Growth, yield and economics of irrigated green gram (*Vigna radiata* .L) as influenced by inorganic fertilizer and various organic inputs

ABSTRACT

A field experiment was conducted at agronomy research farm of Karunya Institute of Technology and Sciences, Coimbatore during *rabi* season 2022 in order to look into the influence by inorganic fertilizer and various organic inputs on the crop growth and yield compared to organic fertilizer in greengram under irrigation. The experiment comprised of ten treatments viz. T1 : Absolute control, T2 : Vermicompost 100% + 2% Cowdung slurry, T3 : Vermicompost 100% + 2% biomineralizer,T4 : Vermicompost 100% + 2% EM solution, T5 : Vermicompost 100% + 2% pleurotus sp, T6 : Vermicompost 50% + RDF 50% + 2% Cowdung slurry, T7 : Vermicompost 50% + RDF 50% + 2% biomineralizer, T8 : Vermicompost 50% + RDF 50% + EM solution, T9 : Vermicompost 50% + RDF 50% + *pleurotus sp* and T10 : RDF alone were arranged in Randomized Block Design and replicated three times. Data was collected in 20, 40 DAS and at harvest stage of greengram crop. Results in all the growth parameters, yield and its attributes and economics had a significant influence under the inorganic fertilizer (100% RDF). The plant height (65.8 cm), dry matter accumulation (3871 kg ha^{-1}) and number of pods/plant (12.32), number of grains/pod (7.2), grain yield (981 kg ha^{-1}), haulm yield (2538 kg ha^{-1}) of greengram were recorded in T10. On the basis of economics, the maximum gross returns (Rs.68670 ha^{-1}), net returns (Rs. 39441 ha^{-1}) and B: C ratio (2.34) was recorded under treatment (100% RDF).

Keywords: RDF; vermicompost; yield; economics.

1. INTRODUCTION

India, being predominantly an agrarian economy, has made significant progress in the production of various cereals, pulses, and oilseed crops. Among the pulse crops cultivated, Greengram (Vigna radiata L.) holds immense importance in India. It is extensively grown during the Kharif season in northern states and as a Rabi crop in southern states due to favorable winter temperatures (Rajesh *et al*., 2022). India is recognized as a leading global producer of greengram, with cultivation taking place in nearly all states, highlighting its significance among other crops. Greengram is highly favored as a pulse crop due to its rich protein, carbohydrate, water, fat, and fiber content. Furthermore, it is considered a low nutrient-demanding pulse crop that can fix atmospheric nitrogen, making it an environmentally beneficial choice. Its ability to prevent soil erosion, coupled with its capacity to absorb essential elements, further enhances its appeal (Jena *et al*., 2022).

Typically, crop success depends on nutrient management practices during the entire crop growth period. The use of chemical fertilizer with the application of full recommended dose influences the plant growth characters, yield attributes and economics for crop cultivation. Whereas, the continuous application of chemical products in the same field is an issue of concern for the various problems it causes, such as the level of pollutants that the fruit may contain, decrease in soil fertility, soil and groundwater pollution.

Organic waste has been considered as a source of soil contamination and has not been sufficiently evaluated as a by-product of agricultural activity which could produce organic fertilizers by composting or vermicomposting. Furthermore, due to the high cost of raw material and imported inputs, there is a need for stable and quality material produced locally and its easy availability. Vermicompost can meet the nutrient demand of various crops and significantly reduce the use of synthetic fertilizers, and in particular, it increases soil fertility without polluting the soil, as well as the quantity and quality of harvested products over a period of time. Consequently, the utilization of organic fertilizers is the promising option in enhancing crop productivity and soil quality and fertility.

Surface (flood or furrow) Irrigation was conducted immediately after sowing and life irrigation on the third day. Subsequent irrigation were given at interval of 10-15 days and as when required.

Predominantly, the inorganic fertilizers shows positive effect on the crops and increases the crop growth, yield and availability of nutrients in the soil in its first application. Whereas, the application of organic fertilizers benefits the crops and soil only after the consistent (or) repeated applications on the same field. Therefore, this field study, looked into the influence by inorganic fertilizer and various organic inputs on the crop growth and yield compared to organic fertilizers.

2. MATERIALS AND METHODS

A field experiment was conducted at agronomy research farm of Karunya Institute of Technology and Sciences, Coimbatore during *rabi* season 2022 with the application of RDF, Vermicompost and various organic inputs in irrigated Greengram (*Vigna radiata.* L.). The experimental site is geographically located in the Western zone of Tamil Nadu at 10.934° North latitude and 76.73° East longitude and at an altitude of 467 metres above mean sea level and it is situated in the Western agroclimatic zone of Tamil Nadu. The mean annual maximum and minimum temperatures were 38°C and 19.41°C respectively. During the cropping period, the maximum and minimum temperatures ranged from 26.54°C to 18.56°C respectively. The soil of the experimental field was medium in available nitrogen (298 kg ha^{-1}), high in available phosphorus (78 kg ha^{-1}) and medium in available potassium (276 kg ha^{-1}). The greengram crop was raised under irrigated condition during October to December. The Green gram (*Vigna radiata .L*) variety was CO 8. The variety CO 8 with the duration of 55- 60 days and an average yield potential of 1050 kg ha^{-1} under irrigated condition. The experiment was laid out in a randomized block design with ten treatments and three replication *viz*. T1 : Absolute control, T2 : Vermicompost 100% + 2% Cowdung slurry, T3 : Vermicompost 100% + 2% biomineralizer,T4 : Vermicompost 100% + 2% EM solution, T5 : Vermicompost 100% + 2% *pleurotus sp*, T6 : Vermicompost 50% + RDF 50% + 2% Cowdung slurry, T7 : Vermicompost 50% + RDF 50% + 2% biomineralizer, T8 : Vermicompost 50% + RDF 50% + EM solution, T9 : Vermicompost 50% + RDF 50% + *pleurotus sp* and T10 : RDF alone. In this field experiment, Cowdung slurry, biomineralizer and EM solution was mixed with water and applied as foliar spray at 25 DAS. The p*leurotus sp* was applied along with vermicompost in the respective plots. The data was collected with respect to the nutrient application and its effect on irrigated greengram at 20, 40 DAS and at harvest which was analyzed through ANOVA (Analysis of Variance) that compare the means among repeated observations.

3. RESULTS AND DISSCUSION

3.1. Plant height

Significant differences were observed among treatments with maximum plant height of 65.8cm recorded in T10 - RDF alone with the application of 100% RDF followed by T4 with the application of vermicompost 100% + 2% EM solution recorded (Table 1). The plant height was not consistent or uniform throughout the entire duration of the growth period. Growth was initially gradual during the early growth stages until 20 days after sowing (DAS). Results revealed that application of full dose of NPK significantly increased the plant height as compared to the control (40.80 cm). The result was supported by the findings of Dinesh Varma *et al*., (2017) and Jangir *et al*. (2016) who observed higher values of growth parameters due to application of 100% RDF.

3.2. Dry matter accumulation

Results have shown significant increase among treatments in dry matter (Table 1). The application of 100% RDF significantly increased the dry matter accumulation due to increased plant height and other growth characters as compared to other treatments. Maximum dry matter accumulation was recorded in T10 (100% RDF) 3871.00 kg per ha followed by vermicompost 100% + 2% EM solution (T4) 3648.11 kg per ha. Minimum dry matter accumulation was recorded in T1 which is an absolute control due to the least plant height and other growth characters. It is evident from the results that dry matter accumulation exhibited a progressive increase as the crop grew, reaching its peak at the harvest stage. The data also revealed that dry matter accumulation was slow up to 20 DAS and increased during 40 DAS and harvest. These results are in agreement with those of Ghaffar *et al*. (2012) and Obidiebube *et al*. (2012).

3.3. Number of pods $plant^{-1}$

Results indicated that the full dose of chemical fertilizer significantly increased number of pod per plants over other treatments (Table 1). The results showed favorable response with the application of 100% RDF in which the maximum number pods were recorded in T10 (12.32) followed by (16.70) in T4 (100%

Vermicompost + 2% EM solution) when compared with other sources of organic manures in varied combinations. Minimum number of pods per plant was noticed in absolute control due to insufficient supply of nutrients to the crop. These results are in agreement with those of Rafiqul Islam *et al*. (2014) and Yubaraj Dhakal *et al*. (2015) who observed higher yield attributes with application of 100% RDF.

3.4. Number of grains pod^{-1}

Results indicated significant difference among treatments on the number of grains per pod (Table 1). Application of RDF and different organic manures exerted marked influence on the number of grains per pod. The maximum number of grains (9.6) per pod were recorded in T10 (100 % RDF) followed by (9.5) in T4 (100% Vermicompost + 2% EM solution). The minimum number of grains per pod (6.8) was observed in T1 (absolute control) due to restricted supply of nutrients to the crop. Similar results were reported by Rafiqul Islam *et al*. (2014) and Yubaraj Dhakal *et al*. (2015).

Table 1: Effect of inorganic fertilizer on growth and yield attributes

TREATMENTS	Plant height (cm)	Dry matter accumulation (kg/ha)	No. of Pods/Plant	No. of Grains/Pod
T1 - Absolute control	40.80	1456.00	11.60	6.80
T2 - Vermicompost 100% + 2% Cowdung slurry	60.60	3136.00	15.50	9.30
T3 - Vermicompost 100% + 2% Biomineralizer	63.90	3426.00	17.00	9.60
T4 - Vermicompost 100% + 2% EM solution	64.20	3648.11	16.70	9.50
T5 - Vermicompost 100% + 2% Pleurotus	62.50	3318.00	14.97	9.10
T6 - Vermicompost 100% + RDF 50% + 2% Cowdung slurry	55.80	2992.00	13.40	8.30
T7 - Vermicompost 100% + RDF 50% + 2% Biomineralizer	58.70	3195.00	14.57	8.90
T8 - Vermicompost 100% + RDF 50% + 2% EM solution	57.40	3082.00	13.80	8.60
T9 - Vermicompost 100% + RDF 50% + 2% Pleurotus	53.90	2952.00	12.80	7.70
T10 - RDF alone	65.80	3871.00	12.32	7.20
Mean values	58.36	3107.61	14.26	8.50
SEd	5.758984	314.5064	1.031112	0.827104
CD (P= 0.05)	12.03104	657.0322	2.154085	1.727894

3.5. Grain yield

Results indicated significant difference among treatments on grain yield (Table 2). Grain yield of green gram could be influenced by various nutrient treatments. Use of RDF, organic manures with foliar

application showed significant increase in yield over control (T1). The highest grain yield of greengram seemed to be the effect of yield attributes such as number of pods per plant, grains per pod, weight and length of pod which were significantly enhanced due to application of 100% RDF in T10 with 981.00 kg per ha. Significantly lower yield under absolute control could be as a result of insufficient nutrients or restricted supply of nutrients of the crop. The application of recommended 100% NPK fertilizers significantly increased crop yield was reported by Dubey *et al*., (2012). Similar findings were reported in the studies by Monika Banotra *et al*. (2021), Awomi *et al*. (2012), Khan *et al*. (2013), Obidiebube *et al*. (2012) in maximum improvement in greengram yields viz. grain and haulm with 100% RDF application.

3.6. Haulm yield

Results showed significant difference among treatments on haulm yield (Table 2). The haulm yield followed almost similar trend as observed in grain yield and could be influenced by various nutrient treatments. It is apparent from the results that maximum haulm yield was recorded in T10 (100%RDF) 2538 kg per ha which was on par with Vermicompost 100% + RDF 50% + 2% Biomineralizer (T7). This was closely followed by 100 % Vermicompost and 2% EM solution in T4 (2367.07 kg per ha). The lowest haul yield was recorded in absolute control (982 kg per ha). These results are in agreement with those of Dubey *et al*. (2012), Awomi *et al*. (2012), Obidiebube *et al*. (2012) and Dinesh Varma *et al*. (2017).

3.7. Economics

The inorganic and organic nutrients significantly enhanced the net returns, gross return and BC ratio (Table 2). Gross Monetary Returns and net monetary returns were maximum with the application of 100% RDF (68670 Rs/ha and 39441 Rs/ha respectively). Maximum grain and haulm yield in T10 could resulted in maximum monetary returns. Maximum BC ratio was obtained in T10 and minimum was obtained in absolute control. This was due to lower cost of chemical fertilizer and higher cost of vermicompost.

Table 2: Effect of inorganic fertilizer on yield and economics

TREATMENTS	Grain Yield (kg/ha)	Haulm Yield (kg/ha)	Gross income (Rs ha^{-1})	Cost of cultivation (Rs ha^{-1})	Net income (Rs ha^{-1})	B:C ratio
T1 - Absolute control	452.00	982.00	31,640	24,200	7,440	1.30
T2 - Vermicompost 100% + 2% Cowdung slurry	907.00	2175.00	67,760	46,750	21,010	1.44
T3 - Vermicompost 100% + 2% Biomineralizer	938.00	2298.00	68,180	47,710	20,470	1.42
T4 - Vermicompost 100% + 2% EM solution	953.03	2367.07	68,530	46,810	21,720	1.46
T5 - Vermicompost 100% + 2% Pleurotus	923.00	2243.00	67,970	48,450	19,520	1.40
T6 - Vermicompost 50% + RDF 50% + 2% Cowdung slurry	869.00	1988.00	66,710	39,943	26,767	1.67
T7 - Vermicompost 50% + RDF 50% + 2% Biomineralizer	896.00	2134.00	67,340	40,903	26,437	1.64
T8 - Vermicompost 50% + RDF 50% + 2% EM solution	882.00	2086.00	66,990	40,003	26,987	1.67
T9 - Vermicompost 50% + RDF 50% + 2% Pleurotus	845.00	1941.00	66,500	41,643	24,857	1.59
T10 - RDF alone	981.00	2538.00	68,670	29,229	39,441	2.34
Mean values	864.60	2075.21	64,029	40,564	23,464	1.59
SEd	86.61533	210.0919				
CD(P=0.05)	180.9472	438.9009				

4. Conclusion

The study inferred that, the application of 100% RDF recorded the highest growth characters, yield and economics in greengram which was closely followed by vermicompost 100% + 2% EM solution compared to other treatments. The Consistent application of organic fertilizers is essential for acquiring their benefits, while the benefits obtained from chemical fertilizers are gained on its first application. From the findings organic produce fetches 15-20% higher in price on the open market, encouraging even the marginal farmers to cultivate greengram using 100% organic substitutes, such as vermicompost interns, which improves the quality of the crop and generates greater profits for farmers at the same time sustaining the soil fertility over a long period of time.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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