**Performance of Black Gram (*Vigna mungo*) under the Influence of Organic and Inorganic Sources of Nutrients in Soils of North Indian Alluvial Plains**

**ABSTRACT**

The field experiment was carried out at a designated location on the Agricultural Research Farm of Graphic Era Hill University in Dehradun during the kharif season of 2023 to study the influence of integrating organic and inorganic sources of nutrients on growth and productivity of black gram (*Vigna mungo*). The experiment was laid outin Randomized Block Design (RBD)consisting of nine treatments*viz*Control (maintain Appropriate space) (T1), 100% RDF (T2), Vermicompost @ 5 tha-1 (T3) Bio nitrogen @ 20gmkg-1 seed (T4), 100% RDF+ Vermicompost @ 5 tha-1 (T5), 100% RDF + Bio nitrogen@ 20gmkg-1 seed (T6), Vermicompost + Bio nitrogen@ 20gmkg-1 seed (T7), 70% RDF + Vermicompost @ 5 tha-1 + Bio nitrogen @ 20gmkg-1 seed (T8), 100% RDF+ Vermicompost @ 5ha-1+ Bio-Nitrogen (T9) each replicated thrice. The result shows that effect of integrating different nutrient sources had a pronounced effect on growth, yield and economics of black gram. Maximum emergence count (13.3 m2) was recorded with 70% RDF + Vermicompost @ 5 tha-1 + Bio nitrogen @ 20gmkg-1 seed which at par with 100% RDF + Bio nitrogen@ 20gmkg-1 seed (T6) and 100% RDF+ Vermicompost @ 5ha-1+ Bio-Nitrogen (T9). Growth parameter *viz.* plant height, number of nodules/plant, dry matter accumulation/m2,branches/plant were reported to be significantly influenced by INM with 70% RDF + Vermicompost @ 5 tha-1 + Bio nitrogen @ 20gmkg-1 seed. Similarly,maximum seed yield (36.33 qha-1) and stover yield (19.43 qha-1) was obtained under 70% RDF + Vermicompost @ 5 tha-1 + Bio nitrogen @ 20gmkg-1 seed. The effect of different treatments on economics of black gram was found to be significant with maximum B:C ratio of 6.12 obtained with 100% RDF+ Bio-Nitrogen @ 20gmkg-1 seed. The study highlights that combining organic and inorganic sources of nutrientsis (Space) a simple and effective strategy to improve initial plant stand of black gram crop, ultimately contributing to increased crop growth, yield and better economic returns.

*Keywords*- Black gram, Integrated Nutrient Management, Productivity, Bio-nitrogen (Keyword must be in italics)

1. **INTRODUCTION**

Pulses are produced all over the world, in which India represents the largest producer followed by the Russian Federation and Poland **(Marcelloand Elena, 2017)**. Pulses are edible dry seeds of plants belonging to the Fabaceae family. Pulses are known to improve soil fertility through their root nodules because of their ability to fix up atmospheric nitrogen through symbiotic nitrogen fixation with the help of bacterium called Rhizobia. Thus, every pulse plant is a mini-fertilizer factory itself and enhance the soil fertility also **(Dotaniya *et.al.,* 2014) (maintain space in between)**.Pulses provide significant nutritional and health benefits and are known to reduce several non-communicable diseases such as colon cancer and cardiovascular diseases **(Jukanti *et.al.,* 2012)**. These pulses are said to be poor man's meat and rich man's vegetables. The daily per capita availability of pulses has decreased from 60 g during sixties to the present level of less than 40g as against the recommendation of 90 g /day.Globally, pulses are grown across a vast expanse of 957 lakh hectares, yielding a total production of 922 lakh tonnes and boasting an average productivity rate of 964 kg ha-1**(FAOSTAT, 2018)**. The major pulses grown in India are Pigeon Peas, Green Beans, Chick Pea, Black gram, Red Kidney Beans, Black Eyed Peas, Lentils, White Peas. India is the world’s largest producer of black gram, contributing 70% of the global production, followed by Myanmar and Pakistan. India produces approximately 2.7 million tons from an approximately 4.4 m ha area with an average yield of 598 kg ha-1 (space). Black gram contributes approximately 10% of the total pulse production in India with more than 90% of its production coming from 10 states, *viz.*, Maharashtra, Karnataka, Madhya Pradesh, Gujarat, Uttar Pradesh, Jharkhand, Telangana, Odisha, Andhra Pradesh and Tamil Nadu **(Directorate of Economics and Statistics, 2021).**

Black gram is one of the most important pulse crops. Black gram goes to family *Fabaceae* also popularly known as urd bean. Black gram is considered as a highly nutritious legume. Crop being a great source of protein-24%, fiber-0.9 and fat - 1.4%.

Black gram is grown up in cropping systems as a mixed crop, catch crop, sequential crop and as per a solitary crop under residual soil moisture condition after the rice harvesting and also after the harvest of other summer crop under semi irrigated and dryland conditions crop. Crop residues (haulms, leaves and pods) are used as fodder for cattle. It plays a vital role in supporting soil fertility by enlightening soil physical characteristics and fixation of atmospheric nitrogen (**Reddy *et al*., 2017).** There are numerous reasons responsible for lower productivity of black gram. Among them, fertilizer management are major factor contributing to low yields of black gram. In the current intensive cropping system. it is not easy to maintain productivity and protection of the environment for long. Unless we create a balance between the nutrient removal by crop from the soil and applied nutrients. Balance nutrition does not mean only added nutrient from outside but also include that nutrient which are present already in the soil. In agriculture a major transformation started with the application of synthetic fertilizers to soil in the 1840. After that crops were dependent partially on chemical fertilizers. Therefore, to save the natural resources by reducing the use of amount of chemical fertilizers thereby maintaining the production capacity of our natural resources. Use of different sources of nutrients in an integrated manner helps to produce sustainable yields with good quality crop. Application of both organic manure in combination with inorganic source of nutrients can sustain high yield significantly along with the application of biofertilizers helps to maintain soil fertility status. Proper combination of inorganic and organic fertilizers plays a vital role in production of vigorous plants having maximum number of branches, leaves, flowers and pod formation, have a positive impact on quality crop production. Since the Integrated Nutrient Management concept is one of the ecofriendly approaches, nutrient management especially organic and inorganic application in legumes assume a significant role in increasing the productivity. Combination of organic manure and inorganic fertilizer and bio-nitrogen improve the crop growth and yield of Black gram.

1. **MATERIAL AND METHODS**

A field experiment was conducted during the Kharif season of 2023 using black gram variety SML-668 at the Agriculture Research Farm, Graphic Era Hill University, Dehradun, Uttarakhand. The experiment consisted of nine treatments which were replicated three times and layout in randomized block design *viz.,*Control (T1), 100% RDF (T2), Vermicompost @ 5 tha-1 (T3) Bio nitrogen @ 20gmkg-1 seed (T4), 100% RDF+ Vermicompost @ 5 tha-1 (T5), 100% RDF + Bio nitrogen@ 20gmkg-1 seed (T6), Vermicompost + Bio nitrogen@ 20gmkg-1 seed (T7), 70% RDF + Vermicompost @ 5 tha-1 + Bio nitrogen @ 20gmkg-1 seed (T8), 100% RDF+ Vermicompost @ 5ha-1+ Bio-Nitrogen @ 20gmkg-1 seed (T9). The gross plot measured 3 m × 3 m and net plot was 2.25 m × 2 m. In each plot, five plants were randomly tagged from the third row to record growth parameters *viz.,* plant height, number of branches/plant whereas, ten plants were taken randomly from the produce harvested from net plot (2.25 m × 2m) for recording yield attributes (pods/plant, pod length, number of seeds/pods, seed index), yield (seed yield, biological yield, stover yield and harvesting index) and economics (cost of cultivation, gross return, net return and benefit-cost ratio). The initial soil samples were collected from the experimental field at 0-15 cm depth. The soil of experimental field was low in organic carbon(0.39%), medium in available nitrogen(157 kg ha-1), available phosphorus (15.5 kg ha-1) and available potassium (112.6 kg ha-1) with natural soil reaction.was sandyloam (check the sentence) in texture, low organic carbon, medium in available nitrogen with neutral soil reaction (pH 7.4).

1. **Result and Discussion**
2. **Emergence count and Plant height**

The result shows that emergence count and plant height of Black gram were significantly affected due to different treatments as presented in Table 1. Highest emergence (13.3/m2) was recorded under 70% RDF + Vermicompost @ 5 tha-1 + Bio nitrogen @ 20gmkg-1 seed (T8)which was statically at par with 100% RDF + Bio nitrogen@ 20gm kg-1 seed (T6)and 100% RDF+ Vermicompost @ 5ha-1+ Bio-Nitrogen@ 20gm kg-1 seed (T9)and significantly higher than rest of the treatments. Minimum emergence count (6.6/m2) was recorded under control(T1). Application of 70% RDF + Vermicompost @ 5 tha-1 + Bio nitrogen @ 20gmkg-1 seed (T8) emergence/m2 resulted in increased emergence count by 60.2% and 101.5% over 100% RDF (T2) and control (T1), respectively at 20 DAS. Treatments where bio-nitrogen is combined with RDF has shown maximum emergence count. Bio-nitrogen containing nitrogen-fixing bacteria like Rhizobium, significantly enhances the emergence number in legume plants. The results are in conformity with **Keerthanan*et al.* (2019)**as they reported that application of recommended dose of fertilizer 25:50:25 NPKkg ha-1+ Vermicompost @ 5 tha-1increases plant population (15.3/m2) significantly.

The results obtained from the experiment showed that the higher plant height (42.1 cm, 62.6 cm and 66.9 cm, respectively at 30, 60 & 90 DAS) was obtained with the application of 70% RDF + Vermicompost @ 5 tha-1 + Bio nitrogen @ 20gmkg-1(T8) seed at all the crop growth stages. It was found to be statistically at par with 100% RDF + Bio-Nitrogen @ 20gmkg-1 seed (T6) and 100% RDF+ Vermicompost @ 5ha-1+ Bio-Nitrogen @ 20gmkg-1 seed (T9) and significantly higher over the remaining treatments.It may be possibly due to the balanced application of NPK, vermicompost and bio-fertilizers, which crucially enhances plant height by providing a balanced and adequate supply of essential nutrients, such as nitrogen, phosphorus, and potassium, tailored to meet the specific needs of leguminous crops.The result showed similarity with **Yuganthra*et al.* (2023)** that the highest plant height (36.73cm) noticed with 50% RDF + 25% FYM + 25% vermicompost.

**Table 1. Effect of Integrated Nutrient Management on emergence/m2 and plant height at different crop growth stages**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatment** | **Emergence**  **m-2** | **Plant height (cm)** | | |
| **30**  **DAS** | **60**  **DAS** | **90**  **DAS** |
| T1 | 6.6 | 28.6 | 49.8 | 52.8 |
| T2 | 8.3 | 35.8 | 55.0 | 58.6 |
| T3 | 6.3 | 32.5 | 54.7 | 56.2 |
| T4 | 7.6 | 30.3 | 53.6 | 56.7 |
| T5 | 6.6 | 33.2 | 54.4 | 56.4 |
| T6 | 12.0 | 37.0 | 57.9 | 61.3 |
| T7 | 4.0 | 33.8 | 54.9 | 57.4 |
| T8 | 13.3 | 42.1 | 62.6 | 66.9 |
| T9 | 12.3 | 38.9 | 58.0 | 63.3 |
| SEm± | 0.6 | 1.7 | 1.8 | 2.0 |
| CD 5 % | 1.8 | 5.2 | 5.6 | 6.1 |

1. **Dry matter accumulation and number of nodules per plant (check the sentence)**

The dry matter of black gram increased continuously with advancement of crop age and attained its maximum value at the maturity stage (Table 2). The results showed that the dry matter accumulation varied significantly under the influence of different treatments at all the crop growth stages. Dry matter accumulation (77.0, 611.3, 1251.7 respectively at 30, 60 & 90 DAS) was recorded maximum under 70% RDF + Vermicompost @ 5 tha-1 + Bio nitrogen @ 20gmkg-1 seed (T8). It was statistically at par with 100% RDF+ Vermicompost @ 5ha-1+ Bio-Nitrogen @ 20gmkg-1 seed(T9) and 100% RDF + Bio nitrogen@ 20gmkg-1 seed(T6) but significantly higher than rest of the treatments. Dry matter accumulation/m2 was recorded minimum (46.1gm/m2, 305 gm/m2& 641.7gm/m2 at 30, 60 & 90 DAS) for control (T1) at all the crop growth stages.This may be due to RDF ensures the precise application of essential nutrients like phosphorus and potassium, promoting balanced growth. Together, these components optimize nutrient uptake, enhance photosynthesis, and improve plant health, leading to increased biomass production and higher dry matter content in legumes. The result showed similarity with **Kumar *et al.* (2024) (use correct way of writing references)**application of 100% RDF+PSB(25g kg-1ofseed)+Rhizobium(25g kg-1seed) +FYM(2.5t ha-1) showed maximum dry matter accumulation (461.54gm/m2).

The number of nodules per plant varied significantly under the influence of various treatments. Maximum number of nodules/plant (32.9, 16.0, 6.5, respectively at 30, 60, 90 DAS) at all the crop growth stages recorded with 70% RDF + Vermicompost @ 5 tha-1 + Bio nitrogen @ 20gmkg-1 seed(T8). It was found statistically at par with 100% RDF+ Vermicompost @ 5ha-1+ Bio-Nitrogen @ 20gmkg-1 seed (T9) and 100% RDF + Bio nitrogen@ 20gmkg-1 seed (T6) and significantly higher than rest of the treatments. Minimum number of nodules/plant (5.6, 5.9 & 4.0, respectively at 30, 60, 90 DAS) was recorded under control (T1) at all the crop growth stages.It might be due to seed treatment with bio nitrogen which has a pivotal role in influencing the number of nodules in legume plants. These bacteria establish symbiotic relationships with legume roots, forming nodules where they convert atmospheric nitrogen into a usable form for the plant. The presence of bio nitrogen encourages the proliferation of nodules on the roots, as the plant responds to the increased availability of nitrogen by forming more nodules to accommodate the nutrient supply. The results are in conformity with**Sahua*et al.* (2023)** application of 100% RDF+ Rhizobium culture @ 25g kg-1 of seed +Vermicompost @ 2.5 t ha-1+ FYM @ 5 t ha-1showed highest number of nodules/plants (123.37).

**Table 2. Effect of Integrated Nutrient Management on dry matter accumulation (g/m2) and number of nodule/plants at different crop growth stages**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Treatment** | **Dry matter accumulation(g/m2)** | | | **Number of nodule/plants** | | |
| **30 DAS** | **60 DAS** | **90 DAS** | **30 DAS** | **60 DAS** | **90 DAS** |
| T1 | 46.7 | 305.0 | 641.7 | 5.6 | 5.9 | 4.0 |
| T2 | 51.7 | 348.3 | 816.3 | 17.1 | 9.9 | 5.1 |
| T3 | 55.3 | 425.0 | 842.3 | 13.0 | 9.4 | 5.2 |
| T4 | 53.0 | 407.7 | 861.0 | 17.4 | 9.4 | 5.3 |
| T5 | 52.0 | 323.7 | 865.7 | 17.8 | 9.7 | 5.2 |
| T6 | 67.3 | 536.0 | 1160.3 | 30.2 | 15.4 | 6.2 |
| T7 | 56.3 | 368.3 | 704.0 | 16.6 | 10.2 | 5.2 |
| T8 | 77.0 | 611.3 | 1251.7 | 32.9 | 16.0 | 6.5 |
| T9 | 68.0 | 570.0 | 1207.3 | 29.5 | 14.7 | 5.9 |
| SEm± | 3.9 | 26.8 | 44.9 | 1.1 | 0.7 | 0.3 |
| CD 5 % | 11.6 | 80.3 | 134.8 | 3.5 | 2.1 | 1.0 |

1. **Seed and Stover yield of black gram**

The results indicated that among the different INM treatments, the seed yield of black gram was highest (36.3 qha-1) with application of 70% RDF + Vermicompost @ 5 tha-1 + Bio nitrogen @ 20gmkg-1 seed (T8). It was significantly higher than rest of the treatments but statistically at par with 100% RDF+ Vermicompost @ 5ha-1+ Bio-Nitrogen @ 20gmkg-1 seed (T9) and 100% RDF + Bio nitrogen@ 20gmkg-1 seed (T6). Minimum seed yield (7.9 qha-1) was recorded under control (T1).This may be due to utilization of RDF in conjunction with vermicompost and bio nitrogen application. This combination shown remarkable effectiveness in boosting the yield of black gram seeds. This integrated approach to nutrient management not only enriches the soil with vital nutrients but also fosters the growth of beneficial microorganisms, thereby enhancing soil fertility and plant vitality. Vermicompost contributes valuable organic matter to the soil, while bio nitrogen aids in nitrogen fixation, ensuring a consistent supply of this crucial element. The combined action of these components facilitates in heightened seed yield and enhanced overall productivity in black gram cultivation. The result showed similarity with **Singh *et al.* (2022) (Follow correct way of writing)** application of Vermicompost @ 1 t ha-1 + 100% RDF (20:40:20 NPK kg ha-1) showed that maximum seed yield (1353 kg ha-1)

The stover yield of black gram varied significantly under the influence of different treatments. Maximum stover yield (19.43 qha-1) was obtained with the application of 70% RDF + Vermicompost @ 5 tha-1 + Bio nitrogen @ 20gmkg-1 seed (T8) which was statistically at par with 100% RDF+ Vermicompost @ 5ha-1+ Bio-Nitrogen @ 20gmkg-1 seed (T9) and 100% RDF + Bio nitrogen@ 20gmkg-1 seed (T6) but significantly higher than rest of the treatments. Application of 70% RDF + Vermicompost @ 5 t ha-1 + Bio nitrogen @ 20gm kg-1 seed (T8) resulted in increased stover yield by 59.2% and 134% over 100% RDF (T2) and control (T1), respectively. This may be due to the application of Vermicompost @ 5 t ha-1 plays a significant role in enhancing the growth and yield of stover. The presence of beneficial microorganisms in vermicompost aids in breaking down organic matter, making nutrients more available to plants. As a result, crops grown with vermicompost exhibit increased stover yield. The results are in conformity with **Divyavani, *et al*., (2020)** as they reported that application of 100% NPK+ 50% Vermicompost +Rhizobium showed maximum stover yield (3056 kg/ha).

**Table 3. Effect of Integrated Nutrient Management on seed yield (q/ha) and stover yield (q/ha)**

|  |  |  |
| --- | --- | --- |
| **Treatment** | **Seed yield**  **(q/ha)** | **Stover yield**  **(q/ha)** |
| T1 | 7.93 | 8.30 |
| T2 | 10.90 | 12.20 |
| T3 | 12.43 | 14.00 |
| T4 | 20.27 | 11.17 |
| T5 | 21.04 | 11.09 |
| T6 | 34.87 | 16.10 |
| T7 | 20.74 | 14.20 |
| T8 | 36.33 | 19.43 |
| T9 | 35.20 | 16.87 |
| SEm± | 0.53 | 1.09 |
| CD 5 % | 1.59 | 3.35 |

1. **Biological yield and harvest index of black gram**

The biological yield of black gram varied significantly under the influence of different treatments. Maximum biological yield (55.7 qha-1) was recorded with the application of 70% RDF + Vermicompost @ 5 t ha-1 + Bio nitrogen @ 20gm kg-1 seed (T8). It is statistically at par with 100% RDF+ Vermicompost @ 5ha-1+ Bio-Nitrogen @ 20gmkg-1 seed (T9) and 100% RDF + Bio nitrogen@ 20gmkg-1 seed (T6). The remaining treatments were significantly lower than 70% RDF + Vermicompost @ 5 t ha-1 + Bio nitrogen @ 20gm kg-1 seed (T8). The precent increased 141.4% & 250.9% over 100% RDF (T2) and control (T1), respectively. Minimum biological yield (15.8 qha-1) was recorded under control (T1).It might be due to the combination of RDF with vermicompost and bio-nitrogen. The integrated use of organic, inorganic and bio fertilizer combination resulted in better growth of plants associated with increased availability of nutrients might have resulted in the translocations and accumulation of photosynthesis resulted in increased biological yield of black gram significantly increased. The result showed similarity with **Prasad *et al*. (2015)**application of 100% RDF (20:30:15 Kg ha-1) + ZnSO4 5kg ha-1+ FeSO4 5kg ha-1showed highest biologicalyield (2713 kg ha-1)

The harvest index of black gram varied significantly under the influence of different treatments. It has been observed that maximum harvest index (67.6%) was obtained with the application of 100% RDF + Bio nitrogen@ 20gm kg-1 seed (T6). It was significantly higher than Control (T1), 100% RDF (T2) and Vermicompost @ 5 tha-1(T3) but was statistically at par with rest of the treatments. Increase in harvest index with the application of 100% RDF + Bio nitrogen @ 20gm kg-1 seed (T6) by 45.0 % and 37.6 % was recorded over 100 % RDF (T2) and control (T1), respectively. Minimum harvest index (49.1%) was recorded under control. It might be due to the application of balanced dose of nutrients. Proper fertilization ensures optimal plant growth, improves nitrogen fixation, and enhances the development of pods and seeds. This balanced nutrient supply leads to a more efficient conversion of the plant's energy and resources into the harvested parts, ultimately increasing the harvest index. The results are in conformity with **Kumar*etal.*(2023)**as they reported that application of 50% RDF + 50% RDN through compost + Rhizobium showed highest Harvest index (30.06)**.**

**Table 4. Effect of Integrated Nutrient Management on Biological yield (q/ha) and Harvest index**

|  |  |  |
| --- | --- | --- |
| **Treatment** | **Biological yield (q/ha)** | **Harvest index** |
| T1 | 15.87 | 49.19 |
| T2 | 23.10 | 46.67 |
| T3 | 26.43 | 46.72 |
| T4 | 31.43 | 65.36 |
| T5 | 32.13 | 65.92 |
| T6 | 51.50 | 67.68 |
| T7 | 34.93 | 59.40 |
| T8 | 55.77 | 65.46 |
| T9 | 52.07 | 67.61 |
| SEm± | 1.57 | 3.29 |
| CD 5 % | 4.72 | 9.86 |

1. **Economics of black gram**

The maximum cost of cultivation (₹ 42558.00ha-1) was recorded under 100% RDF+ Vermicompost @ 5ha-1+ Bio-Nitrogen @ 20gmkg-1 seed (T9). whereas minimum cost of cultivation (₹ 25606.00 ha-1) was recorded under control (T1). The gross return of black gram varied significantly under the influence of different treatments.

It has been observed that highest gross return (₹ 252516.67ha-1) was obtained 70% RDF + Vermicompost @ 5 tha-1 + Bio nitrogen @ 20gmkg-1 seed (T8). It was significantly higher than rest of the treatments except 100% RDF + Bio nitrogen@ 20gmkg-1 seed (T6) and 100% RDF+ Vermicompost @ 5ha-1+ Bio-Nitrogen @ 20gmkg-1 seed (T9). The results were in conformity with **Banotra*et al.* (2019)** where highest gross returns (₹58203ha-1) noticed with 75% NPK+25% N through vermicompost and FYM (1:1).

The Net return of black gram varied significantly under the influence of different treatments. It has been observed that highest net return (₹ 211813.67ha-1) was obtained with 70% RDF + Vermicompost @ 5 tha-1 + Bio nitrogen @ 20gmkg-1 seed (T8). It was significantly higher than rest of the treatments except 100% RDF+ Vermicompost @ 5ha-1+ Bio-Nitrogen @ 20gmkg-1 seed (T9) and 100% RDF + Bio nitrogen@ 20gmkg-1 seed (T6). Minimum net return (₹ 29530.67ha-1) was recorded under control (T1). Higher net return under these treatments shows that these treatments accrued high gross return with a lower or similar cost of production. The results are in conformity with **Keerthanan*et al.* (2019)** as they reported that maximum Net income (₹ 52150.00/ha) was recorded with integration of nutrients (RDF 25:50:25 NPK kgha-1 +Vermicompost @ 5 tha-1).

The Benefit cost ratio of black gram varied significantly under the influence of different treatments. It has been observed that highest B:C ratio (6.12) was obtained with 100% RDF+ Bio-Nitrogen @ 20gmkg-1 seed (T6). The result showed that 100% RDF + Bio nitrogen@ 20gmkg-1 seed (T6) higher than all the other treatments. Minimum B:C ratio (1.15) was recorded under control (T1). The results are in conformity with **Muwal&Dhaked (2022)** as they reported that maximum B:C ratio (2:45) was recorded with application of Vermicompost 1 tha-1+ 50% RDN. Higher B:C ratio under different treatments reveal that net return per unit cost of production was higher under these treatments.

**Table 5. Effect of INM on Cost of cultivation, gross return, net return and B:C ratio**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatment** | **Cost of cultivation** | **Gross return** | **Net return** | **B:C ratio** |
| T1 | 25606.00 | 55136.67 | 29530.67 | 1.15 |
| T2 | 33758.00 | 75755.00 | 41997.00 | 1.24 |
| T3 | 36076.00 | 86411.67 | 50335.67 | 1.40 |
| T4 | 27876.00 | 140853.33 | 140853.33 | 4.05 |
| T5 | 42258.00 | 146258.89 | 104000.89 | 2.46 |
| T6 | 34058.00 | 242323.33 | 208265.33 | 6.12 |
| T7 | 36376.00 | 144148.15 | 107772.15 | 2.96 |
| T8 | 40703.00 | 252516.67 | 211813.67 | 5.20 |
| T9 | 42558.00 | 244640.00 | 202082.00 | 4.75 |
| SEm± | - | 3675.72 | 3675.72 | 0.12 |
| CD 5 % | - | 11019.00 | 11019.00 | 0.37 |

**CONCLUSION**

Based on the present study, it is concluded that the use of Integrated Nutrient Management with application of 70% RDF + Vermicompost @ 5 t ha-1 + Bio nitrogen @ 20gm kg-1 seed (T8) as an agricultural practice holds significant promise for enhancing the growth and yield of black gram. This outcome may be attributed to the improved nutrient provisioning achieved through integrating different nutrient sources which facilitated optimal growth and yield and highest harvest index. Different nutrient management presents a promising and sustainable approach to modern agriculture. By judiciously combining organic and inorganic nutrient sources, this practice potentially reduces 25% as observed, the reliance on chemical fertilizers while ensuring a robust crop yield. As we face the challenges of feeding a growing global population while conserving our ecosystems, integrated nutrient management stands as a vital step towards achieving both agricultural productivity and ecological balance.

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