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Effect of integrated nutrient management on yield and yield attributes of black gram (*Vignamungo*L.)

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Abstract : To study the effect of integrated nutrient management on yield and yield attributes of blackgram (*Vigna mungo* L.),**a** field experiment was carried out at the instructional farm of Rajasthan College of Agriculture, Udaipur, during the *kharif* season of 2023.Theexperiment comprised twelve integrated nutrient management (INM) treatment sand was conducted with three replications using a randomised block design. The results indicated that the treatment of 75% recommended dose of fertilisers (RDF) combined with 25% nutrients from vermicompost (T_6) yielded the highest number of pods per plant (35.95), seeds per pod (4.85), and test weight (42.67 g) compared to the other treatments. Additionally, the seed (867 kg ha^{-1}), haulm (1615 kg ha^{-1}), and total biological yield (2481 kg ha^{-1}) were significantly greater under treatment T_6. However, the harvest index of black gram did not show a significant variation due to the INM practices. These findings suggest that integrating 75% RDF with 25% vermicompost is an effective nutrient management strategy for enhancing the yield and yield attributes of blackgram under semi-humid conditions.

Keywords: *Blackgram, Farm Yard Manure, Integrated Nutrient Management, Poultry Manure, Vermicompost,*

Introduction

The word soil represents one of the most active and complex natural systems on the earth's surface. It is essential for the existence of many forms of life and provides support to plant growth and also supplies the ir nutritional requirements (Zaware, 2014). Black gram (*Vigna mungo* L.) is a warm-season legume extensively cultivated for its nutritious seeds. It is mainly grown in India, Pakistan, Nepal, and several other Asian nations. It is well-suited for tropical and subtropical climates, flourishing in temperatures between 25°C and 35°C (77°F to 95°F). Black gram (*Vigna mungo* L.) is a key pulse crop in India, accounting for13% of the total pulses area and 10% of the total pulse production in the country. Black gram seeds are highly nutritious, comprising 24% protein, 60% carbohydrates, 1.3% fat, 3.2% minerals, 0.9% fiber, and 154 mg of calcium per 100 g, along with 385 mg of phosphorus, 9.1 mg of iron, and trace amounts of B-complex vitamins. It integrates well into various multiple and inter cropping systems as a short-duration crop. After harvesting the pods, the plant can be used as high-quality green or dry fodder or as green manure. Being a legume, it also enriches the soil by fixing atmospheric nitrogen. The crop needs a frost-free growing season and can tolerate various rainfall levels; however, optimal growth occurs with well-distributed rainfall between 600 to 800 mm. Black gram can thrive in different soil types but prefers well-drainedloamy soils with a pH between 6 and 7. Typically, black gram

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requires nitrogen (N), phosphorus (P), and potassium (K) fertilizers.

Conducting a soil test is advisable to assess nutrient levels, and fertilizers should be applied based on the available nutrient status. Incorporating well-decomposed organic manure before planting can enhance soil fertility. Integrated Nutrient Management (INM) is essential for sustainable agriculture, focusing on managing resources to fulfil evolving human needs while preserving environmental quality and conserving crucial natural resources. INM aims to maintain soil fertility at optimal levels for crop productivity by maximising the benefits from all available sources of plant nutrients, both organic and inorganic, in a coordinated approach (Aulakh and Grant,2008). IN Memphasizes the effective use of organic, inorganic, and biological resources to achieve optimal yields, enhance or maintain soil physical and chemical properties, and provide crop nutrition packages that are technically sound, economically viable, practically achievable, and environmentally safe. Among organic materials, Farmyard Manure (FYM) is a traditional and widely used source that farmers have utilised for centuries. Incorporating organic materials, such as FYM, into the soil helps sustainits fertility and productivity. Vermicompost, rich in essential plant nutrients, positively impacts overall plant growth, promoting new leaf development and enhancing the quality and shelf life of produce. It also improves soil structure, texture, aeration, and water retention, while preventing soil erosion. Combining farmyard manure or vermicompost with reduced amounts of inorganic fertilisers has been shown to boost soil fertility, crop growth, and yields. For improving black gram yield, it is advantageous to combine recommended fertiliser doses with FYM and vermicompost, as these nutrient sources providea balanced and sustained supply of nutrients, enhanceing photosynthesis and yield components. Both FYM and vermicompost improve soil quality by increasing the availability of essential nutrients and enhancing soil physical and chemical properties. However, relying solely on organic sources may not meet the immediate nutrient needs of the crop, as they release nutrients gradually through mineralization. Therefore, using a combination of organic (farmyard manure and vermicompost) and inorganic (fertilizers) nutrients ensures optimal nutrient delivery throughout the growth cycle. This study aimed to investigate the effects of INM on the growth and yield of irrigated black gram.

Material and Methods

The trial was conducted during the 2023 *kharif* season at the Instructional Farm of Rajasthan College of Agriculture in Udaipur. The farm is located at a latitude of 24º35'and longitude of 73º42', with an average elevation of 582.2 meters above sea level. This area falls under agro-climatic zone IV-a of Rajasthan, known as the Sub-humid Southern Plain and Aravalli Hills Zone. The region has a typical subtropical climate, featuring mild winters and moderate summers. The south-west monsoon period at Udaipur is from late June through September, contributing to the city's average annual rainfall of 637 mm. The experiment utilised a randomised block design, featuring three replications and twelve integrated nutrient management treatments (Table 1), with treatments randomly assigned to different experimental units. The Mash-479 black gram variety was use das the test crop, with a planting geometry of 30 cm x 10 cm. The recommended doses of NPK were applied at 20:40:0 kg ha^{-1}, using Urea and di-ammonium phosphate for fertilisation. The clay loam soil at the site had a pH of 8.18, indicating it was slightly alkaline. It was high in potassium (362.17 kg ha^{-1}), low in available nitrogen (265.32 kg ha^{-1}), and medium in phosphorus (19.50 kg ha^{-1}).

Results and Discussion

Yield Attributes

The results (Table 2 and Fig. 1) indicated that application of 75% RDF + 25% through Vermicompost (T_6) significantly increased pods $plant^{-1}$, seeds pod^{-1} and test weight by 73.76, 67.94, 66.03 per cent compared to control (T_1). However, treatment T_6 was at par with 75% RDF + 25% through poultry manure (T_{11}) and 75% RDF + 25% through FYM (T_5) in respect of pods $plant^{-1}$, seeds

Table 1: Treatment combination used in the study

S. No.	Treatments	Symbols
1.	Control	T1
2.	100% Recommended Dose of Fertilizer (RDF)	T2
3.	75% RDF	T3
4.	50% RDF	T4
5.	75% RDF+25% through Farm Yard Manure (FYM)	T5
6.	75% RDF+25% through Vermicompost	T6
7.	50% RDF+50% through FYM	T7
8.	50% RDF+50% through Vermicompost	T8
9.	75% RDF+*Rhizobium*+PhosphateSolubilisingBacteria (PSB)	T9
10.	50% RDF+*Rhizobium*+ PSB	T10
11.	75% RDF+25% through Poultry manure	T11
12.	50% RDF+50% through Poultry manure	T12

pod^{-1} and test weight. Application of 75% RDF + 25% through Vermicompost (T_6) resulted in the highest pods plant^{-1}, seeds pod^{-1} and test weight (Fig. 1).

The beneficial response of vermicompost to yield attributes and yield could be attributed to the availability of sufficient amounts of plant nutrients throughout the growth period, particularly during critical growth periods of the crop, resulting in better uptake, plant vigour, and superior yield attributes (Brar and Pasricha,1998). Shekhawat *et al*. (2018), Tyagi and Singh (2019) and Meera *et al*. (2022) also found similar results.

Table 2: Effect of integrated nutrient management on yield at tributes of black gram

Treatments	Yield attributes		
	Numberof pods plant^{-1}	Numberof seeds pod^{-1}	Test weight(g)
T1: Control	20.69	2.87	25.70
T2: 100% RDF	27.13	3.66	33.50
T3: 75% RDF	23.90	3.24	32.75
T4: 50% RDF	23.15	3.23	29.05
T5: 75% RDF + 25% through FYM	33.46	4.51	41.41
T6:75% RDF + 25% through Vermicompost	35.95	4.82	42.67
T7:50% RDF + 50% through FYM	29.52	3.94	36.97
T8:50% RDF+50% throughVermicompost	31.76	4.06	38.00
T9: 75% RDF + *Rhizobium* + PSB	26.75	3.54	33.03
T10:50% RDF + *Rhizobium* + PSB	23.86	3.10	29.50
T_{11}: 75% RDF + 25% through Poultry manure	34.73	4.74	41.77
T_{12}: 50% RDF+ 50% through Poultry manure	30.62	4.04	37.57
SEm±	0.822	0.122	1.111
CD (P=0.05)	2.410	0.357	3.257

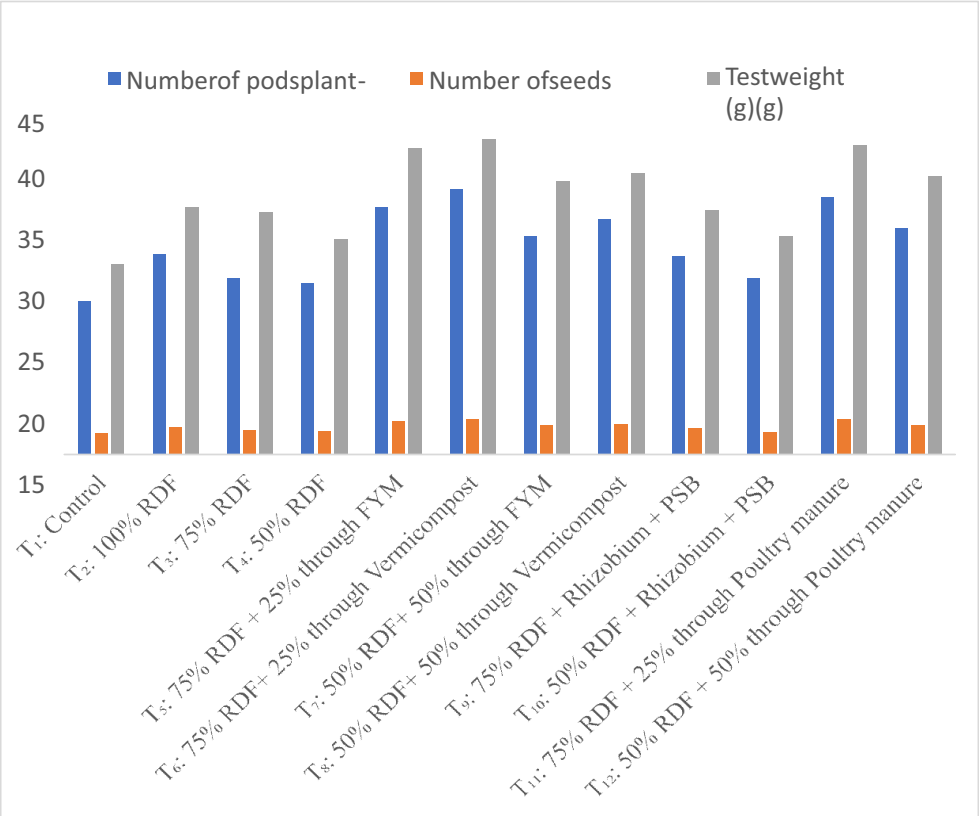

Fig. 1: Effect of integrated nutrient management treatment plans on number of pods, number of seeds and test weight (g) of blackgram

Seed yield

The seed yield of blackgram increased significantly due to INM and varied among the INM treatments (Table 3 and Fig. 2). The highest seed yield (867 kg/ha) was recorded in T_6 (75% RDF + 25% through vermicompost), closely followed by T_{11} (855 kg ha^{-1}; 75% RDF + 25% poultry manure) and T_5 (846 kg ha^{-1}; 75% RDF + 25% FYM). These treatments significantly outperformed the control (T_1), which recorded the lowest seed yield of 531 kg ha^{-1}. Treatments involving 100% RDF (T_2: 692 kg ha^{-1}) and 75% RDF alone (T_3: 615 kg ha^{-1}) yielded moderately, whereas partial substitution with organics (T_5, T_6, T_{11}) substantially improved seed yield. In general, combining 75% RDF with organic sources resulted in greater seed yield than either full RDF or reduced RDF with biofertilizers alone. This pattern underscores the beneficial role of integrating chemical fertilizers with organic amendments—particularly vermicompost and poultry manure—in enhancing black gram productivity. Vermicompost also improves the physical state of the soil, which enhances nutrient uptake and, in turn, tissue differentiation from somatic to reproductive meristematic activity. This results in an increase in the development of the floral primordial and a higher yield of blackgram. These findings corroborate the results of several other studies such as Kanwar *et al*. (2017), Gadi *et al*. (2017) and Meena *et al*. (2017).

Haulm yield

The haulm yield data reveal that integrated nutrient management practices significantly influenced the vegetative biomass production of blackgram. The highest haulm yield was recorded in T_6 (75% RDF + 25% vermicompost) at 1615 kg ha^{-1}, followed closely by T_{11} (75% RDF + 25% poultry manure) and T_5 (75% RDF + 25% FYM) with 1576 kg ha^{-1} and 1528 kg ha^{-1}, respectively. These treatments markedly outperformed

the control (T_1), which produced the lowest haulm yield of 1012 kg ha^{-1}. Treatments incorporating 50% RDF combined with organic sources (T_7, T_8, T_{12}) also produced higher haulm yields (ranging from 1404 to 1427 kg ha^{-1}) compared to RDF alone, highlighting the contribution of organic matter in enhancing plant growth. The trend indicates that integrating 75% RDF with organic sources not only supports higher seed yield but also significantly boosts haulm production, thereby improving the overall biomass yield of the crop. As plants grew and developed, the steady supply of nutrients from organic manure kept the production of metabolites and the efficiency of photosynthetic reactions at a higher level. Later, the translocation of photo synthates to differents in ksledtohigher seed andhaulm yields. Singh *et al*. (2017), Bhadu *et al*. (2018), Todawat and Sharma (2021), and Jakhar *et al*. (2022) and also found comparable results in their studies.

Biological yield

The biological yield, which represents the total above-ground biomass (seed + haulm), varied notably across the treatments, reflecting the combined effects of seed and haulm yield enhancements under different nutrient management practices. The highest biological yield was observed in T6 (75% RDF + 25% vermicompost) at 2481 kg/ha, followed by T11 (75% RDF + 25% poultry manure) with 2431 kg/ha and T5 (75% RDF + 25% FYM) at 2374 kg/ha. These treatments significantly outperformed the control (T1), which recorded the lowest biological yield of 1542 kg/ha, emphasizing the positive impact of integrating organic sources with chemical fertilizers. Treatments with 50% RDF combined with organics (T7, T8, T12) also showed improved biomass (around 2174–2206 kg/ha) compared to RDF alone. The data clearly demonstrate that partial substitution of RDF with quality organic amendments enhances overall crop growth, leading to higher total productivity. This trend supports the use of integrated nutrient management approaches for sustainable black gram cultivation, especially under semi-humid conditions where balanced nutrient availability is crucial for maximizing biomass.

Harvest index

Data in Table 3 clearly shows that there was no significant variation in the harvest index of black

Table 3: Effect of integrated nutrient management on yield of blackgram

Treatments	Yield (kg ha^{-1})			Harvest index (%)
	Seed	Haulm	Biological	
T1: Control	531	1012	1542	34.40
T2: 100% RDF	692	1293	1985	34.88
T3: 75% RDF	615	1187	1803	34.14
T4: 50% RDF	600	1148	1747	34.31
T5: 75% RDF+25% through FYM	846	1528	2374	35.65
T6:75%RDF+25% through Vermicompost	867	1615	2481	35.02
T7:50% RDF+50%through FYM	758	1419	2177	34.84
T8:50%RDF+50%through Vermicompost	778	1427	2206	35.23
T9: 75% RDF+*Rhizobium* +PSB	685	1267	1952	35.10
T10:50% RDF+*Rhizobium* +PSB	608	1166	1774	34.23
T11: 75% RDF+25% through Poultry manure	855	1576	2431	35.16
T12: 50% RDF+50% through Poultry manure	770	1404	2174	35.44
SEm±	22.22	39.15	44.78	0.95
CD (P=0.05)	65.19	114.84	131.36	NS

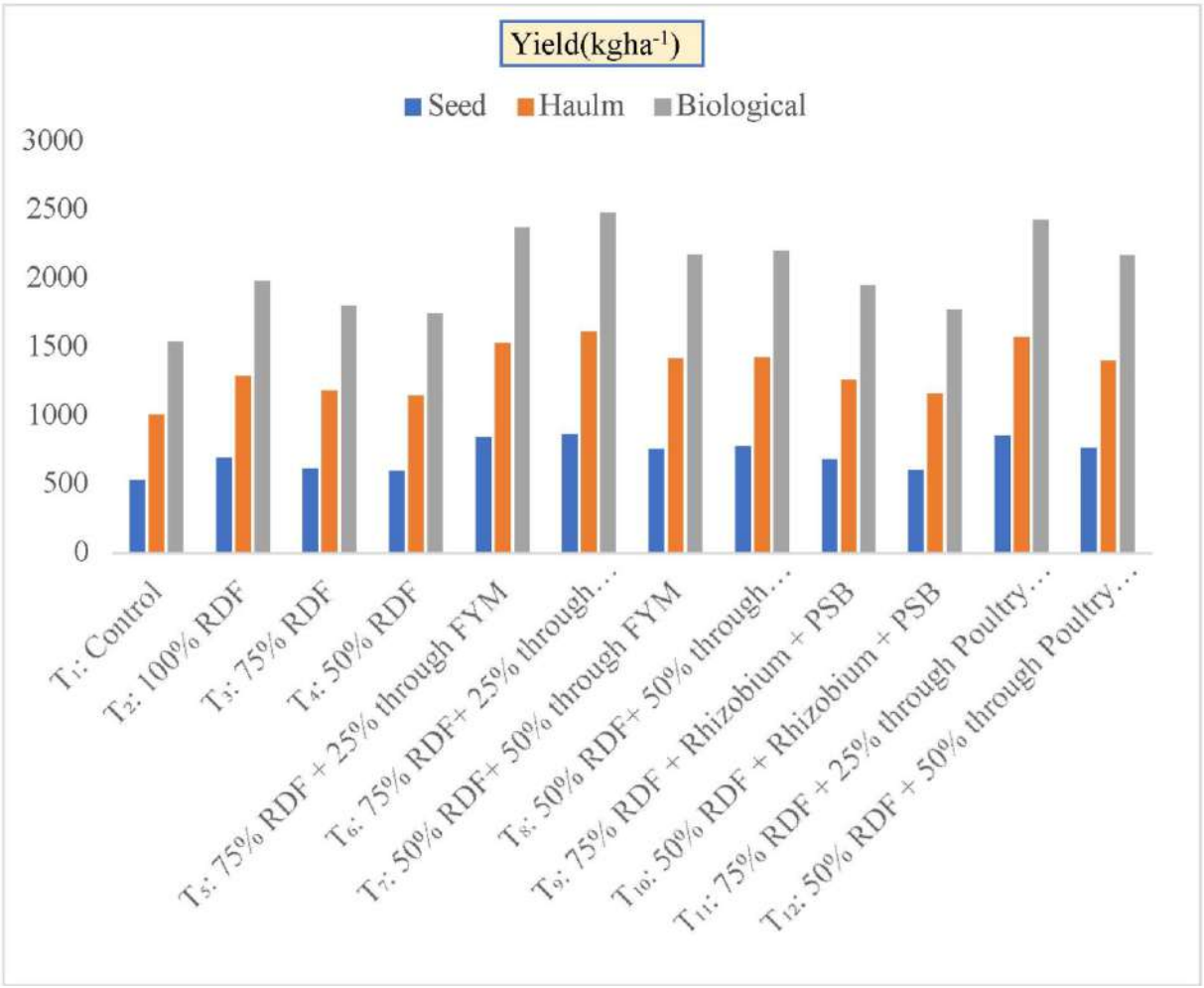

Fig. 2: Effect of integrated nutrient management treatments on yield parameters of blackgram

Conclusion

Based on the trial results, it is concluded that the application of 75% RDF + 25% through Vermicompost, which resulted in the maximum number of pods plant^{-1}, number of seeds pod-1and test weight, could be recommended for increasing the productivity of black gram. Therefore, integrating 75% RDF with 25% vermicompost is an effective nutrient management strategy for enhancing the yield and yield attributes of black gram under semi-humid conditions.

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