

EFFECT OF ORGANIC, INORGANIC AND BIOFERTILIZERS ON GROWTH, YIELD AND QUALITY OF CLUSTER BEAN (*Cyamopsis tetragonaloba* L.)

ABSTRACT

Cluster bean (*Cyamopsis tetragonaloba* L. Taub) popularly known as "Guar" is an important legume crop mainly grown under rainfed conditions in arid and semi-regions of Rajasthan during kharif season. The main objective is to optimize the concentration of NPK, FYM, Vermicompost, PSB, *Rhizobium*, which can be applied in the treatment of the soil, to maximize the crop yield and find out the most treatment combination of plant growth, yield and quality. This study was conducted in the horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj (UP) from July 2021- October 2021 to investigate the impact of organic, inorganic, and biofertilizers on the growth, yield, and quality of cluster beans (*Cyamopsis tetragonaloba* L.). The experiment was laid out in RBD with nine Treatments conducted in the horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj (UP) During from July 2021- October 2021. The experiment was laid out in RBD with nine treatments with three replications. The results revealed that T8 (N₂₀P₅₀K₅₀ Vermicompost 5 t ha⁻¹ + PSB 5 kg ha⁻¹ + *Rhizobium* 5 kg ha⁻¹) – performed the best in terms of Plant Height (140.22), Number of Branches (21.39), Length of Pods (25.00), Width of Pods (3.70), Weight of Pods (4.10), Number of cluster per plant (21.60), Number of Pods per plant (89.17), Number of seeds per pod (11.80), Number of Pod yields per plant (196.87), Number of pod yield per plot (68.03), TSS (12) B:C Ratio (2.5:1). Therefore, the treatment T8 (N₂₀P₅₀K₅₀ Vermicompost 5 t ha⁻¹ + PSB 5 kg ha⁻¹ + *Rhizobium* 5 kg ha⁻¹) is the best when compared to other treatments. As, the highest benefit cost ratio was observed in T8 (N₂₀P₅₀K₅₀ Vermicompost 5 t ha⁻¹ + PSB 5 kg ha⁻¹ + *Rhizobium* 5 kg ha⁻¹). i.e., (2.5:1) which states that is economically profitable compared to all other treatments.

Keywords: Guar, Vermicompost, PSB, *Rhizobium*.

INTRODUCTION

Cluster bean (*Cyamopsis tetragonaloba* L. Taub) popularly known as "Guar" is an important legume crop mainly grown under rainfed condition in arid and semi-regions of Rajasthan during kharif season. Cluster bean (*Cyamopsis tetragonaloba* L. Taub), often known as "guar," is a significant legume crop that is mostly farmed during the kharif season under wet conditions in desert and semi-arid parts of Rajasthan. It is a very hardy and drought tolerant crop. Its deep penetrating roots enable the plant to utilize available moisture more efficiently and thus offer better scope for rainfed cropping. The crop also survives even in moderate salinity and alkalinity conditions. There is no other legume crop so hardy and drought are tolerant as Cluster bean, which is especially suited for the soil and climate of Rajasthan. (Kherawat *et al* (2013). The pods of

Cluster bean are as rich in food value as that of Cluster Bean. According to (Aykroyd (, 2007) the composition of Cluster bean is 81.0 (g) moisture, 10.8 (g) carbohydrate, 3.2 (g) protein, 1.4 (g) of fat, 1.4 (g) of minerals, 0.09 (mg) thiamine, 0.03(mg) riboflavin, 47 I.U. vitamin C, 316 I.U, vitamin A (100 g⁻¹) of edible portion. Nitrogen is required for the synthesis of chlorophyll and amino acids, which contribute to the protein building blocks and consequently plant growth. Clusterbean cultivars with nitrogen applied had higher crude protein, crude fibre, ash percentage, carbs, leaf area per plant, dry matter, and green fodder yields (Ayub et al., 2010). Phosphorus is the second most critical nutrient to add to the soil in order to maintain plant growth and crop yield. It boosts rhizobium activity and promotes the production of root nodules. As a result, it aids in the fixation of more nitrogen from the atmosphere in root nodules, Handbook of Agriculture by ICAR (2010). Potassium benefits ascribed to k include the resistance of plant against pest, disease, and stresses caused by drought, salinity and sodicity in assuring improving crop quality characteristics (Kherawat et al (2013). Farmyard manure the organic manure like FYM is the oldest and cheapest source of nutrients being popular in ancient times. Application of FYM on field to enrich the soil fertility is an old practice unlike chemical fertilizers which contain only one, two or three plant nutrients. FYM seems to act directly for increasing the crop yields either by the acceleration of respiratory process with increasing cell permeability and hormonal growth action or by a combination of all these processes. FYM provides plants with both macro and micronutrients. A well decomposed FYM contains 0.5%N, 0.2% P₂O₅ and 0.5% K₂O, Handbook of Agriculture by ICAR (2010). Vermicompost are products derived from the accelerated biological degradation of organic wastes by earthworms and microorganisms. Earthworms consume and fragment the organic wastes into finer particles by passing them through a grinding gizzard and derive their nourishment from microorganisms that grow upon them. These materials contained mineral contents (% dry weight) ranging from 2.2–3.0 N, 0.4–2.9 P, 1.7–2.5 K and 1.2–9.5 Ca compared to those of a commercial plant growth (Arancon et al., 2005). Rhizobium the use of biofertilizers is more eco-friendly in nature. They can play a significant role in fixing atmospheric nitrogen; biofertilizer enriches soil fertility and improves soil fertility. Of these biofertilizers, rhizobium inoculants specific for different leguminous crops in the most important in India. The objective is application of NPK, FYM, Vermicompost, PSB, Rhizobium to increase the yield of crop and to find the best treatment of combination. The largest contribution of biological nitrogen fixation to agriculture is derived from the symbiosis between legumes and Rhizobium species. So, this study was conducted to investigate the impact of organic, inorganic, and biofertilizers on the growth, yield, and quality of cluster beans (*Cyamopsis tetragonaloba* L.).

MATERIALS AND METHODS

The experiment was conducted at Experimental Research Field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (UP) in 2021 during Kharif season in India. The experiment material consists of MDU 1 variety of cluster beans, which is released from Tamil Nadu agricultural university, Tamil Nadu. The soil of the experimental field was alkaline, with sandy loam and a

pH of 7.2. The pit was dug with 30×30×30 cm³ and the applied dose of FYM is 20 tonnes/ha-1 and N, P and K is 20 kg, 50kg and 50kg/ha-1, respectively. The experiment was laid out in randomized block design with three replications consisting of eight treatment combinations, inorganic fertilizers, two kinds of organic manures (FYM and vermicompost) and biofertilizers (*Rhizobium* and PSB) alone, some treatments are comprised of organic manures with biofertilizers and different quantity levels of inorganic fertilizers. The plot size was 45cm×30cm spacing rows and plants. Statistical analysis of variance was performed on the data collected throughout the experiment. The observation was recorded for Plant height (cm), Number of Branches per plant, Length of pods, Width of pods, Weight of pods, Number of Cluster per plant, Number of Pods per plant, Number of Seeds per pod, Number of pod yield per plant (g), Number of pod yield per plot (kg), Total soluble solid TSS (°Brix), economics were analyzed statistically. The significance of the treatments was determined using the 'F' test at a level of significance of 5%.

3. RESULTS AND DISCUSSION

Growth Parameters

The data on growth parameters in different treatment combinations were recorded (Table 1). The maximum height (33.50, 48.83 and 140.22 cm) at 30, 60, 90 DAT was recorded on 80% RDF Chemical fertilizers + 20% Vermicompost + PSB+ *Rhizobium*. While the minimum Plant height was recorded in Absolute Control (23.83, 38.00 and 94.30 cm). It might be due to improved soil's physical, chemical and biological properties. Higher availability of all plant nutrients resulted in the improved plant characters like plant height. These findings are in conformity with the findings of Kumar *et al.* (2004) and Ashwini (2005) in French bean.

The maximum Number of Branches (15.50, 17.67 and 21.39) at 30, 60, 90 DAT was recorded on 80% RDF Chemical fertilizers + 20% Vermicompost + PSB+ *Rhizobium*. While the minimum Number of Branches was recorded in Absolute Control (6.18, 8.17 and 8.94). An increase in the number of branches per plant due to PSB inoculation may be attributed to the conversion of unavailable phosphorus to available forms particularly during the early crop growth phase which would have helped in the absorption of all major and minor nutrients required for the plant to put forth early vigour in vegetative phase and helps to increase the number of branches similar observations were also recorded by Prasad *et al.* (2013) in cowpea.

Yield Parameters

Maximum Length of Pods (25.00) at 90 DAT was recorded on 80% RDF Chemical fertilizers + 20% Vermicompost + PSB+ *Rhizobium*. While the minimum Length of Pods was recorded in Absolute Control (8.83). An Increase in Length An increase in the Length of pods is due to better assimilation of photosynthates and better portioning into developing pod clusters that have taken place and improving yield attributing characters like pod length and diameter. Similar results are in accordance with the Ashwini (2005) in French Bean. Width of Pods (3.70) at 90

DAT was recorded on 80% RDF Chemical fertilizers + 20% Vermicompost + PSB+ *Rhizobium*. While the minimum Width of Pods was recorded in Absolute Control (2.50). At various amounts of NPK, Vermicompost, PSB, and *Rhizobium*, the mean value of the Width of Pods was determined to be significant. Enhanced yield attributing features such as pod width have occurred due to improved photosynthate assimilation and better partitioning into growing pod clusters. **Nirmala and Vadivel (1978)** made similar observations in cucumber. Weight of Pods (4.10) at 90 DAT was recorded on 80% RDF Chemical fertilizers + 20% Vermicompost + PSB+ *Rhizobium*. While the minimum Weight of Pods was recorded in Absolute Control (2.50). At various amounts of NPK, Vermicompost, PSB, and *Rhizobium*, the mean value of the Weight of Pods was determined to be significant. Enhanced yield attributing features such as pod width have occurred due to improved photosynthate assimilation and better partitioning into growing pod clusters. **Gandhi and Sivakumar (2010)** made similar observations about cucumbers.

Number of Cluster per plant (21.60) at 90 DAT was recorded on 80% RDF Chemical fertilizers + 20% Vermicompost + PSB+ *Rhizobium*. While the minimum Number of Cluster per plant was recorded in Absolute Control (14.42). PSB could be the greater availability of nutrients in the soil and resulted in better growth and development which might be attributed to the better mobilization of phosphorus and increased allocation of photosynthates towards the economic parts and also hormonal balance in the plant system **Ramana et al. (2011)**. The number of Pods per plant (89.17) at 90 DAT was recorded on 80% RDF Chemical fertilizers + 20% Vermicompost + PSB+ *Rhizobium*. While the minimum Number of Pods per plant was recorded in Absolute Control (67.40).

The maximum Number of Seeds per pod (11.80) at 90 DAT was recorded on 80% RDF Chemical fertilizers + 20% Vermicompost + PSB+ *Rhizobium*. While the minimum Number of Seeds per pod was recorded in Absolute Control (7.93). The significant improvement in yield attributes of cluster bean was due to the fact that *rhizobium* inoculation increased the root volume through better root development, nodulation and more nutrient availability resulting in vigorous plant growth which in turn results in better flowering, pod formation and increased pod yield. Since, PSB helps in reducing phosphorus fixation by its chelating effect and also solubilized the fixed phosphorus leading to more uptakes of nutrients and reflected in better yields. Similar findings were found by **Mishra and Baboo (2002)**.

The maximum Number of Pod yields per plant (196.87) at 90 DAT was recorded on 80% RDF Chemical fertilizers + 20% Vermicompost+ PSB+ *Rhizobium*. While the minimum Number of Pod yields per plant was recorded in Absolute Control (156.47). PSB could be due to the greater availability of nutrients in the soil and resulted in better growth and development which might be attributed to the better mobilization of phosphorus and increased allocation of photosynthates towards the economic parts and also hormonal balance in the plant system. These findings are in conformity with the findings of, **Ramana et al., (2011)**. The higher mobilization of phosphorus and increased allocation of photosynthates to the economic portions as well as hormonal balance in the plant system may be responsible for PSB's increased nutrient availability in the soil and

the better growth and development that occurred. These results are consistent with those of **Ramana et al., (2011)**. The maximum Number of Pod yields per plot (68.03) at 90 DAT was recorded on 80% RDF Chemical fertilizers + 20% Vermicompost + PSB+ **Rhizobium**. While the minimum Number of Pod yields per plot was recorded in Absolute Control (46.47). The Enhancing yield attributing features such pod width have occurred due to improved photosynthate assimilation and better portioning into growing pod clusters. **Gandhi and Sivakumar (2010)** made similar observations about cucumbers.

The maximum TSS (Brix) (12) at 90 DAT was recorded on 80% RDF Chemical fertilizers + 20% Vermicompost + PSB+ **Rhizobium**. While the minimum TSS (Brix) was recorded in Absolute Control (8.66). The increased protein content is attributed to an increase in N content and uptake by the crop due to phosphorus application. The increase of protein content of **cluster beans over** due to the seed inoculation increased the N content of pods which ultimately reflects the TSS content of pods. Similar findings were found by **Tripathi and Edward (2017)** in guar.

Plant Height			Number of Branches			Length of pods	Width of pods	Weight of pods	No. of cluster plant ⁻¹	No. of pods plant ⁻¹	No. of seeds pod ⁻¹	Pod yield plant ⁻¹	Pod yield plot ⁻¹ (kg)	TSS
30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS									
23.83	38	94.3	6.18	8.17	8.94	8.83	2.5	2.5	14.42	67.4	7.93	156.5	46.47	8.66
25.67	41.28	100.7	7.5	10.39	17.99	12.5	2.55	2.55	15.37	71.43	8	169.9	47.27	9.33
27.56	44.33	103.9	8.5	12.39	18.05	12.51	2.59	2.59	16.02	73.22	8.06	176.5	48.43	10.4
26.5	38.07	122.8	7.5	15.06	21	16.75	2.89	3.1	19.39	82.71	9.33	184.6	57.32	10.83
27.5	37.6	122.3	12	15.1	20.13	16	2.8	2.9	18.66	79.13	9.26	180.5	56.64	10.8
28.06	40.63	110.8	7.78	12.22	18.67	14.1	2.6	2.6	16.89	78.42	8.4	178.1	49.47	10.5
26.89	38.39	122.2	6.6	14.94	19.67	15	2.7	2.8	17.15	78.46	8.46	179.1	50.55	10.6
30.83	45.17	130.3	12	15.1	21.39	21	2.9	3.5	19.82	85.34	11.46	192.1	67.33	11
33.5	48.83	140.2	15.5	17.67	21.39	25	3.7	4.1	21.6	89.17	11.8	196.9	68.03	12
S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
0.71	2.31	8.45	0.53	0.78	1.09	1.00	0.18	0.19	1.12	4.63	0.442	8.93	0.36	0.65
2.01	4.40	5.03	4.58	4.76	4.60	4.96	4.91	5.07	4.91	4.78	3.79	3.92	4.51	4.91
0.342	1.111	4.076	0.25	0.376	0.523	0.484	0.084	0.09	0.52	2.23	0.213	4.3	0.17	0.31

Table 1: Plant characteristics

DAS – Days after sowing

CONCLUSION

The result from the present investigation concluded that the treatment T8 which received RDF Chemical dfertilizers + 20% Vermicompost + PSB + *Rhizobium* was found superior in Plant height, Number of branches, Number of days of first picking, Average fruit width, Fruit yield per plant (kg), Number of seeds per fruit, Average fruit length, Number of clusters plant, Number of pods in a cluster, TSS°(Brix), net income of 84750.00 Rs./ ha-1 and B:C ratio of 2.5.

REFERENCES

Anupama, Dolkar, R., Vadodaria, J.R. and Verma, P. (2016) Effect of different varieties of cluster bean (*Cyamopsis tetragonaloba* (L)Taub.) and biofertilizers on growth, yield and quality parameters.*Ecology, Environment Conservation*, 22 :457-462.

Ayub, M., Ali S.A., Tahir M., Tahir sh., Tanveer, A., and Siddiqui, M. H. (2012) Evaluating the role of phosphorus solubilizing bacterial inoculation and phosphorus application on forage yield and quality of Cluster bean (*Cyamopsis tetragonaloba* L.). *International journal of modern agriculture*, 22(2):479-483.

Ayub, M., Khalid, M., Tariq, M., Nadeem, M.A., and Naeem, M. (2011) Effect of different seeding densities and nitrogen levels on growth, forage yield and quality attributes of Cluster bean (*Cyamopsis tetragonaloba* Tuab.). *Journal of Agricultural Technology*, 7(5): 1409-1416.

Ayub, M., Nadeem, M. A., Naeem, M., Tahir, M., Tariq, M. and Ahmad, W. (2012) Effect of different levels of P and K on growth, forage yield and quality of Cluster bean (*Cyamopsis Tetragalobus* L.)*The journal of animal and plant sciences*, 2012; 22(2),479-483.

Ayub, M., Tahir, M., Nadeem, M. A., Zubair, M. A., Tariq, M., and Ibrahim, M. (2010) Effect of nitrogen applications on growth, forage yield and quality of three Cluster bean varieties. *Pak. j. life soc. Sci.* 8 (2): 111-116.

Arya, M.P.S and Singh, R. (1996). Effect of N, P and k on the nodulation, growth and yield characters of horse gram (*Macrotyloma uniflorum* (Lam) Verdc). *Legume Research*.19(2):65-69

Atiyash R., Edward C., Metzger J, Lee S. and Arancon N. (2002). The influence humic acids derived from earthworms – produced organic waste on plant growth, *Bioresource technology*, 84, pp7-14

Baliah, T.N. and Muthulakshmi, B. (2017). Effect of microbially enriched vermicompost on growth and biochemical characteristics of okra (*Abelmoschus esculentus* L. Moench) *Advances in Plants and Agriculture Research*, 6(5): 0022

Babiskar, V.S., Damame, H.S., Raj and Shette, P.G (2012). Growth, yield and quality of cluster bean (*Cyamopsis tetragonaloba* L.Taub.) as influenced by organic fertilizers and different levels of sulphur for vegetable purpose. *Crop research*.43 (1,2&3):52-54

Bhathal, S. and Kumar, R. (2016) Response of integrated nutrient management on growth, yield and yield attributing characters of Cluster bean (*Cyamopsis tetragonaloba* L. TAUB.) under irrigated conditions of Amritsar. *International Journal in Management and Social Science*; 4 (5): 42-47.

Deshmukh, R. P., Nagre, P. K., Wagh, A. P. and Dod, V. N. (2014) Effect of different bio-fertilizers on growth, yield and quality of Cluster bean *Indian Journal of Advances in Plant Research (IJAPR)* 1(2): 39-42; ISSN: 2347-8918.

Gireesh, S.P., and Malabasari, T. A. (2014) Effect of major nutrient and picking stage on seed yield and quality of Cluster bean (*Cyamopsis tetragonaloba* L.); 3(4): 8-12.

Gandhi, A. and Sivakumar, K. (2010). Studies on shelf life of *Azospirillum lipoferum*, *Bacillus megaterium* and *Pseudomonas fluorescens* in vermicompost carrier. *Journal of Phytochemistry* 2009, 1(2): 100–107.

Indirabai, W. P. S. and Suja, P. S. R. (2009). Vermicompost of kitchen waste by the earthworm, *Lampito mauritii* for kitchen garden. *The Ecoscan*; 3 (3&4): 231-234.

Jackson, M. L., (1958). Soil Chemical Analysis Prentice Hall of India Pvt Ltd., New Delh.

Kherawat, B. S., Munnalal, Agarwal, M., Yadav, H. K. And Kumar, S. (2013) Effect of applied potassium and manganese on yield and uptake of nutrients by Cluster bean (*Cyamopsis tetragonaloba*). *Journal of Agricultural Physics*. 13(1):22- 26

Kumar, M., Sinha, K. K. and Roysherma, R. P. (2004). Effect of organic manure, NPK and boron application on the productivity of French bean in sandy loam soil of north Bihar. *Indian Journal of Pulse Research*. 17(1):42-44.

Meena R., Jat N. L. and Meena N. L. (2002) Effect of phosphorus and biofertilizer (*Rhizobium* and PSB) on yield and quality of Cluster bean (*Cyamopsis tetragonaloba* L. Taub). *Ann. Agric. Res.*, 23(2): 349-351.

Munsell, A. H. (1921) Munsell's description of his colour system, from a lecture to the American Psychological Association. *American journal of psychology* 23(2): 236 244.

Muthuvel, P., Udayasoorian, C., Natesan, R. and Ramaswamy, P. P. (1992) Introduction to Soil Analysis, Tamil Nadu Agricultural University Coimbatore-641002

Olsen, S.R., Cole, S.C. and Dean, L.A. (1954) Response of available phosphorus in soils by extraction with HNO₃, U.S.D.A. Pp. 939.

Patel, C. S., Patel, J. B., Sathar, J. V. and Patel, P. M. (2006) Effect of integrated nutrient management on Cluster bean (*Cyamopsis tetragonaloba* L.) seed production of cv. Pusa navbahar. *International journal of Agricultural research*, 6:206-208.

Prabhu, T, Narwadkar, P.R. Sajindranath, A.K., Rathod, N. G. (2002). Integrated nutrient management in coriander. *South Indian Horticulture* ;**50(1):680-84.**

Ponnumani, A.and Semmalar, R. (2015). Effect of Panchagavya on growth parameter analysis on *Capsicum frutescens*. *Species*, **14(44):88-99**

Reager, M. L., Choudhary, G. R. and Dahama, A. (2007) Effect of weed control and phosphorus on growth and quality of Cluster bean (*Cyamopsis tetragonaloba* L.) *Ann. Agri. Res.* **24 (3):563-56**

Rajkhowa, D.J., Saitya, M. and Rakhowa, K.M. (2003). Effect of vermicompost and levels of fertilizer on green gram. *Legume Research* ,**26(1):63-65.**

Sharma, S. J., Dixit, A. K. and Sharma, A. K. (2011). Growth and yield of capsicum (*Capsicum annum*) and garden pea (*Pisum sativum*) as influenced by organic manures and bio fertilizers. *Indian Journal of agricultural sciences*: **81:637-6.**

Sajid, M., Ahmed, I., and Rab, A. (2009) Effect of nitrogen level on the yield and yield component of guar gum (*Cyamopsis tetragonaloba* L.). *Am, Eurasian J. Sustain Agric* **3 (1): 29-32.**

Saravanan, P., Sathish K. S. and Ignesh, A. (2013) Effect of organic manures and chemical fertilizers on the yield and macronutrient concentrations of green gram. *International Journal of Pharmaceutical Science Invention ISSN (Online):2319-6718.*

Sharma, S. K. and Jain, N. K. (2012) Effect of balanced fertilization on productivity and soil fertility status of Cluster bean. *Legume Research*, **35(1):32-35.**

Singh, B. and Kumar, R. (2016) Effect of integrated nutrient management on growth, yield and nutrient uptake of Cluster bean (*Cyamopsis tetragonaloba*) under irrigated conditions. *Agric. Sci. Digest*,**36 (1): 35-39.**

Singh, R. (2002) Effect of integrated nutrient management in Cluster bean (*Cyamopsis tetragonaloba*)- wheat (*Triticum aestivum*) cropping system. under western Rajasthan conditions. *Indian Journal of Agronomy*, **47(1):41-45.**

Subbiah, B. V. Asija, and G. L. (1956) A rapid procedure for the estimate of Available nitrogen in soil. *Current Sci.*, **25:259-260.**

Takase, M., Sam-Amoah, Owusu, L. K. and Sekyere, J. D. (2011) the effects of four sources of irrigation water on soil chemical and physical properties. *Asian Journal of Plant Sciences* **10:(1) 92-96.18.**

Toth, S.J. and Prince, A.L. (1949) Estimation of cation exchange capacity and exchangeable Ca, K and Na content of soil by Flame Photometer technique. *Soil Sci.*, **67: 439-445.**

Walkley, A. and Black, I.A. (1947) Critical examination of rapid method for determining organic

carbon in soils, effect of variance in digestion conditions and of inorganic soil constituents. *Soil Sei*, 632:251.

Wilcox, L. V. (1950). Electrical conductivity Am. water work Assoc. Yellow River in Northwest China *Chinese J. of Eco-Agri* 18: 5: 917-922.