



The Response of Inorganic and Organic Fertilizers on Growth, Yield and Quality of Cluster Bean [*Cyamopsis tetragonoloba* (L.) Taub.] in the Village Chikkenahalli of Challakere Taluk, Chitraduraga District

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Cluster bean is one of the significant yet underutilized leguminous vegetables belonging to family fabaceae. It is known by various names across the country such as gaur, chavli kaayi, gori kaayi, khutt, govar, and kothavare. A field experiment on cluster bean was carried out during the summer season of the year 2024 at the farm of P. L. Dodda Rangegowda in Chikkenahalli of Challakere taluk, Chitradurga district, Karnataka. The primary objectives of the study are to examine the effects of organic and inorganic fertilizers on the productivity and growth characteristics of cluster bean; to identify the advantages and disadvantages of these fertilizers in relation to productivity, soil fertility, and environment and further to review the effects of mixed organic and inorganic fertilizers on yield and soil fertility. The experiment was laid out in a randomized block design with four replications and five treatments which comprised of 100 percent organic (FYM and chicken manure), 100 percent inorganic (NPK), 50 percent organic + 50 percent inorganic, 100 percent organic + jeevamruta and control. The results revealed that, treatment T3 outperformed the others, showing the highest values for plant height, number of branches per plant, days to first flowering, days to first vegetable harvest, pod length, pod width, yield per plant, yield per plot, and yield per hectare, while the control recorded the lowest values. Soil properties such as pH, EC, SOC and NPK levels improved when combination of organic and inorganic fertilizers were applied together. Based on these results, it can be concluded that, the application of organic manures, along with chemical fertilizers, positively enhanced the vegetative growth, reproductive growth, yield, quality of cluster bean and soil parameters.

Keywords: Cluster bean; organic fertilizer; jeevamruta; farmyard manure; chicken manure.

1. INTRODUCTION

The environment sustains life. It is essential for humans to understand its significance and contribute to maintaining a healthy and productive environment. In today's context of climate change and the COVID-19 pandemic, there is a growing awareness of the need to protect both the planet and public health. The pandemic has brought about numerous social, economic, political and environmental challenges [1]. Agriculture plays a crucial role in many societies and represents the sector with the most significant interaction between humans and the environment. By its nature, agriculture profoundly influences the natural environment, while that environment also imposes constraints on agricultural production systems. In essence, changes in agricultural practices impact the natural environment, and conversely, environmental conditions affect agriculture [2].

In the 20th century, the introduction of synthetic fertilizers brought about a major change in agricultural practices. Chemical fertilizers including nitrogen, phosphorus and potassium (NPK) became widely available, leading to a significant boost in global food production. This contributed to the green revolution and helped sustain a growing human population [3]. While chemical fertilizers enhance plant growth and vigor, contributing to global food security, they

can hinder the development of important plant characteristics such as robust root and shoot systems and nutritional quality. Moreover, their continuous application can degrade soil health and quality, leading to soil pollution. Therefore, it is crucial to recognize that reliance on these fertilizers is depleting our environment and ecosystem [4]. Thus to mitigate the negative impacts of synthetic fertilizers on human health and the environment, a new agricultural approach known as organic agriculture, sustainable agriculture, or ecological agriculture has emerged. Organic matter serves as the foundation of soil fertility, and organic fertilizers can be sourced from a variety of materials, including crop residues, animal manures, compost, and green manure cover crops. These materials are rich in organic matter and essential nutrients. Organic fertilizers offer a beneficial alternative to synthetic fertilizers, enhancing soil health, promoting sustainability, and improving nutrient management in agriculture [5,6].

Combining organic amendments with inorganic fertilizers as part of integrated nutrient management is a strategic approach designed to improve fertilizer efficiency, enhance soil health, and optimize crop productivity. This method combines the advantages of both organic and inorganic nutrient sources, resulting in a balanced nutrient supply, reduced nutrient losses, and sustainable agricultural practices.

Both inorganic and organic fertilizers are primary sources of plant nutrients used to replenish agricultural soils [7]. Therefore, to enhance soil productivity by providing all essential plant nutrients in readily available forms and to maintain healthy soil, it is essential to use organic fertilizers in combination with inorganic fertilizers for optimal yields.

Cluster bean [*Cyamopsis tetragonoloba* (L.) Taub] is an important leguminous vegetable. Gaur is a native plant of the Indian subcontinent, primarily cultivated for gum extraction in Rajasthan, Haryana, Gujarat, and Punjab, and to a lesser extent for vegetable use in Uttar Pradesh, Madhya Pradesh, Karnataka and Andhra Pradesh [8]. In modern agriculture, nutrient management and fertilizer application are critical factors influencing plant growth, yield and quality. This study on the cluster bean crop aims to examine the effects of organic and inorganic fertilizers on its growth, yield, quality and soil health.

2. MATERIALS AND METHODS

The experiment was conducted at the farm of P. L. Dodda Rangegowda in Chikkenahalli of Challakere taluk, Chitradurga district, Karnataka during the summer season of the year 2024. The village chikkenahalli is a small village which is 14 Kms away from Challakere. Challakere belongs to agro-climatic zone- IV i.e., Central dry zone of Karnataka situated at 14.312 °N latitude, 76.615 °E longitude and at an elevation of 585 m above the mean sea level. The district comprises of deep and shallow black soil, mixed red and black soil, red loamy and sandy soil. The soil

chemical composition of experimental plot is shown in Table 1. The experiment was laid out in a randomized block design with four replications and five treatments viz., T1 – 100 percent organic farmyard manure (Form Yard Manure + chicken manure), T2 – 100 percent inorganic (NPK), T3 – 50 percent organic (FYM+ chicken manure +50 percent inorganic (NPK), T4 – 100 percent organic (FYM + chicken manure) + jeevamruta and T5 – control. The local cluster bean variety was sown at a spacing of 45 X 20 cm with the seed rate of 15-20 kg/ ha.

Organic manures viz., FYM and chicken manure, each were applied at recommended dose to the plots of given treatment before 15 days sowing and light irrigation was given. Manures were applied to the plots as needed at the intervals of 30 and 60 days. Jeevamruta was applied to the plots twice or thrice at an interval of 15, 30 and 60 days. The recommended dose of NPK were applied through urea, single super phosphate, murate of potash respectively. During sowing, half the dose of nitrogen and the full doses of phosphorus and potassium were applied, while the remaining half of the nitrogen was added approximately 30 days after sowing. The matured pods were harvested and weighed in kg/ ha. Observations were recorded for various parameters such as plant height (cm), number of branches per plant, days to first flowering, days to first vegetable harvest, pod length (cm), pod width (cm), pod yield per plant (g), pod yield per plot (kg) and pod yield per hectare (q). The general view of the experimental plot at 30 DAS is shown in Fig. 1.



Fig. 1. General view of the experimental plot at 30 DAS

Table 1. Chemical composition of soil of experimental plot

Soil Parameters	pH	Electrical conductivity (dS/m)	Soil organic carbon (%)	Nitrogen (kg/ ha)	Phosphorus (kg/ ha)	Potassium (kg/ ha)
Initial Values	6.90	0.51	0.48	231	32.7	260

Table 2. Vegetative and reproductive characteristics of plants

Sl. No	Treatments	Plant height (cm)			No. of branches per plant			No. of days from sowing to flowering	No. of days from sowing to first picking
		45 DAS	60 DAS	90 DAS	45 DAS	60 DAS	90 DAS		
T1	50 % FYM + 50 % chicken manure	62.25	89.25	99.58	0.05	1.28	2.85	32.25	47.25
T2	100 % RDF	66.70	101.65	110.83	0.20	1.48	2.90	29.75	42.25
T3	50 % RDF + 25 % FYM + 25 % chicken manure	71.20	104.05	114.3	0.30	1.65	3.20	28.25	41.50
T4	75 % chicken manure and FYM + 25 % jeevamruta	63.75	95.95	105.53	0.05	1.40	2.80	30.75	45.50
T5	Control	55.85	83.35	93.20	0.05	1.14	2.35	33.25	48
	SE±	1.7897	2.9250	2.3683	0.0725	0.0276	0.1313	0.6770	0.8127
	CD at 5%	5.5145	9.0128	7.2974	0.2233	0.0849	0.4047	2.0861	2.5041

Note: DAS: days after sowing; FYM: farm yard manure; RDF: recommended dose of fertilizers; SE: standard error and CD: coefficient of deviation.

3. RESULTS AND DISCUSSION

3.1 Vegetative Growth

The data on growth parameters in different treatments are presented in Table 2. The treatment T3 exhibited the highest plant height at 45, 60 and 90 days after sowing, while the control recorded the lowest heights during the same periods. This difference may be attributed to the favorable soil composition and the nutrient release from both organic and inorganic fertilizers. Similar findings were observed by Bathal and Kumar [9] in cluster bean, Sachan and Krishna [10] in french bean and Reddy et al., [11] in cluster bean.

The number of branches per plant at 45, 60, and 90 days after sowing was highest when a combination of organic and inorganic sources was used, compared to either applied alone. This is likely due to the fact that inorganic fertilizers provide essential NPK, while organic sources enhance the physical, chemical and biological properties of the soil. These results are in conformity with the findings of Seerangan et al., [12] and Anugonda et al., [13] in cluster bean.

3.2 Reproductive Growth

The data in respect of average number of days required for appearance of first flower and number of days required from sowing to first picking in various treatments are presented in

Table 2. The treatment T3 resulted in earlier flower initiation compared to the other treatments, except for T2 and T4, which were statistically at par with T3. The treatment T5 recorded late flower initiation and treatment T3 also led to earlier pod picking, which was statistically at par with the results of treatment T2. In contrast, treatment T5 took the longest time from sowing to the first picking. These observations are in line with the findings of Aslam et al., [14] in mung bean and Parween et al., [15] in french bean.

3.3 Yield Parameters

The data indicated that the combination of organic manures and inorganic fertilizers influenced the yield parameters of cluster bean, as presented in Table 3. In this study, among different treatment combinations, the treatment T3 recorded maximum yield per plant (0.63 g), yield per plot (7.83 kg), yield per hectare (156.71 q) followed by treatments T2 and T4. The minimum yield was recorded in treatment T5. The increase in yield may be attributed to enhanced vegetative growth and flower characteristics, which subsequently led to higher pod yield. In contrast, the lower yield in the control group could be due to the lack of available nutrients during the plant's development. Organic manures enhance the soil's water-holding capacity and promote the activity of beneficial microorganisms. The increase in these microorganisms, along with adequate levels of nitrogen and organic matter, likely contributed to the improved yield. Similar results were reported by Quadiri et al., [16] in common bean, Narwariya et al., [17] in okra and Srivatsava et al., [18] in tomato.

3.4 Quality Parameters

The data revealed that, the combination of organic and inorganic fertilizers affected the quality of cluster bean as shown in Table 3. In the current study, the maximum pod length and pod weight were recorded in treatment T3 followed by treatment T2, while treatment T5 showed the lowest values. The increased pod weight may be attributed to enhanced mobility of photosynthetic products from the source to the sink that is influenced by growth hormones synthesized from organic fertilizers. These results are in accordance with Uddin et al., [19]

in garden pea and Tomar et al., [20] in french bean.

3.5 Soil Fertility

Soil pH, electrical conductivity (EC) and soil organic carbon (SOC): Soil pH varied with different treatments (Table 4). The application of chemical fertilizers has resulted in increase in soil pH, whereas the use of organic manures and the combined application of organic and inorganic fertilizers have led to decrease in pH. Similar results were observed by Ullah et al., [21].

Soil electrical conductivity (EC) measures the salt content in the soil and is a crucial indicator of soil health. Both excessively high and low EC levels can impede crop growth. If the soluble salt content (EC value) in the substrate is too high, it can create reverse osmosis pressure, causing water to be drawn out of the root system and resulting in brown or dry root tips. High EC levels also raise the risk of root rot caused by cotton rot fungus. Conversely, a low EC value indicates insufficient effective nutrients. The optimal EC value for plant growth is usually between 0.8-1.8 dS/ m and it should not exceed 2.5 dS/ m. The data represented in Table 4, showed that, the electrical conductivity is maximum in treatment T3, while treatment T2 recorded the minimum electrical conductivity [22].

Soil organic carbon has been decreased by chemical fertilizer application but was increased with all types of organic manure application and further with the combined application of organic and inorganic fertilizers, maximum soil organic carbon was noticed (Table 4). These results are in accordance with findings of Shilpa et al., [23]

Nitrogen, Phosphorus and Potassium (NPK):

As represented in Table 4, soil available nitrogen, phosphorus and potassium is maximum in plants receiving 50 per cent RDF through inorganic fertilizers + 25 per cent FYM + 25 per cent chicken manure while, minimum was recorded with the application of 100 per cent RDF through chemical fertilizers. Similar results were reported by Raut et al., [24].

Table 3. Yield and quality attributes of plants

Sl. No	Treatments	Yield/ plant (gm)	Yield/ plot (kg)	Yield/ hectare (g)	Length of pod (cm)	Weight of pod (gm)
T1	50 % FYM + 50 % chicken Manure	0.52	6.06	121.14	12.95	2.30
T2	100 % RDF	0.57	6.82	136.45	13.15	2.48
T3	50 % RDF + 25 % FYM + 25 % chicken manure	0.63	7.83	156.71	14.88	2.57
T4	75 % chicken manure and FYM + 25 % jeevamruta	0.54	6.45	129.05	13.15	2.36
T5	Control	0.47	5.05	100.99	11.75	2.27
	SE±	0.0112	0.2584	5.1699	0.9129	0.0710
	CD at 5%	0.0344	0.7962	15.9302	2.8129	0.2187

Note: FYM: farm yard manure; RDF: recommended dose of fertilizers; SE: standard error and CD: coefficient of deviation

Table 4. Chemical composition of soil

Sl. No	Treatments	pH	Electrical conductivity (dS/m)	Soil organic carbon (%)	Nitrogen (kg/ ha)	Phosphorus (kg/ ha)	Potassium (kg/ ha)
T1	50 % FYM + 50 % chicken Manure	6.97	0.55	0.51	233.50	33.40	273.00
T2	100 % RDF	7.10	0.53	0.48	237.25	34.95	285.75
T3	50 % RDF + 25 % FYM + 25 % chicken manure	6.95	0.57	0.53	242.25	37.33	294.25
T4	75 % chicken manure and FYM + 25 % jeevamruta	6.97	0.56	0.51	233.75	33.48	273.75
T5	Control	7.20	0.52	0.47	230.75	32.38	260.50
	SE±	0.0172	0.0031	0.0045	0.6292	0.2209	1.1998
	CD at 5%	0.0531	0.0094	0.0139	1.9386	0.6808	3.6970

Note: FYM: farm yard manure; RDF: recommended dose of fertilizers; SE: standard error and CD: coefficient of deviation

4. CONCLUSION

The results of the study confirmed that, the parameters such as vegetative growth, reproductive growth, yield parameters, quality attributes and soil chemical properties were maximum and showed significant differences with combined application of recommended dose of fertilizers along with organic manures than applied alone. From this brief study, it may be concluded that, widespread nutrient deficiencies or toxicities are deteriorating the soil health day

by day. Due to this low productivity and profitability is seen in crops, majorly by low nutrient use efficiency. A judicious use of chemical fertilizers in combination with naturally available organic sources gives a break through effect in maintaining soil health and sustaining the environment. Thus the adoption of integrated nutrient management practices involving organic manures in cropping system enriches the soil fertility status, improves the growth and yield of crop and ultimately the quality of food as well.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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