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Influence of Organic Nutrients on Growth and Yield of Summer Greengram (*Vigna radiata*)

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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

Greengram (*Vigna radiata* L.), commonly called as mungbean is an important pulse crop grown mainly in *Zaid* and *Kharif* season in India. Organic farming is one of the sustainable farming practices that can overcome the harmful effects of chemical farming and provides quality production. A field experiment was conducted during *Zaid,* 2023 to study the "Effects of organic nutrients on growth and yield of summer Greengram (*Vigna radiata* L.)" at SHUATS Model Organic Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The experiment was laid out in a randomized block design with nine treatments replicated thrice. The treatment consisted of 3 different solid manures i.e. Farm Yard Manure, Vermicompost, Goat manure and 3 different liquid manures i.e. Fish Amino Acid, Panchagavya and Seaweed (*Kappaphycus alvarezii)* sap. The experimental field soil was sandy loam in texture, moderately basic in reaction (pH 7.8), available medium Organic Carbon (0.662 %) low in available nitrogen (249.5 kg/ha), and very high accessible phosphorus (38.7 kg/ha) and available potassium (240.8 kg/ha). The result showed that

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significantly higher growth parameters viz., plant height (42.09 cm), number of nodules (22.22/plant), dry weight (19.35g/plant) and yield attributes such as effective pod/plant (11.05), seed/pod (9.68), test weight (38.41 g), seed yield (1643.54 kg/ha) and stover yield (3023.55 kg/ha) were observed with application 5 t/ha FYM and foliar spray of 7.5 % K sap (T_9). Highest net return (Rs. 100383.30/ha) and benefit cost ratio (1.84) was also recorded in the same treatment. This concludes that application of 5 t/ha FYM along with foliar spray of 7.5 % K sap at 15 and 30 DAS performed better in terms of yield and economic returns.

Keywords: Fish amino acid; goat manure; greengram; panchagavya; Seaweed sap; vermicompost.

1. INTRODUCTION

"Greengram (*Vigna radiata*) is one of the important legume plants of the pulse family (Fabaceae). It is commonly known as mungbean, mungo, Oregon pea, or simply mung and is also cultivated as a green manure crop. It is grown as a catch crop in between the *Zaid* and *kharif* seasons and is one of India's major *Zaid* pulse crops. Its seed is more palatable, nutritive, digestible, and non-flatulent than other pulses grown in the world. The seed of Greengram contains an average of 20-24% protein, 62.5% carbohydrates, 1.4% fat, 4.2% fiber, vitamins, and minerals" [1]. "It provides enough fibers and iron hence becomes easily digestible. Because of its short growing time, which allows it to fit into intercropping systems with diverse crops, high tonnage capacity, and exceptional nutritional properties for food, feed, and forage, it has a wide range of adaptations. In second generation world, pulses are frequently referred to as "poor man's meat" since they are less expensive than meat" [2]. "India is the major producer of Greengram in the world, and is grown in almost all the states. It covers an area of 40.38 lakh hectares with a total production of 31.5 lakh tonnes with a productivity of 783 kg/ha and contributes 11% of the total pulse production in the year 2021-22. Some of the states like Rajasthan (20.89 lakh/ ha), Madhya Pradesh (1.57 lakh/ ha) and Uttar Pradesh (0.30 lakh/ha) are the major producer of Greengram in India" (GOI, 2021).

Any considerable improvement to the agricultural system that raises output needs to be environmentally benign and strengthen the system's sustainability. The indiscriminate use of chemical fertilizers and pesticides damages soil flora and fauna and raises important issues. Due to these reasons the farmers need more sustainable farming practices. Organic farming can be one of them that comprises of various options like organic manure, bio-stimulants, growth regulators, etc., to enhance the fertility of the soil and yield of the crops.

The soil application of organic manure and foliar sprays of liquid manure during crop growth period significantly enhances the seed yield and seed quality parameters of Greengram. Use of organic manure alone or in combination with liquid organic manure will help to improve soil physico-chemical properties and the effective utilization of applied organic manure for improved seed yield and seed quality. Singh *et al*. (2017). [3] reported that "FYM will decompose in moist soil to improve the soil structure and release the nutrients contained in it in soluble form for the growth of the crop". "Vermicompost is a mixture of organic waste and Vermicast that is produced by utilizing different species of worms, primarily red wigglers, white worms, and earthworms. It improves the soil structure and increases its water-holding capacity" Rajkhowa *et al.* [4] and Singh *et al.* [5]. Goat manure is a great soil conditioner because of its high nitrogen, phosphorus and potassium content which adds nutrients to the soil and makes a positive change in the physical properties of the soil. Enhancing the texture of the soil allows more oxygen to reach the roots and nodules, promoting efficient water consumption and plant growth (Kumar *et al.*)[6].

"Foliar application of liquid fertilizer supplies plant nutrients more rapidly than methods involving uptake by root due to seed/root treatment. Foliar application of nutrients play a vital role in pulse production by stimulating root development, various metabolic processes, translocation activity in plants and pod setting, thereby increases the yield" (Mononmani and Srimathi) [7]. Fish protein dramatically increases the amount of organic matter in the soil, may quickly encourage the spawning of soil microorganisms, greatly activates soil nutrients, and increases soil fertility. Fish Amino Acid topically boosts Greengram's yield and growth (Setia *et al*.)[8].An

organic compound called Panchagavya can strengthen plant systems by fostering development and immunity (Jegode *et al.*)[9]. The application of Panchagavya as foliar spray considerably enhances the quantity of pods on each Greengram plant, hence directly contributing to larger crop production (Singh *et al*) [5]. Seaweed liquid fertilizers are useful for achieving higher agricultural production, because the extract contains growth promoting hormones, IAA, IBA, Cytokinin, Gibberellin, trace elements, vitamins, amino acids, antibiotics, and micronutrients (Zodape *et al.*) [10]. Seaweed extracts from *Kappaphycus alvarezii* have been found to increase the yield of *Vigna sinensis* and *Vigna radiate* (Sivasankari *et al.*,[11] Zodape *et al*. [10].

2. MATERIALS AND METHODS

A field experiment was carried out in alluvial soil at the Crop Research Farm of the Department of Agronomy, SHUATS, Prayagraj, U.P., during the *Zaid* season of 2023. There were nine treatment combinations replicated thrice and conducted in randomized block design. The sandy loam soil of the experimental plot had a virtually neutral soil response (pH 7.8), 0.618 ds/m electrical conductivity, medium organic carbon (0.662 %), low available nitrogen (249.5 kg/ha), medium potassium (240.8 kg/ha) and very high accessible phosphorus (38.7 kg/ha). On 19th April 2023, Greengram seeds (Virat IPM 205-7) were sown at 25 cm x 10 cm spacing. The treatment combinations consisted of three different solid manure i.e. Vermicompost 2.5 t/ha, Goat manure 1 t/ha, FYM 5 t/ha and foliar applications of liquid manure i.e. 3% Fish Amino Acid, 5% Panchagavya and 7.5% K sap (Seaweed sap) at 15 and 30 DAS. To apply organic manure as broadcasting method, 4-5 cm deep furrows were dug along the seed rows by the method of hand hoeing. The gap filling was done 10 DAS whereas to maintain the recommended spacing, thinning was done by removing excess plants. In order to reduce crop density and weed competition, intercultural operations were carried out twice at 15 and 30 DAS. At regular intervals from germination to harvest, plant growth attributes such as plant height (cm) and dry weight (g/plant), root nodules were assessed from 15 DAS to 60 DAS at 15 days interval. Whereas at harvest, yield metrics such as pods/plant, seeds/pod, test weight (g), seed yield (kg/ha), stover yield (kg/ha), and harvest index (%) were recorded and statistically analyzed using analysis of variance (ANOVA) for randomized block design [12].

3. RESULTS AND DISCUSSION

3.1 Growth Parameter

The data of growth parameter are presented in Table 1. During research it was observed that after germination, height of the plant started increasing and reached maximum till 60 DAS. On the other hand, the increment in root nodules was observed till 45 DAS and thereafter the root nodules got decreased at 65 DAS. This might be due to the death of the root nodules which occurs after flowering, because the symbiotically fixed nitrogen accumulated in the nodules is used for the growth of generative parts. Significantly highest plant height (42.09 cm), number of nodules (22.22) and dry weight (19.35g) were recorded with the application of FYM 5 t/ha + 7.5 % K sap (T_9). However, plant height was found statistically at par (39.79 cm) in FYM 5 t/ha + Panchagavya 5 % (T_8), while number of nodules were found statistically at par with the application of FYM 5 t/ha + FAA 3 % (T_7) and T_8 i.e., 20.45 and 21.09 with the highest respectively. Although dry weight was found statistically at par i.e.,18.12 g in T_8 with T_9. The increased height might be due to the presence of seaweed sap which contains growth hormones like Cytokinin, Gibberellin, trace elements, vitamins, and micronutrients such as Zn, Fe, Mn and Ca that enhanced the growth of plant. Similar results were reported by Balakrishnan *et al.* [13] and Minj *et al.* [14] that Significant increase in nodule number was observed at flowering stage due to increased soil microbes' activity due to FYM 5 t/ha and foliar spray of 7.5 % K sap. This might be due to FYM application which increases the porosity and bulk density of the soil leading in increased microbial activity of rhizobium that solubilizes phosphorus hence increases nodulation in plants. These results are in conformity with Pramanick *et al*. [15]. Foliar application of seaweed saps had significantly influenced the dry weight of the plant. This might be due to presence of growth promoting hormones such as IAA, Gibberellin, Cytokinin, etc., in seaweed extract attributed to the activation of cell division and cell elongation in the axillary buds hence resulted in increased dry weight. These results are in close vicinity with the findings of Patel *et al*. [16] and Sivasankarari *et al*. [11]. Interaction effect of organic manures and bioenhancers on dry weight of plant was found to be significant for Greengram.

Table 1. Effect of organic nutrient on growth attributes of Greengram

S. No.	Treatments	Plant height 60 DAS	Dry weight (g) 60 DAS	No of Nodules 45 DAS	CGR (g/g/day) 30-45 DAS	RGR (g/g/day) 30-45 DAS
1	Vermicompost 2.5 t/ha + Fish amino acid 3 %	32.14	12.65	15.96	16.489	0.1231
2	Vermicompost 2.5 t/ha + Panchagavya 5 %	32.92	13.52	16.99	16.604	0.1161
3	Vermicompost 2.5 t/ha + 7.5 % K sap	33.40	14.11	17.19	16.427	0.1107
4	Goat manure 1 t/ha + Fish amino acid 3 %	33.89	15.17	17.34	16.578	0.1094
5	Goat manure 1 t/ha + Panchagavya 5 %	35.49	16.02	18.40	17.209	0.1073
6	Goat manure 1 t/ha + 7.5 % K sap	37.02	16.49	19.19	17.200	0.1019
7	FYM 5 t/ha + Fish amino acid 3 %	37.79	17.13	20.45	18.960	0.1068
8	FYM 5 t/ha + Panchagavya 5 %	39.79	18.12	21.09	19.689	0.1047
9	FYM 5 t/ha + 7.5 % K sap	42.09	19.35	22.22	20.124	0.1008
	SEm(±)	1.30	0.67	0.95	1.29	0.0081
	CD (P= 0.05)	3.87	2.02	2.86	3.88	-

Table 2. Effect of organic nutrient on yield attributes and yield of Greengram

S. No.	Treatments	No. of Pods/ plant	No. of Seeds /pod	Test weight (g)	Grain yield (kg/ha)	Stover yield (kg/ha)	Harvest index (%)	Net returns (₹/ha)	Benefit cost ratio (B:C)
1	Vermicompost 2.5 t/ha + Fish amino acid 3%	8.63	7.35	34.62	1025.3	2076.6	33.05	53303.73	1.20
2	Vermicompost 2.5 t/ha + Panchagavya 5 %	8.80	7.65	34.86	1072.8	2155.8	33.14	58050.60	1.32
3	Vermicompost 2.5 t/ha + 7.5 % K sap	9.27	7.91	35.39	1138.8	2239.7	34.11	58517.59	1.18
4	Goat manure 1 t/ha + Fish amino acid 3 %	9.94	8.16	35.59	1155.8	2357.3	33.88	68316.87	1.63
5	Goat manure 1 t/ha + Panchagavya 5 %	10.08	8.38	36.47	1232.4	2477.6	33.27	75743.14	1.82
6	Goat manure 1 t/ha + 7.5 % K sap	10.44	8.55	36.73	1311.4	2628.8	33.38	105572.53	1.65
7	FYM 5 t/ha + Fish amino acid 3 %	10.78	8.72	37.91	1425.1	2862.9	33.20	86260.58	1.75
8	FYM 5 t/ha + Panchagavya 5 %	10.96	8.89	38.05	1483.1	3010.4	32.35	88551.86	1.81
9	FYM 5 t/ha + 7.5 % K sap	11.05	9.68	38.41	1643.5	3023.5	35.22	100383.30	1.84
	SEm(±)	0.48	0.33	1.15	63.23	103.33	1.44	5359.98	0.115
	CD (P= 0.05)	1.45	1.06	-	189.57	310.19	-	1606.25	0.345

3.2 Yield Attributes

The data pertaining to yield-attributing characters are presented in Table 2. The maximum number of pods/plant (11.05) was recorded with the application of FYM 5 t/ha + 7.5 % K sap (T_9) which was found statistically at par with treatment 5, 6, 7 and 8 (10.08, 10.44, 10.78, 10.96). Significantly higher number of seeds/pod (9.68) were recorded with application of FYM 5 t/ha + 7.5 % K sap in (T_9). Whereas T_8 was found statistically at par (8.89) with T_9 respectively. While significantly highest test weight (38.41 g) was found in T_9 among all treatments. Foliar application of Seaweed sap had significantly influenced the growth and yield of Greengram such as number of pods per plant, number of seeds per pod, test weight. Results revealed that maximum plant growth and yield attributes were obtained in T_9. The increase in yield attributes may be due to higher uptake of macro and micronutrients by plant and presence of growth promoting substances like auxins and cytokinin in seaweed saps. Similar finding was reported by Leindah and Mani, [17] that number of pods per plant, test weight and number of seeds per pod were increased by foliar application of K*appaphycus alvarezii* on Greengram.

3.3 Grain Yield

The statistical data in Table 2. showed that significantly highest grain yield (1643.5 kg/ha) was recorded due to FYM 5 t/ha + 7.5 % K sap (T_9), whereas FYM 5 t/ha + Panchagavya 5% (T_8) was found statistically at par (1483.10 Kg/ha) with the highest (Jadhav *et al*.)[18]. Seaweed sap contains several microelements such as B, Fe, Mn, etc., along with other microelements. The increase in seed yield might be due to presence of boron leading in enhancement of cell wall, tissue difference, sugar transport, maintenance of conducting tissue with regulatory effect also promoting flower production, pollen tube elongation and seed and fruit development (Chaudhary *et al*).[19] Highest seed yield was also obtained due to availability of iron in seaweed sap during the crop growth period. Iron improves photosynthesis and assimilates transportation to sinks and finally increases seed and stover yield. This may include increase in carbohydrate synthesis (Pramanick *et al*).[15]

3.4 Stover Yield

The data in Table 2. showed that a significantly maximum stover yield (3023.5 kg/ha) was recorded with the application FYM 5 t/ha + 7.5 % K sap (T_9) whereas, all treatments were respectively found statistically at par with the highest. This might be due to greater photosynthetic accumulation in vegetative components leading to superior vegetative development such as plant height, dry matter accumulation hence the stover yield increased. Similar results were reported by Patel *et al*. [2], Akhila *et al.* [20], Chaudhary *et al.* [21]

3.5 Harvest Index

Data presented in Table 2. showed that the highest harvest index was recorded with the application of FYM 5 t/ha + 7.5 % K sap (T_9) i.e., 35.22 % among all treatments.

3.6 Economics

The data on the economics of different treatments presented in Table 2. showed that the significantly maximum net return (₹1,00,383.30/ha) and benefit-cost ratio (1.84) were recorded with the application of FYM 5 t/ha + 7.5 % K sap (T_9) and the minimum net return (₹53,303.73/ha) and benefit-cost ratio (1.20) was recorded in Vermicompost 2.5 t/ha + Fish Amino Acid 3 % (T_1). These results might be due to higher grain and stover yields in the same treatment because of enhanced availability of nutrients in soil by FYM during crop growth period that provided crop with more fixed nitrogen resulting in greater biomass yield and better utilization of micronutrients along with the growth promoting hormones supplied by K sap which let in formation of healthier flowers, pods and fruits development. Therefore, yield per hectare became higher and profitable. Similar findings were reported by Yadkar *et al.* [22] and Yadev *et al*. [23]. Thus, adoption of organic farming can be an advantage to achieve a sustainable and eco-friendly environment [24-28].

4. CONCLUSION

On the basis of one year experimentation, it concludes that the application of FYM 5 t/ha along with foliar spray of 7.5 % K sap performed better in obtaining higher yield as well as economic returns from Greengram.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Sehrawat N, Jaiswal PK, Yadav M, Bhat KV, Sairam RK. Salinity stress restraining mung bean (*Vigna radiata* L.) production: Gateway for genetic improvement. International Journal of Agricultural Crop Sciences. 2013;6(9):505-509.
2. Patel R, Babady E, Theel ES, Storch GA, Pinsky BA, St. George K. Report from the American Society for Microbiology COVID-19 International Summit, value of diagnostic testing for SARS– CoV-2/COVID-19. M Bio. 2020;11(2):10-128.
3. Singh RK, Dawson Joy, Srivastava N. Effect of sources of nutrient on growth and yield of black gram (*Vigna mungo* L.) Varieties in NEPZ of India. Journal of Pharmacognosy and Phytochemistry. 2017; 6(4):1064-1066.
4. Rajkhowa DJ, Gogoi AK, Kandali R, Rajkhowa KM. Effect of vermicompost on greengram nutrition. Journal of Indian Society of Soil Science. 2000;48:207-208.
5. Singh Manisha, Pathan, Muddassir, Khan, Ibrahim, Dawson Joy, Verma, Raksha. Effect of vermicompost and Panchagavya on growth and yield of greengram (*Vigna radiata* L.) The Pharma Innovation Journal. 2022;11(4):1483-1487
6. S.G Kumar Santhosh, Dawson Joy, Pavithra BV. Effect of spacing and organic manures on growth and yield of Greengram (*Vigna radiata* L.) *.The Pharma Innovation Journal.* 2021;10(12): 1612-1617.
7. Manonmani V, Srimathi P. Influence of mother crop nutrition on seed and quality of blackgram. Madras Agric. J. 2009;96:125-128.
8. Setia Pratap Bhanu, Vishnu Moond, Jigyasa Ninama, Lovepreet Singh, Karanveer Saharan, Arun Pratap Singh. Effect of various organic manures and systems of planting on growth, yield attributes and yield of scented rice. The Pharma Innovation Journal. 2021;12(10): 618-622.
9. Jegoda SK, Patel DM, Patel VK, Chaudhary NB. Effect of cow-based growth enhancers on growth and yield of summer greengram (*Vigna radiata* L.) under organic farming. International Journal of Chemical Studies. 2019;7(6):77-81.
10. Zodape ST, Mukhopadhyay Soumita, Eswaran K, Reddy MP, Chikara. Enhance yield and nutritional quality in greengram (*Phaseolus radiata* L.) treated with seaweed (*Kappaphycus alvarezii*) extract. Journal of Scientific and Industrial Research. 2010;69:468- 471.
11. Sivasankari S, Venkatesalu V, Anantharaj M, Chandrasekaran M. 2006. Effect of seaweed extracts on the growth and biochemical constituents of *Vigna sinensis*. Biores. Technol. 2006;97:1745–1751
12. Gomez KA, Gomez AA. Statistical procedures for agricultural research. John Wiley and Sons; 1984.
13. Balakrishnan CP, Kumar V, Mohan VR, Athiperumalsami T. Study on the effect of crude seaweed extracts on seedling growth and biochemical parameters in (*Cyamopsis tetragonoloba* L.) Taub. Plant Archives. 2007;7(2):563-567.
14. Minj Nidhi, Pragya, Dawson Joy. Effect of organic source of nutrient and methods of application of iron on growth and yield of summer greengram. (*Vigna radiata* L.) *The Pharma Innovation Journal. 2023;12(3):4930-4933.*
15. Pramanick B, Brahmachary Koushik, Chogh Arup. Effect of seaweed saps on growth and yield improving of greengram. African Journal of Agricultural Research. 2013;8(13):1180-1186.
16. Patel KC, Patel KP, Kandoria HK, Jetani KL, Ramani VP. Yield and uptake of micronutrient by groundnut (*Arachis hypogea* L.) as influenced by foliar application of seaweed liquid fertilizer under rainfed condition of Jamkhambhaliya, Saurashtra region. Asian Journal of soil science. 2008;3(2): 252-256.
17. Leindah ND, Mani S. Effect of seaweed sap on growth, yield and quality of soybean Co. (soy) 3. Seaweed Research Utilizat. 2015;37(1):26-32.
18. Jadhav RL, Shyamrao Kulkarni. Effect of foliar spray of nutrients productivity of greengram (*Vigna radiata* L.) in North Eastern transitional zone of Karnataka,

Indian Legume Research. 2016;39(5):817-819.

19. Chaudhary. MG, JK Malav, YB Vala and NA, Desai. Influences of different organic sources and seaweed extract on quality, nutrient content, uptake, soil fertility status and soil microbial population after harvest of summer greengram (*Vigna radiata* L.).The Pharma Innovation Journal. 2021; 10(11): 1390-1394.
20. Akhila K, Kaswala AR, Priyanka, Dubey PK. Effect of liquid fertilizers on growth yield and economics of the green gram (*Vigna radiata* L.) crop under organic farming. International Journal of Chemical Studies. 2017;5(6):809-812.
21. Chaudhary DC. Integrated nutrient management in summer groundnut (*Arachis hypogaea* L.) under North Gujarat Agroclimatic conditions. M.Sc. (Agri.) Thesis (Unpublished) submitted to *Sardarkrushinagar Dantiwada Agricultural University*, Sardarkrushinagar (Gujarat); 2008.
22. Yadkari M, Ramesh T, Latchanna A. Dry matter production and nutrient uptake of mung bean (*Vigna radiata* L.)as influenced by nitrogen and phosphorus application during wet season. *Legume Research*. 2004;27(1):58-61.
23. Yadav SK, Babu S, Yadav MK, Singh Y, Singh K. Profitability of high value cops with organic nitrogen sources under rice (*Oryza sativa*) based cropping system. Indian Journal of Agricultural sciences. 2014;84(3):343-348.
24. Sharma KL, Srinivas K, Mandal UK, Vittal KPR, Grace KJ, Maruthi SGR. Integrated nutrients management strategies for sorghum and green gram in semi-arid Tropical Alfisol. Indian Journal of Dry Land Agricultural Research and Development. 2004;19(1):13-23.
25. Choudhary GL, Sharma SK, Singh KP, Choudhary S, Bazaya BR. Effect of Panchagavya on growth and yield of organic blackgram (*Vigna mungo* L.). International Journal of Current Microbiology and Applied Sciences. 2017;6(10):1627-1632.
26. Devi N, Leindah, Mani S. Influence of seaweed saps on growth, yield and quality of greengram (*Vigna radiata* L.). An Asian Journal of Soil Science. 2018;13(1):50-57.
27. Patel MM, Patel DM, Patel KM. Effect of panchagavya on growth and yield of Cowpea [*Vigna unguiculata* (L.) WALP.] – An International e- Journal. 2013;2(3):313-317.
28. GOI. Agricultural statistics at a glance, agricultural statistics division, directorate of economics and statistics. Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, New Delhi; 2021
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