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EFFECT OF ORGANIC NUTRIENT SOURCES ON GROWTH AND YIELD OF GREENGRAM (*VIGNA RADIATA* L.)

Manikant Kumar, Shikha Singh and Priyanka Priya*
Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, - 211007, India.
*Corresponding author E mail: Priyankapihu049@gmail.com
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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* Season 2024 to study the "Effects of Organic nutrient sources on growth and yield of 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 ten treatments replicated thrice along with control. The treatment consisted of 3 different solid manures *i.e*., Cow Dung Manure - 2 t/ha, Biochar - 2 t/ha, Goat manure - 2 t/ha and 3 different liquid manures *i.e*., Panchagavya - 5%, Jeevamruth - 5 % and Vermiwash - 5 % along with control FYM 5 t/ha. The experimental field soil was sandy loam in texture, moderately basic in reaction (pH 7.5), available medium organic Carbon (0.310 %) low in available nitrogen (69.75 kg/ha), and very high accessible phosphorus (18.0 kg/ha) and available potassium (246.4 kg/ha). The result showed that significantly higher growth parameters *viz.,* Plant height (51.33 cm), number of nodules (17.33/plant), number of branches (6.33), dry weight (6.59 g/plant), pods/plant (9.77), seed/pod (9.94), test weight (37.95 g) and yield attributes and yield grain yield (1216.39 kg/ha) and stover yield (2076.00 kg/ha) were recorded in treatment 9 (Goat manure 2 t/ha + Vermiwash 5 %) compared to other treatments. and maximum gross return (INR 113164.96/ha), net return (INR 73864.96/ha) and B:C ratio (1.88) were also recorded in treatment 9 (Goat manure 2 t/ha + Vermiwash 5 %). It concludes that application of Goat manure 2 t/ha along with Vermiwash 5 % at 15 and 30 DAS performed better in terms of yield and economic returns.

Keywords **:** Biochar, Cow Dung Manure, Goat manure, Greengram, Jeevamruth, Panchagavya, Vermiwash.

Introduction

Greengram (*Vigna radiata* L.) is a significant legume plant belonging to the Fabaceae family of pulses. It is also grown as a green manure crop and is usually referred to as mungbean, mungo, Oregon pea, or just mung. One of India's main Zaid pulse crops, it is planted as a catch crop between the Zaid and Kharif seasons. Compared to other pulses cultivated worldwide, its seed is more pleasant, nutritious, digestive, and non-flatulent. According to Sehrawat *et al.* (2013), greengram seeds provide an average of 20–24% protein, 62.5% carbs, 1.4% fat, 4.2% fiber, and vitamins and minerals. Because it contains adequate iron and fiber, it is easily digested. 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 (Patel *et al*., 2020). 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 tones 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 significant output-boosting changes to the agricultural system must be environmentally friendly and enhance the system's sustainability. The careless application of chemical pesticides and fertilizers harms soil wildlife and plants and creates significant problems. Farmers require more sustainable farming methods as a result of these factors. One of these is organic farming, which uses a variety of techniques to improve soil fertility and crop productivity, such as using organic manures, biostimulants, growth regulators, etc. Use of organic manures alone or in combination with liquid organic manures will help to improve soil physico-chemical properties and effective utilization of applied organic manures for improved seed yield and seed quality. Sharma *et al*. (2012) reported that Cow dung manure will decompose in moist soil to improve the soil structure and release the nutrients contained in it, in the soluble form for growth of the crop. It improves physical, chemical and biological properties of the soil and its nutrients contents

The soil application of organic manures and liquid organic foliar sprays at flower initiation and 15 days after flowering (DAF) significantly enhances the seed yield and seed quality parameters of Greengram. Use of organic manures alone or in combination with liquid organic manures will help to improve soil physico-chemical properties and effective utilization of applied organic manures for improved seed yield and seed quality. Sharma *et al*. (2012) reported that Cow dung manure will decompose in moist soil to improve the soil structure and release the nutrients contained in it, in the soluble form for growth of the crop. It improves physical, chemical and biological properties of the soil and its nutrients contents, N (3 %), P_2O_5 (2 %) and K_2O (1 %) there by increases number of nodules in Greengram. Biochar N (15 %), P_2O_5 (15%) and K_2O (15 %). enhances soil fertility by improving nutrient availability and promoting microbial activity, which are essential for plant growth. its porous structure increases the soil's water-holding capacity, making it more resilient to drought conditions. Biochar can reduce the need for chemical fertilizers by improving nutrient availability and promoting efficient nutrient cycling. Biochar increases availability of phosphorus in soil, which in turn improves various vegetative and reproductive growth parameters of Greengram (Singh *et al*. 2022). Goat manure is rich in nitrogen levels, which makes it as an excellent soil conditioner. The major nutrients available in Goat Manure are 3 % N, 1 % P_2O_5 and 2 % K_2O along with Ca and Mg. It improves the soil texture so it uses water efficiently and allows more oxygen to reach the roots nodules and plant growth inoculation showed more available phosphorus in soil, which favored better root growth and resulted in a beneficial effect of nodulation with increased PSB bacterial activity.

Foliar application targets the above ground parts where the nutrient is needed and rapid absorption is facilitated. To compensate the decline in root activity and nutrient up taken specially during reproductive stages, foliar application can be a better strategy. It is a short-term approach which improves the quality of produce by reaching the site of food synthesis directly and preserves the crop yield with low environmental impact. Jeevamruth is a natural soil fertilizer and a crop growth enhancer. It is a bio-fertilizer rich in microorganisms that help improve the soil fertility and the productivity of the crop. Jeevamruth is derived from two words “Jeevan” and “Amrit”. Jeevan means life and Amrit means medicine (Abhishek, 2020; Kumari *et al.,* 2022). Jeevamruth, often called the “elixir of life” for the soil, is a natural fertilizer that harnesses the power of beneficial microorganisms to rejuvenate farmlands and promote sustainable farming practices. Jeevamruth is rich in beneficial microorganisms such as nitrogen-fixing and phosphate-solubilizing bacteria (Kaur, 2020; Kumar *et al.,* 2021). Panchagavya is an organic product having the potential to play the role of promoting growth and providing immunity to plant system. Panchagavya consists of major five products viz. cow dung, cow urine, milk, curd, ghee and in addition to this it also contains some raw materials like jaggery, banana, tender coconut, and water. Foliar spray of Panchagavya significantly increases higher number of pods per plant of green gram and plays direct role in increasing yield of the crop (Singh *et al.,* 2022). Vermiwash is rich in dissolved nutrients and amino acids which are easily obtainable for plants. It is a non-toxic and eco-friendly compound, which arrests the bacterial growth and forms a protective layer for their survival and growth. Vermiwash at 5 to 10 percent dilution inhibits the mycelial growth of pathogenic fungi. It has the capacity to encounter worms thereby saving the plants and their productivity. As a foliar spray, it was reported to initiate flowering and lasting inflorescence. It can be used as a liquid fertilizer applied to the rhizosphere. The Vermiwash contains necessary plant nutrients, plant growth-promoting hormones (auxin and gibberellins), enzymes (cocktail of protease, amylase urease and phosphatase that acts as antimicrobic), symbiotic microbes (nitrogen fixing bacteria such as *Azotobacter sp., Agrobacterium sp.,* and *Rhizobium*

and some *Phosphate Solubilizing Bacteria (PSB)* in addition to the macronutrients and micronutrients. It can be used as a foliar spray as well as soil application whereby it acts as a pesticide and natural fertilizer for the crop plants in sustainable agriculture (Pramanick *et al*., 2002).

Materials and Method

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 2024. 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. field soil was sandy loam in texture, moderately basic in reaction (pH 7.5), available medium organic Carbon (0.310 %) low in available nitrogen (69.75 kg/ha), and very high accessible phosphorus (18.0 kg/ha) and available potassium (246.4 kg/ha). Greengram seeds (Virat IPM 205-7) were sown on April 11th 2024 with a spacing of 30 cm x 10 cm. The experiment was conducted in a Randomized Block Design consisting of 9 treatment combinations and 3 replications along with control FYM 5 t/ha. The treatment consisted of 3 different solid manures *i.e*., Cow Dung Manure - 2 t/ha, Biochar - 2 t/ha, Goat manure - 2 t/ha and 3 different liquid manures *i.e*., Panchagavya - 5%, Jeevamruth - 5 % and Vermiwash - 5 % 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. Manual weeding was done with the help of khurpi at 15 and 30 days after sowing to minimize the crop weed competition. The crop was harvested on 13th June 2024. Plant growth parameters *viz.,* plant height (cm), dry weight (g/plant), number of nodules/plant and number of branches were measured at a regular interval from germination till harvest and yield metrics *viz.,* pods/plant, seeds/pod, test weight (g), seed yield (kg/ha), stover yield (kg/ha) and harvest index (%) were measured at harvest. The observed data was statistically analyzed using analysis of variance (ANOVA) as applicable to randomized block design (Gomez and Gomez, 1984).

Results and Discussions

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 40 DAS and thereafter the root nodules got decreased at 60 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 (51.33 cm cm), number of nodules (17.33) and dry weight (19.35g) were recorded with the application of Goat manure 2 t/ha + Vermiwash 5 % (T_9). while number of nodules were found statistically at par with (T_7) and (T_8) with the highest respectively. Although dry weight was found statistically at par with other treatment. and maximum number of branches/plant (6.33) was recorded in T_9 (Goat manure 2 t/ha + Vermiwash 5 %) which was found non-significant with other treatments. The increased height might be due to the presence of Vermiwash 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 that seaweed extract contains growth regulators like betaines and oligosaccharides that induced growth responses in plant (Balakrishnan *et al*. 2007). Significant increase in nodule number was observed at flowering stage due to increased soil microbes' activity due to Goat manure 2 t/ha and foliar spraying of Vermiwash 5 %. This might be due to Goat manure 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.* (2013). Foliar application of Vermiwash 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*. (2008) and Akhila *et al.* (2017). Interaction effect of organic manures and bioenhancers on dry weight of plant was found to be significant for Greengram.

Yield attributes

The data pertaining to yield-attributing characters are presented in Table 2. The maximum number of pods/plant (9.77) was recorded with the application of Goat manure 2 t/ha along with Vermiwash 5 % (T_9) which was found statistically at par with treatment 5, 6, 7 and 8. Significantly higher number of seeds/pod (9.94) were recorded with application of Goat manure 2 t/ha along with Vermiwash 5 % in (T_9). Whereas T_8

was found statistically at par with T_9 respectively. While significantly highest test weight (37.95 g) was found in T_9 among all treatments. Foliar application of Vermiwash 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 liquid manures. Similar finding was reported by Leindah and Mani, (2015). That number of pods per plant, test weight and number of seeds per pod were increased by foliar application of Vermiwash on Greengram.

Grain yield

The statistical data in Table 2. showed that significantly highest grain yield (1216.39 kg/ha) was recorded due to Goat manure 2 t/ha along with Vermiwash 5 % (T_9), Whereas, Goat manure 2 t/ha + Panchagavya 5% (T_8) was found statistically at par with the highest. Vermiwash 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. Highest seed yield was also obtained due to availability of micronutrients in vermiwash 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.* 2013).

Stover yield

The data in Table 2. showed that a significantly maximum stover yield (2076.00 kg/ha) was recorded with the application Goat manure 2 t/ha along with Vermiwash 5 % (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 reported by Patel *et al.* (2008), Akhila *et al.* (2017), Chaudhary *et al.* (2008).

Harvest index

Data presented in table 2. showed that the highest harvest index was recorded with the application of Goat manure 2 t/ha along with Vermiwash 5 % (T_9) *i.e.,* (36.99 %) which was statistically at par with all treatments.

Economics

The data on the economics of different treatments presented in Table 2. showed that the Highest gross return (INR 113164.96/ha) significantly maximum net return (INR 58038.70/ha) and benefit-cost ratio (1.88) were recorded with the application of Goat manure 2 t/ha along with Vermiwash 5 % and the minimum net return (Rs. 39711.35/ha) and benefit-cost ratio (0.99) was recorded in Cow dung Manure 2 t/ha along with Jeevamruth 5 % (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 Goat Manures 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 Vermiwash 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.* (2004) and Yadev *et al*. (2014). Thus, adoption of organic farming can be an advantage to achieve a sustainable and eco-friendly environment.

Conclusion

On the basis of one year experimentation, it concludes that the application of Goat manure 2 t/ha along with Vermiwash 5 % performed better in obtaining higher yield as well as economic returns from Greengram.

Table 1 : Influence of organic nutrient sources on growth attributes of Greengram.

S. No.	Treatments	Plant height (cm)	No. of Branches	Dry weight (g)	No of Nodules	CGR (g/g/day)	RGR (g/g/day)
		60 DAS	6.07	60 DAS	45 DAS	30-45 DAS	30-45 DAS
1	Cow dung Manure 2 t/ha + Jeevamruth 5 %	41.33	5.87	4.07	14.50	0.655	0.072
2	Cow dung Manure 2 t/ha + Panchagavya 5 %	38.27	5.47	4.30	14.00	0.710	0.073
3	Cow dung Manure 2 t/ha + Vermiwash 5 %	39.73	5.87	4.92	13.83	0.860	0.068
4	Biochar 2 t/ha + Jeevamruth 5 %	39.33	5.73	4.55	16.50	0.735	0.063
5	Biochar 2 t/ha + Panchagavya 5%	42.27	4.67	4.90	14.83	0.853	0.076

6	Biochar 2 t/ha + Vermiwash 5 %	45.93	5.53	4.76	15.50	0.761	0.059
7	Goat manure 2 t/ha + Jeevamruth 5%	41.53	5.80	4.72	16.83	0.740	0.056
8	Goat manure 2 t/ha + Panchagavya 5%	40.13	6.33	5.84	17.17	0.904	0.054
9	Goat manure 2 t/ha + Vermiwash 5 %	51.33	5.93	6.59	17.33	1.049	0.042
10	Control (Cow dung Manure 2 t/ha)	47.53	6.07	4.03	11.50	0.626	0.069
SEm(+)		2.60	4.48	0.34	2.01	0.24	0.0007
CD (P= 0.05)		7.75	-	-	-	0.7	0.07

Table 2 : Influences of organic nutrient sources on yield attributes and Economics 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 (Rs. /ha)	Benefit cost ratio (B:C)
1	Cow dung Manure 2 t/ha + Jeevamruth 5 %	9.20	8.82	31.92	851.52	1540.00	35.76	39711.35	0.99
2	Cow dung Manure 2 t/ha + Panchagavya 5 %	8.67	7.87	33.98	733.23	1595.67	31.16	33690.09	0.86
3	Cow dung Manure 2 t/ha + Vermiwash 5 %	8.97	8.96	34.55	918.09	1607.00	36.47	51213.61	1.49
4	Biochar 2 t/ha + Jeevamruth 5 %	8.05	9.27	35.15	868.04	1688.33	33.78	39541.03	0.94
5	Biochar 2 t/ha + Panchagavya 5%	8.86	9.61	36.77	962.34	1700.33	36.13	48869.38	1.19
6	Biochar 2 t/ha + Vermiwash 5 %	9.04	9.40	35.31	881.21	1716.67	33.85	46645.60	1.28
7	Goat manure 2 t/ha + Jeevamruth 5%	9.01	9.48	36.25	1025.11	1789.67	36.36	50320.15	1.11
8	Goat manure 2 t/ha + Panchagavya 5%	9.00	9.71	37.77	1085.31	2056.00	34.69	58038.70	1.32
9	Goat manure 2 t/ha + Vermiwash 5 %	9.77	9.94	37.95	1216.39	2076.00	36.99	73864.96	1.88
10	Control (Cow dung Manure 2 t/ha)	8.68	8.01	31.45	800.23	1488.33	35.26	41961.09	1.27
SEm(+)		0.54	0.44	1.04	69.74	108.85	4.48	-	-
CD (P= 0.05)		1.61	1.31	3.11	207.22	323.43	7.28	-	-

Note: Price of grain yield - Rs. 8450/q (MSP) and price of stover yield - Rs. 500/q and Rs. 84.50/kg grain yield and stover yield - Rs. 5/kg.

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Competing Interests

Authors have declared that no competing interests exits.

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