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Influence of Vermicompost and Foliar Applications on Growth, Physiological and Yield Parameters of Irrigated Blackgram (*Vigna mungo* L. Hepper)

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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

Field experiments were conducted at the South farm in Karunya Institute of Technology and Sciences, Division of Agronomy, Coimbatore, during the Rabi season of 2022. The experimental site is situated in the western agro-climatic zone of Tamil Nadu, at a latitude of 10°56'N and longitude of 76°44'E, with an elevation of 474 meters above mean sea level. The soil composition of the experimental field was identified as clay loam, moderately drained, and exhibited low availability of nitrogen (202 kg/ha), high availability of phosphorus (12.3 kg/ha), medium availability of potassium (415 kg/ha), and organic carbon content of 0.51%. The experiment followed a randomized block design (RBD) with 10 treatment groups, each replicated three times *viz.,*T_1 -

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Control, T_{2} - Vermicompost 100% (on N Equivalent basis)+ Cowdung slurry, T_{3} - Vermicompost100% (on N Equivalent basis)+TNAU Biomineralizer,T_4 -Vermicompost100% (on N Equivalent basis) + (Effective microorganism),T_{5} - Vermicompost 100% (on N Equivalent basis) + *Pleurotus sp* + Urea, T_{6}- Vermicompost (50%) +RDF (50%) + Cowdung slurry, T_{7}- Vermicompost (50%) +RDF (50%) + TNAU Biomineralizer, T_{8} - Vermicompost (50%) + RDF (50%) + EM (Effective Microorganism),T_{9} - Vermicompost (50%) + RDF (50%) + *Pleurotus sp* ,T_{10} - RDF alone. The objective of the study was to investigate the impact of vermicompost and other foliar applications on the growth, physiological characteristics, and yield parameters of an irrigated Black gram (VBN8 variety). The promotion of yield can be attributed to the increased vegetative growth and the balanced carbon-to-nitrogen (C: N) ratio, which likely stimulated the synthesis of carbohydrates. This, in turn, facilitated the overall improvement in seed yield. The application of RDF played a significant role in enhancing growth, leading to various positive changes in yield-related characteristics. Ultimately, the increased seed yield observed can be largely attributed to the improved plant growth and subsequent positive effects on yield-related attributes resulting from the RDF application. Thus, From this Experiment it was Concluded that the RDF (T_{10}) Shows a highest range in growth, physiological and yield parameters of irrigated Blackgram due.

Keywords: Blackgram; foliar spray; organic manures; pulses; RDF; vermicompost; yield.

1. INTRODUCTION

For a significant portion of the global population, legumes, commonly referred to as pulses, hold immense dietary importance. While not all legumes fall under the category of pulses, the terms "legumes" and "pulses" are used interchangeably. The leguminoseae family comprises legume species that serve as essential sources of nourishment for both humans and domestic animals, often in the form of dried grains. Pulse grains are rich in phytochemicals, vitamins, minerals, dietary fiber, protein, and carbohydrates. Pulses are a staple in the diets of many individuals worldwide, providing a vital source of protein alongside cereal consumption. The high lysine and folate levels in pulses make them an excellent choice for combining with cereals to create composite flours. In terms of total carbohydrates, fat, niacin, riboflavin, thiamine, and vitamin B6, pulses and cereal grains exhibit comparable levels. However, pulses surpass cereal grains in terms of protein, folate, iron, magnesium, potassium, and zinc content. Pulses, which are leguminous crops cultivated on an annual basis, have a dual purpose of being utilized as both food and feed. Within their pods, pulses produce variable-sized, shaped, and colored grains or seeds, ranging from 1 to 12. These crops hold significant worth due to their substantial protein content and their ability to contribute to a low glycemic index [1]. They form an integral part of the staple diets in many developing countries in South Asia and Africa, where they are consumed by a significant portion of the population [2].

In contemporary agriculture, extensive reliance on synthetic fertilizers and pesticides is common practice among farmers to boost the yield of various crops. However, the use of these chemical substances poses a significant risk to both soil fertility and human well-being. Consequently, there has been a notable upsurge in interest regarding the adoption of organic manures as an alternative approach. Organic farming has gained popularity as an environmentally conscious method that aims to achieve economically sustainable crop production. This agricultural practice involves the utilization of organic soil amendments as nutrient sources. One valuable organic manure is farmyard manure, which contains approximately 0.5% nitrogen, 0.2% phosphorus, and 0.5% potassium. When used in conjunction with chemical fertilizers, it helps maintain soil health and enhance crop productivity. Vermicompost, created through the decomposition process facilitated by various species of worms, such as red wigglers, white worms, and other earthworms, is another beneficial organic amendment. Vermicompost is a mixture of decomposing vegetables or food waste, bedding materials, and vermicast. With approximately 0.6% nitrogen, 1.34% phosphorus, and 0.4% potassium, vermicompost provides valuable nutrients to support plant growth [3].

Foliar fertilizers have gained significant attention due to the numerous advantages associated with their application method. By applying nutrients directly to the plant's foliage, foliar fertilizers offer a swift and efficient response to the plant's nutritional needs, require smaller product quantities, and bypass soil conditions. The supplementation of crop growth through foliar fertilization is widely recognized for improving the mineral status of plants, leading to increased crop yields.

Blackgram, scientifically known as *Vigna mungo* and commonly referred to as Urad in India, has its origins in India and is primarily cultivated in various Asian countries such as Pakistan, Myanmar, and select regions of Southern Asia. India holds the distinction of being the largest global producer and consumer of blackgram. According to the 1st Advance Estimates of Production of Food grains for 2022-23, as of February 3, 2023, the estimated production of black gram in India during the Rabi season reached 1.84 million tonnes. However, there was a 5.0% decrease in black gram cultivation area, which stood at 7.77 lakh hectares (19.21 lakh acres), compared to 8.18 lakh hectares (20.23 lakh acres) in the previous year.

1.1 Objective of the Study

To investigate the impact of vermicompost and other foliar applications on the growth, physiological characteristics and yield parameters of irrigated blackgram.

2. MATERIALS AND METHODS

Field experiments were conducted at the South farm in Karunya Institute of Technology and Sciences, Division of Agronomy, Coimbatore, during the Rabi season of 2022.. The experimental site is situated in the western agro-climatic zone of Tamil Nadu, at a latitude of 10°56'N and longitude of 76°44'E, with an elevation of 474 meters above mean sea level. (Fig. 1) The soil composition of the experimental field was identified as clay loam, moderately drained, and exhibited low availability of nitrogen (202 kg/ha), high availability of phosphorus (12.3 kg/ha), medium availability of potassium (415 kg/ha), and organic carbon content of 0.51%. The experiment followed a randomized block design (RBD) with 10 treatment groups, each replicated three times. (Fig. 2).

T_1- Control**,** T_2 -Vermicompost 100%(on N Equivalent basis)+ Cowdung slurry, T_{3}- Vermicompost 100%(on N Equivalent basis) + TNAU Biomineralizer, T_4 -Vermicompost 100% (on N Equivalent basis) + (Effective microorganism) ,T_5 - Vermicompost 100% (on N Equivalent basis) + *Pleurotus sp* + Urea, T_{6}- Vermicompost (50%) + RDF (50%) + Cowdung slurry, T_{7}- Vermicompost (50%) + RDF (50%) + TNAU Biomineralizer, T_8 -Vermicompost (50%) + RDF (50%) + EM (Effective Microorganism) ,T_9 - Vermicompost (50%) + RDF (50%) + *Pleurotus sp* ,T_{10} - RDF alone.

2.1 Statisitical Analysis

All the data were subjected to analysis of variance (ANNOVA) at P(0.05) significance using STAR (Statistical Tool for Agricultural Research) Version 2.0.1.

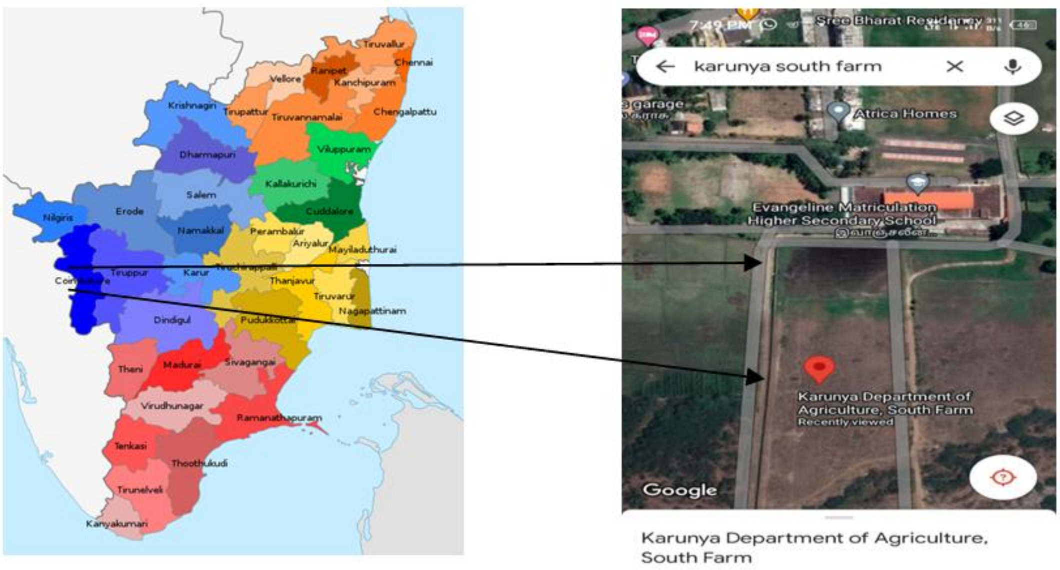

Fig. 1. Experimental Site location During rabi season 2022-2023

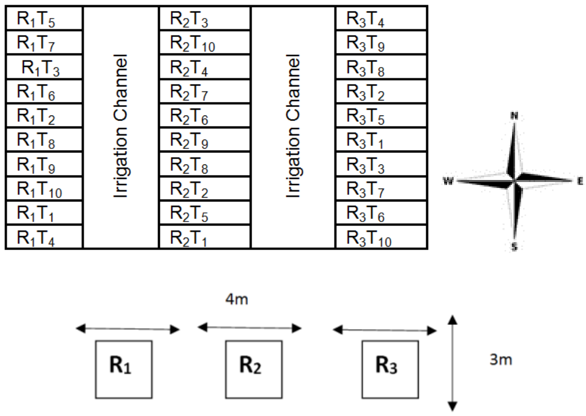

Fig. 2. Layout of the field experiment

3. RESULTS

3.1. Growth Parameters

Throughout different stages of crop growth, namely 20DAS, 40DAS, 60DAS, and Harvest, the effects of vermicompost and other foliar applications on the plant height of irrigated black gram were recorded. The highest plant height measurements were consistently observed in the RDF (T_{10}) alone, measuring 22.52cm, 35.76cm, 38.93cm, and 39.66cm across all growth stages. On the other hand, the lowest plant height measurements were consistently recorded in the Control (T_1), measuring 15.20cm, 25.47cm, 26.69cm, and 27.39cm in the respective growth stages. The significant influence of the crop on plant height was observed in this season as mentioned in Fig. 3 and Table 1.

The data collected demonstrates the impact of vermicompost and other foliar sprays on the dry matter production of black gram. The observations were recorded at different growth stages, including 20DAS, 40DAS, 60DAS, and Harvest. There was a significant increase in dry matter production (DMP) from 20DAS to 40DAS and a slight increase from 60DAS to the harvest stage. The maximum range of DMP across all observations was observed in only RDF was applied (320 kg ha^{-1}, 910 kg ha^{-1}, 1345 kg ha^{-1}, 3390 kg ha^{-1}). Conversely, the minimum range of DMP was observed in Control (T_1) (170 kg ha^{-1}, 402 kg ha^{-1}, 706 kg ha^{-1}, 2100 kg ha^{-1}). Fig. 4 and Table 1.

3.2. Physiological Parameters

3.2.1. Leaf area index

The data collected for this parameter from this experiment the highest range was observed in RDF (T_{10}) alone (0.42) and it was significantly on par with Vermicompost 100% (on N Equivalent basis)+ 2% TNAU Biomineralizer (T_3), Vermicompost In 100% (on N Equivalent basis)+ 2% Effective Microorganism (T_4), and a lesser range of (0.10) in Control (T_1) was statistically on par with, T_9- Vermicompost 50% + RDF 50% + 2% *Pleurotus. sp* +2% Urea at 20DAS. as mentioned in Table 2.

At 40 DAS the highest range of observation was reported in T_{10}- RDFalone (3.84) and it was on par with Vermicompost 100% (on N Equivalent basis)+ 2% TNAU Biomineralizer (T_3), Vermicompost 100% (on N Equivalent basis)+ 2% Effective Microorganism (T_4), Vermicompost 100% (on N Equivalent basis)+ 2% *Pleurotus.sp*+ 2%Urea (T_5) and minimum range of observation were acquired in Control (T_1) (1.47) and it was inferior to all other treatments. The data recorded in 60DAS shows that the highest range was observed at RDF (T_{10}) alone (5.53) and it was on par with the following treatments Vermicompost 100% (on N Equivalent basis)+ 2% Cowdung slurry (T_2) Vermicompost 100% (on N Equivalent basis)+ 2% TNAU Biomineralizer (T_3), Vermicompost 100% (on N Equivalent basis)+ 2% Effective Microorganism (T_4) Vermicompost 100% (on N Equivalent basis)+ 2% *Pleurotus.sp*+ 2%Urea (T_5), Vermicompost 50% + RDF 50% + 2% TNAU Biomineralizer (T_7), Vermicompost 50% + RDF 50% + 2%Effective Microorganism (T_8), Vermicompost 50% + RDF 50% + 2% Cowdung Slurry (T_6), Vermicompost 50% + RDF 50% + 2%Effective Microorganism (T_8), and the least value was observed in Control (T_1) (3.56) it was significantly on par with, Vermicompost 50% + RDF 50% + 2% *Pleurotus. sp* +2% Urea. (T_9) as mentioned in Fig. 5.

3.2.2 Crop growth rate

The data collected in this parameter during 20-40 DAS of this experiment shows the highest range of (2.95 g $m^{-2}day^{-1}$) in RDF (T_{10}) alone and it was on par with Vermicompost 100% (on N Equivalent basis)+ 2% Cowdung slurry (T_2) Vermicompost 100% (on N Equivalent basis)+ 2% TNAU Biomineralizer (T_3), Vermicompost 100% (on N Equivalent basis)+ 2% Effective Microorganism (T_4), Vermicompost 100% (on N Equivalent basis)+ 2% *Pleurotus.sp* + 2% Urea (T_5), and the lesser range was observed Control (T_1) (2.18 g $m^{-2}day^{-1}$) and it was on par with Vermicompost 50% + RDF 50% + 2% *Pleurotus.sp* +2% Urea (T_9) as mentioned in Fig. 6.

At 40-60 DAS the highest range of crop growth rate was observed in RDF alone(T_{10}) (2.58 g $m^{-2}day^{-1}$) and it was significantly on par with Vermicompost 100% (on N Equivalent basis)+ 2% TNAU Biomineralizer (T_3), Vermicompost 100% (on N Equivalent basis)+ 2% Effective Microorganism (T_4) on the other hand least value obtained was Control (T_1) it was significantly on par with Vermicompost 100% (on N Equivalent basis)+ 2% Cowdung slurry (T_2) Vermicompost 100% (on N Equivalent basis)+ 2% *Pleurotus.sp*+ 2%Urea (T_5), Vermicompost 50% + RDF 50% + 2%Effective Microorganism (T_8), Vermicompost 50% + RDF 50% + 2% *Pleurotus.sp* +2% Urea (T_9) . as mentioned in Table 2.

3.3 Yield Parameters

3.3.1 Grain yield

The data collected in this experiment has the highest yield on RDF (T_{10}) alone (950 kg ha^{-1}) which was statistically on par with Vermicompost 100% (on N Equivalent basis)+ 2% Cowdung slurry (T_2), Vermicompost 100% (on N Equivalent basis)+ 2% TNAU Biomineralizer (T_3), Vermicompost 100% (on N Equivalent basis)+ 2% Effective Microorganism (T_4), Vermicompost 100% (on N Equivalent basis)+ 2% *Pleurotus.sp*+ 2%Urea (T_5), Vermicompost 50% + RDF 50% + 2% Cowdung Slurry (T_6), Vermicompost 50% + RDF 50% + 2% TNAU Biomineralizer (T_7), Vermicompost 50% + RDF 50% + 2%Effective Microorganism (T_8) at harvest and it was lesser in range at Control (T_1) (597 kg ha^{-1})which was significantly on par with, Vermicompost 50% + RDF 50% + 2% *Pleurotus. sp* +2% Urea (T_9) at harvest as mentioned in Table 3 and Fig. 7.

3.3.2 Halum yield

From these observed data, this parameter shows a higher haulm yield in RDF (T_{10}) (2405 kg ha^{-1}) and it was on par with Vermicompost 100% (on N Equivalent basis)+ 2% TNAU Biomineralizer (T_3), Vermicompost 100% (on N Equivalent basis)+ 2% Effective Microorganism (T_4), and the lesser value ranges in Control (T1)(1463 kg ha^{-1}) it was statistically on par with Vermicompost 100% (on N Equivalent basis)+ 2% Cowdung slurry (T_2) Vermicompost 100% (on N Equivalent basis)+ 2% *Pleurotus.sp*+ 2%Urea (T_5), Vermicompost 50% + RDF 50% + 2% TNAU Biomineralizer (T_7), Vermicompost 50% + RDF 50% + 2%Effective Microorganism (T_8), Vermicompost 50% + RDF 50% + 2% Cowdung Slurry (T_6), Vermicompost 50% + RDF 50% + 2%Effective Microorganism (T_8), Vermicompost 50% + RDF 50% + 2% *Pleurotus.sp* +2% Urea (T_9) at harvest as mentioned in Table 3 and Fig. 7.

The utilization of an integrated nutrient management system that combines organic inputs such as farmyard manure (FYM) with chemical fertilizers has proven to be an effective approach in achieving higher Grain and Halum yield and improving yield attributes. This success can be attributed to several factors. Firstly, the inclusion of organic inputs helps to maintain a balanced carbon-to-nitrogen (C: N) ratio, which promotes vegetative growth and stimulates the synthesis of carbohydrates. This, in turn, contributes to an overall improvement in seed yield. Additionally, the application of fertilizers plays a significant role in enhancing plant growth and brings about positive changes in various yield-related characteristics. Ultimately, the increased seed yield observed can be primarily attributed to the improved plant growth and the subsequent positive effects on yield-related attributes resulting from the application of fertilizers [4].

4. DISCUSSION

From this study it shows the highest range in all the Growth, physiological and yield parameters was observed in RDF alone (T_{10}) due to the increase in various parameters may be attributed increased availability of nutrients over long periods, which have positive effect on growth of the plant.

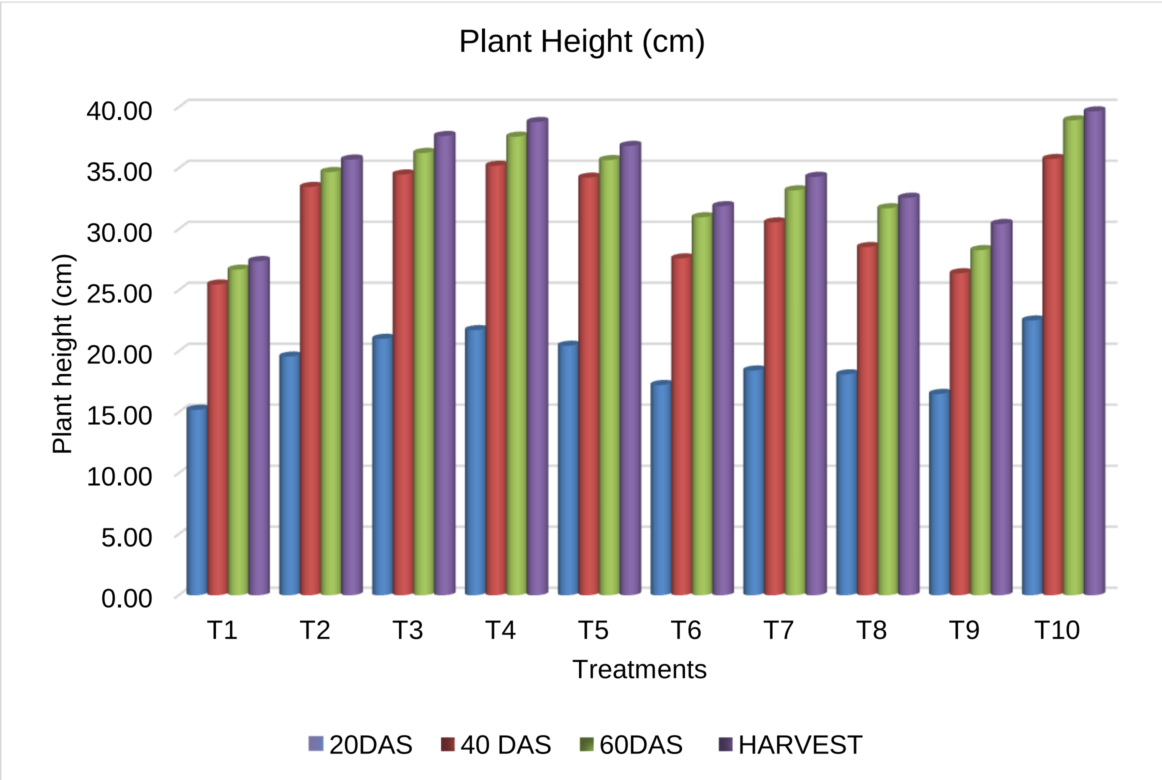

Fig. 3. Influence of vermicompost and other foliar application on plant height of Irrigated Blackgram

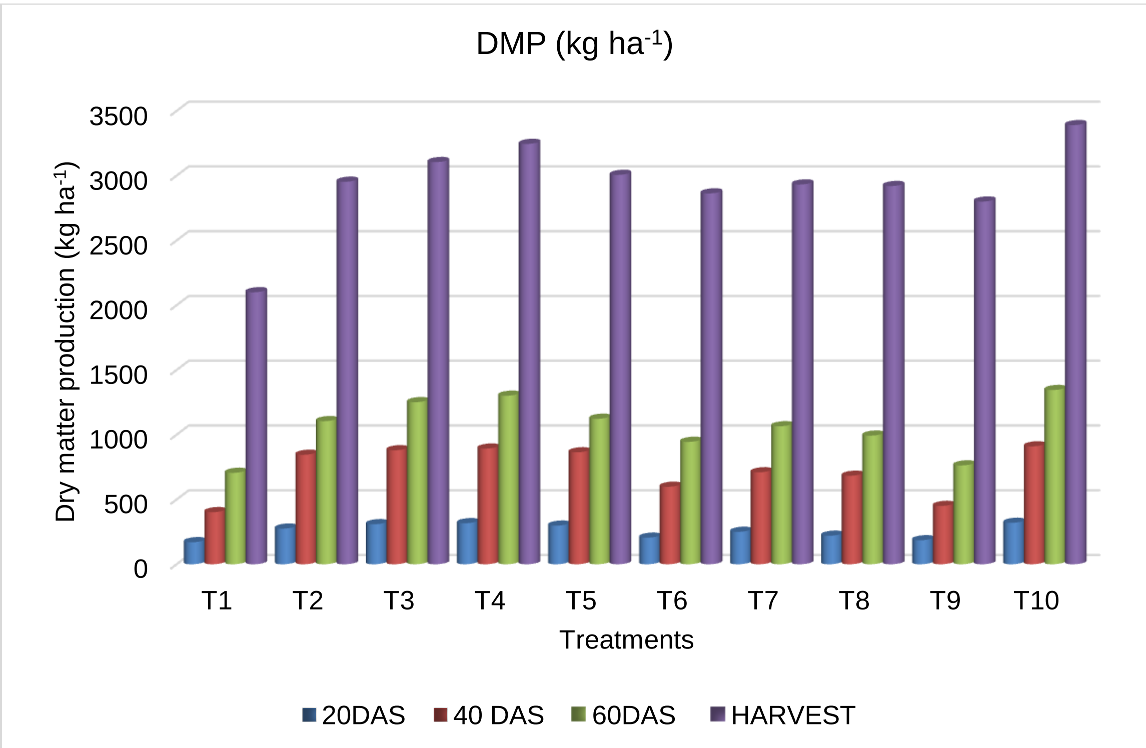

Fig. 4. Influence of vermicompost and other foliar application on Dry Matter Production of Irrigated Blackgram

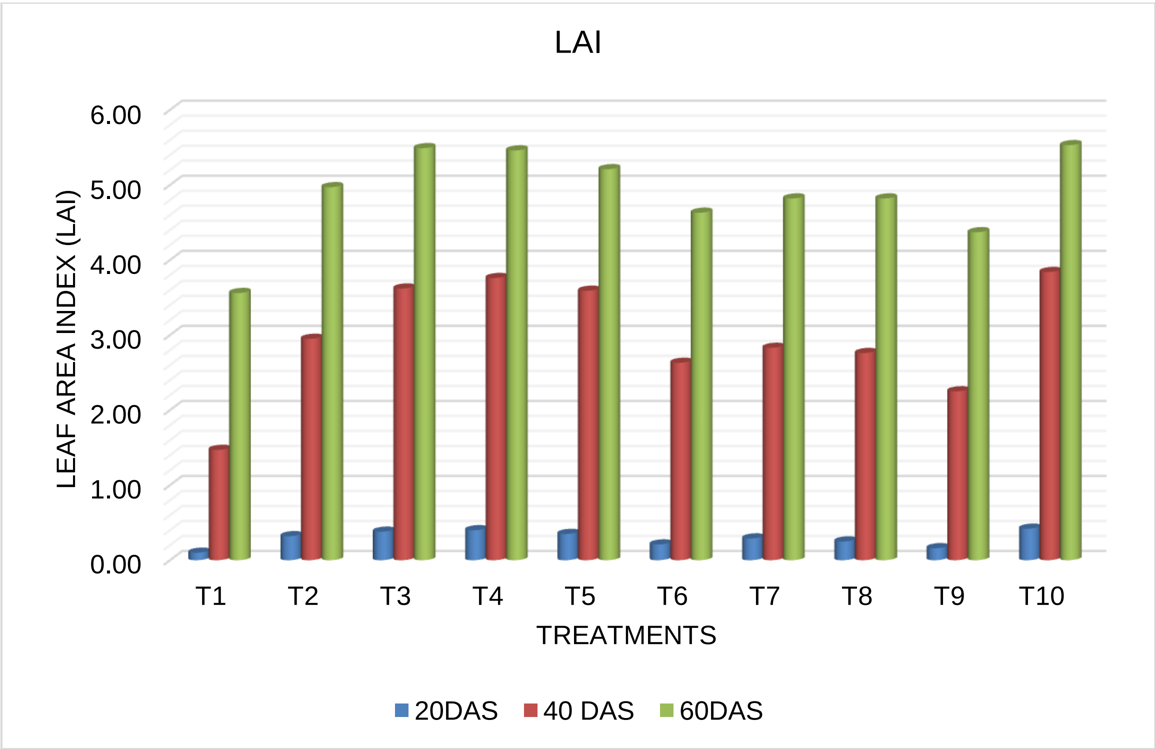

Fig. 5. Influence of vermicompost and other foliar application on Leaf area index of Irrigated Blackgram

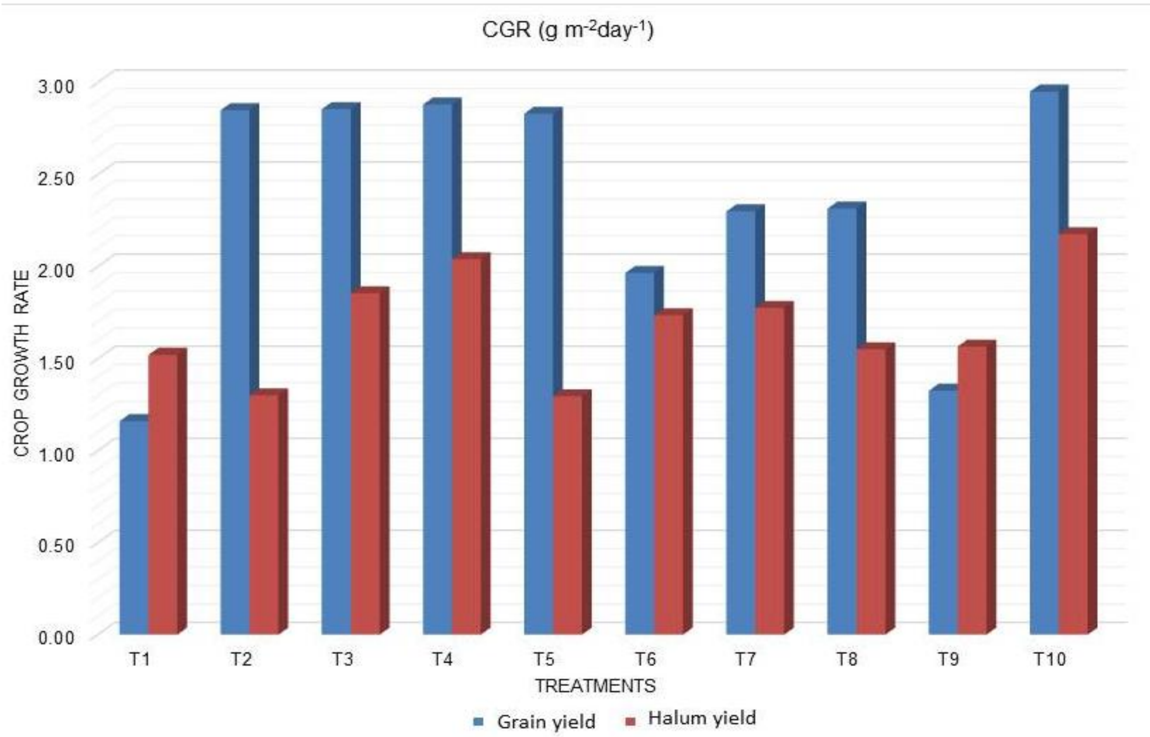

Fig. 6. Influence of vermicompost and other foliar application on the Crop growth rate of Irrigated Blackgram

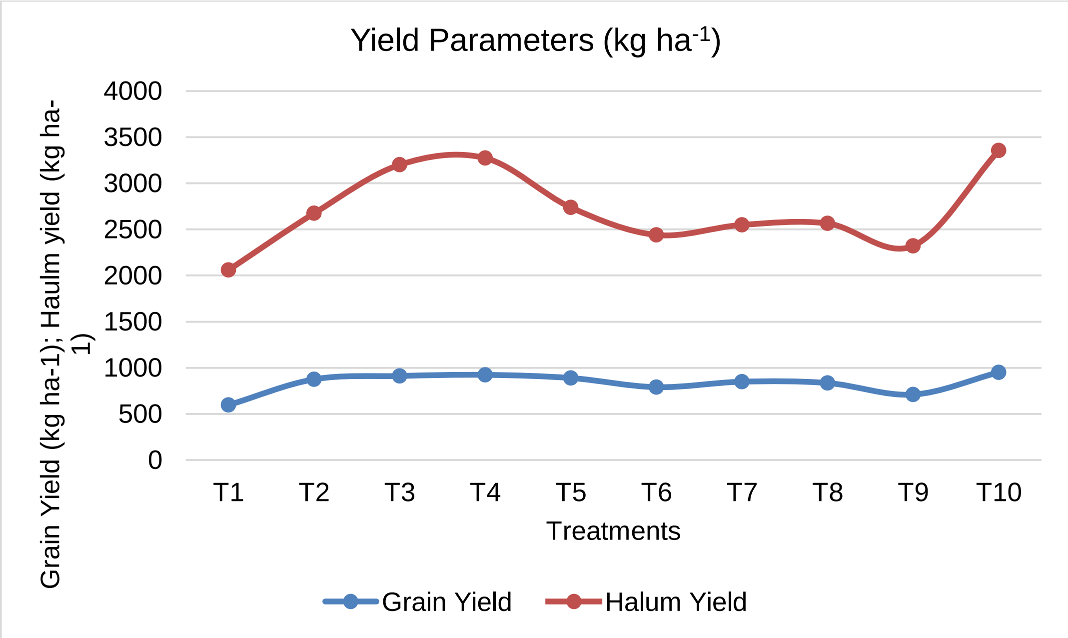

Fig. 7. Influence of vermicompost and other foliar application on Yield parameters of Irrigated Blackgram

Table 1. Influence of vermicompost and other foliar application on Growth parameters of Irrigated Blackgram

Treatments	Plant height (cm)				DMP (kg ha^{-1})			
	20DAS	40 DAS	60DAS	HARVEST	20DAS	40 DAS	60DAS	HARVEST
T_1	15.20	25.47	26.69	27.39	170	402	706	2100
T_2	19.56	33.47	34.69	35.71	275	845	1105	2953
T_3	21.02	34.49	36.26	37.64	309	880	1251	3105
T_4	21.73	35.20	37.59	38.79	317	893	1301	3245
T_5	20.45	34.23	35.67	36.83	298	864	1123	3006
T_6	17.23	27.61	30.98	31.89	205	598	945	2863
T_7	18.42	30.56	33.19	34.29	250	710	1065	2932
T_8	18.10	28.54	31.72	32.58	220	683	993	2920
T_9	16.50	26.39	28.29	30.43	185	450	763	2800
T_{10}	22.52	35.76	38.93	39.66	320	910	1345	3390
SE (d)	**1.89**	**3.07**	**3.29**	**3.40**	**25.49**	**73.67**	**106.09**	**290.16**
CD p=0.05	**3.99**	**6.51**	**6.97**	**7.21**	**53.97**	**155.97**	**224.62**	**614.32**

*T_1 - Control **,** T_2 - Vermicompost 100% (on N Equivalent basis)+ Cowdung slurry; T_3 -Vermicompost100% (on N Equivalent basis)+TNAU Biomineralizer,T_4 -Vermicompost 100% (on N Equivalent basis) + (Effective microorganism),T_5 - Vermicompost 100% (on N Equivalent basis) + Pleurotus sp + Urea, T_6- Vermicompost (50%) +RDF (50%) + Cowdung slurry, T_7- Vermicompost (50%) +RDF (50%) + TNAU Biomineralizer, T_8 -Vermicompost (50%) + RDF (50%) + EM (Effective Microorganism),T_9 -Vermicompost (50%) + RDF (50%) + Pleurotus sp ,T_{10} - RDF alone*

Table 2. Influence of vermicompost and other foliar application on Physiological parameters of Irrigated Blackgram

Treatments	LAI			CGR(g m^{-2}day^{-1})	
	20DAS	40 DAS	60DAS	20-40 DAS	40-60 DAS
T1	0.10	1.47	3.56	1.16	1.52
T2	0.32	2.95	4.97	2.85	1.30
T3	0.38	3.62	5.49	2.86	1.86

Treatments	LAI			CGR(g $m^{-2}day^{-1}$)	
	20DAS	**40 DAS**	**60DAS**	**20-40 DAS**	**40-60 DAS**
T4	0.40	3.76	5.46	2.88	2.04
T5	0.35	3.59	5.21	2.83	1.30
T6	0.21	2.63	4.63	1.97	1.74
T7	0.29	2.83	4.82	2.30	1.78
T8	0.25	2.76	4.82	2.32	1.55
T9	0.16	2.25	4.37	1.33	1.57
T10	0.42	3.84	5.53	2.95	2.18
SE (d)	**0.03**	**0.30**	**0.48**	**0.24**	**0.16**
CD p=0.05	**0.07**	**0.63**	**1.01**	**0.51**	**0.34**

*T_1 - Control **,** T_2 - Vermicompost 100% (on N Equivalent basis)+ Cowdung slurry; T_3 -Vermicompost100% (on N Equivalent basis)+TNAU Biomineralizer,T_4 -Vermicompost 100% (on N Equivalent basis) + (Effective microorganism),T_5 - Vermicompost 100% (on N Equivalent basis) + Pleurotus sp + Urea, T_6- Vermicompost (50%) +RDF (50%) + Cowdung slurry, T_7- Vermicompost (50%) +RDF (50%) + TNAU Biomineralizer, T_8 -Vermicompost (50%) + RDF (50%) + EM (Effective Microorganism),T_9 -Vermicompost (50%) + RDF (50%) + Pleurotus sp ,T_{10} - RDF alone*

Table 3. Influence of vermicompost and other foliar application on Yield parameters of Irrigated Blackgram

Treatments	Grain Yield (kg/ha)	Halum Yield (kg/ha)
T1	597	1463
T2	875	1800
T3	911	2290
T4	923	2350
T5	889	1849
T6	790	1650
T7	849	1700
T8	835	1730
T9	710	1611
T10	950	2405
SE (d)	**82.31**	**187.44**
CD p=0.05	**174.26**	**396.85**

*T_1 - Control **,** T_2 - Vermicompost 100% (on N Equivalent basis)+ Cowdung slurry; T_3 -Vermicompost100% (on N Equivalent basis)+TNAU Biomineralizer,T_4 -Vermicompost 100% (on N Equivalent basis) + (Effective microorganism),T_5 - Vermicompost 100% (on N Equivalent basis) + Pleurotus sp + Urea, T_6- Vermicompost (50%) +RDF (50%) + Cowdung slurry, T_7- Vermicompost (50%) +RDF (50%) + TNAU Biomineralizer, T_8 -Vermicompost (50%) + RDF (50%) + EM (Effective Microorganism),T_9 -Vermicompost (50%) + RDF (50%) + Pleurotus sp ,T_{10} - RDF alone*

The increased plant height observed in RDF alone which was attributed due to the utilization of chemical fertilizers, which promotes improved vegetative growth. This, in turn, contributes to enhanced plant height and total dry matter production. This was in accordance with Dwivedi (2022). Similar findings were reported by (Amruta et al. 2016). The nutrients that are available through supply of inorganic fertilizers and mineralization process accelerates the cell division and cell elongation which ultimately improved the growth attributes of black gram [5]. These findings are similar with Kant et al. [6].

One potential reason for the increase in dry matter production could be the enhanced nitrogen availability resulting from the presence of facultative methylotrophs with nitrogen-fixing capabilities as reported by Ajaykumar et al. [7]. The application of inorganic fertilizers could have helped in steady and balanced availability of both native and applied nutrients which might have enabled the leaf area duration to extend, thereby providing an opportunity for the plants to increase the photosynthetic rate which in turn resulted in higher accumulation of drymatter [8].

The higher leaf area index (LAI) could be a result of enhanced activity of meristematic tissues in plants, facilitated by the availability of adequate nutrients for an extended period. As a consequence, there is greater cell differentiation, meristematic division, and translocation of food materials within plants. These processes ultimately lead to the production of a greater number of branches at different stages of growth [9].

The combined application NPK rates to the blackgram increased availability of major and minor nutrients to plant might have enhanced early root growth and cell multiplication leading to more absorption of other nutrients from deeper layers of soil ultimately resulting in increased plant growth attributes and finally increased crop growth rate [10].

The increased yield attributes and yield might be due the increased supply of the major nutrients by translocation of photosynthates accumulated under the influence of the sources of inorganic nutrients. [11,12]. The absorption of nutrients might have helped the plant in greater photosynthesis, nitrogen metabolism and synthesis of carbohydrates. Similar findings were reported by Jha et al*.* [10].

The application of fertilizers had a significant impact on the growth and yield attributes, as it increased the availability of essential nutrients to the plants. Was reported by Kumari et al*.* [13].

These physiological processes contributed to the overall increase in seed and stover yield, demonstrating the positive impact of the combined use of inorganic fertilizers and organic manures on crop productivity Zahida et al. [14].

The higher application rate of RDF likely contributed to an increase in haulm yield. This can be attributed to the adequate supply of NPK nutrients, which supported improved vegetative growth and prevented stickiness in the plant. Furthermore, the reduced flower drop, possibly resulting from the nutrient foliar spray, may have contributed to increased pod biomass. The cumulative effect of these factors ultimately led to a higher haulm yield in blackgram Shekhawat [15], [16,17].

5. CONCLUSION

In conclusion, this study aimed to evaluate the influence of vermicompost application on the growth and yield parameters of black gram. The results demonstrated that Diapplying a recommended dose of fertilizer (RDF) alone (T_{10}) showed significant improvements in all growth and yield parameters, indicating the high efficacy of vermicompost as an organic fertilizer for enhancing black gram growth and productivity. This highlights the potential of vermicompost as a sustainable and environmentally friendly approach to agriculture, promoting nutrient-rich soil and sustainable crop production.

Furthermore, the study assessed the foliar application of various organic inputs on black gram's growth and yield parameters. The combination of Vermicompost 100% (on N Equivalent basis) and 2% Effective Microorganism (T4) proved to be the most effective treatment, as it exhibited the highest efficacy across all growth and yield parameters. This specific combination of organic inputs demonstrated a significant positive impact on black gram's growth and yield. Additionally, the treatment that combined Vermicompost 50%, RDF 50%, and 2% TNAU Biomineralizer (T7) displayed a wide range of positive effects on growth and yield parameters. These findings suggest a synergistic effect between organic and inorganic inputs when used together, leading to improved outcomes in black gram cultivation.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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