	USDA, Triangle	Piper (1950)
II. Chemical characteristics			
pH	8.27	Potentiometric pH meter	Jackson (1973)
Electrical conductivity (dS/m)	0.25	EC meter	Jackson (1973)
Organic carbon (%)	0.45	Walkley and Black rapid titration method	Jackson (1973)
Available N (kg/ha)	218	Alkaline permanganate method	Subbiah and Asija (1956)
Available P_2O_5 (kg/ha)	18.2	Olsen's method	Olsen (1954)
Available K_2O (kg/ha)	402	Flame photometer method	Stanford and English (1949)
B. Irrigation water characteristics			
pH	7.5	Potentiometric pH meter	Jackson (1973)
Electrical conductivity (dS/m)	1.2	Electrical conductivity bridge CM -180	Jackson (1973)

Soil samples were collected from 0 to 30 cm depth at different places on 0, 30, 45, 60 DAS and at harvest stage of the crop in each plot. The composite soil samples were collected, mixed and kept for shade drying. A representative soil sample was made (1 kg) by quartering method and packed into labelled polythene bags. This processed sample is used for analysis

of soil chemical properties namely soil pH, EC, OC, available nitrogen, phosphorous, potassium using the methods mentioned in Table 1.

Five plants samples were taken randomly from sampling row on each plot for destructive sampling during 30, 45, 60 DAS and 90 DAS. Shade dried for three days, then oven dried for one day at 65^0C for obstinate dry weight, then powdered and utilized for the analysis of nutrients and method of analysis followed as mentioned in Table 2.

Table 2. Methods adopted for plant analysis

Element	Method	Reference
Nitrogen	Micro Kjeldahl method	Humphries (1956)
Phosphorus	Vanadomolybdo phosphoric yellow colour method	Piper (1966)
Potassium	Flame photometer method	Muhr *et al*. (1965)

Nutrient uptake was computed based on dry weight basis of aerial biomass at harvest stageusingthe following formulae.

Uptake of nutrient (kg/ha) = Nutrient content (%) x Dry matter production (kg/ha)

100

Quality parameters such ascrude fibre content in green pods was determined by the method suggested by Association of Official Analytical chemists Inc., USA.(AOAC, 1975). Two grams of pod sample (W_1) were grounded then refluxed with 1.25% H_2SO_4 and then washed, again refluxed with 1.25% NaOH for 30 minutes. Later, sample was dried out, to takeinitial weight (W_2). Ignite the sample in a muffle furnace and again had taken weight (W_3). Loss in weight was considered as crude fibre content and expressed on the basis of using following relationship.

$$\text{Crude fibre (\%)} = (W_2\text{-}W_3/ W_1) \times 100$$

Where, W_1 = Initial weight of sample, W_2 = Weight of refluxed sample and W_3 = Weight of ignited sample.

Protein percentage was enumerated by assessing thetotal nitrogen using Kjeldahl method in pod (Humphries, 1956)and then nitrogen percentage is multiplied a factor 6.25.Ascorbic acid

content was measured with the help of procedure given byHorwitz *et al*. (1970)and expressed in mg/100 grams of fresh sample. Moisture content of pods measured in percentage form selected 10 pods from each treatment. Initial weight is noted using standard balance, then dried in oven at 65˚C for 3 days for complete moisture loss. Thereafter final dry weights were noted and substituted in the following formula.

Moisture content (%) = [Fresh weight (g) - Dry weight (g)/ Fresh weight (g)] x 100

The experimental data was statistically analyzed by analysis of variance using Agres software. The level of significance was P=0.05.

Results and Discussion:

The mean statistically analyzed data of soil pH, EC and organic carbon on 30, 45, 60 DAS and at harvest stages and moisture percentage in cluster bean pods were not changed significantly with application of various organic manures. Whereas, significantly higher soil available nitrogen (260.8 kg/ha, 254.0 kg/ha and 250.6 kg/ha on 30, 45 and 60 DAS, respectively), available phosphorus (23.4 kg/ha, 21.8 kg/ha, 21.3 kg/ha and 16.4 kg/ha on 30 DAS, 45 DAS, 60 DAS and 90 DAS, respectively) and available potassium (424.5 kg/ha, 413.5 kg/ha and 406.5 kg/ha on 30, 45, 60 DAS and 90 DAS, respectively) and also higher uptake of nitrogen (41.4 kg/ha), phosphorous (7.1 kg/ha) potassium (23.5 kg/ha) nutrients by cluster bean at harvest stage were noted with RDF + TNAU pulse wonder (T_{11}), which were statistically on par with organic farmers' practice (T_1) and FYM @ 25 t/ha in addition to foliar spray of 3% *Panchagavya* (T_2). Whereas, at 90 DAS available nitrogen (238.6 kg/ha) was found higher with organic farmers' practice (T_1). But, it was on parity with T_{11} and T_2 (Table 3.). This may be owing to rapid and direct availability of available nutrients from urea, single super phosphate and muriate of potassium. Whereas, with application of organic treatments like addition FYM and *Jeevemrutham* had resulted in higher amount organic manure, microbial population, organic acids and enzymes like dehydrogenase, urease and

phosphatase in soil helps in conversion of unavailable form of nutrients to available form of nutrients for better plant uptake. *Jeevamruth* has large amount of free living N fixers, symbiotic N fixers and associated N fixer and phosphorous solubilizers (Devakumar *et al*., 2008) that might have led to more number of nodules, higher amount of nitrogen fixation and phosphorous solubilization (Yadav and Chhipa, 2007). All this collective action might have resulted into higher availability of nitrogen, phosphorous and potassium in soil. Naga (2013), (2014), *Manohar et al.* (2018a), Prabhavathi (2014) and Lodha (2016a). Lower available nitrogen, phosphorus and potassium and lower uptake of these nutrients by cluster bean plants was observed under absolute control (T_{12}).

The application of farm yard manure improves soil quality by altering bulk density, enhancing aeration, enhancing microbial life in the soil, and increasing plant nutrient availability. During microbial decomposition of FYM in organic treatments, microbes feed on FYM and release organic acids and organic collides with greater cation exchange sites (Yadav *et al*., 2019), which results in faster mineralization of organic waste in the soil. Eventually, the availability of nitrogen increase (Yadav and Chhipa, 2007) along with increase solubility of native phosphates and reduction of Potassium fixation(Bharadwaj and Omanwar, 1994). The added organic collides with greater cation exchange sites improved available potassium (Yadav *et al*., 2019)by holding applied K and released K from non-exchangeable K. (CHOGATAPUR, 2015; LODHA, 2016b; Prabhavathi, 2014)

Statistically more crude fibre content in pod (4.7%) and protein percentage (4.1%) in vegetable pod of cluster bean was obtained in RDF in addition to TNAU pulse wonder (T11), but it maintained statistically parity with organic farmers' practice (T1) and FYM @ 25 t/ha in addition to foliar spray of Panchagavya @ 3 % (T2). As mentioned earlier higher rapid availability of nutrients from soil and foliar application and better micro and macro nutrient

uptake might have promoted higher synthesis of protein and crude fibre. Reddy (2011), Prabhavathi (2014) and Choudhary (2015).

Ascorbic acid represents vitamin C content, which is very essential for human. Significantly higher ascorbic acid (52.7 mg/100g) was noted with organic farmer's practice (T1), which was statistically on par with FYM @ 25 t/ha in addition to foliar spray of 3% *Panchagavya* (T2) and RDF addition of TNAU pulse wonder (T_{11}). The reason behind higher accumulation of ascorbic acid was due to better uptake of nutrient especially K (quality element). Potassium has close relationship with metabolism of carbohydrate and ascorbic acid synthesis Boraiah *et al*. (2017); (El-Sayed and El Sayed, 2013) and(Vanitha *etal.*, 2014). Lower crude fibre (3%), protein percentage (2.6%) and lowest ascorbic acid (33.8 mg/100g) was recorded under absolute control (T_{12}) than others. Moisture percentage in pods was statistically analyzed had not shown any significant difference among the treatments with application of organic manures.

The higher significant yield (11084 kg/ha) was attained in RDF + TNAU pulse wonder (T11) and followed by organic farmers' practice (T1) and FYM @ 25 t/ha + foliar spray of 3% Panchagavya (T2) as statistically on par treatments. Whereas, significant lowest yield (7102 kg/ha) was registered in absolute control (T12). Compared to the absolute control, the yield of the RDF with TNAU pulse wonder was 56% higher. However, compared to the absolute control (T12), organic farmers' practices (T1) and FYM @ 25 t/ha, along with a foliar spray of 3% Panchagavya (T2), produced yields that were 43% and 42% higher, respectively.

Vegetable clusterbeans gained more nutrients from the soil as a composite consequence. Panchagavya, Jeevamrutham and FYM might had enhanced plant vegetative growth with sustainable release of macro and micro nutrients. Eventually, higher photosynthate producedmay get partitioned and translocated into pods for enhancing yield. The composite effect of all above discussed had made organic treatments statically on par with inorganic treatment.(Manohar et al., 2018b; RAJPOOT, 2006).

The reason behind higher yield parameters in inorganic treatment was due to quick available form of nutrient supplied to the plant through soil and foliar application enhanced growth parameters like plant height, number of leaves, leaf area/plant along with higher chlorophyll content resulted into synthesis more quantity of photosynthates. The synthesized food material then might have transferred from source (leaves and stems) to sink successfully (pods) with minimum losses. Thus, resulted in increased yield parameters.(Prabhavathi, 2014)

Conclusion:

Although, inorganic treatment as a nutrient source had shown higher NPK nutrient availability in soil, higher NPK nutrient uptake in plant and higher crude fibre content, protein percentage in pods and higher yield was observed. The organic farmers' practice of FYM, *jeevamrutham* and foliar spray of *panchagavya* was recommended for better fruit quality and sustainable clusterbean production by considering the negative effects caused by chemical farming to environment and life on the earth,

Table 3. Effect of organic manures on pod quality parameter, soil available nitrogen, phosphorous, potassium and their uptake by clusterbean.

	Available nitrogen (kg/ha)				Available phosphorus (kg/ha)				Available potassium (kg/ha)				Plant uptake			Quality parameters			Pod Yield
Treatment	**30 DAS**	**45 DAS**	**60 DAS**	**90 DAS**	**30 DAS**	**45 DAS**	**60 DAS**	**90 DAS**	**30 DAS**	**45 DAS**	**60 DAS**	**90 DAS**	**N uptake (kg/ha)**	**P uptake (kg/ha)**	**K uptake (kg/ha)**	**Crude protein (%)**	**Crude Fibre (%)**	**Ascorbic acid (mg/100g)**	**(kg/ha)**
T1	253.1	250.6	246.7	238.6	21.6	20.0	19.6	15.1	419.9	411.0	404.3	394.5	37.0	6.3	23.5	3.8	4.3	52.7	10215
T2	256.9	249.9	243.1	236.6	21.4	19.9	19.5	15.0	417.0	406.0	399.0	390.0	39.3	6.7	22.4	3.7	4.3	48.6	10145
T3	234.0	227.1	224.9	214.9	19.4	18.0	17.7	13.6	386.5	371.0	375.5	354.5	31.6	5.4	19.3	3.4	3.9	43.7	9190
T4	232.6	228.9	223.1	215.4	19.6	18.2	17.9	13.7	384.8	368.7	373.8	355.0	34.5	5.9	20.9	3.4	3.9	44.2	9283
T5	234.0	227.5	223.5	213.7	19.3	17.9	17.5	13.5	382.0	368.5	371.0	352.7	31.8	5.4	19.1	3.4	3.8	43.4	9125
T6	234.3	228.7	224.1	214.2	19.6	18.2	17.8	13.7	379.7	367.6	368.7	353.6	34.7	5.9	17.9	3.4	3.9	44.0	9256
T7	225.7	224.0	218.4	209.4	17.0	16.8	15.5	11.9	367.6	356.6	356.6	340.6	24.1	4.1	20.2	3.0	3.4	38.3	8042
T8	227.8	223.5	219.1	210.1	17.2	15.9	15.6	12.0	365.5	354.5	354.5	339.5	25.9	4.4	21.3	3.0	3.4	38.6	8115
T9	229.8	224.1	221.6	212.5	17.3	16.0	15.7	12.1	370.5	359.5	359.5	343.5	24.7	4.2	20.1	3.0	3.4	38.8	8164
T10	230.4	226.9	223.1	214.1	19.1	17.8	17.4	13.4	371.1	359.1	358.1	344.1	29.8	5.1	20.9	3.3	3.8	43.1	9055
T11	260.8	254.0	250.6	220.2	23.4	21.8	21.3	16.4	424.5	413.5	406.5	387.0	41.4	7.1	21.0	4.1	4.7	48.3	11084
T12	198.3	194.8	189.1	182.6	15.0	14.9	13.7	10.5	327.0	316.0	311.0	301.0	21.0	3.6	17.4	2.6	3.0	33.8	7102
S. Ed	12.0	11.8	11.1	12.0	0.9	1.1	0.9	0.7	19.2	19.9	18.8	17.6	1.6	0.3	1.1	0.2	0.2	2.3	498
CD (P=0.05)	24.9	24.5	23.1	25.0	2.0	2.2	1.9	1.5	39.7	41.2	38.9	36.5	3.4	0.6	2.3	0.4	0.4	4.7	1033

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