Original Research Article

THERESPONSEOFINORGANIC ANDORGANICFERTILIZERSONGROWTH,YIELDANDQUALITYOFCLUSTERBEAN[*cyamopsistetragonoloba*(L.)Taub.] IN THE VILLAGE CHIKKENAHALLI OF CHALLAKERE TALUK, CHITRADURAGA DISTRICT

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ABSTRACT

Cluster bean is one of the significant yet underutilized leguminous vegetables belonging to family fabaceae. It isknownby various namesacrossthecountrysuchasgaur, 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 per cent organic (FYM and chicken manure), 100 percent inorganic (NPK), 50 per cent organic + 50 per cent inorganic, 100 per cent 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 controlrecorded the lowest values. Soil properties suchaspH, EC, SOC andNPKlevels improvedwhencombinationoforganicand 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.

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Keywords:Clusterbean,OrganicFertilizer,Jeevamruta, Farmyardmanure,Chickenmanure

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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 boththe planet and public health. The pandemic has brought about numeroussocial, economic, political and environmental challenges (Mc Neely., 2021). Agriculture plays a crucialrole in manysocieties 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 (Mahdi *et al.*, 2012).

In the 20th century, the introduction ofsynthetic 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(Ali*etal.*, 2023). Whilechemicalfertilizersenhanceplant growthand vigor, contributingto global food security, they can hinder the development of important plant characteristicssuch 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 (Hussainy, 2019). Thus to mitigate the negative impacts of synthetic fertilizerson human health and the environment, a new agricultural approach knownas 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 avariety of materials, including crop residues, animal manures, compost, and green manurecover crops. These materials are rich in organic matter and essential nutrients. Organic fertilizers offer a beneficial alternative to synthetic fertilizers, enhancing soilhealth,promotingsustainability,and improving nutrient management inagriculture.(Tejada *et al*., 2006).

Combiningorganicamendmentswithinorganicfertilizersaspartofintegratednutrient

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(Tejada et al., 2006; Demirkıran, 2021)

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 organicfertilizers are primary sources of plant nutrients used to replenish agricultural soils (Masarirombi *et al.*, 2012). 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 (Rai and Dharmatti, 2013). 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 oforganic and inorganic fertilizers on its growth, yield, quality and soil health.

2. MATERIALAND 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. Challakerebelongstoagro-climaticzone-IV*i.e.*,CentraldryzoneofKarnatakasituatedat 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 loamyand sandysoil. The soilchemicalcompositionofexperimentalplot isshown inTable 1. The experiment was laid out ina randomized blockdesignwith four replications and five treatments *viz.*, T1 – 100 per cent organicfarmyard manure ((FYM)+ chicken manure), T2– 100 per cent inorganic (NPK), T3 – 50 per cent organic (FYM+ chicken manure +50 per cent inorganic (NPK), T4 – 100 per cent organic (FYM + chicken manure) + jeevamrutaand 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.

Comment [r5]: (FYM+ chicken manure)

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 phosphorusandpotassiumwereapplied, whilethe remaininghalfofthe nitrogenwasadded approximately 30 days after sowing. The matured pods were harvested and weighed in kg/ ha.Observationswererecordedforvariousparameterssuchasplant height (cm),numberof branches per plant, days to first flowering, days to first vegetable harvest, pod length (cm), podwidth(cm),podyieldperplant(g),podyieldperplot(kg)andpodyieldperhectare (q).Thegeneralviewoftheexperimentalplotat30DASisshownin Fig.1

Table1: Chemicalcompositionofsoilof experimentalplot

Soil Parameters	pH	Electrical condutivity (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

Fig.1:Generalview oftheexperimentalplotat30DAS

3. RESULTSAND DISCUSSION

3.1 Vegetativegrowth

The data on growth parameters in different treatments are presented in Table 2. The treatment T3exhibitedthe highest plant height at45,60and90daysaftersowing,whilethe control recorded the lowest heights during the same periods. This difference may be attributedto the favorable soil composition and the nutrient release from both organic and inorganic fertilizers. Similar findings were observed byBathal and Kumar (2018) in cluster bean, Sachan and Krishna (2020) in french bean and Reddy *et al.*, 2014 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.*, 2019 and Anugonda *et al.*, 2022 in cluster bean.

3.2 Reproductivegrowth

The data in respect of average number of days required for appearance of first flower and number ofdays required fromsowing 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 statisticallyat par withthe resultsoftreatment T2.Incontrast,treatment T5tookthe longest time from sowing to the first picking. These observations are in line with the findings of Aslam *et al.*, 2024 in mung bean and parween *et al.*, 2019 in french bean.

3.3 Yieldparameters

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

Comment [r6]: Reddy *et al.*, (2014)

Comment [r7]: Seerangan *et al.*, (2019) and Anugonda *et al.*, (2022)

Comment [r8]: Aslam *et al.*, (2024)

Comment [r9]: *? et al.* (2019)

T2 and T4. The minimum yield was recorded intreatment T5. The increase in yield may be attributedto enhanced vegetative growthand flower characteristics, whichsubsequently led to higher podyield. Incontrast,the lower yield inthe controlgroupcould be dueto the lack of available nutrients during the plant's development. Organic manures enhance the soil's water-holding capacityand promotethe activityof 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.*, 2023 in common bean, Narwariya *et al.*, 2023 in okra and Srivatsava *et al.*, 2023 in tomato.

Comment [r10]: Quadiri *et al.*, (2023) in common bean, Narwariya *et al.*, (2023) in okra and Srivatsava *et al.*, (2023) in tomato.

3.4 Qualityparameters

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 treatmentT5 showed the lowest values. The increased pod weight may be attributed to enhanced mobilityofphotosynthetic products fromthe source to the sink that is influenced by growth hormones synthesized from organic fertilizers. These results are in accordance with Uddin*et al.*, 2023 in garden pea and Tomar*et al.*, 2022 in french bean.

Comment [r11]: Uddin*et al.*, (2023) in garden pea and Tomar *et al.*, (2022) in french bean.

3.5 Soilfertility

3.5.1 SoilpH,electricalconductivity(EC) and soilorganic 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.*, 2008.

Comment [r12]: by Ullah *et al.*, (2008).

Soil electrical conductivity (EC) measures the salt content in the soil and is a crucial indicator of soil health. Both excessively high andlow 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 inbrown 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 optimalEC 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 T2recordedthe minimumelectricalconductivity(Choudhary *et al.*, 2024).

Table2:Vegetative andreproductive characteristicsofplants

Sl.No	Treatments	Plantheight(cm)			No.ofbranchesperplant			No. of days from sowingtoflowering	No. of days fromsowingto first picking
		45DAS	60DAS	90DAS	45DAS	60DAS	90DAS		
T1	50%FYM+50 %chickenmanure	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% chickenmanure	71.20	104.05	114.3	0.30	1.65	3.20	28.25	41.50
T4	75 % chicken manureandFYM +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 at5%	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.

Comment [r13]: The statistically importance and groups should be added to the Table.

Table3: Yield and qualityattributesofplants

Sl.No	Treatments	Yield/plant (gm)	Yield/plot(kg)	Yield/hectare(q)	Lengthof pod (cm)	Weightofpod(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%chickenmanure	0.63	7.83	156.71	14.88	2.57
T4	75%chickenmanureand 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
	CDat5%	0.0344	0.7962	15.9302	2.8129	0.2187

Note:FYM:farmyard manure;RDF:recommendeddoseoffertilizers;SE:standarderrorandCD:coefficient of deviation.

Comment [r14]: The statistically importance and groups should be added to the Table.

Soilorganic carbon has beendecreased bychemicalfertilizer applicationbut 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.,* 2022.

3.5.2 Nitrogen,PhosphorusandPotassium(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.,* 2023.

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Table4:Chemicalcompositionofsoil

Sl. No	Treatments	pH	Electrical conductivity (dS/m)	Soilorganic 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 %chickenmanure	6.95	0.57	0.53	242.25	37.33	294.25
T4	75%chickenmanureand 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
	CDat5%	0.0531	0.0094	0.0139	1.9386	0.6808	3.6970

Note:FYM:farmyardmanure;RDF: recommendeddoseoffertilizers;SE:standard errorandCD:coefficientofdeviatio

Comment [r15]: The statistically importance and groups should be added to the Table.

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 maybe concludedthat,widespread nutrient deficienciesortoxicitiesare deterioratingthesoil 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 naturallyavailableorganicsourcesgivesa break throughеffect in maintaining soil healthand 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.

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