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Effect Of Foliar Application Of Organic Nutrient On Yield And Quality Of Cluster Bean [*Cyamopsis Tetragonoloba* (L.) Taub.] Cv. Mdu-1

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ABSTRACT

Present study was carried out during two seasons of 2022–2023 at Tamilnadu Agricultural University, Coimbatore, Tamilnadu to to study the effect of foliar application of organic nutrient on yield and quality of cluster bean [*Cyamopsis tetragonoloba* (L.) Taub.] cv. MDU-1. Experiment was conducted in a randomized block design (RBD) comprised of 3 different foliar applications of temor karaisal, viz. Temor kraisal @ 3%; temor karaisal, @5%; temor karaisal, @7%; and 3 foliar applications of panchakaya, viz. panchakaya @ 3%; panchakaya @5 %; and panchakaya @7% and 3 foliar applications of vermiwash; vermiwash @3%; vermiwash @5%; vermiwash @7 % and control replicated thrice. The results revealed that the application of a consortium of organic foliar spray significantly to enhanced the quality and yield attributes of cluster beans when compared to the control. The yield parameters *viz*, single pod weight (2.86 g), pod yield plant^{-1} (132.16 g), estimated pod yield^{-1} (9.81 t ha^{-1}) and quality parameters *viz*, parameter pod crude protein content (187.6%) and fibre (42.71%) were recorded with the application of temor karaisal @ 7% followed by the treatment with the application of temore @5%. Based on the growth, yield, post-harvest soil nutrient status, nutrient uptake, and cost economics, the combined use of temore at 7% can be considered the best treatment of organic amendment and mulching practice for higher yield and quality of cluster bean.

Keywords: Clusterbean,Organic Foliar Sprays,Temore Karaisal,Protein and Fibre Content

INTRODUCTION

The cluster bean [Cyamopsis tetragonoloba (L.) Taub. (Syn. C. psoraliodes)] is a bushy annual herb having a deep rooted system, and a resilient and drought resilient leguminous crop grown on sandy soils of arid and semiarid regions. Cluster bean is a rich source of proteins, dietary fiber and also contains minerals namely phosphorous, calcium, iron, potassium and with zero cholesterol and fats. MDU 1 is a popular variety of cluster bean for vegetable purpose that is grown for its young tender green immature pods with maximum yield. MDU1 is a single stem variety and the pods are of 15 cm with better quality. Gum obtained from cluster bean seeds is a choice of agrochemical in paper, food, cosmetics, textile, oil and pharmaceutical industries across the world (Bhatt et al., 2017). The world's total cluster bean production has been figured to be around 7.5–10 lakh tones every year. The production list of cluster bean is dominated by India as leading producers of the crop in the world contributing to around 75–82% of the total production. The variety MDU1 was released from Agricultural Research Institute,Madurai.It matures 45 to 50 DAS and attains height 50 to 60 cm. The average yield of variety is 10 to 15 q/ha. The use of inorganic fertilizers has been associated with reduced crop yield, soil acidity and nutrient imbalance, creates poor physical properties of the soil and nutrient retention characteristics; hence adversely affects crop growth and yield (Ballal and Kadam, 2016). Organic farming reduces the risks of human, animal, and environmental exposure to toxic materials and also helps in recycling animal and fish wastes back into the farm. Therefore, the application of plant nutrients through organic sources like temor karaisal, vermiwash and fish panchya kavya remains a good choice for maintaining its quality and sustainable yield (Sharma, 2012). Somashekar et al. (2018) suggested that promoting low cost organic practices will not only increase the yield of the crop but also improves the fruit quality and enhance the shelf life of the fruits. Keeping the above facts in view, the experiment was conducted with the objective to study the productivity and profitability of cluster bean production in different agro ecological regions, and to standardize the best organic foliar spray for cluster bean production.

MATERIAL AND METHODS

Present study was carried out during two seasons of 2022–2023 at Tamilnadu Agricultural University, Coimbatore, Tamilnadu to to study the effect of foliar application of organic nutrient on yield and quality of cluster bean [*Cyamopsis tetragonoloba* (L.) Taub.] cv. MDU-1. Experiment was conducted in a randomized block design (RBD) comprised of 3 different foliar applications of temor karaisal, viz. Temor kraisal @ 3%; temor karaisal, @5%; themor karaisal, @7%; and 3 foliar applications of panchakavya, viz. panchakavya @3%; panchakavya @5%; and panchakavya @7% and 3 foliar applications of vermiwash; vermiwash @3%; vermiwash @5%; vermiwash @7 % and replicated thrice.

Pod per plant^{-1} :The number of pod plant^{-1} was recorded in each tagged plant and mean value expressed in numbers.

Single pod weight (g): Weight of ten freshly harvested pods from each plot and measured using an electronic weighing scale and single pod weight expressed in grams.

Pod yield per plant : The weight of green and marketable pods from each tagged plant recorded at every harvest and mean pod weight per plant expressed in gram.

Estimated pod yield t ha^{-1} : From the values of yield per plot, the yield per hectare was estimated and expressed in t ha^{-1}.

Pod protein content (%): Protein content in Cluster bean estimated as per the method developed by Lowry *et al*. (1981).

Preparation of organic foliar sprays

Temor karaisal: 1liter of coconut milk and 1 liter of buttermilk are enough to make Temor solution at home. (Whey butter removed from curd.) Grate the coconut and grind it in a mixer and take coconut milk. It is important to note that, to extract one liter of coconut milk from one coconut, pour 1 liter of water and extract coconut milk. Do not pour more than one liter of water. Grind the coconut, filter it well and take only coconut milk that is free from curds. Allow this mixture to ferment in a plastic container or plastic water cane. If you prepare this Temor solution in an earthen pot, cover the earthen pot with a cloth and tie it tightly with a rope. After five to six days, the solution is well fermented, full of microbial nutrients, and readyNow open the lid of the solution container, leave a tick and mix it well. With the fermented broth, the Temor solution is ready.

Vermiwash: Vermiwash may be collected from the vermicompost units as a byproduct liquid extract. Whereas other method (Kale, 1998) [16] of Vermiwash preparation is followed by taking One kg adult earthworms (approximately 1000 worms) of the same species (E. euginiae) were collected and without any mixing of the casts, they were released into a 500 ml of lukewarm distilled water (37 0C - 40 0C) and agitated for two minutes. Earthworms were taken out and again washed in another 500 ml at room temperature (+30 0C) and released back into the tanks. The agitation in lukewarm water made the earthworms to release sufficient quantities of mucus and body fluids. This is known as true vermiwash. Transferring into ordinary water was to wash the mucus sticking still on to their body surface and this also helped the earthworms to revive from the shock. Another method for the preparation of vermiwash, a plastic container of 15 to 20 liters capacity is required and the base of the container is fitted with tap to collect the watery worm extract. The container is filled with different succesive layers. First base layer, medium sized bricks or stones up to a height of 10-15 cm filled. Above the base layer a layer of coarse sand (up to 6 inches) and fine sand (5 inches) are spread. Introduction of locally available earthworms (Eisenia foetida) mixing with fertile soil applied. After that, a layer of partially decomposed cow dung (20-25 cm) and organic residues of 40-45 cm were poured. All the layers in the container is moistened by sprinkling water over it. Container is sprinkled with approx 2 L water per day. After 16 to 20 days preperation of vermiwash in the unit begains. Everyday about 1-2 L of vermiwash will be collected and

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Preparation of panchakavya

- Cow dung - 7 kg
- Cow ghee - 1 kg

Mix the above two ingredients thoroughly both in morning and evening hours and keep it for 3 days

- Cow Urine - 10 liters
- Water - 10 liters

After 3 days mix cow urine and water and keep it for 15 days with regular mixing both in morning and evening hours. After 15 days mix the following and panchagavya will be ready after 30 days.

- Cow milk - 3 liters
- Cow curd - 2 liters
- Tender coconut water - 3 liters
- Jaggery - 3 kg
- Well ripened poovan banana – 12 nos.

All the above items can be added to a wide mouthed mud pot, concrete tank or plastic can as per the above order. The container should be kept open under shade. The content is to be stirred twice a day both in morning and evening. The Panchagavya stock solution will be ready after 30 days. (Care should be taken not to mix buffalo products. The products of local breeds of cow is said to have potency than exotic breeds). It should be kept in the shade and covered with a wire mesh or plastic mosquito net to prevent houseflies from laying eggs and the formation of maggots in the solution. If sugarcane juice is not available add 500 g of jaggery dissolved in 3 liter of water.

Preparation of reagents

Reagent A: Prepared by dissolving 20 g of anhydrous sodium carbonate (Na_2CO_3 $2H_2O$) and sodium hydroxide 4 g in 1000 ml of distilled water.

Reagent B: Mixing 1 ml of 1.35% sodium potassium tartrate and 0.1 ml of 5.5% of copper solution ($CuSO_4$ $5H_2O$).

Reagent C: Alkaline copper solution prepared by mixing 50 ml of reagent A with 1 ml of reagent B just before usage.

Reagent D: Prepared by mixing Folin-ciocalteau phenol reagent with distilled water at a ratio of 1:1.

preparation of Working Standard

50 mg of Bovine serum albumin (BSA) of 50 g dissolved in distilled water, and the final volume made up to 50 ml in a volumetric flask. From this, 10 ml of stock solution taken into another volumetric flask and volume made up to 50 ml. From the working standard, different concentrations prepared.

Procedure

Seed sample (500 g) weighed and ground with pestle and mortar with 5 ml of 10% Trichloro Acetic Acid (TCA). Then it washed with 5 ml of cold TCA and kept in ice for 15 min. The material centrifuged at 3500 rpm for 15 min and the supernatant discarded, and the precipitate dissolved in 4ml of 2N NaOH. It allowed for an overnight. After it centrifuged at 3500 rpm for 15 minutes, the supernatant was collected, and finally, the aliquot made up to 10 ml. A sample extract of 0.1 ml taken in a pipette, to which 5 ml of reagent- C added. The contents mixed well and allowed to stand for 10 min. Afterwards, 0.5 ml of reagent-D was added, mixed well, and incubated for 30 min at room temperature in the dark. Using a colourimeter at 660 nm, the colour intensity measured.

Calculation

From the standard curve, concentrations of protein content in different entries estimated and expressed in % age.

Soil analysis Collection of soil samples:

Soil samples were gathered both at the beginning and conclusion of the experiment from the region beneath the tree canopy in all four directions and were combined.

Processing of soil samples:

The soil samples were naturally dried in the shade for a period of 3–4 days. Subsequently, they were ground using mortar and pestle, sieved from a 2 mm sieve to remove coarse fragments. The discarded coarse fragments were excluded and remaining fine earth samples were employed for analysis.

Available nitrogen (kg/ha):

The Subbiah and Asija (1956) alkaline permanganate method was employed to determine available nitrogen in soil samples. In an 800 ml Kjeldahl flask, 2 g of soil combined with 20 ml of water and 0.32% $KMnO_4$ solution. In a separate conical flask, 5 ml of N/50 H_2SO_4 with 2 to 3 drops of the methyl red indicator prepared, further end of tube delivering was immersed into this flask. After that tap water circulated through condenser. Following this, 100 ml of 2.5% NaOH solution introduced into flask and corked which activated the heater. After distillation, flask having distillate was removed and heater turned off. Excess H_2SO_4 was titrated for N/100 NaOH and volume recorded. A concurrent blank solution was also runned. After cooling, the Kjeldahl flask was carefully emptied of its contents.

Available phosphorus (kg/ha): To measure available phosphorus Olsen's approach (Olsen et al. 1954) was applied. A 100 ml wide mouth bottle was filled with 2 g of soil. It was mixed with 20 ml of the 0.5M NaHCO3 and a small pinch of the Darco G-60. After 30 min of shaking using a mechanical shaker, suspension was filtered through Whatman no. 1 filter paper. A 25 ml volumetric flask was filled with 5 ml of ammonium molybdate solution after 5 ml of filterate had been put to it. To make roughly 20 ml, distilled water was added and used to wash down the sides. Next, 1 ml of recently diluted SnCl2 solution added to it, and distilled water was used to bring the volume up to the desired level. After the contents combined, spectrophotometer's red filter was used to detect blue colour's intensity at 660 nm in wavelength.

Available potassium (kg/ha): It was calculated by neutral normal NH4OAC solution using flame photometer (Hanway and Heidal 1952). A 5 g of soil taken in a 100 ml of the conical flask and about 25 ml of neutral normal NH4OAC solution added to it. Further, conical flask was shaken for around 5–6 min. After that, it was filtered via Whatman no. 1 (filter paper).

Leaf analysis: Leaf specimens were gathered from the center of various plants. Each plants contributed around 10–15 leaves, which were grinded using grinder and the resulting powder collected was stored in the pristine polythene bags.

Digestion: A 0.2 g plant sample was placed in a 50 ml conical flask. A diacid mixture (H2SO4 and HClO4 in a 9:1 ratio for N, P, K and HNO3, and HClO4 in a 4:1 ratio for Zn, Fe) totaling 10 ml was added, and the mixture was left overnight. Subsequently, mixture was gently heated (on a very hot plate), continuously heated till it formed a clear colourless solution of approximately 3–4 ml with all fumes dissipating. After cooling, it was shifted to a volumetric flask of 50 ml. After that, the solution was then filtered using the filter paper (Whatman number 1).

Nitrogen (%): To determine total nitrogen utilized, Lindner's Colorimetric or Nessler's method (1944) was used. 0.2 ml of digested plant material was combined with 5 ml of distilled water in a 25 ml of volumetric flask. To this mixture, approximately 1 ml of 10% NaOH was added to neutralize acidity. Following this, 1 ml of 10% sodium silicate was introduced, and the volume was adjusted to about 20 ml. Subsequently, 2 ml of Nessler's reagent was added, resulting in an orange-coloured complex. The volume was brought to the mark, and the colour intensity was measured on a spectrophotometer using a blue filter at a wavelength of 440 nm. Nitrogen content was then calculated.

Phosphorus (%):For determination of total phosphorus in plant samples, method given by Koenig and Johnson (1942) i.e. Vanado-molybdophosphoric yellow colour method was employed. 2 ml aliquot was combined with 2–3 drops of 2,4-dinitrophenol indicator in a 25 ml of volumetric flask. Subsequently, ammonia solution was added until a yellow colour appeared, followed by the addition of 6 N HCl until it returned to a colourless state. 5 ml of vanadomolybdate solution was introduced and volume adjusted. After thorough mixing, yellow colour intensity was measured on a spectrophotometer using a blue filter at a wavelength of 440 nm and the phosphorus content was determined.

Potassium (%): The Flame photometer was employed to ascertain the potassium concentration in the acid digest of plant samples. 5 ml digested plant material was taken and volume adjusted with distilled water in a 25 ml of the volumetric flask.

Economic analysis

The net return has worked out for the treatments by subtracting the cost of cultivation from the gross return. The return per rupee invested, calculated by the following formula.

$$BCR = \frac{\text{Gross return (RS. ha}^{-1})}{\text{The total cost of cultivation (RS. ha}^{-1})}$$

Statistical analysis

The data on observations statistically analysed. Whenever the results found to be significant, the critical differences worked out of a 5% level to draw the statistical conclusion Panse and Sukhatme, 19781. The IRRISTAT software used for the statistical analysis of the data.

RESULTS AND DISCUSSION

Organic Foliar applications significantly improved the yield and quality parameters of cluster bean Cv. MDU1. Results (Table 1) showed that the maximum pod yield was recorded by foliar application of the Temor karaisal, @7% (9.92 kg/ha) and minimum was recorded under control (4.69 kg/ha). Increase in yield owed to increase in no. of pods, weight of pod and decrease in the flower drop of cluster bean. The maximum pod yield per plant was observed in foliar application of Temor karaisal, @7% (134.56 g) and minimum was recorded under control (72.45 g). Pod weight increased due to increase in chlorophyll content by the application of Temor karaisal, was due to the availability of micronutrient traces in the organic foliars and increases the uptake of nitrogen for protein synthesis, which would have indirectly influenced the photosynthetic activities resulting in better process of assimilation. Temor karaisal contains Magnesium as nucleolus as nitrogen atoms as basic bricks of chlorophyll molecules, ultimately increase the photosynthetic activities which are associated with major photosynthetic process of plants Ambika and Balakrishnan, (2015). Similar results were observed by Sharma *et al.* (2012) in dolichous bean and John *et al.* (2013) in bengal gram (Sangeeta *et al*., 2018) in cluster bean and Anburani and Sulaiha, (2020) in cow pea. The maximum pod length was recorded under foliar application of temor karaisal, @7% (15.13 cm) and minimum was recorded under control (7.75 cm). Similarly, maximum pod width was recorded by foliar application of temor karaisal, @7% (11.58 cm) and minimum was recorded under control (7.33cm). The highest fibre content was temor karaisal, @7% (42.82) and minimum was recorded under control (35.01). The maximum crude protein content was found under control (14.75) and minimum was noted under control (1.01). This might be due to vigorous vegetative growth with accelerated photosynthetic activities thereby increasing the supply of carbohydrates to the plants. themor karaisal

proves to be an effective foliar spray which contributes the growth, yield and quality attributes of plants and also observed less insect-pest population. (Hamzah et al. 2022). Likewise, panchakavya was effective in increasing the yield and quality. Maximum pod yield (132.16 g/plant) was found by the application of panchakavya @7% and minimum yield was obtained in control (72.45 g/plant) (Table 1). The maximum pod length was observed in foliar application of panchakavya, @7% (14.95 cm) and least was noted under the control (7.75 cm). pod weight and length increased because of building up of sugar and improving transport of sugars to tissues of cluster bean pod. The minimum fibre (35.01 %) was recorded under foliar application of 7% panchakavya, . This could be caused by a higher protein content, better transport of protein into the pod, or a neutralisation of organic acids resulting from high nutrients levels in the pod tissue (Tisdale and Nelson 1966). On the other hand, maximum fibre was found under foliar application of 5% temor karaisal, (42.71) and minimum was noted under control (35.01). The higher synthesis of some metabolites and certain intermediates contributed to increased levels of protein in cluster bean with foliar sprays of different nutrients. temor karaisal, is the fermented organic manure with high microbial load with effective microorganism (EMO) and methylotrophs profile bacteria. These EMO in panchakavya would have enhanced the productivity of phytohormones like auxins and gibberellins that might have in turn, stimulated the growth and yield parameters as reported by Long *et al*. (1997). Another reason for improved yield might be due to the fact that, panchakavya, supplies all growth regulators, micro and macro nutrients. (Paras Jain *et al*., 2013). Similar results were found by Noor *et al*.(2010) in garden bean, Kashyap (2014) in cow pea, Siddeswaran and Shanmugam (2013) in bengal gram and Srinivasan *et al*.(2014) in cluster bean . Maximum nitrogen (89.56kg/ha), phosphorus (27.29kg/ha), potassium (72.99%) and zinc (49.60 mg/kg) content in cluster bean plant were observed by the foliar application of temor karaisal minimum was recorded under control (Table 2). It may be owing to that nutrient content increased by application of the temor karaisal . Similarly plant nutrient uptake was highly influenced by the foliar application of temor karaisal. Nitrogen, phosphorus and potassium concentration was increased in plant due to an increased concentration of temor karaisal@7%. Similar results were reported by Amiri et al. (2008) in cow pea; Darshan et al. (2023) and Gupta et al. (2023) in cluster bean. Foliar application of temor karaisal improves nitrogen use efficiency, enhancing nitrogen uptake and better utilization by plants. Similar findings were reported by Somashekar et al. (2019) in green gram and Shaon et al., (2014). in cow pea. Macronutrients like potassium and micronutrients like zinc have a very drastic role in growth, development and yield improvement. Above results concludes that maximum yield (46.2 kg/plant) was noted by foliar spray of temor karaisal @7% which was at par with panchakavya @7% Quality parameters of cluster bean i.e. maximum fibre (10.6°Brix) and protein (187.4 mg/100 g) were found by foliar spray of panchakavya @7%. Foliar application of the temor karaisal significantly improved the yield, nutrient uptake and post harvest nutrient status of soil in cluster bean cv.MDU 1. Therefore, the present experiment concluded that temor karaisal (7%) and Panchakavya (7%) can highly be recommended as foliar spray to reap high quantity cluster bean and benefit the farmers. Besides high yield, the environmental pollution and soil pollution by chemical sprays' residues can also be controlled.

Table.1. Effect of foliar application of organic nutrient on yield and quality of cluster bean [*Cyamopsis tetragonoloba* (L.) Taub.] cv. MDU-1.

Treatments	**Pod length (cm)**	**Pod width (mm)**	**Pod yield plant^{-1} (g)**	**Estimated yield (t ha^{-1})**	**Pod crude protein content (%)**	**Pod Fibre content (%)**
Themor karaisal @3%	10.74	9.78	114.06	**8.01**	13.78	**40.56**
Themor karaisal @5%	12.43	10.88	126.58	9.18	16.27	41.34
Themorkaraisal@7%	15.13	11.58	134.56	9.92	17.45	42.82
Panchakavya@3%	9.63	9.82	109.02	7.61	13.23	40.06
Panchakavya@5%	12.50	10.44	121.20	8.45	15.86	41.98
Panchakavya@7%	14.95	11.48	132.16	9.81	17.68	42.71
Vermi wash@3%	8.75	9.41	101.95	6.90	12.78	39.98
Vermi wash@5%	11.53	10.32	118.89	7.90	14.92	41.06
Vermi wash@7%	**13.92**	**11.02**	**125.72**	9.12	**16.52**	42.01
control	**7.75**	**7.33**	**72.45**	4.69	**10.65**	35.01

CD(P=0.05)	**0.98**	**0.25**	**4.03**	**0.27**	**1.01**	0.82

Table.2. Effect of foliar application of organic nutrient on nutrient uptake of cluster bean [*Cyamopsis tetragonoloba* (L.) Taub.] cv. MDU-1.

Treatments	**Nutrient uptake (kg ha^{-1})**		
	N	**P**	**K**
Themor karaisal @3%	78.62	19.13	65.65
Themor karaisal @5%	84.48	23.92	67.72
Themorkaraisal@7%	89.56	27.29	72.99
Panchakavya@3%	76.22	17.17	59.52
Panchakavya@5%	82.01	22.14	63.36
Panchakavya@7%	88.65	26.99	73.52
Vermi wash@3%	70.54	15.35	49.11
Vermi wash@5%	80.73	21.03	62.34
Vermi wash@7%	87.38	24.77	70.11
control	57.52	13.17	43.10
CD(P=0.05)	2..97	1.32	2.57

Table.3. Effect of foliar application of organic nutrient on nutrient status of soil in cluster bean [*Cyamopsis tetragonoloba* (L.) Taub.] cv. MDU-1.

Treatments	**Available soil nutrient (kg ha^{-1})**		
	Nitrogen	**Phosphorus**	**Potassium**
Themor karaisal @3%	167.43	46.95	236.42
Themor karaisal @5%	185.06	53.17	245.16
Themorkaraisal@7%	208.89	60.14	260.18
Panchakavya@3%	156.14	40.45	229.05
Panchakavya@5%	177.02	50.93	240.25
Panchakavya@7%	207.26	59.51	259.52
Vermi wash@3%	151.32	35.34	223.34
Vermi wash@5%	173.55	45.23	235.12
Vermi wash@7%	202.34	53.21	253.13
control	143.54	30.12	204.54
CD(P=0.05)	4.54	2.34	4.32

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