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Effect of organic manure and biofertilizer on yield and yield attributes of green gram (*Vigna radiata* L.)

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Abstract

A field experiment entitled “Effect of Organic Manure and Biofertilizer on Yield and Yield Attributes of Green Gram (*Vigna radiata* L.)” was conducted during the Kharif season of 2024 at the Organic Research Farm, Karguwan Ji, Bundelkhand University, Jhansi, Uttar Pradesh. The experiment was conducted to evaluate the effect of different combinations of organic manures and biofertilizers on yield attributes and productivity of green gram. Nine treatments were evaluated in a Randomized Block Design (RBD) with three replications using green gram variety PDM 139 (Samrat). The results revealed significant differences among treatments for all the yield attributes and yield parameters. Treatment T₇, comprising vermicompost (1.6 t ha⁻¹) + neem cake (0.33 t ha⁻¹) + Rhizobium (165 g L⁻¹), recorded the highest number of pods plant⁻¹ (25.60), pod weight (10.80 g plant⁻¹), seeds pod⁻¹ (11.40), pod length (5.00 cm), test weight (40.20 g), seed yield (1210 kg ha⁻¹), straw yield (1988 kg ha⁻¹), husk yield (496 kg ha⁻¹), biological yield (3198 kg ha⁻¹) and harvest index (37.80%). Treatment T₈, consisting of vermicompost (1.6 t ha⁻¹) + neem cake (0.33 t ha⁻¹) + Azotobacter (165 g L⁻¹), ranked second for most parameters. The control treatment (T₀) recorded the lowest values for all major yield attributes and yield. The results indicate that the integrated application of vermicompost, neem cake and Rhizobium was the most effective treatment for improving yield attributes and productivity of green gram under the conditions.

Keywords: Organic, biofertilizer, manures, vermicompost, neem cake, rhizobium

Introduction

Green gram (*Vigna radiata* L.) is an important short-duration pulse crop belonging to the family Fabaceae and is widely cultivated in tropical and subtropical regions of the world, particularly in India. Green gram grains are rich in protein, carbohydrates, minerals and vitamins and therefore constitute an important component of human nutrition. In addition to its nutritional importance, the crop contributes to soil fertility through biological nitrogen fixation and is considered suitable for sustainable and resource-efficient cropping systems (Meena *et al.*, 2020) [8]. Green gram can perform reasonably well under comparatively low-input conditions and is particularly important for small and resource-poor farmers. Efficient nutrient management is essential for improving growth, yield attributes and seed yield of the crop. Integrated application of organic nutrient sources and biofertilizers has considerable potential for improving crop productivity while maintaining soil health.

Organic manures such as vermicompost and neem cake are important sources of plant nutrients and organic matter. Vermicompost improves soil physical properties, nutrient availability and microbial activity, while neem cake supplies nutrients gradually and contributes to improvement of soil biological conditions. Shukla and Tyagi (2011) reported that the application of vermicompost and enriched compost improved soil properties, plant growth and nodulation of mungbean. Vermicompost produced particularly favourable effects on root and shoot growth and nodulation, demonstrating its potential as an important organic nutrient source in mungbean production. Biofertilizers also play an important role in improving nutrient availability and crop productivity. Rhizobium is particularly important in green gram because of its symbiotic association with legume roots and its ability to fix atmospheric nitrogen. Biofertilizer inoculation can improve nodulation, nitrogen nutrition, plant growth and yield formation. The response of

greengram to biofertilizers under different fertility levels and reported beneficial effects of biofertilizer application on crop productivity Kumawat *et al.*, (2010) [7]. Organic manures and Rhizobium culture improved growth, yield attributes and grain yield of summer mungbean, with the combined application of vermicompost and Rhizobium producing particularly favourable results Jat *et al.*, (2014) [5]. The integration of organic manures with biofertilizers may provide complementary benefits by improving nutrient availability, microbial activity and root development. Kumar *et al.*, (2017) reported that the combined application of phosphorus and bio-organic sources, particularly vermicompost with microbial inoculants, substantially improved pods per plant, grains per pod, grain yield, straw yield, biological yield and economic returns of mungbean. The response of green gram to organic and inorganic nutrient sources has also been demonstrated under different agro-ecological conditions. Organic and inorganic sources of nutrients in mungbean and emphasized the importance of nutrient integration for improving growth, yield and quality Meena *et al.*, (2020) [8]. Similarly, Integrated nutrient management involving vermicompost and Rhizobium improved growth, nodulation and yield attributes of mungbean under an agri-horti system in the Vindhyan region of Uttar Pradesh Pankaj *et al.*, (2020). Therefore, the identification of suitable combinations of vermicompost, neem cake and biofertilizers such as *Rhizobium* and *Azotobacter* is important for developing productive and sustainable green gram production systems.

Materials and Methods

A field experiment was conducted during the *Kharif* season of 2024 at the Organic Research Farm, Karguwan Ji, Bundelkhand University, Jhansi, Uttar Pradesh, using green gram (*Vigna radiata* L.) variety PDM 139 (Samrat). The experiment was laid out in a Randomized Block Design (RBD) with three replications and nine treatments comprising a control receiving the recommended dose of fertilizer (RDF), vermicompost, neem cake, *Azotobacter* and *Rhizobium* in different combinations. The treatments were T₀: Control ((1:2:1)); T₁: vermicompost @ 5 t ha⁻¹; T₂: neem cake @ 1 t ha⁻¹; T₃: vermicompost @ 2.5 t ha⁻¹ + *Azotobacter* @ 250 g L⁻¹; T₄: neem cake @ 0.5 t ha⁻¹ + *Azotobacter* @ 250 g L⁻¹; T₅: vermicompost @ 2.5 t ha⁻¹ + *Rhizobium* @ 250 g L⁻¹; T₆: neem cake @ 0.5 t ha⁻¹ + *Rhizobium* @ 250 g L⁻¹; T₇: vermicompost @ 1.6 t ha⁻¹ + neem cake @ 0.33 t ha⁻¹ + *Rhizobium* @ 165 g L⁻¹; and T₈: vermicompost @ 1.6 t ha⁻¹ + neem cake @ 0.33 t ha⁻¹ + *Azotobacter* @ 165 g L⁻¹. Standard agronomic practices were followed uniformly for all treatments. Yield attributes, viz., number of pods plant⁻¹, pod weight plant⁻¹, number of seeds pod⁻¹, pod length and test weight, were recorded at maturity. Yield parameters including seed yield, straw yield, husk yield and biological yield were recorded and expressed in kg ha⁻¹. Harvest index was calculated as the ratio of seed yield to biological yield and expressed as percentage. The experimental data were subjected to statistical analysis appropriate for RBD, and treatment means were compared using the standard error of mean (S.E.m. ±) and critical difference (C.D.) at 5% probability level to determine the significance of differences among treatments.

Results And Discussion

The effect of organic manures and biofertilizers on yield attributes and yield of green gram (*Vigna radiata* L.) is presented in Table 1. The number of pods plant⁻¹ was significantly influenced by the application of organic manures and biofertilizers (Table 1). The values ranged from 18.30 pods plant⁻¹ in T₀ (control) to 25.60 pods plant⁻¹ in T₇. Treatment T₇, comprising vermicompost @ 1.6

t ha⁻¹ + neem cake @ 0.33 t ha⁻¹ + *Rhizobium* @ 165 g L⁻¹, recorded the maximum number of pods plant⁻¹ (25.60), followed by T₈ (25.00), T₅ (24.20) and T₆ (23.40). Among the individual organic manure treatments, T₁ (vermicompost @ 5 t ha⁻¹) recorded 21.40 pods plant⁻¹, whereas T₂ (neem cake @ 1 t ha⁻¹) recorded 20.50 pods plant⁻¹. The superiority of T₇ may be attributed to the complementary effects of vermicompost, neem cake and *Rhizobium*, which potentially improved nutrient availability, microbial activity and plant growth, ultimately favouring reproductive development. Similar beneficial effects of integrated organic manure and biofertilizer application on yield attributes of green gram have been reported by Dkhar *et al.*, (2019) [3] and Bhadu *et al.*, (2018) [1].

Pod weight ranged from 7.20 to 10.80 g plant⁻¹. The maximum pod weight was recorded in T₇ (10.80 g plant⁻¹), followed by T₈ (10.50 g) and T₅ (10.20 g), whereas the control recorded the minimum value (7.20 g plant⁻¹). Vermicompost alone and neem cake alone recorded 9.00 and 8.50 g plant⁻¹, respectively. The greater pod weight under T₇ indicates better pod development under combined organic manure and *Rhizobium* application. The number of seeds pod⁻¹ varied from 9.10 in T₀ to 11.40 in T₇. T₇ recorded the maximum number of seeds pod⁻¹ (11.40), followed by T₈ (11.30) and T₅ (11.10). The minimum value was recorded under the control. Vermicompost and neem cake alone resulted in 10.20 and 10.00 seeds pod⁻¹, respectively. The higher number of seeds pod⁻¹ under T₇ may be associated with improved nutritional availability and better reproductive development resulting from the combined application of organic manure and *Rhizobium*. Bhadu *et al.*, (2018) [1] similarly reported improved pods plant⁻¹ and seeds pod⁻¹ under integrated organic nutrient management involving FYM, vermicompost, *Rhizobium* and PSB.

Pod length ranged from 4.10 cm in T₀ to 5.00 cm in T₇. The longest pods were recorded under T₇ (5.00 cm), followed by T₅ and T₈ (4.90 cm each). The control recorded the shortest pods (4.10 cm), whereas T₁ and T₂ recorded 4.50 and 4.40 cm, respectively. The improvement in pod length under integrated treatments may be related to improved plant nutrition and enhanced vegetative and reproductive growth. Rao *et al.*, (2021) [10] and Pandey *et al.*, (2019) [9] reported that organic manure and biofertilizer treatments significantly affected pod length and other yield attributes of green gram.

Test weight was significantly influenced by the treatments and ranged from 34.60 to 40.20 g. The highest test weight was recorded in T₇ (40.20 g), followed by T₈ (39.60 g) and T₅ (39.00 g), while the control recorded the lowest value (34.60 g). Rao *et al.*, (2021) [10] also reported significant effects of organic manure and biofertilizer treatments on test weight of green gram.

Seed yield ranged from 856 kg ha⁻¹ in T₀ (control) to 1210 kg ha⁻¹ in T₇, with T₇ [vermicompost @ 1.6 t ha⁻¹ + neem cake @ 0.33 t ha⁻¹ + *Rhizobium* @ 165 g L⁻¹] recording the maximum seed yield, followed by T₈ (1182 kg ha⁻¹), T₅ (1158 kg ha⁻¹) and T₆ (1130 kg ha⁻¹). Vermicompost alone (T₁) and neem cake alone (T₂) produced 1012 and 972 kg ha⁻¹, respectively. Compared with T₀, T₇ increased seed yield by 354 kg ha⁻¹ (41.36%). The combined application of vermicompost, neem cake and *Rhizobium* may have improved nutrient availability, microbial activity and biological nitrogen fixation, thereby promoting reproductive growth and seed formation. Similar enhancement in grain yield of green gram through integrated application of organic manures and biofertilizers was reported by Dkhar *et al.*, (2019) [3]. Sahu *et al.*, (2021) [11] also reported improved grain and straw yields under integrated nutrient management involving organic manure, inorganic fertilizer and *Rhizobium* in green gram under the Bundelkhand region. Kacha *et al.*, (2020) [6] observed

substantial improvement in grain yield of summer green gram through the combined application of organic nutrient sources and biofertilizers. Straw yield varied from 1542 kg ha⁻¹ in T₀ to 1988 kg ha⁻¹ in T₇. Treatment T₇ recorded the maximum straw yield (1988 kg ha⁻¹), followed by T₈ (1950 kg ha⁻¹) and T₅ (1920 kg ha⁻¹), whereas the control recorded the minimum value. The straw yield under T₇ was 446 kg ha⁻¹ (28.92%) higher than T₀, indicating greater vegetative growth and biomass accumulation under integrated nutrient management. The enhanced straw production may be attributed to improved nutrient supply and greater microbial activity resulting from the combined application of organic manure and biofertilizer. Similar improvement in straw yield under integrated nutrient management in green gram was reported by Sahu *et al.* (2021) ^[11], while Pal *et al.* (2019) also observed higher grain and straw yields with the combined use of fertilizers, biofertilizers and organic manure. Husk yield ranged from 382 kg ha⁻¹ in T₀ to 496 kg ha⁻¹ in T₇, with T₈ (488 kg ha⁻¹) and T₅ (478 kg ha⁻¹) recording the next highest values. Treatment T₇ produced 114 kg ha⁻¹ (29.84%) more husk than the control. The higher husk yield may be associated with enhanced crop growth and greater total biomass production under integrated organic nutrient management. Biological yield followed a similar trend and ranged from 2398 kg ha⁻¹ in T₀ to 3198 kg ha⁻¹ in T₇. The maximum biological yield was recorded under T₇ (3198 kg ha⁻¹), followed by T₈ (3132 kg ha⁻¹) and T₅ (3078 kg ha⁻¹), whereas T₀ recorded the minimum value. Treatment T₇ increased biological yield by 800 kg ha⁻¹ (33.36%) over the control. The greater biomass accumulation under T₇ corresponded with its higher pod production, pod weight and seed yield, suggesting a favourable influence of integrated organic manure and *Rhizobium* application

on overall crop growth. Dkhar *et al.* (2019) ^[3] similarly reported enhanced grain and biomass production of green gram through integrated application of vermicompost, *Rhizobium* and PSB, while Sahu *et al.* (2021) ^[11] observed improved grain and straw production under integrated nutrient management in green gram. Harvest index ranged from 35.70% in T₀ to 37.80% in T₇. The maximum harvest index was recorded under T₇ (37.80%), closely followed by T₈ (37.70%), while T₅ and T₆ each recorded 37.60%. The control recorded the lowest harvest index (35.70%). Jagtap *et al.* ^[4] also reported improvement in harvest index with improved fertility and biofertilizer management in green gram.

Across all the measured parameters, T₇ (vermicompost @ 1.6 t ha⁻¹ + neem cake @ 0.33 t ha⁻¹ + *Rhizobium* @ 165 g L⁻¹) was the most effective treatment. It recorded the maximum values for pods plant⁻¹ (25.60), pod weight (10.80 g plant⁻¹), seeds pod⁻¹ (11.40), pod length (5.00 cm), test weight (40.20 g), seed yield (1210 kg ha⁻¹), straw yield (1988 kg ha⁻¹), husk yield (496 kg ha⁻¹), biological yield (3198 kg ha⁻¹) and harvest index (37.80%). T₈, involving *Azotobacter* instead of *Rhizobium*, generally ranked second. The results demonstrate the beneficial effect of integrating organic nutrient sources with biofertilizers rather than relying exclusively on a single organic input. The findings are supported by Dkhar *et al.*, (2019) ^[3], who found vermicompost + *Rhizobium* + PSB to be highly effective for green gram productivity, and by Sahu *et al.*, (2021) ^[11], who reported positive responses to integrated nutrient management under the Bundelkhand agro-ecosystem. The results are also consistent with Rao *et al.*, (2021) ^[10], who documented significant effects of organic manure and biofertilizers on pods plant⁻¹, pod length, seed yield and test weight of green gram.

Table 1: Effect of organic manure and biofertilizer on yield and yield attributes of green gram (*Vigna radiata* L.)

Tr. No.	Treatment	No. of pods/plant	Pod weight (g)/plant	No. of seeds/pod	Pod length (cm)	Test weight (g)	Seed Yield (kg/ha)	Straw Yield (kg/ha)	Husk Yield (kg/ha)	Biological Yield (kg/ha)	Harvest index (%)
T ₀	Control ((1:2:1))	18.30	7.20	9.10	4.10	34.60	856	1542	382	2398	35.70
T ₁	Vermicompost (5 t/ha)	21.40	9.00	10.20	4.50	37.10	1012	1765	438	2777	36.40
T ₂	Neem cake (1 t/ha)	20.50	8.50	10.00	4.40	36.50	972	1700	426	2672	36.40
T ₃	Vermicompost (2.5 t/ha) + <i>Azotobacter</i> (250 gm/L)	23.80	9.70	10.80	4.70	38.30	1115	1860	465	2975	37.50
T ₄	Neem cake (0.5 t/ha) + <i>Azotobacter</i> (250 gm/L)	22.90	9.30	10.60	4.60	37.90	1084	1815	454	2899	37.40
T ₅	Vermicompost (2.5 t/ha) + <i>Rhizobium</i> (250 gm/L)	24.20	10.20	11.10	4.90	39.00	1158	1920	478	3078	37.60
T ₆	Neem cake (0.5 t/ha) + <i>Rhizobium</i> (250 gm/L)	23.40	9.80	10.90	4.80	38.60	1130	1875	470	3005	37.60
T ₇	Vermicompost (1.6 t/ha) + Neem cake (0.33 t/ha) + <i>Rhizobium</i> (165 gm/L)	25.60	10.80	11.40	5.00	40.20	1210	1988	496	3198	37.80
T ₈	Vermicompost (1.6 t/ha) + Neem cake (0.33 t/ha) + <i>Azotobacter</i> (165 gm/L)	25.00	10.50	11.30	4.90	39.60	1182	1950	488	3132	37.70
S.E.m±		0.39	0.16	0.18	0.08	0.65	18.57	31.27	7.80	49.83	0.64
C.D. (@5%)		1.18	0.49	0.55	0.24	1.95	55.66	93.75	23.37	149.39	1.91

Conclusion

The organic manure and biofertilizer combinations significantly influenced yield attributes and yield of green gram. T₇, comprising vermicompost (1.6 t ha⁻¹) + neem cake (0.33 t ha⁻¹) + *Rhizobium* (165 g L⁻¹), was the most effective treatment, recording the highest values for all measured parameters. It produced 25.60 pods plant⁻¹, 10.80 g pod weight plant⁻¹, 11.40 seeds pod⁻¹, 5.00 cm pod length, 40.20 g test weight, 1210 kg ha⁻¹ seed yield, 1988 kg ha⁻¹ straw yield, 496 kg ha⁻¹ husk yield, 3198 kg ha⁻¹ biological yield and 37.80% harvest index. T₈, consisting of vermicompost + neem cake + *Azotobacter*, was the second-best treatment, whereas the control recorded the lowest performance. Thus, the integrated use of vermicompost, neem cake and *Rhizobium* emerged as the most promising treatment for enhancing yield and yield attributes of green gram under the

experimental conditions of Jhansi, Uttar Pradesh.

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