

Full Length Research Paper

Effect of organic foliar sprays on yield of cluster bean (*Cyamopsis tetragonoloba* L. Taub) cv. Pusa Navbahar

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This experiment was conducted during the year 2020-2021 in open field condition at three locations such as Madurai (Kalvelip-atti-L1), Ramnad (Thiruvarangam-L2) and Kunnathur (Peraiyur-L3) of Tamil Nadu, India to assess the effects of organic foliar sprays viz. Panchakavya, vermiwash and cow urine on yield and growth parameters of cluster bean (*Cyamopsis tetragonoloba* (L.)Taub.) cv. Pusa Navbahar). Four treatments viz., control (T1), 5% Panchakavya (T2), 5% vermiwash (T3) and 5% cow urine (T4) were tried in Randomized Block Design (RBD) with five replications. The standard recommended cultural practices were followed for all the divided experimental plots. The maximum values of growth parameters like plant height, number of leaves per plant, leaf area, number of pods, pod length (cm), pod weight/plant and pod yield were recorded by the treatment of 5% vermiwash over the control, followed by other foliar sprays. Among the locations, the maximum values of vegetative growth parameters were recorded in the location Kunnathur. Whereas, the maximum values of reproductive parameters like number of pods, pod length, pod weight and productivity were recorded in the location Madurai. The experiment revealed that vermiwash (5%), Panchakavya (5%) and cow urine (5%) can highly be recommended as foliar spray to reap high quantity clusterbean and benefit the farmers as well as consumers.

Key words: Cluster bean, Vermiwash, Panchakavya, Cow urine, Foliar spray, Plant height, Pod yield.

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 semi-arid 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. Pusa Navbahar (Pusa Mausami x Pusa Sadabahar) is a popular variety of cluster bean for vegetable purpose that is grown for its young tender

green immature pods with maximum yield. Pusa Navbahar 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

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Table 1. Field layout plan for three locations.

Treatments/Replication	R1	R2	R3	R4	R5
T1 Control	T1	T2	T3	T4	T3
T2 Panchakavya	T2	T3	T4	T3	T1
T3 Vermiwash	T3	T4	T1	T2	T4
T4 Cowurine	T4	T1	T2	T1	T2

Table 2. Detail of Cultural practices followed in three locations.

S/N	Operations	Work done
1	Sowing	29/08/2020
2	Irrigation	Weekly Intervals
3	Hoeing and weeding	20 Days after sowing
4	First spraying	21 Days after sowing
5	Second spraying	35 Days after sowing
6	Third spraying	45 Days after sowing
7	Harvesting	50 Days after sowing

the total production. The variety Pusa Navbahar was released from Indian Agricultural Research Institute, New Delhi. 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 wastes back into the farm. Therefore, the application of plant nutrients through organic sources like Panchakavya, vermiwash and cow urine 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.

MATERIALS AND METHODS

The field experiments were conducted in three locations viz., Madurai (Kalvelipati), Ramnad (Thiruvarangam) and T.Kallupatti (Kunnathur) during *Kharif* season of 2020. The authentic source of Cluster bean seeds of Pusa Navbahar) and the organic foliar spray products like Panchakavya and Vermiwash were purchased from Private Seed Farms and fertilizer shops. Cow urine was freshly collected from desi cow and diluted at 5% concentration by adding

water. The experiment was laid out in randomized block design (RBD) and replicated five times. The treatments were randomly allotted to different plots, using random number table of Fisher and Yates (1963). Standard agronomical practices were followed in all plots. Panchakavya, Vermiwash and Cow urine were applied as per treatments through foliar spray at 5% concentration during 20 and 30 Days After Sowing (DAS).

Five plants were randomly selected in each plot in each treatment and tagged (Table 1). Five plants tagged from each plot were used to measure all the biometric parameters. The height of each tagged plant was measured at 25, 35 and 45 Day After Sowing (DAS) and at harvest. The plant height was measured in meter scale from ground to tip of the plant apex. Number of leaves was counted at 25, 35 and 45 DAS from five tagged plants. The fully expanded leaves were separated from the plant, and leaf area was immediately determined (Table 2 and Figure 1). Edible pods from each treatment were taken and fresh weight was noted.

The experiment was laid out in randomized block design and replicated five times. The treatments were randomly allotted to different plots, using random number table of Fisher and Yates (1963).

The crop was harvested on end of October, 2020. The pods were harvested treatment-wise manually at the right marketable stage (field maturity). All the clusters arising on the tagged plants were counted. Finally, the average was calculated to record number of pods per plant. Randomly, ten edible pods were selected from the harvested pods from the tagged plants at peak fruiting time. The length of each pod was measured from head to tip. The pods were collected from tagged plants in treatment-wise and weighed in electronic weighing balance. Pod yield was recorded separately for each plot, summed in order to obtain the pod yield for a plot and then weighed in spring weighing scale.

The data were analyzed by following the standard procedure of Panse and Sukhatme (1967) and the differences between the treatments were estimated at 5% level of significance.

To find out the most profitable treatments, economics of different treatments were worked out in terms of net return per acre. Benefit:Cost (B:C) ratio was also calculated treatment-wise by the following formula to ascertain economic viability of the treatments.

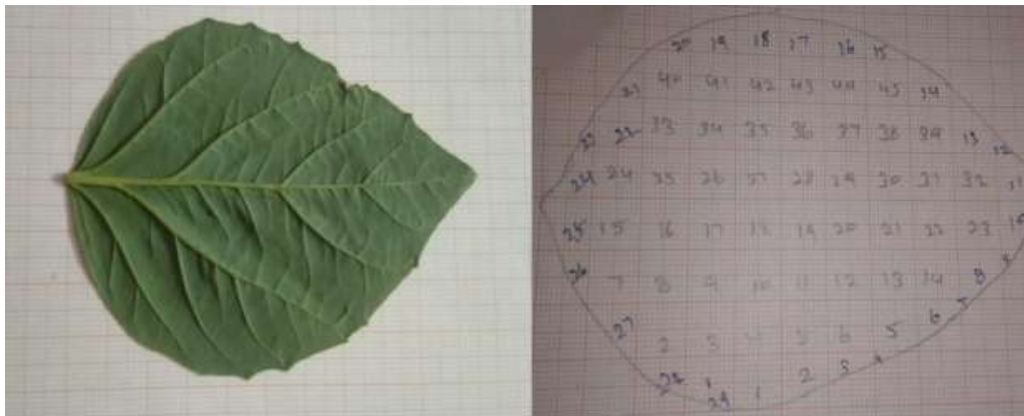


Figure 1. Determination of leaf area.

Total income = Yield (kg) x Market price

Net returns = Total income – Cost of cultivation

Benefit Cost Ratio = Net returns / Cost of cultivation

RESULTS AND DISCUSSION

The plant height was found to be highly significant interaction effect between location and duration of crop. Among the treatments, the maximum plant height was recorded in treatment vermiwash (T3) with the average height of 44.2 cm and the minimum plant height was recorded by Control (T1) with the average height of 39.56 cm. Better environmental condition of the soil might have helped in increasing the absorption and transportation of nutrients towards the developing part of the plant (Table 3). There was no significant interaction effects between treatments and locations.

Number of leaves per plant was affected by the highly significant interaction effect between location and duration of the crop and also between location and treatments. Among the treatments, the maximum number of leaves was recorded in treatment vermiwash (T3) with the average number of 21.36 leaves which corresponds to the findings of Rajan and Murugesan (2012) and the minimum number of leaves was recorded by Control (T1) with the average number of 17.57 leaves.

Leaf area was affected by the highly significant interaction effect between location and duration of the crop and also between location and treatments. Among the treatments, maximum leaf area was recorded in treatment vermiwash (T3) with the average leaf area of 45.12 cm² and the minimum leaf area was recorded by Control (T1) with the average leaf area of 31.93 cm² (Table 4).

The highly significant interaction effect between location and treatments was observed in number of pods. Among the treatments, the maximum number of pods

was recorded in treatment vermiwash (T3) with the average number of pods 82.57 and the minimum number of pods was recorded by Control (T1) with the average number of pods 49.49.

Somashekar et al. (2019) concluded that Gangajal-1 variety performed well in organic bitter gourd cultivation. The bitter gourd crops was provided 3 foliar sprays of Panchakavya (3%) at 20, 40, 60 DAS and vermiwash (10%) AT 25, 50, and 75 DAS. This foliar application increased the quality and shelf life of the plant.

Among the treatments, the maximum pod length was recorded in treatment vermiwash (T3) with the average length of 13.97 cm which concurred with the findings of Sudhanshu et al. (2018) and the minimum pod length was recorded by Control (T1) with the average length of 10.66 cm (Table 5 and Figure 2). Sivasubramaniam et al. (2012) tried various bovine urines to invigorate the pulse seeds and recommended that pulse crop viz., green gram, cowpea and grass gram seeds biofortified with 5% cow urine performed well in terms of germination percentage, speed of germination and vigour index. Significantly higher plant height, leaf dry weight, and more number of tillers were recorded 60 days after sowing, higher leaf area duration and higher straw yield were recorded for wheat seeds soaked in 10% cow urine (Shivamurthy and Patil, 2010).

Significantly, maximum pod yield was recorded in treatment vermiwash (T3) with the average yield of 8.36 q/acre and 9.72 kg/plot (Table 6). The minimum pod yield was recorded by Control (T1) with the average yield of 5.51 q/acre and 6.42 kg/plot. Maximum pod yield might be due to vigorous vegetative growth with accelerated photosynthetic activities thereby increasing the supply of carbohydrates to the plants.

Vermiwash proves to be an effective foliar spray which contributes the growth, yield of plants and also observed less insect-pest population. Experiment shows that vermiwash along with vermicompost can be used as a substituent of commercial fertilizers available in market

Table 3. Effect of different organic foliar sprays on plant height (cm) of cluster bean on 45 DAS.

Treatment	L1				Mean	L2				Mean	L3				General mean
	25 DAS	35 DAS	45 DAS	Mean		25 DAS	35 DAS	45 DAS	Mean		25 DAS	35 DAS	45 DAS	Mean	
T1	18.152	36.44	46.348	33.6467	22.516	30.756	34.884	29.3853	49.66	57.592	59.72	55.6573	39.5631		
T2	18.908	39.228	54.072	37.4027	23.592	35.256	40.168	33.0053	51.98	57.608	61.66	57.0827	42.496		
T3	19.384	39.248	58.688	39.1067	25.54	36.976	41.74	34.752	52.288	59.816	64.124	58.7427	44.2		
T4	18.176	37.572	49.956	35.2347	20.632	31.06	36.068	29.2533	48.488	56.36	59.604	54.8173	39.768		
Mean	18.655	38.122	52.266	36.3477	23.07	33.512	38.215	31.599	50.604	57.844	61.277	56.575	41.5068		
	L		T		D		L×T		T×D		L×D		L×T×D		
SEd	0.62284		0.7192		0.62284		1.24568		1.24568		1.07879		2.15759		
CD (0.05)	1.23169**		1.42224**		1.23169**		NS		NS		2.13336**		NS		

L1: Madurai; L2: Ramnad; L3: Kunnathur.

Table 4. Effect of different organic sprays on number of leaves and leaf area (Sq.cm) in cluster bean on 45 DAS.

Treatment	L1				Mean	L2				Mean	L3				General Mean
	25 DAS	35 DAS	45 DAS	Mean		25 DAS	35 DAS	45 DAS	Mean		25 DAS	35 DAS	45 DAS	Mean	
T1	17.696	26.508	46.428	30.2107	28.568	31.824	35.108	31.8333	30.232	31.852	46.84	36.308	33		
T2	24.672	32.328	52.088	36.3627	35.02	38.488	41.568	38.3587	49.584	50.656	52.28	50.84	41.853		
T3	27.564	38.744	56.368	40.892	37.568	39.724	43.264	40.1853	52.352	54.56	56.02	54.3107	45.129		
T4	20.24	28.672	48.632	32.5147	30.56	34.784	38.124	34.4893	27.372	28.852	30.188	28.804	31.936		
Mean	22.543	31.563	50.879	34.995	32.929	36.205	39.516	36.2167	39.885	41.48	46.332	42.5657	37.9795		
	L		T		D		L×T		T×D		L×D		L×T×D		
SEd	1.04115		1.20222		1.04115		2.0823		2.0823		1.80333		NS		
CD(0.05)	2.05892**		2.37743**		2.05892**		4.11783**		NS		3.56615**		NS		

L1: Madurai; L2: Ramnad; L3: Kunnathur.

(Sudhanshu et al., 2018). The greatest response from the plants could be observed only when the vermicompost was used at 10-4% in blackgram which was reported by Parthasarath et al. (2008). Panchakavya application increases the immunity power in plants, confers resistance against pest

and diseases and also provided various beneficial metabolites produced by microorganisms. Thus, Panchakavya plays a major role in organic farming (Prmod et al., 2018).

The results of our experiment revealed that the application of organic foliar spray 5% vermiwash

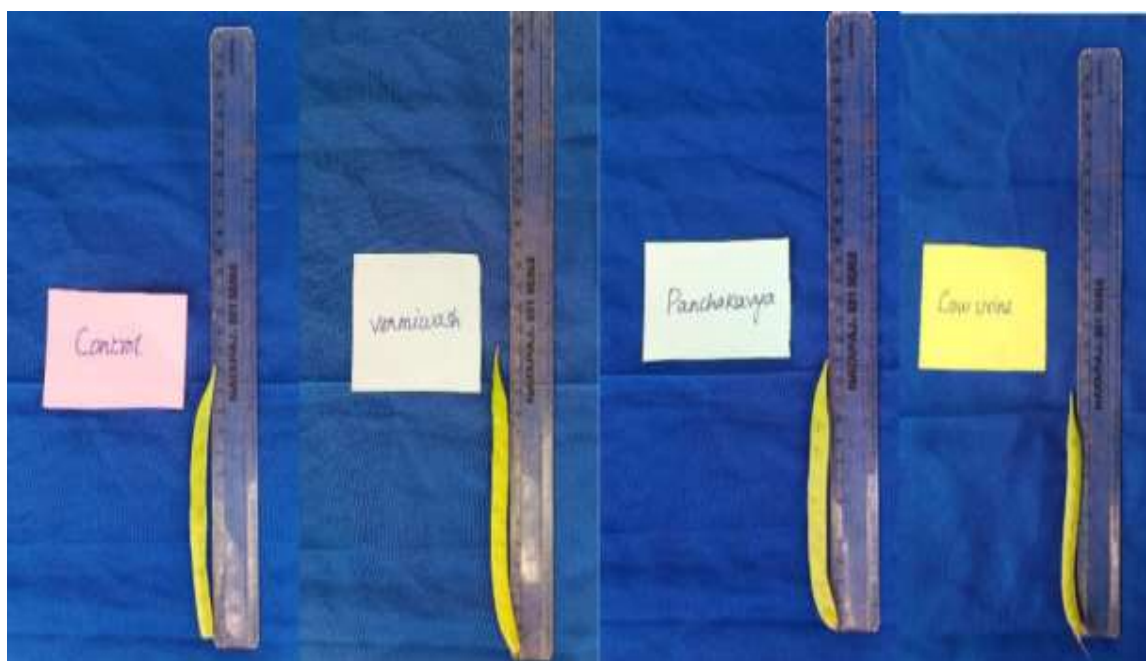
significantly increased the vegetative growth and higher yield per unit area in cluster bean crop. Vermiwash 5% can be recommended for superior quality of cluster bean pods followed by maximum value in number of pods, pod length, pod weight and pod yield were recorded in the location

Table 5. Effect of different organic foliar sprays on number of pods/plant and pod length (cm) on cluster bean.

Treatment	No. of pods\plant				Pod length (cm)			
	L1	L2	L3	Mean	L1	L2	L3	Mean
T1Control	44.48	45.84	58.16	49.49	11.776	11.1	9.128	10.67
T2Panchakavya	77.52	75.04	74.08	75.55	14.712	13.572	11.84	13.37
T3Vermiwash	87.52	80.24	79.96	82.57	15.532	14.496	11.908	13.98
T4Cowurine	66.6	59.2	44.52	56.77	14.236	11.844	8.18	11.42
Mean	69.03	65.08	64.18	66.10	14.06	12.75	10.26	12.36

	No.of pods\plant			Pod length(cm)		
	L	T	L×T	L	T	L×T
SEd	1.70712	1.97122	3.41424	1.23303	1.42378	2.46606
CD(0.05)	3.4405*	3.97275**	6.881**	2.485 **	2.869 **	NS

L1: Madurai; L2: Ramnad; L3: Kunnathur

**Figure 2.** Effect of foliar sprays on cluster bean pod length on 50 DAS.

Madurai.

The cost of production and Benefit-Cost ratio of cluster bean crop revealed that the vermiwash (T3) shows the maximum Benefit-Cost ratio and Control (T1) shows the minimum Benefit-Cost ratio among all the treatments irrespective of locations (Table 7).

The cow urine treatment with 1:10 concentration was found very suitable to treat seeds of finger millet for good germination and seedling vigour (Shankaranarayanan et al., 1994). Cow urine can be recommended as organic seed priming in cluster bean for increasing the germination percentage, root length, shoot length, vigour

index I and vigor index II among different concentrations (control, 4%, 6%, 8%, 10% and hydro priming) in cluster bean under rain fed condition (Ambika and Balakrishnan, 2015). Zambare et al. (2008) reported that application of vermiwash has shown sustainable growth in terms of appearance, cost effectiveness ease of availability, time saving, reproduction, eco-friendly and reliability. Vermiwash seems to have an intrinsic property; it acts not only as a liquid organic fertilizer but also as a mild biodegradable, which can be used as an effective input in organic farming for both soil health and disease management for sustainable crop production (Shaon et

Table 6. Effect of different organic foliar sprays on yield attributes of cluster bean cv Pusa Navbahar.

Treatment	Pod weight\plant(g)				Pod yield (kg)\plot(kg)				Pod yield(q)\acre			
	L1	L2	L3	Mean	L1	L2	L3	Mean	L1	L2	L3	Mean
T1Control	133.4	137.52	203.552	158.15	6.182	6.9	6.2	6.42	5.248	4.756	6.54	5.52
T2Panchakavya	232.2	225.12	206.65	221.43	10.14	7.23	9.064	8.81	8.568	7.248	6.86	7.56
T3Vermiwash	262.5	240.72	233.30	245.52	10.82	8.1	10.23	9.72	9.202	8.184	7.71	8.37
T4Cowurine	198.6	177.6	155.82	177.34	7.986	5.43	7.74	7.05	6.782	6.188	5.15	6.04
Mean	206.7	195.24	199.83	200.61	8.78	6.91	8.31	8.00	7.45	6.59	6.57	6.87

Parameter	Pod weight\plant (g)			Pod yield (kg)\plot(kg)			Pod yield (q)\acre		
	L	T	L×T	L	T	L×T	L	T	L×T
SEd	4.65931	5.38011	9.31863	0.18559	0.2143	0.37118	0.17242	0.1991	0.34484
CD(0.05)	9.39029*	10.8429**	18.780**	0.37403**	0.4318**	0.74806**	0.3475**	0.40125**	0.6949**

L1: Madurai; L2: Ramnad; L3: Kunnathur

Table 7. A comparison of Benefit: Cost Ratio (BCR) of different foliar spray treatments.

Particular	Control (T1) cost (Rs.)	Panchakavya 5% (T2) cost (Rs.)	Vermiwash 5% (T3) cost (Rs.)	Cow urine 5% (T4) cost (Rs.)
Seed (5 kg)	2000	2000	2000	2000
Vermiwash(1 L)	-	-	480	-
Panchakavya(1 L)	-	500	-	-
Cow urine (1 L)	-	-	-	-
Ploughing	2000	2000	2000	2000
Bed preparation	4000	4000	4000	4000
Seed sowing	1800	1800	1800	1800
Weeding	2800	2800	2800	2800
Spraying/Irrigation	1000	1000	1000	1000
1 st harvest	2400	2400	2400	2400
2 nd harvest	2000	2000	2000	2000
3 rd harvest	2000	2000	2000	2000
4 th harvest	1600	1800	1800	1800
Total input cost	21600	22300	22280	21800
Average yield (kg)	2480	3625	4094	3096
Total income	49600	72500	81880	61920
Net returns	28000	50200	59600	40120
BCR	1:1.29	1:2.25	1:2.67	1:1.84

al., 2014).

Therefore, the present experiment concluded that vermiwash (5%), Panchakavya (5%) and cow urine (5%) 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.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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