



Assessment of Correlation between Growth and Yield of Blackgram with Residual Effect of Organic and Inorganic Sources of Nutrients and AM Fungi Applied to Rice in Aerobic Rice-blackgram Cropping System

A. Sangothari¹, S. Radhamani¹

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ABSTRACT

Background: Cultivation of cereal followed by legume on the same land not only provide essential dietary carbohydrate, protein and vitamin to household but also enhances soil fertility through the symbiotic process of nitrogen fixation by legume. Moreover, legume contribute quality crop residues suitable for livestock feed. Beyond these nutritional and soil health benefits, adopting such farming practices has the potential to boost the income and livelihoods of smallholder farmers. The concurrent use of organic manure and inorganic fertilizer not only mitigates soil hazards but also significantly enhances crop productivity.

Methods: A field experiment was conducted at wetland farms, Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore, India during summer-*kharif* seasons of the year 2022 and *navarai* - summer seasons of the year 2022-23 on aerobic rice-blackgram cropping system.

Result: The positive influence of legumes on soil quality is considered a crucial factor in enhancing the production of non-legume crops grown in a rotation system. The success of a cropping system relies on the judicious management of resources, with a particular emphasis on the balanced utilization of organic manures, inorganic fertilizers and biofertilizer. The present study concluded that residual effect of 50% RDN through inorganic fertilizer + 25% of RDN through enriched FYM + 25% RDN through vermicompost + AM fungi + foliar application of nutrients (0.5% Urea + 1% FeSO₄ + 0.5% ZnSO₄ at 25 and 45 DAS) (S₆) recorded significantly higher growth parameters, yield parameters and yield of succeeding blackgram compared to other sources of nutrients.

Key words: Aerobic rice, AM fungi, Blackgram, Growth, Vermicompost, Yield.

INTRODUCTION

Black gram is considered a vital legume crop in India, cultivated across 4.2 million hectares and annual productivity of 557 kg ha⁻¹ (Anonymous, 2021). Rice-based cropping systems play a fundamental role in global food production (Samant *et al.*, 2021). In India, rice serves as the predominant crop during the *kharif* season and the land left fallow after rice cultivation is not fully utilized. There is substantial potential to make productive use of the fallow land under rice cultivation, presenting a significant opportunity to address food and nutritional insecurity. Black gram, being a short-duration and hardy crop, is well-suited for inclusion in the cropping sequence, as it efficiently utilizes residual nutrients, moisture and other inputs from the preceding rice crop. This approach enhances overall agricultural productivity and resource utilization. The extensive practice of cultivating rice through monocropping, coupled with the excessive application of chemical fertilizers and inadequate management of crop and nutrients, has led to the degradation of soil physico-chemical and biological properties. This degradation poses a significant threat to the productivity and sustainability of the agricultural system (Patra *et al.*, 2019). One potential partial solution to this problem is transitioning to a rice-legume cropping system (Deep *et al.*, 2018).

¹Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore-641 003, Tamil Nadu, India.

Corresponding Author: S. Radhamani, Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore-641 003, Tamil Nadu, India. Email: subhamythili@yahoo.co.in

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Organic manures serve as a valuable source of organic carbon, as well as macro and micro nutrients, contributing to the improvement of soil properties. They not only enhance the soil fertility but also exhibit a carry-over effect that positively influences the succeeding crops in a rice-based cropping system (Shweta *et al.*, 2021). *Dhanicha* (*Sesbania aculeate*) is a green manuring crop, contribute approximately 60-80 kg of nitrogen per hectare upon soil incorporation. It increases soil humus, available soil nitrogen and improves soil physico-chemical and biological properties and also acts as chelating compound that help in increasing the availability of nutrients such as zinc, copper,

manganese and others to the subsequent crop (Sanjeev and Sukul, 2020). To enhance the productivity and yield of legumes, farmers often utilize significant amounts of chemical fertilizers. However, this practice has adverse effect on the soil such as buildup the toxic salts. An alternative and more environmentally friendly solution is the application of bio-fertilizers, which not only mitigates environmental impact but also proves to be a cost-effective option. Arbuscular mycorrhizal (AM) fungi represent a type of mycorrhizae characterized by the penetration of the fungus into the cortical cells of vascular plant roots. The term "mycorrhizal" denotes connection between "fungus" and "roots." This association is symbiotic, occurring in the root system, where the fungus derives carbon from the host plant photosynthates. In return, the host plant benefits by obtaining essential nutrients, including phosphorus, calcium, copper, zinc, etc., facilitated by the fine absorbing hyphae of the fungus. These nutrients are typically inaccessible to the plant without the assistance of the mycorrhizal association (Havugimana *et al.*, 2016). In contrast, chemical fertilizers are synthetically manufactured substances that provide mineral nutrients in higher concentrations, making them soluble and easily accessible to plant. However, the consistent use of nutrients from chemical sources can lead to the degradation of soil fertility over time (Masu *et al.*, 2019). Therefore, integration of both organic and inorganic fertilizers will play a crucial role in improving soil nutrient availability, restoring fertility and enhancing overall sustainability (Mahmood *et al.*, 2017; Kamble *et al.*, 2018; Saikia *et al.*, 2018; Midya *et al.*, 2021). This strategy is flexible, minimizing the utilization of chemical fertilizers, improving soil health and generating a more pronounced carry-over effect on the subsequent crop (Jana *et al.*, 2020). Moreover, engaging in a rice-fallow pulse cropping rotation not only ensures financial stability for farmers through higher yield and income but also enhances the sustainability of the rice production system by promoting soil health. This approach contribute to improving food and nutritional security for small farm families affected by poverty. Considering this perspective, a field experiment was carried out to examine the residual impact of diverse nutrient management practices applied in aerobic rice on the growth parameters, yield attributes and yield of the subsequent black gram crop.

MATERIALS AND METHODS

The main field experiment was conducted at field No.F1 wetland farms, Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore to study the INM practices in aerobic rice and their residual effect on succeeding blackgram. The experimental field was located at 11°01'06"N Latitude, 76°58'21"E Longitude and 426.7 m above Mean Sea Level (MSL). The experimental field exhibited a uniform topography with a mild slope, providing effective drainage and possessed clay loamy texture. At a depth of 0-15 cm, the soil in the experimental field showed low in organic carbon (0.66 and 0.68 g kg⁻¹) and available

nitrogen (210 and 222 kg ha⁻¹), medium in available phosphorus (20.2 and 21.7 kg ha⁻¹), high in potassium (690 and 699 kg ha⁻¹) and alkaline pH (8.10 and 8.00), during the *kharif* and summer seasons, respectively. The research site situated in the western Agro-Climatic Zone of Tamil Nadu. The experiment as conducted during summer-*kharif* season (March-October, 2022) and *navarai*-summer (Decembe-July, 2022-23). The field experiment was conducted in split plot design with three replications. Main plot treatments comprised of M₁- Rice alone and M₂ - Rice + *Dhaincha* intercropping and sub plot treatments were S₁ - Control, S₂ - 100% Recommended Dose of Nitrogen (RDN) through inorganic fertilizer, S₃ - 50% RDN through inorganic fertilizer + 50% of RDN through enriched FYM, S₄ - 50% RDN through inorganic fertilizer + 50% of RDN through enriched FYM + AM fungi + foliar application of nutrients (0.5% Urea +1% FeSO₄ + 0.5% ZnSO₄ at 25 and 45 DAS), S₅ - 50% RDN through inorganic fertilizer + 25% of RDN through enriched FYM + 25% RDN through vermicompost (top dressed at 25 DAS) and S₆ - 50% RDN through inorganic fertilizer + 25% of RDN through enriched FYM + 25% RDN through vermicompost (top dressed at 25 DAS) + AM fungi + foliar application of nutrients (0.5% Urea +1% FeSO₄ + 0.5% ZnSO₄ at 25 and 45 DAS).

Paddy seeds were directly sown under dry soil conditions with a spacing of 20 × 10 cm. Along with rice, *dhaincha* seeds were sown in an additive series (1:1 ratio) as per the treatment schedule and the green manure was incorporated at 25 DAS by manually. The inoculum of AM fungi collected from the Department of Microbiology, Tamil Nadu Agricultural University, Coimbatore, was mixed with FYM and applied at the time of sowing of paddy seeds. EFYM was prepared by mixing of FYM with recommended quantity of phosphorus and then, allowed for 15 days under shade. This will ensure that the phosphate fertilizer and other nutrients are readily available for plants when applied to soil. EFYM was applied before sowing of the crop basally. Vermicompost was top dressed at 25 DAS of the rice crop as per treatment schedule. The recommended dose of inorganic sources of nitrogen was applied in split doses as per the treatments schedule. Nitrogen was applied in four splits as 20% at 15 DAS, 30% each at tillering and panicle initiation stages and 20% at flowering stage of rice crop. Potassium was applied in two equal splits as 50% at basal and 50% at panicle initiation stages. Foliar applications of urea, Fe and Zn were given at 25 and 45 DAS. Before the incorporation of organic manures, their N contents were analysed and the quantity of manures required per hectare was worked out. The nitrogen content of enriched FYM was 1.87 per cent and vermicompost was 2.21 per cent. Fresh biomass of *dhaincha* at 25 DAS was 2186 and 2091 kg ha⁻¹ and the corresponding N contents were 1.23 and 1.20 per cent during the years 2022 and 2023, respectively.

After harvest of rice crop, blackgram was sown in the rice stubbles. Recommended package of practices were followed to blackgram and the residual effect of organic

manures applied to the rice field was studied. Data on various growth parameters such as plant height, leaf area index and dry matter accumulation were recorded periodically at 20, 40 DAS and at harvest stage. At the time of harvest, yield components, yield were recorded.

Statistical analysis

Data were analysed with split plot design by using R software package (GrapesAgri1, Version 1.0.0). In the manuscript, the normality of the parameters was assessed using R software, revealing that all parameters exhibited a normal distribution. The means were distinguished through Duncan's multiple range tests, applying the least significant difference (LSD) method with a significance level of $P \leq 0.05$. Additionally, correlation analysis was done using the Pearson method with the R software (Gopinath *et al.*, 2021).

RESULTS AND DISCUSSION

Growth attributes

Residual effect of intercropping of *dhaincha* (M_2) showed non significant effect on growth attributes at all the stages of succeeding crop in both the seasons.

During *kharif* season, among the INM practices, plot received with 50% RDN through inorganic fertilizer + 25% of RDN through enriched FYM + 25% RDN through vermicompost + AM fungi + foliar application of nutrients (0.5% Urea + 1% FeSO_4 + 0.5% ZnSO_4 at 25 and 45 DAS) (S_6) for rice crop has recorded significantly higher plant height of blackgram compared to all other treatments (Table 1 and 1a). The treatment S_6 recorded maximum plant height of 19.1, 29.3 and 34.5 cm at 20, 40 DAS and at harvest, respectively. This was closely followed by application of 50% RDN through inorganic fertilizer + 50% of RDN through

Table 1: Residual effect of INM practices on plant height (cm) of blackgram (*Kharif*, 2022).

Treatments	Plant height (cm)		
	20 DAS	40 DAS	Harvest
Main plot: Rice + <i>Dhaincha</i> intercropping			
M_1 - Rice alone	15.0 ^a	23.4 ^a	28.5 ^a
M_2 - Rice + <i>Dhaincha</i> (1:1)	16.3 ^a	25.9 ^a	30.6 ^a
SEd	0.6	0.7	0.6
CD ($P=0.05$)	NS	NS	NS
Sub plot: INM practices			
S_1 - Control	12.0 ^d	18.3 ^d	24.5 ^e
S_2 - 100% RDN through inorganic	14.1 ^d	21.7 ^d	26.8 ^{de}
S_3 - 50% RDN through inorganic+ 50% of RDN through EFYM	14.8 ^{cd}	24.7 ^c	28.6 ^{cd}
S_4 - S_3 + AM fungi + (0.5% Urea + 1% FeSO_4 + 0.5% ZnSO_4 at 25 and 45 DAS)	17.6 ^{ab}	27.8 ^{ab}	32.3 ^{ab}
S_5 - 50% RDN through inorganic + 25% of RDN through EFYM + 25% RDN through Vermicompost	16.4 ^{bc}	26.2 ^{bc}	30.7 ^{bc}
S_6 - S_5 + AM fungi + (0.5% Urea + 1% FeSO_4 + 0.5% ZnSO_4 at 25 and 45 DAS)	19.1 ^a	29.3 ^a	34.5 ^a
SEd	0.7	1.3	1.3
CD ($P=0.05$)	1.5	2.8	2.8

Table 1a: Residual effect of INM practices on plant height (cm) of blackgram (*Summer*, 2023).

Treatments	Plant height (cm)		
	20 DAS	40 DAS	Harvest
Main plot: Rice + <i>Dhaincha</i> intercropping			
M_1 - Rice alone	18.6 ^a	28.7 ^a	38.9 ^a
M_2 - Rice + <i>Dhaincha</i> (1:1)	20.5 ^a	30.9 ^a	41.1 ^a
SEd	0.5	0.8	1.0
CD ($P=0.05$)	NS	NS	NS
Sub plot: INM practices			
S_1 - Control	16.9 ^d	25.0 ^d	35.1 ^d
S_2 - 100% RDN through inorganic	17.5 ^{cd}	26.0 ^d	38.0 ^{cd}
S_3 - 50% RDN through inorganic + 50% of RDN through EFYM	18.2 ^{cd}	29.2 ^c	39.4 ^{bc}
S_4 - S_3 + AM fungi + (0.5% Urea + 1% FeSO_4 + 0.5% ZnSO_4 at 25 and 45 DAS)	21.3 ^b	32.9 ^{ab}	42.8 ^{ab}
S_5 - 50% RDN through inorganic + 25% of RDN through EFYM + 25% RDN through Vermicompost	19.4 ^c	31.0 ^{bc}	40.4 ^{bc}
S_6 - S_5 + AM fungi + (0.5% Urea + 1% FeSO_4 + 0.5% ZnSO_4 at 25 and 45 DAS)	24.0 ^a	34.7 ^a	44.4 ^a
SEd	0.9	1.3	1.6
CD ($P=0.05$)	1.8	2.7	3.4

enriched FYM + AM fungi + foliar application of nutrients (0.5% Urea + 1% FeSO_4 + 0.5% ZnSO_4 at 25 and 45 DAS (S_4). The lowest plant height of blackgram was recorded in control plot (S_1). Similar trend was observed at 20, 40 DAS and at harvest during summer season also. This might be due to application of a higher proportion of nutrients through organic sources during the cultivation of aerobic rice. These

organic sources, such as enriched farmyard manure and vermicompost provided a substantial amount of nutrients to the soil. The slow decomposition of these organic materials allowed for a gradual release of nutrients, which could have carried over to the succeeding blackgram crop. As a result, the blackgram crop benefited from the residual nutrients, lead to improved growth and increased the yield

Table 2: Residual effect of INM practices on leaf area index of blackgram (*Kharif*, 2022 and *summer*, 2023).

Treatments	Leaf area index			
	<i>Kharif</i> , 2022		<i>Summer</i> , 2023	
	20 DAS	40 DAS	20 DAS	40 DAS
Main plot: Rice + <i>Dhaincha</i> intercropping				
M_1 - Rice alone	0.48 ^a	2.31 ^a	0.51 ^a	2.42 ^a
M_2 - Rice + <i>Dhaincha</i> (1:1)	0.52 ^a	2.58 ^a	0.56 ^a	2.83 ^a
SEd	0.02	0.07	0.01	0.11
CD (P=0.05)	NS	NS	NS	NS
Sub plot: INM practices				
S_1 - Control	0.33 ^e	1.65 ^f	0.34 ^d	1.69 ^d
S_2 - 100% RDN through inorganic	0.41 ^d	1.87 ^e	0.43 ^c	2.16 ^c
S_3 - 50% RDN through inorganic + 50% of RDN through EFYM	0.48 ^c	2.24 ^d	0.53 ^b	2.60 ^b
S_4 - S_3 + AM fungi + (0.5% Urea + 1% FeSO_4 + 0.5% ZnSO_4 at 25 and 45 DAS)	0.62 ^a	3.05 ^b	0.65 ^a	3.13 ^a
S_5 - 50% RDN through inorganic + 25% of RDN through EFYM + 25% RDN through Vermicompost	0.54 ^b	2.62 ^c	0.58 ^b	2.78 ^b
S_6 - S_5 + AM fungi + (0.5% Urea + 1% FeSO_4 + 0.5% ZnSO_4 at 25 and 45 DAS)	0.65 ^a	3.25 ^a	0.67 ^a	3.38 ^a
SEd	0.02	0.09	0.03	0.12
CD (P=0.05)	0.05	0.19	0.06	0.25

Table 3: Residual effect of INM practices on yield of blackgram during *kharif*, 2022 and *summer*, 2023.

Treatments	<i>Kharif</i> , 2022		<i>Summer</i> , 2023	
	Grain yield	Haulm yield	Grain yield	Haulm yield
	(kg ha ⁻¹)	(kg ha ⁻¹)	(kg ha ⁻¹)	(kg ha ⁻¹)
Main plot: Rice + <i>Dhaincha</i> intercropping				
M_1 - Rice alone	350 ^a	1019 ^a	483 ^a	1140 ^a
M_2 - Rice + <i>Dhaincha</i> (1:1)	415 ^a	1126 ^a	540 ^a	1231 ^a
SEd	15	27	14	26
CD (P=0.05)	NS	NS	NS	NS
Sub plot: INM practices				
S_1 - Control	240 ^e	915 ^d	355 ^e	980 ^e
S_2 - 100% RDN through inorganic	338 ^d	1027 ^c	467 ^d	1082 ^{de}
S_3 - 50% RDN through inorganic + 50% of RDN through EFYM	383 ^c	1036 ^c	511 ^{cd}	1176 ^{cd}
S_4 - S_3 + AM fungi + (0.5% Urea + 1% FeSO_4 + 0.5% ZnSO_4 at 25 and 45 DAS)	440 ^b	1151 ^{ab}	572 ^b	1291 ^{ab}
S_5 - 50% RDN through inorganic + 25% of RDN through EFYM + 25% RDN through Vermicompost	393 ^c	1091 ^{bc}	525 ^{bc}	1231 ^{bc}
S_6 - S_5 + AM fungi + (0.5% Urea + 1% FeSO_4 + 0.5% ZnSO_4 at 25 and 45 DAS)	503 ^a	1215 ^a	638 ^a	1355 ^a
SEd	17	54	28	45
CD (P=0.05)	36	113	59	93

of blackgram. The results were in confirmation with the findings of Ghosh *et al.* (2013) and Dash *et al.* (2017).

With respect to leaf area index of the blackgram, higher leaf area index (0.65 and 3.25 in *kharif* season 2022, 0.67 and 3.38 in summer season 2023) was recorded at 20 and 40 DAS, respectively in the plot received with 50% RDN through inorganic fertilizer + 25% of RDN through enriched FYM and vermicompost + AM fungi + foliar application of nutrients (0.5% Urea + 1% FeSO_4 + 0.5% ZnSO_4 at 25 and 45 DAS) (S_6) when compared to other treatments. The differences in leaf area per plant observed in various treatments could be attributed to variations in the number of leaves per plant due to the availability of nutrients derived from both inorganic and organic fertilizers (Table 2). The present results are in accordance with the

findings of Elamin and Madhavi (2015) and Rao *et al.* (2019). Treatments with AM fungi were found to enhance overall plant growth by promoting cell proliferation, development and playing a significant role in shoot developmental morphology. These observations were supported by the findings of Kumar *et al.* (2022).

Residual effect of 50% RDN through inorganic fertilizer + 25% of RDN through enriched FYM and vermicompost + AM fungi + foliar application of nutrients (0.5% Urea + 1% FeSO_4 + 0.5% ZnSO_4 at 25 and 45 DAS) (S_6) recorded significantly higher dry matter production (491, 1630 and 1976 kg ha^{-1} in *kharif* 2022 and summer, 2023, 525, 1740 and 2185 kg ha^{-1} in summer season 2023 than all other treatments at 20, 40 DAS and at harvest, respectively) (Fig 1 and 1a). This could be attributed to the higher

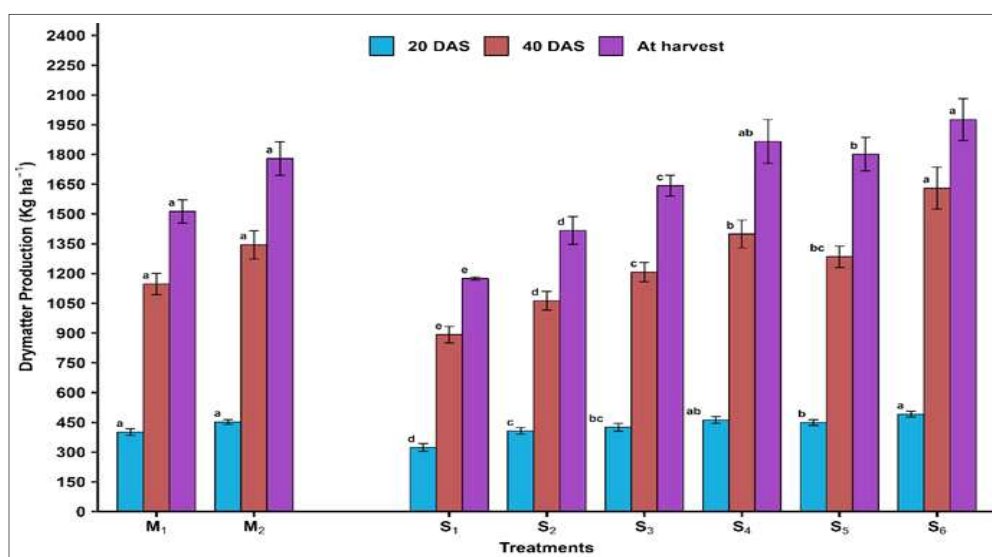


Fig 1: Residual effect of INM practices on drymatter production (kg ha^{-1}) of blackgram (*Kharif*, 2022).

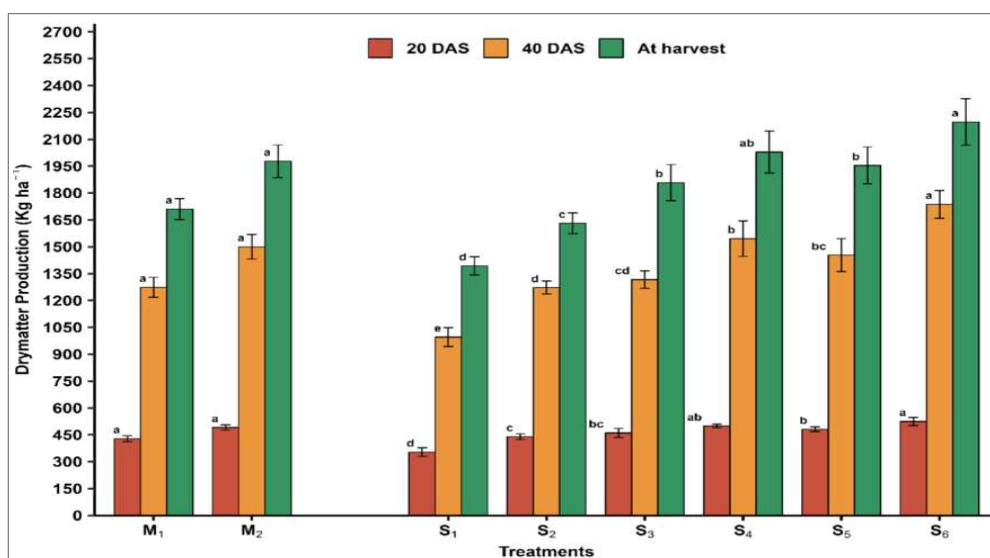


Fig 1a: Residual effect of INM practices on drymatter production (kg ha^{-1}) of blackgram (*Summer*, 2023).

availability of nutrients under INM treatments. This increased nutrient availability led to a higher conversion of carbohydrate into protein, subsequently contributing to the elaboration of protoplasm and cell wall materials, thereby increasing cell size. This morphological expression was evident in terms of plant height, the number of branches plant⁻¹ and ultimately, greater dry matter accumulation. It is noted that cellulose, being a highly persistent component, requires an extended period for decomposition. As a result, EFYM and Vermicompost may not have been fully utilized by the aerobic rice crop. However, their effect were notably beneficial to the succeeding blackgram crop. Sodavadiya *et al.* (2023) Reported similar findings in a chickpea-sorghum cropping system. Interaction effect between

residual effect of *dhaincha* intercropping and INM practices on growth attributes of blackgram was non-significant during *kharif* and *summer* seasons.

Yield attributes and yield

There was no significant influence on residual effect of *dhaincha* intercropping (M_2) on yield attributes and yield of the blackgram in both the seasons.

During *kharif* and summer seasons, the yield components viz., number of pods plant⁻¹, (31.0 and 34.5), number of seeds pod⁻¹ (6.3 and 6.5) grain (503 and 638 kg ha⁻¹) and haulm yield (1215 and 1355 kg ha⁻¹, respectively) was significantly higher with the residual effect caused by combined application of 50% RDN through inorganic fertilizer + 25% of RDN through enriched FYM + 25% RDN

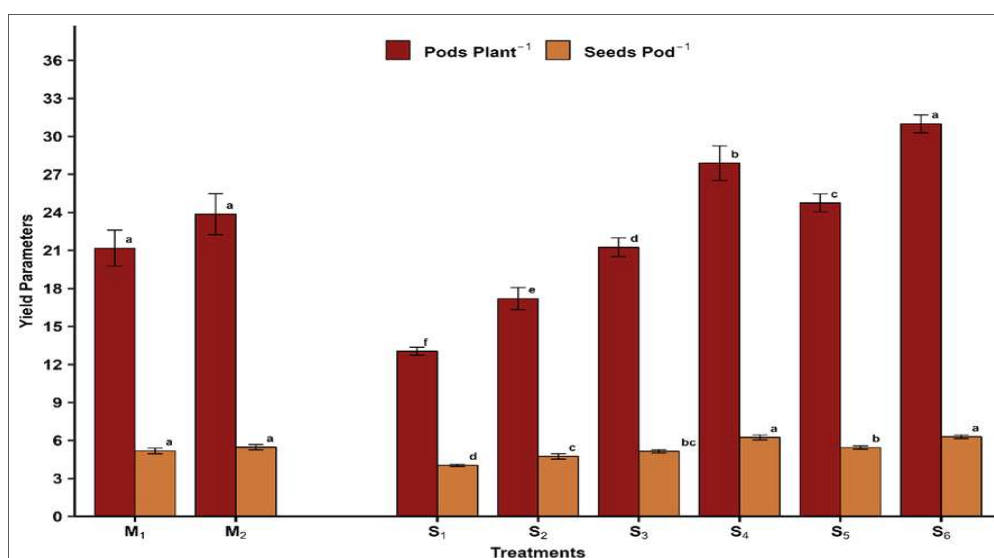


Fig 2: Residual effect of INM practices on pods plant⁻¹ and seeds pod⁻¹ of blackgram (*Kharif*, 2022).

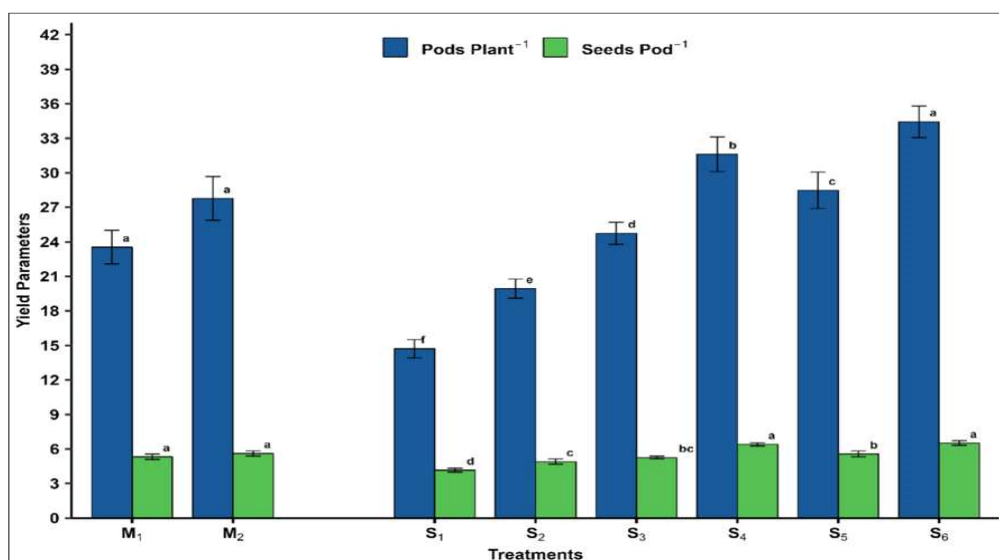


Fig 2a: Residual effect of INM practices on pods plant⁻¹ and seeds pod⁻¹ of blackgram (*Summer*, 2023).

through vermicompost + AM fungi + foliar application of nutrients (0.5% Urea + 1% FeSO_4 + 0.5% ZnSO_4 at 25 and 45 DAS) (S_6) over other treatments. Whereas, it was followed by combined application of 50% RDN through inorganic fertilizer + 50% of RDN through enriched FYM + AM fungi + foliar application of nutrients (0.5% Urea + 1% FeSO_4 + 0.5% ZnSO_4 at 25 and 45 DAS) (S_4). The lowest yield component and yield was recorded in control plot (S_1) (Fig 2 and 2a). Interaction effect between residual effect of *dhaincha* intercropping and INM practices on yield attributes and yield of blackgram was non-significant during *kharif*

and *summer* seasons. The combined application of organic manures and inorganic fertilizer to the preceding rice crop resulted in significantly increased in yield attributes such as, number of pods plant⁻¹ and number of seeds pod⁻¹, as well as grain and haulm yields of blackgram (Table 3). This effect was more pronounced in INM practices compared to application of recommended dose of fertilizer alone. The superior performance of the residual effect of enriched farmyard manure, vermicompost, could be attributed to the slow decomposition of these organic materials. The slow release of nutrients provided a

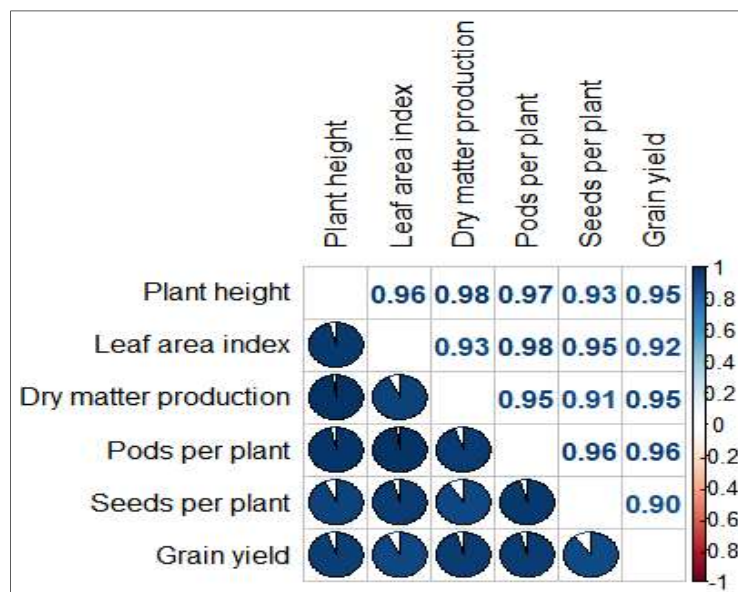


Fig 3: Correlation of growth and yield attributes with grain yield of succeeding blackgram during *kharif*, 2022.

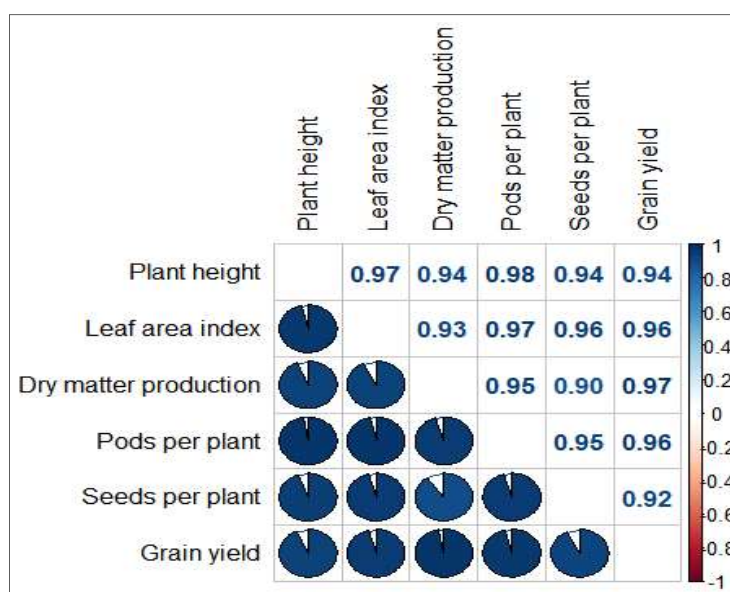


Fig 3a: Correlation of growth and yield attributes with grain yield of succeeding blackgram during *summer*, 2023.

sustained supply of essential elements to the crops over an extended period, ensuring optimal nutrient availability and uptake by the plants. In contrast, the recommended dose of fertilizer might have led to a relatively faster release of nutrients, which might not have been as efficient in meeting the crop nutrient demands throughout its growth cycle. Similar results were also obtained in previous studies conducted by Balasubramanian and Murugan (2019) and Mounika *et al.* (2020). The enhanced crop yield observed with mycorrhizal inoculation could be attributed to the increased root mass of blackgram plants, which directly influenced by the presence of mycorrhizal fungi. The development of a larger root mass, combined with the presence of fungal hyphae, might have contribute to improved nutrient accumulation and uptake in the plants. As a result, plant height, leaf area index and dry matter production was enhanced, lead to an increase in crop yield attributes and yield. The similar observations were also reported by Rahman *et al.* (2019).

Correlation studies

Correlation analysis was carried out for growth and yield attributes and yield of succeeding blackgram. Results revealed that there was positive correlation between plant height (0.96 and 0.94), leaf area index (0.92 and 0.96), drymatter production (0.96 and 0.97), pods plant⁻¹ (0.96 and 0.96), seeds pod⁻¹ (0.90 and 0.92), of backgram were observed with grain yield of blackgram during *kharif* and summer seasons, respectively (Fig 3 and 3a). This might be due to the effect of gradual release mechanism that ensures that nutrients remain available for subsequent crops. This approach reduced the nutrient losses and enhanced their availability to plants. The increased availability of nutrients plays a crucial role in facilitating the synthesis and translocation of carbohydrates from the source to the sink, ultimately lead to the production of higher growth and yield attributes and yield of blackgram.

CONCLUSION

Application of 50% RDN through inorganic fertilizer + 25% of RDN through enriched FYM + 25% RDN through vermicompost + AM fungi + foliar application of nutrients (0.5% Urea + 1% FeSO₄ + 0.5% ZnSO₄ at 25 and 45 DAS) along with *dhaincha* intercropping to preceding aerobic rice significantly influenced the growth attributes, yield components and yield of succeeding blackgram. This integrated system not only enhances overall crop productivity but also plays a crucial role in maintaining and sustaining soil health for future generation. Additionally, it contribute to the economic stability of farmers.

Conflict of interest

All authors declare that they have no conflicts of interest.

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