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Effect of organic nutrients management on growth and yield of cluster bean

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Abstract

A field experiment entitled “Effect of organic nutrients management on growth and yield of cluster bean (*Cyamopsis tetragonoloba* L.)” conducted at organic research Farm, Kargua ji, Department of agronomy, Institute of Agricultural Sciences, Bundelkhand University, Jhansi, U.P., situated at Bundelkhand region of Uttar Pradesh at 25°31'07.1” N latitude and longitude of 78°33'47.4 E with 284 meters above from mean sea level (MSL) during *kharif*, 2024. The experiment consisted 8 treatments; Control (T₀), FYM 10 t ha⁻¹ (T₁), VC 5 t ha⁻¹ (T₂), VC 5 t ha⁻¹ + biofertilizers (T₃), FYM 5 t ha⁻¹ + Bio fertilizers (T₄), VC 2.5 t ha⁻¹ + Bio fertilizers (T₅), FYM 5 t ha⁻¹ + VC 2.5 t ha⁻¹ (T₆) and FYM 5 t ha⁻¹ + VC 2.5 t ha⁻¹ + Bio fertilizers (T₇). The experiment was laid out in randomized block design with three replications. The results clearly revealed that application of significantly higher number of pods per plant, number of seeds per pod, test weight and yield found in FYM 5 t ha⁻¹ + VC 2.5 t ha⁻¹ + Bio fertilizers (T₇) treatment. Therefore, it can be summarized that addition of FYM 5 t ha⁻¹ + VC 2.5 t ha⁻¹ + Bio fertilizers (T₇) recommendation significant increase in clusterbean growth parameters, yield attributes and yields.

Keywords: Cluster bean, *Cyamopsis tetragonoloba*, organic nutrient management

Introduction

Clusterbean (*Cyamopsis tetragonoloba* L.) popularly known by its indigenous name “Guar” belongs to the family Fabaceae (Leguminosae). It is an important cash crop, grown in semi-arid and arid regions of tropical India during *kharif* season. Among leguminous crops, it is comparatively more drought hardy crop due to its deep root system. Clusterbean is grown for various purpose since ancient time viz., vegetable, green fodder, production of seed and endospermic gum. It is also cultivated for hay, silage and green manure (Grestaa *et. al.*, 2013) [8]. In the recent years, besides its conventional uses, it has emerged as an industrial crop due to presence of galactomannan (gum). The spherical shaped endosperm contains 28-33% gum (Goldstein and Alter, 1959) [6]. Guar gum has diversified uses in food processing, beverages, mining, pharmaceuticals, ceramics, synthetic resins, cosmetics, paper-textiles, explosive, paints, plastics, petroleum and oil industries. Newly, galactomannans are used in the water proof biocide film production (Selvaraj and Prasanna, 2012) [16]. Mature clusterbean seed contain 23% protein, 1.7% fat, 6% carbohydrate and traces of vitamins and minerals. It is very good source of vitamin A, calcium, phosphorus, iron and ascorbic acid. It contains many beneficial nutrients, phytochemicals such as saponin and flavonoids. It is well-known traditional plant used in folklore medicine. It provides nutritional concentrate and fodder for cattle and increases the fertility of soil by fixing considerable amount of atmospheric nitrogen. As a legume, it has capacity to ameliorate the poor soil fertility conditions encountered in the arid regions. Clusterbean enriches the soil by fixing atmospheric nitrogen almost 50-150 kg ha⁻¹, thus it helps in nitrogen economy. Sometimes it is used in reclamation of saline and alkaline soils (Kay, 1979) [9]. India occupies apex position in the world trade of guar gum.

Organic manure (FYM and vermicompost) is the important component of the integrated nutrient management system. Manure supply plant nutrient in small quantities and provide organic matter in large quantities. When manure was applied in conjunction with chemical fertilizers for optimum growth of crop, the decline in organic carbon was arrested and the gap between actual yield and plotsential yield was bridged to a large extent (Singh *et al.*, 2007) [19]. According to Roy and Singh

(2006) ^[15], the use of vermicompost is being advocated for sustaining soil fertility in various field crops. Vermicompost is nutritionally rich organic fertilizer, which slowly release nutrients in the soil, to overcome the problem of leaching. It is also playing an important role in soil and water conservation by their binding and aggregation properties. Moreover, they also help in balancing the nutrient availability to growing as well as succeeding crop and boost up the quality and production of crop. Organic manures supply adequate amounts of humus substances. Humus improves the structure, water holding, aeration, solubility of soil minerals, drainage, buffer and exchange capacity of the soil and serves as a source of energy for the development of microorganisms. Biofertilizer is microbial inoculants of selective microorganisms which have the capacity to mobilize nutritionally important elements from non-available to available form through biological processes such as atmospheric nitrogen fixation, phosphate solubilization, excretion of plant growth promoting substances or cellulose and lignin biodegradation in soil, compost and other environments. They are effective, renewable and low-cost source of plant nutrients to the supplement of chemical fertilizers (Boraste *et al.*, 2009) ^[2]. Biofertilizers have the ability to mobilize the nutritionally important elements from non-available to available form through biological processes and known to increase yield in several vegetables (Kumar and Singh, 2002) ^[13]. Biofertilizers help in the maintaining long term soil fertility and sustainability. It may increase yield of crops by 10-30% (Khandelwal *et al.*, 2012) ^[11]. They are totally harmless, pollution free and low-cost inputs. They play a significant role in improving availability of nutrient to the plants. They are recognized as a constituent of integrated plant nutrient supply system. Clusterbean being a legume crop which has the capacity to fix atmospheric nitrogen by its effective root nodules. Biofertilizer increases the number of such microorganism and effective root nodule. The major part of nitrogen is met through nitrogen fixation.

Materials and Methods

A pot experiment was conducted during the *kharif* season of 2024-2025. Organic Research Farm, Kargua ji, Department of Agronomy, Institute of Agricultural Sciences, Bundelkhand University, Jhansi, U.P., situated at Bundelkhand region of Uttar Pradesh at 25°31'07.1" N latitude and longitude of 78°33'47.4 E with 284 meters above mean sea level (MSL). According to NARP, Bundelkhand falls in Agro-climatic Zone VI (Bundelkhand Zone of UP). The soils of the district are characterized by their varying depth, topographic situations, and colors. The two main soil groups are red and black, generating four soil series locally known as rakar, parwa, kabar, and mar. The soil texture varies from rocky, gravelly, sandy, and sandy loam to clay loam. It has a gentle to steep (0.5 to 10%) slope with low to medium organic carbon content and very low to high water holding capacity. Jhansi situated in the tropical and subtropical climatic tract of India. The average annual rainfall is 884.6 mm, with 90-95 percent of that rainfall occurring during the southwest monsoon, which commences in June and reaches a peak in August and ends in October.

The treatments were T₀: Control (RDF), T₁: FYM 10 t ha⁻¹, T₂: VC (Vermicompost) 5 t ha⁻¹, T₃: VC 5 t ha⁻¹ + Bio fertilizers (*Rhizobium*), T₄: FYM 5 t ha⁻¹ + Bio fertilizers, T₅: VC 2.5 t ha⁻¹

+ Bio fertilizers, T₆: FYM 5 t ha⁻¹ + VC 2.5 t ha⁻¹, T₇: FYM 5 t ha⁻¹ + VC 2.5 t ha⁻¹ + Bio fertilizers. Different observations of the plant were taken during the Crop period. The height of plants was measured from ground level to the extreme growing tip using a meter scale. Observations were recorded at Different stages: Plant height, The number of branches plant⁻¹ was counted of each plant at different stages, five plants were randomly collected from each plot for estimating dry matter accumulation plant⁻¹ at harvest. The plant samples were filled in perforated brown paper bags separately followed by sun drying for 2-3 days. Later on, these samples were kept in oven at 700 C till a constant weight was attained. Thereafter, weight of each sample was recorded, averaged and expressed as g plant⁻¹. Number of fully matured and developed pods of five tagged plants was counted at harvest from each plot. The mean value for number of pods plant⁻¹ was calculated and expressed as pods plant⁻¹. One thousand seeds were counted from each sample drawn from threshed produce of each net plot and weighed on electric balance and expressed in g. After harvesting of crop seed Yield, halum yield, biological yield and HI was calculated

Statistical Analysis

The experimental data recorded for growth, yield, and other characters were subjected to statistical analysis by the "Analysis of Variance" technique suggested by (Fisher, 1936). The appropriate standard error for each of the factors was worked out. The significance of differences among treatment effects was tested by "F" test. Critical difference (CD) was worked out, wherever the difference was found significant at 5.0 or 1.0 percent level of significance.

Results and Discussion

The critical appraisal of data presented in table 1 revealed that the combinations of different organic manures influenced the plant height significantly at harvesting of clusterbean. At harvesting, treatment T₇ (5 t ha⁻¹ FYM + 2.5 t ha⁻¹ VC + Bio fertilizers) recorded significantly higher plant height 73.41 cm, which was at par with treatment T₂, T₃ and T₅. Lower plant height was observed with control (60.33 cm).

According to the current experiment, the richer availability of soil nutrients for plant growth and development from an early stage due to organic manures application along with biofertilizer which increase microbial activity in the root zone appears to be the cause of the profound influence on many growth parameters of the crop. Therefore, under varying organic manures combinations, a better nutritional environment appears to have boosted plant height, dry matter accumulation and number of branches per plant through active cell division and elongation, and even improved chlorophyll production. The bigger canopy development, plant height and branches with the application of a combination of organic manure with biofertilizer may have boosted solar energy interception, absorption, and utilization, which in turn increased overall growth, photosynthesis, and ultimately the accumulation of dry matter. The present investigation's observations of an improvement in the crop's overall vegetative growth following the application of organic manures consistent with those of Yogi *et al.* (2016) ^[20], Sharma *et al.* (2019) ^[18], Gamit *et al.* (2022) ^[5], Sharma *et al.* (2023) ^[17].

Table 1: Effect of different organic manures on plant height (cm), dry matter accumulation and number of branches per plant at harvest of clusterbean

Treatments	Plant height (cm)	Dry matter accumulation (g)	Number of branches per plant at harvest
T ₀	60.33	9.40	7.53
T ₁	63.34	10.82	8.67
T ₂	70.45	12.05	9.67
T ₃	70.07	12.05	9.73
T ₄	63.74	10.81	8.66
T ₅	72.24	12.29	9.86
T ₆	65.36	11.16	8.97
T ₇	73.41	12.45	9.93
SEm ±	1.89	0.31	0.27
CD(P=0.05)	5.73	0.95	0.82

The critical appraisal of data presented in table 1 revealed that the influenced of organic manures on number of branches per plant significantly at harvesting of clusterbean. Treatment T₇ (FYM 5 t ha⁻¹ + VC 2.5 t ha⁻¹ + Bio fertilizers) recorded significantly higher number of branches per plant 9.93. Lower number of branches per plant was observed with control (7.53).

It is explicit from the data (Table 1) that application of organic manures significantly enhanced dry matter accumulation at harvest of clusterbean. Dry matter accumulation at harvest (12.45 g plant⁻¹) was increased significantly with application of T₇ (FYM 5 t ha⁻¹ + VC 2.5 t ha⁻¹ + Bio fertilizers) as compared to control. The increment in dry matter of clusterbean at harvest was 32.44 per cent, respectively over control.

Organic manures improve physico-chemical properties of soil, which ultimately provided balance nutrition to crop and produce bigger canopy development, plant height and branches with the application of a combination of organic manure with biofertilizer may have boosted solar energy interception, absorption, and utilization, which in turn increased overall growth, photosynthesis, and ultimately the accumulation of dry matter. The present investigation's observations of an improvement in the crop's overall vegetative growth following the application of organic manures consistent with those of Sharma *et al.* (2019) [18], Sharma *et al.* (2023) [17].

The critical appraisal of data presented in table 2 revealed that the application of organic manures influenced the number of seeds per pod significantly at harvesting of clusterbean. Treatment T₇ (FYM 5 t ha⁻¹ + VC 2.5 t ha⁻¹ + Bio fertilizers) recorded significantly higher average fruit weight (9.18). Lower number seeds per pod were observed with control (6.93).

Result of present investigation revealed that balance nutrition to crop significantly increased the yield and yield attributes viz., number of pods plant⁻¹, number of seed pod⁻¹, test weight, seed yield, haulm yield and biological yield of clusterbean (Table 4.2 and Table 4.3). A faster growth rate in terms of plant height and dry matter accumulation in plant parts as evinced of organic manures influence have played a significant role in reducing the competition for photosynthates and nutrients with other plant. At the time of reproductive stage, greater assimilating surface

resulted adequate production of metabolites and their translocation towards sink. It increase the numbers of seeds per pod and number of pods per plant. Macro and micro nutrients availability may have accelerated a number of physiological processes, which in turn boosted plant growth and yield attribute like test weight, numbers of seeds per pod and number of pods per plant. The findings of the current study were consistent with those of Bhuvu *et al.* (2017) [1], Prajapati *et al.* (2020), Gamit *et al.* (2022) [5], Kumar *et al.* (2022) [12].

It is evident from data presented in table 2 found that the application of organic manures before sowing of clusterbean significant increased the number of pods plant⁻¹. The application of treatment T₇ (FYM 5 t ha⁻¹ + VC 2.5 t ha⁻¹ + Bio fertilizers) was observed higher number of pods plant⁻¹ as compared to control. The maximum number of pods plant⁻¹ was recorded in treatment T₇ (24.20) that were FYM 5 t ha⁻¹ + VC 2.5 t ha⁻¹ + Bio fertilizers, which was at par with T₂, T₃ and T₅.

The increased number of pods per plant might be due to the increase in parameters such as number of branches as cited by Manjesh *et al.* (2022) [14]. It was also stated that the more photosynthesis from a larger area of the leaves and the translocation of photosynthates to the sink which is ultimately the cause of the increase in number of pods per plant. The similar results were reported by Gamit *et al.* (2022) [5] and Kumar *et al.* (2022) [12].

The data presented in Table 2 indicate that application of vermicompost, FYM and biofertilizers recorded significantly higher test weight in clusterbean over control. The extent of increase in test weight was 38.65 per cent as compared to control. Balance nutrition to crop significantly increased the size of seed because at the time of reproductive stage, greater assimilating surface resulted adequate production of metabolites and their translocation towards sink of clusterbean. Macro and micro nutrients availability may have accelerated a number of physiological processes, which in turn boosted plant growth and yield attribute like test weight, numbers. The findings of the current study were consistent with those of Gamit *et al.* (2022) [5], Kumar *et al.* (2022) [12], Manjesh *et al.* (2022) [14].

Table 2: Effect of different organic manures on number of pods per plant, number of seeds per pod and test weight of clusterbean

Treatments	Number of pods plant ⁻¹	Number of seeds pod ⁻¹	Test weight (g)
T ₀	17.70	6.93	19.40
T ₁	20.39	7.98	21.96
T ₂	22.68	8.89	24.43
T ₃	22.68	8.91	24.40
T ₄	20.49	7.99	22.10
T ₅	23.24	9.08	25.05
T ₆	21.07	8.25	22.70
T ₇	24.20	9.18	26.04
SEm±	0.56	0.24	0.62
CD(P=0.05)	1.69	0.73	1.88

Effect of different organic manures treatments on seed yield of clusterbean during *kharif* 2024-25 were depicted in table 3. Significantly highest seed yield (928.42 kg ha⁻¹) was recorded with FYM 5 t ha⁻¹ + VC 2.5 t ha⁻¹ + Bio fertilizers, i.e. T₇ treatment. It was at par with T₂, T₃ and T₅; it was statistically superior over T₀, T₁, T₄ and T₆.

Result of present investigation revealed that balance nutrition to crop significantly increased the yield and yield attributes viz., number of pods plant⁻¹, number of seed pod⁻¹, test weight, seed yield, haulm yield and biological yield of clusterbean (Table 4.2 and Table 4.3). Due to greater availability of macro and micro nutrients at the time of reproductive stage, greater assimilating

surface resulted adequate production of metabolites and their translocation towards grain and was evident from nutrient concentration and their uptake. NPK availability and plant uptake may have accelerated a number of physiological processes, which in turn boosted plant growth and yield characteristics and increased seed and haulm yields. The yields of seed and haulm determine the biological yield. The application of organic manures with biofertilizers led to a considerable increase in biological yield, which might be attributed to higher grain and haulm yields. The findings of the current study were consistent with those of Bhuva *et al.* (2017)^[1], Prajapati *et al.* (2020), Gamit *et al.* (2022)^[5], Kumar *et al.* (2022)^[12], Manjesh *et al.* (2022)^[14].

Table 3: Effect of different organic manures on seed yield, haulm yield, biological yield and HI of clusterbean

Treatments	Seed yield (kg ha ⁻¹)	Haulm yield (kg ha ⁻¹)	Biological yield (kg ha ⁻¹)	HI (%)
T ₀	669.67	1015.00	1684.67	39.63
T ₁	791.47	1106.84	1898.31	41.76
T ₂	904.86	1247.73	2152.59	42.12
T ₃	849.96	1165.28	2015.24	42.26
T ₄	765.71	1047.69	1813.40	42.34
T ₅	883.77	1198.36	2082.14	42.51
T ₆	799.71	1088.46	1888.17	42.42
T ₇	928.42	1161.77	2090.19	44.47
SEm ±	17.09	8.55	16.79	0.62
CD(P=0.05)	51.83	25.94	50.94	NS

Effect of different organic manures treatments on haulm yield of clusterbean during *kharif* 2024-25 were depicted in table 3. Significantly highest haulm yield (1161.77 kg ha⁻¹) was recorded with FYM 5 t ha⁻¹ + VC 2.5 t ha⁻¹ + Bio fertilizers, i.e. T₇ treatment. It was at par with T₂, T₃ and T₅; it was statistically superior over T₀, T₁, T₄ and T₆.

Data depicted in table 3 indicated that application of organic manures with biofertilizers significantly increased the biological yield of clusterbean during *kharif*–2024-25. Significantly highest biological yield (2090.19 kg ha⁻¹) was recorded with the application of FYM 5 t ha⁻¹ + VC 2.5 t ha⁻¹ + Bio fertilizers i.e. T₇ over rest of all treatments.

It is explicit from the data presented in table 3 that application of organic manures with biofertilizers did not show any significant variation in harvest index of clusterbean crop.

Conclusion

On the basis of this experimentation, it is concluded that T₇ (FYM 5 t ha⁻¹ + VC 2.5 t ha⁻¹ + Bio fertilizers) in clusterbean should be applied for better nutrient management throughout the cropping season for obtaining higher yields and economic returns over rest of the treatments.

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