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# EVALUATING THE INFLUENCE OF VARIED SYNTHETIC FERTILIZER CONCENTRATIONS IN CONJUNCTION WITH VERMICOMPOST AND FYM ON THE GROWTH, YIELD, AND ECONOMIC ASPECTS OF BLACK GRAM (*Vigna mungo*) CULTIVATION IN THE DEHRADUN REGION OF UTTARAKHAND

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**Abstract–** To explore the effects of vermicompost, farmyard manure (FYM), and synthetic fertilizers on the growth, yield, and economics of black gram cultivation, a field experiment was conducted during the summer season of 2019-20 at the Research Block of Uttaranchal University in Dehradun, Uttarakhand. The experimental layout followed an incomplete randomized block design featuring ten treatments and three replications. The findings highlighted that among all the treatments, Treatment T10, which consisted of 75% Vermicompost, 50% FYM, and 50% recommended dose of fertilizer (RDF), emerged as the most favourable option from the farmer's perspective. It exhibited notable improvements in various parameters, including plant height (58.67 cm), straw yield (80 q/ha), the number of pods per plant (69), and grain yield (15.023 quintals per hectare) at harvest. Furthermore, Treatment T10 also yielded a commendable net return of 88,215.65 Rs per hectare, which is economically advantageous for farmers. Based on the results of this study, it can be concluded that the combination of 75% Vermicompost, 50% FYM, and 50% RDF significantly enhances the growth, yield, and overall economic viability of black gram cultivation, especially in the agro-climatic conditions of Dehradun.

## INTRODUCTION

Pulses also play a pivotal role in sustainable agriculture. They are nitrogen-fixing crops, enhancing soil fertility by reducing the need for synthetic fertilizers (Herridge *et al*., 2008). Crop rotation with pulses prevents soil degradation and promotes biodiversity (Kumar *et al.,* 2011). Furthermore, the environmental sustainability of pulses, including black gram, is notable due to their lower water requirements and reduced greenhouse gas emissions compared to other crops (Smith *et al.,* 2007).

Black gram (*Vigna mungo*), hold significant importance in global agriculture and nutrition. These leguminous crops are rich sources of plant-based protein, making them invaluable for vegetarians and vegans and a primary protein source in many developing countries (FAO, 2016). Moreover, they are high in dietary fibre, aiding digestion, regulating blood sugar, and maintaining healthy cholesterol levels (Burlingame *et al.,* 2019). Black gram, in particular, stands out for its abundant essential micronutrients like iron, folate, magnesium, and potassium, which contribute to overall health (Khokhar *et al.,* 2016).

Cultivating and increasing production of black gram (*Vigna mungo*) in India is most importance for

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several reasons. Firstly, black gram is a nutritional powerhouse, rich in protein, dietary fiber, vitamins, and minerals, making it a crucial contributor to addressing protein deficiencies, especially among the country's large vegetarian population (Khokhar *et al.,* 2016) and black gram cultivation serves as a source of livelihood for millions of smallholder farmers, enhancing their income and economic well-being (Sharma *et al.,* 2020). Moreover, it aids in crop diversification, reducing the risks associated with mono-cropping and improving soil health through nitrogen fixation, thus contributing to soil fertility and sustainability (Kumar *et al*., 2017; Herridge *et al*., 2008).

Furthermore, black gram exhibits resilience to changing climatic conditions, aligning with India's efforts to adapt to climate change in agriculture (Singh *et al*., 2017). Its potential for increased production not only promotes food security but also offers export opportunities, boosting India's agricultural trade and economic growth (FAO, 2020). In the context of the government's initiatives to support pulse cultivation and improve nutrient intake, black gram plays a pivotal role in combating malnutrition and ensuring a nutrient-rich diet for the population (Nair *et al*., 2019).

## MATERIALS AND METHODS

The present research was conducted during the summer season of 2017-18 in the Research Block of Uttaranchal University, located in Dehradun, Uttarakhand. Field experiments were carried out on sandy loam soil and were organized using a completely randomized block design. There was a total of 10 treatments, each with 3 replications. For fertilizer application, the recommended dose of 20:40:40 kg per hectare was used, following local farming practices. Additionally, different concentrations of vermicompost, farmyard manure (FYM), and recommended dose of fertilizer (RDF) were applied at two different times during the experiment: first, 20 days after sowing, and second, 40 days after sowing (DAS).The experiment included treatments T1 – Control, T2 - RDF (20:40:40), T3 - 25% Vermicompost + 50%RDF, T4 - 50% Vermicompost + 50%RDF, T5 - 25%FYM +50% RDF, T6 - 50% FYM+ 50% RDF, T7 - 25% Vermcompost + 25% FYM + 25 % RDF, T8 - 50% Vermicompost + 25% FYM + 50% RDF, T9 - 100% Vermicompost + 50% FYM + 25% RDF , T10 - 75% Vermicompost + 50% FYM + 50% RDF. Seeds were sowed during the second week of March, with a spacing of 30x10 cm between each plant. The crop was subsequently harvested during the first week of June. Various growth parameters such as plant height, the number of pods per plant, and the number of seeds per pod were recorded and yield parameters including grain yield and straw yield were observed during the study.

## RESULTS AND DISCUSSION

### Plant height

Plant height is a crucial factor that directly influences straw yield, which in turn contributes to overall crop production. The analysis of variance revealed significant variations in plant height, with treatment T7 (25% Vermicompost + 25% FYM + RDF 25%) recording the tallest plants at 62.33 cm. Conversely, the shortest plants at 56 cm were

**Table 1.** Influence of various treatments on Height, no. of pod per plant, no. of seed per pod, Grain yield, Straw yield and harvesting index of black gram.

| Treatment | | Height (cm) | Pods/ Plant (no) | Grain yield (q per ha) | Straw yield (q per ha) | Harvesting index % |
|---|---|---|---|---|---|---|
| T1 | Control | 61.67 | 59.67 | 11.41 | 86.436 | 13.93 |
| T2 | RDF (20:40:40) | 60.67 | 43 | 11.58 | 86.174 | 15.06 |
| T3 | 25% Vermicompost + + RDF 50% | 56 | 53.33 | 10.222 | 79.6 | 13.18 |
| T4 | 50% Vermicompost + RDF 50% | 61 | 75.67 | 11.642 | 125.106 | 11.18 |
| T5 | 25%FYM ++ RDF 50% | 58.33 | 46 | 8.46 | 64.977 | 13.13 |
| T6 | 50% FYM+ RDF 50% | 57.67 | 48 | 9.071 | 68.371 | 13.63 |
| T7 | 25% Vermcompost + 25% FYM + RDF 25% | 62.33 | 49.67 | 8.853 | 60.034 | 14.63 |
| T8 | 50% Vermicompost + 25%+ FYM + RDF 50% | 61.33 | 56.33 | 9.662 | 80.465 | 13.37 |
| T9 | 100% Vermicompost + 50% FYM + RDF 25% | 61.67 | 49.67 | 12.469 | 84.8 | 15.87 |
| T10 | 75% Vermicompost + 50% FYM + 50% RDF | 58.67 | 69 | 15.023 | 80.885 | 18.27 |
| | CD (0.05%) | 1.73 | 2.07 | 1.78 | 2.35 | 2.05 |

observed in treatment T3 (25% Vermicompost + 50% RDF) is presented in Table 1 and Fig. 1. The positive impact of the combination of 25% Vermicompost, 25% FYM, and 25% RDF on plant height was consistent with the findings of Rathore *et al.* (2010) and Sheikh *et al.* (2012). These studies also emphasized the role of organic and inorganic fertilizers in enhancing vegetative growth and promoted proper root development compared to the other treatments.

**Number of pods per plant**

The number of pods per plant is a critical factor in pulse crops as it directly impacts the yield. The highest number of pods per plant, with values of 75.67 and 69, were observed in treatment T4 (50% Vermicompost + 50% RDF) and T10 (75% Vermicompost + 50% FYM + 50% RDF), respectively. In contrast, the lowest number of pods per plant, with a count of 43, was recorded in treatment T2 (RDF 20:40:40) presented in Table 1 and Fig. 2. The higher number of pods per plant in treatments with vermicompost and RDF was in line with Kumawa *et al.* (2013); Kokani *et al.* (2014). These references supported the idea that nutrient availability, especially through organic sources like vermicompost, contributed to increased pod development.

**Grain yield (q/ha)**

The highest grain yield, recorded at 15.023 quintals per hectare (q/ha) in treatment T10 (75% Vermicompost + 50% FYM + 50% RDF). In contrast, treatment T5 (25%FYM ++ RDF 50%) produced a comparatively lower grain yield, standing at 8.460 q/ha presented in Table 1 and Fig.3. The highest grain yield in Treatment T10 (75% Vermicompost + 50% FYM + 50% RDF) aligned with the findings of Patil *et al.* (2014); Kumar *et al.* (2011), which highlighted the benefits of combining organic and inorganic fertilizers for maximizing grain yield inblack gram.

**Straw yield**

The highest straw yield, measuring 125.106 quintals per hectare (q/ha), was achieved at T4 [50% Vermicompost + RDF 50%]. On contrast with Treatment T1 (CONTROL) and Treatment T2 [RDF (20:40:40)], both of which yielded straw at rates of 86.436 q/ha and 86.174 q/ha, respectively presented in Table 1 and Fig. 4. The substantial straw yield in Treatment T4 (50% Vermicompost + RDF 50%) was

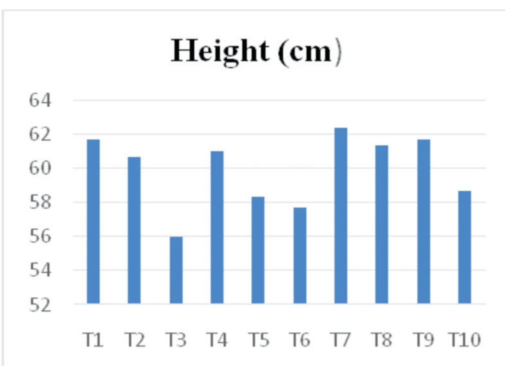


**Fig. 1.** Showed the Height of diff treatments

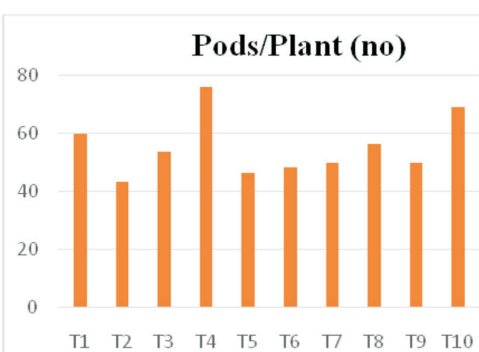


**Fig. 2.** Showed the no. of pods /plant

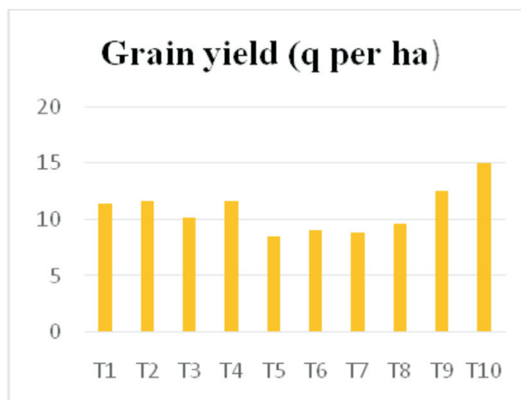


**Fig. 3.** Showed the Grain yield

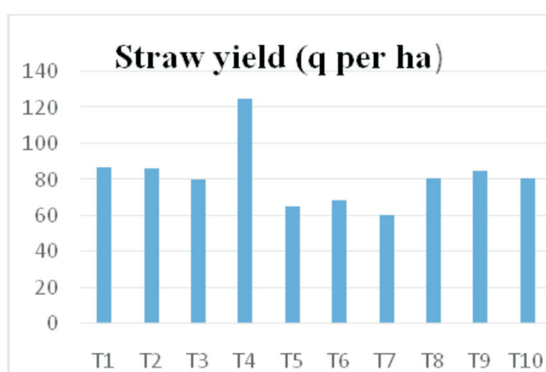


**Fig. 4.** Showed the Straw yield (q/ha)

consistent with the results reported by Prasad *et al.* (2015), Amruta *et al.* (2015), and Kokani *et al.* (2014), who observed higher straw yield when using a combination of organic and inorganic fertilizers.

### Harvest Index

The highest Harvest Index (HI) at 18.27% was achieved by the application of [75% Vermicompost + 50% FYM + 50% RDF] in Treatment T10. This result was statistically similar to the outcomes of Treatment T9 [100% Vermicompost + 50% FYM + RDF 25%] and Treatment T2 (RDF 20:40:40), which yielded HI values of 15.87% and 15.06%, respectively. In contrast, Treatment T4 [50% Vermicompost + RDF 50%] exhibited the lowest HI at 11.18% presented in Table 1 and Fig. 5. These results suggest that all the treatments involving vermicompost, farmyard manure (FYM), and recommended doses of fertilizer (RDF) were effective in significantly influencing Harvest Index (HI). The highest Harvest Index (HI) achieved in Treatment T10 (75% Vermicompost + 50% FYM + 50% RDF) corresponded to the outcomes reported in other studies, such as those of Rathore *et al.* (2010) and Sheikh *et al.* (2012), which emphasized the importance of nutrient management in optimizing HI.

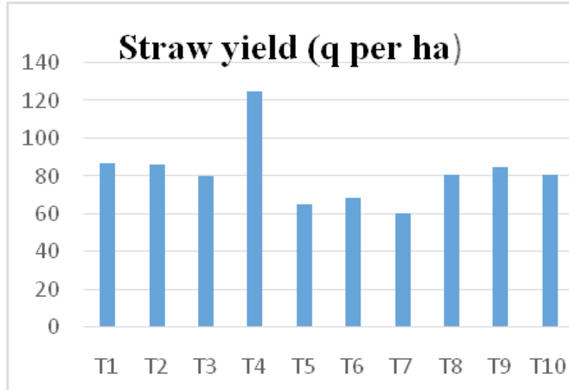


**Fig. 5.** Showed the Harvesting index (HI)

### Economic analysis

The economics of various treatments had a notable impact on the total return, influenced by both seed and straw yield. Among the treatments, Treatment T10 (75% Vermicompost + 50% FYM + 50% RDF) yielded the highest total return, amounting to 105,912.15 Rs. Conversely, Treatment T5 (25%FYM ++ RDF 50%) resulted in the lowest return, totalling 59,643 Rs.

Furthermore, the data presented in Table 2 reveals significant variations in Gross return, Cost of

**Table 2.** The impact of different treatments on the economic aspects of black gram cultivation

| Treatment | | Seed Rate | Grass rate | Gross income | Cultivation cost | Net Income | B:C ratio |
|---|---|---|---|---|---|---|---|
| T1 | Control | 80440.5 | 8643.6 | 89084.1 | 24515 | 64569.1 | 2.63 |
| T2 | RDF (20:40:40) | 81639 | 8617.4 | 90256.4 | 26573 | 63683.4 | 2.39 |
| T3 | 25% Vermicompost + + RDF 50% | 72065.1 | 7960 | 80025.1 | 25548.7 | 54476.4 | 2.13 |
| T4 | 50% Vermicompost + RDF 50% | 82076.1 | 12510.6 | 94586.7 | 25580.5 | 69006.2 | 2.69 |
| T5 | 25%FYM ++ RDF 50% | 59643 | 6497.7 | 66140.7 | 25616.25 | 40524.45 | 1.58 |
| T6 | 50% FYM+ RDF 50% | 63950.55 | 6837.1 | 70787.65 | 25717.5 | 45070.15 | 1.75 |
| T7 | 25%Vermcompost + 25% FYM + RDF 25% | 62413.65 | 6003.4 | 68417.05 | 25683.75 | 42733.3 | 1.66 |
| T8 | 50% Vermicompost + 25%+ FYM + RDF 50% | 68117.1 | 8046.5 | 76163.6 | 25650 | 50513.6 | 1.96 |
| T9 | 100% Vermicompost + 50% FYM + RDF 25% | 87906.45 | 8480 | 88754.45 | 25751.25 | 63003.2 | 2.44 |
| T10 | 75% Vermicompost + 50% FYM + 50% RDF | 105912.15 | 8088.5 | 114000.65 | 25785 | 88215.65 | 3.42 |


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cultivation, Net return, and the Benefit-to-Cost (B: C) ratio across different treatments. Treatment T10 (75% Vermicompost + 50% FYM + 50% RDF) stood out with the maximum Gross return, reaching 114,000.65 Rs, the highest Net return at 88,215.65 Rs, and a B: C ratio of 3.42. In contrast, Treatment T5 (25%FYM +RDF 50% displayed the lowest Gross return at 66,140.7 Rs, the minimum Net return at 40,524.45 Rs, and a B:C ratio of 1.58.

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## CONCLUSION

In conclusion, the field experiment conducted at Uttaranchal University revealed that the combination of 75% Vermicompost, 50% FYM, and 50% RDF (Treatment T10) proved to be the most favorable for black gram cultivation in Dehradun's agro-climatic conditions. This treatment exhibited significant improvements in plant height, straw yield, pod quantity per plant, and grain yield, showcasing its positive impact on growth and productivity. Importantly, Treatment T10 also demonstrated economic viability with a commendable net return of 88,215.65 Rs per hectare, making it a promising choice for farmers seeking optimal results and financial benefits in black gram cultivation.

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