

Response of Bio-organics on Soil Fertility Status, Growth and Yield Parameters of Black Gram(*Vigna mungo*) var. Shekar 2

ABSTRACT

An experiment to study the response of bio-organics on soil fertility status, growth and yield parameters of Black Gram (*Vigna mungo*) was conducted during *Zaid* (April- July) season in 2021-22 at central research farm department of Soil Science and Agricultural Chemistry, SHUATS, Prayagraj. The Experiment was a randomized block design with having two factors and three levels of both vermicompost and neem cake 0, 50, and 100% per ha resulting in nine treatments. Data collected included soil bulk density, particle density, pore space, water holding capacity, pH, EC, organic carbon, nitrogen, phosphorus and potassium. On both growth and yield parameters of Black gram plant height, number of leaves per plant, pod length, number of pods per plant, test weight, dry weight and grain yield were collected. Treatment 9 which comprised of 100% vermicompost and 100% neem cake at 5 t ha⁻¹ had an effect on physical and chemical properties of soil. Results were significant with maximum values on pore space 48.20% and 46.96%, water holding capacity of 43.22 and 41.98% , organic carbon (%) (0.181 and 0.182%) , Nitrogen 264.45 and 265.50 kg ha⁻¹ , Phosphorus 24.82 and 24.15 kg ha⁻¹ and Potassium 186.58 and 178.41 per kg at 0-15 and 15-30 cm soil depths respectively. The same treatment 9 recorded maximum plant height of 34.6; number of leaves per plant of number of branches per plant of 37.33; number of pods of 31.66; test weight of 32.88; dry weight per plant of 21.65; maximum (B:C) ratio of 1:1.56; maximum gross returns of Rs/ha⁻¹ 129600 with net profit of Rs/ha⁻¹ 74720 per ha highest grain yield of 12.096 per ha 75 DAS respectively. Further experimentation will help to better understand the effects and make desirable recommendations.

Keyword: Soil nutrients, vermicompost, neem cake and Black gram

1. INTRODUCTION

Black gram *vigna mungo*.L is the fourth important pulses crop grown in India covering an area of about 3.45 million hectares, accounting for the production of 1.55 million tonnes with a productivity of 512 kg ha⁻¹ (The Hindu, 2012). Black gram (Urd) ranks third in terms of tones average production after chick pea (*cicer arietinum*) and pigeon pea (*Cajanus cajan*). This crop has been cultivated for a long time in the Indian subcontinent and A drought resistant crop grown, both during summer and winter often in rotation with rice.

Sometimes in mixed cultivation it is planted on a rough seed bed as too much tilt encour-

ages vegetative growth at the expense of the seed. Black gram Period of mature in 70-120 days. It is cultivated in about 161,000 acres of land in Bangladesh and total annual production is about 50,000 million tonnes. India is one of the ancient countries in the world growing a wide range of pulse crops as prime source of protein. In this, India is the leading country in pulse cultivation area and 25-27% of the world production and consumption respectively but also the largest importer of pulses with the contribution of 34% of the global food (FAO 2012). India shares 70% of the total world black gram and green gram (*Vigna radiata*) production in which black gram constitute 1.65 MT with the share of 12.4% (Elzebrok, 2008). Black gram is predominantly cultivated and consumed in southern states like Andhra Pradesh, Karnataka and Tamil Nadu. Generally, Black gram is best consumed along with cereals with benefits mentioned in several ancient literatures as food, feed, medicine and manure (Nene, 2006). The objective of the research was to study the response of bio organics on soil fertility status, growth yield parameters of Blackgram (*Vignamungo*) var. shekar 2

Vermicompost is rich in essential plant nutrients such as nitrogen, phosphorus, potassium, and micronutrients. These nutrients are present in a form that is readily available to plants, making it easier for black gram plants to absorb and utilize them. The increased nutrient availability can promote healthy growth and development of black gram plants. Enhanced soil structure: Vermicompost helps improve soil structure and texture. It improves soil aeration, water-holding capacity, and drainage. Black gram plants grown in vermicompost-amended soil can benefit from better root development and increased access to oxygen, water, and nutrients, leading to improved overall plant health and increased microbial activity V. Saravana *et al.*, (2011)

Neemcake, derived from the seeds of the neem tree (*Azadirachta indica*), is a rich source of organic matter and essential nutrients. When incorporated into the soil along with the introduction of black gram, it can enhance the availability of nitrogen, phosphorus, potassium, and other micronutrients. This increased nutrient availability can promote healthier plant growth and improve crop yield. Neemcake acts as an organic fertilizer and soil conditioner. Its addition to the soil can improve soil structure, water-holding capacity, and nutrient retention. This, in turn, enhances soil fertility and promotes the growth of beneficial soil microorganisms. The effect of neemcake in black gram can lead to sustainable agriculture practices by reducing the dependence on synthetic fertilizers and Neemcake contains various bioactive compounds, such as azadirachtin, which have insecticidal and nematicidal properties. Incorporating neemcake into the soil can help suppress soil-borne pests and nematodes, reducing their population and subsequent damage to crops. Additionally, neemcake can also exhibit antifungal properties, contributing to the control of soil-borne pathogens. Soil health and sustainability application of neemcake as a soil amendment can improve overall soil health. D. Devi *et al.*, (2015)

2. MATERIALS AND METHODS

The Experiment was conducted at reserch farm Comprise of Soil Science Research Farm, Naini Agricultural Institute SHUATS, Prayagraj during *Zaid* season (March – June) 2022. Prayagraj, the area is situated on the south of Prayagraj on the right side of the river Yamuna on the South of Rewa Road at a distance of about 6 km from Prayagraj city. It is situated at 25°57” N latitude, 81°59” E longitude and at the altitude of 98 meter above sea level. The detail of the experiment site, and climate is described in this chapter to get his with the experimental design, Plan layout, cultural practice and techniques employed for growth

2.1 Climate condition in the experimental area

The area of Prayagraj district comes under subtropical belt in the South east of UttarPradesh, which experience extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to 46°C – 48°C and seldom falls as low as 4°C – 5°C. The relative humidity ranges between 20 to 94 percent. The average rainfall in this area is around 1100 mm annually.

2.2 Soil analysis

2.3.1 Physical analysis

Method employed were Soil Colour Munsell (1971) Bulk density ($Mg\ m^{-3}$) Muthuaval *et al.*, (1992) Particle Density (Mgm^{-3}) 1992 Pore Space (%) muthuavel *et al.*, (1992) Water holding capacity (%) Muthuaval *et al.*, (1992)

2.3.2 Chemical analysis

Soil pH and rest of the parameters were determined according to Jackson (1958); , EC ($dS\ m^{-1}$) by Wilcox 1950); Organi ccarbon (%) by Walkley and Black (1947); Available Nitrogen ($kg\ ha^{-1}$) by Subbiah and Asija (1956); Available phosphorus ($kg\ ha^{-1}$ by Olsen *et al.*, (1954) and available potassium ($kg\ ha^{-1}$) by Toth and Prince (1949).

2.3.3 Treatments and design

The study had nine different treatment combinations of vermicompost and neem cake replicated three times (Table 1) in the randomized block design (RBD).

Table1: Different combinations of vermicompost and neemcake

| S. No. | Treatments No. | Treatment combinations |
|--------|----------------|----------------------------------|
| 1. | T ₁ | 0% vermicompost + 0% Neem Cake |
| 2. | T ₂ | 0% Vermicompost + 50% Neem Cake |
| 3. | T ₃ | 0% Vermicompost + 100% Neem Cake |

| | | |
|-----------|----------------|------------------------------------|
| 4. | T ₄ | 50% Vermicompost + 0% Neem Cake |
| 5. | T ₅ | 50% Vermicompost + 50% Neem Cake |
| 6. | T ₆ | 50% Vermicompost + 100% Neem Cake |
| 7. | T ₇ | 100% Vermicompost + 0% Neem Cake |
| 8. | T ₈ | 100% Vermicompost + 50% Neem Cake |
| 9. | T ₉ | 100% Vermicompost + 100% Neem Cake |

2.3.4 Data collected

The following data were collected on soil properties: bulk density, particle density, pore space, water holding capacity, pH, EC, organic carbon, nitrogen, phosphorus and potassium. On both growth and yield parameters of Black gram plant height, number of leaves per plant, pod length, number of pods per plant, test weight, dry weight and grain yield were collected.

2.4 Statistical Analysis

The data recorded during the course of the investigation was subjected to analysis of variance. The significant and non-significant effect was judged with the help of “F” (variance ratio) table. The significant difference between the means was tested against the critical difference of 5% level.

3.0 RESULTS AND DISCUSSIONS

3.1. Response of Bio-organics on Physical properties of soil after harvest

Observations regarding the response of Bio-organics on soil fertility status and morphological status in Vermicompost (0, 50, and 100%) and Neem cake the three levels (0, 50, and 100%) affected the soil bulk density (mg m^{-3}), particle density (mg m^{-3}), pore space (%), water holding capacity (%), in the 0-15 and 15-30cm soil depths are given in (table 2 and 3). The minimum bulk density (mg m^{-3}) (1.42 & 1.45) at 0-15 and 15-30 cm soil depth after harvest was found in T₉, 100% Vermicompost + 100% Neem cake @ 5 t ha⁻¹ and maximum bulk density (mg m^{-3}) (1.49 and 1.51) was recorded in T₁. The maximum particle density (mg m^{-3}) (2.316 and 2.317) pore space (%) (48.20 and 46.96) water holding capacity (%) (43.22 and 41.98) at 0-15 and 15-30 cm soil depth was recorded in T₉, 5 t ha⁻¹. However minimum values are recorded in T₁. (Table 2 and 3, fig 1 and 2)

3.2. Response of bio-organics on chemical properties of soil after harvest

Observations regarding the response of Bio-organics on soil fertility status and morphological status in Vermicompost and Neem cake at the three levels of (0, 50, and 100%) affected pH, EC dS m^{-1} , Organic carbon, available nitrogen (kg ha^{-1}), available phosphorus (kg ha^{-1}), and available potassium (kg ha^{-1}). The result of the data showed that the minimum pH (7.250 and 7.567) at 0-15 and 15-30 cm soil depth was found in T_0 . 100% Vermicompost +100%Neemcake @5 t ha^{-1} and maximum pH (7.657 & 7.810) soil depths was recorded in T_1 . (control) and respectively. The maximum EC dSm^{-1} (0.338 and 0.334) Organic carbon(%) (0.181 and 0.182) nitrogen (kg ha^{-1}) (264.45 and 263.50) phosphorus (kg ha^{-1}) (24.82 and 24.15) potassium (kg ha^{-1}) (186.58 and 178.41)) at 0-15 and 15-30 cm soil depth was found in T_0 . 100%Vermicompost +100%Neemcake@5t ha^{-1} However minimum values are detected in T_1 . (control) 0-15 and 15-30 cm soil depth respectively(Table 2 and 3 fig 1,2)

3.3. Response of bio-organics on growth and yield parameters of Black gram

It is indicated from table (4) that nutrient sources significantly improved the growth and yield attributes of Black gram .Among the nutrient sources 100% Vermicompost+100% Neem cake @5 t ha^{-1} gave highest and significant values of plant height at 75DAS (34.6cm), number of leaves per plant at 75DAS(93.66) , number of pods per plant (31.66), pod test weight(32.88), dry weight per plant (21.65g), Grain yield q ha^{-1} (12.096)

Table 2: Response of Bio-organics on Physico-chemical Properties of Soil BD, PD, % Porespace, WHC and pH

| S. No. | Treatments No. | Treatment combinations | Bulk Density (mg m ⁻³) | | Particle Density (mg m ⁻³) | | Pore space(%) | | Water holding capacity(%) | | pH | |
|--------|----------------|------------------------------------|------------------------------------|-----------|--|--------------|---------------|-------------|---------------------------|-------------|--------------|--------------|
| | | | 0-15 cm | 15-30 cm | 0-15 cm | 15-30 cm | 0-15 cm | 15-30 cm | 0-15 cm | 15-30 cm | 0-15 cm | 15-30 cm |
| 1 | T ₁ | Control | 1.49 | 1.51 | 2.310 | 2.311 | 42.34 | 40.12 | 38.35 | 36.16 | 7.657 | 7.810 |
| 2 | T ₂ | 0% Vermicompost + 50% Neem Cake | 1.48 | 1.49 | 2.313 | 2.314 | 42.99 | 40.86 | 38.99 | 36.87 | 7.553 | 7.767 |
| 3 | T ₃ | 0% Vermicompost + 100% Neem Cake | 1.46 | 1.47 | 2.315 | 2.316 | 43.53 | 41.28 | 39.51 | 37.23 | 7.537 | 7.697 |
| 4 | T ₄ | 50% Vermicompost + 0% Neem Cake | 1.48 | 1.48 | 2.313 | 2.314 | 43.87 | 41.98 | 39.87 | 37.95 | 7.503 | 7.660 |
| 5 | T ₅ | 50% Vermicompost + 50% Neem Cake | 1.47 | 1.49 | 2.314 | 2.315 | 45.38 | 43.51 | 40.33 | 38.52 | 7.487 | 7.663 |
| 6 | T ₆ | 50% Vermicompost + 100% Neem Cake | 1.46 | 1.48 | 2.311 | 2.312 | 46.95 | 45.22 | 41.96 | 40.26 | 7.403 | 7.633 |
| 7 | T ₇ | 100% Vermicompost + 0% Neem Cake | 1.45 | 1.46 | 2.311 | 2.312 | 47.35 | 45.98 | 42.32 | 40.93 | 7.400 | 7.657 |
| 8 | T ₈ | 100% Vermicompost + 50% Neem Cake | 1.44 | 1.46 | 2.313 | 2.314 | 47.86 | 46.37 | 42.84 | 41.31 | 7.367 | 7.603 |
| 9 | T ₉ | 100% Vermicompost + 100% Neem Cake | 1.42 | 1.45 | 2.316 | 2.317 | 48.20 | 46.96 | 43.22 | 41.98 | 7.250 | 7.567 |
| | | F-Test | NS | NS | NS | NS | S | S | S | S | NS | NS |
| | | C. D. at 5% | | | 0.074 | 0.090 | 2.25 | 2.11 | 1.64 | 1.75 | 0.376 | 0.386 |
| | | S.Em. (+) | | | 0.024 | 0.030 | 0.75 | 0.70 | 0.54 | 0.58 | 0.125 | 0.128 |

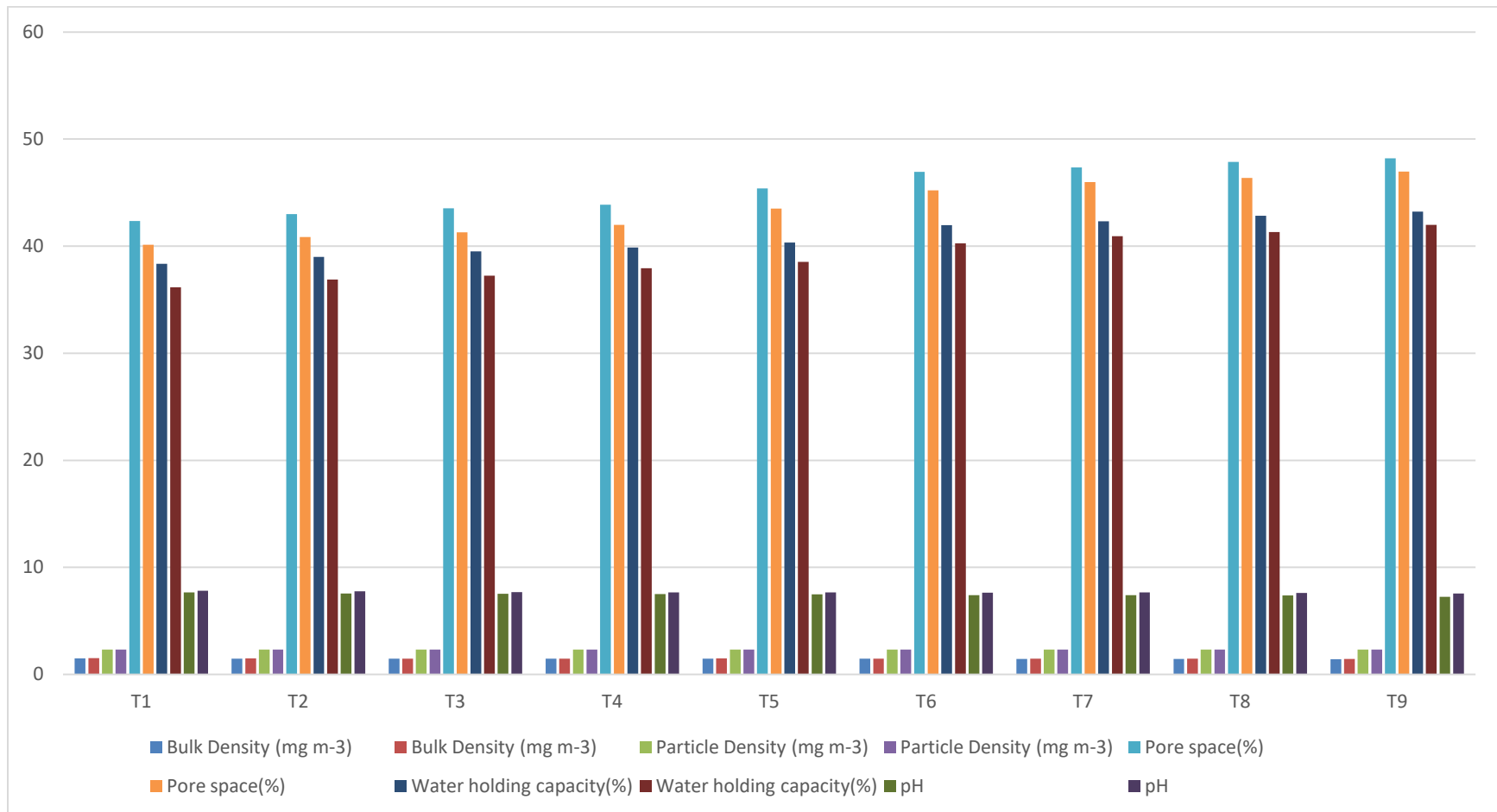


Fig . 1 Response of Bio-organics on physico-Chemical properties of Soil BD,PD,Porespace,WHC and p^H

Table:3 Response of bio-organics on physico-chemical Properties of Soil EC dS m⁻¹, organic carbon(%), nitrogen, Phosphorus and potassium.

| S. No. | Treat-ments No. | Treatment combina-tions | EC (dS m ⁻¹) | | Organic car-bon(%) | | Nitrogen (kg ha ⁻¹) | | Phosphorus (kg ha ⁻¹) | | Potassium (kg ha ⁻¹) | |
|--------|-----------------|----------------------------------|--------------------------|--------------|--------------------|--------------|---------------------------------|---------------|-----------------------------------|--------------|----------------------------------|--------------|
| | | | 0-15 cm | 15-30 cm | 0-15 cm | 15-30 cm | 0-15 cm | 15-30 cm | 0-15 cm | 15-30 cm | 0-15 cm | 15-30 cm |
| 1 | T ₁ | Control | 0.319 | 0.315 | 0.150 | 0.151 | 262.50 | 261.25 | 22.30 | 21.64 | 140.25 | 132.08 |
| 2 | T ₂ | 0% Vermicompost +50 Neem Cake | 0.321 | 0.317 | 0.153 | 0.154 | 262.25 | 260.50 | 22.50 | 21.75 | 142.59 | 134.43 |
| 3 | T ₃ | 0% Vermicompost +100 Neem Cake | 0.324 | 0.319 | 0.170 | 0.171 | 261.75 | 260.85 | 21.75 | 20.63 | 169.32 | 161.15 |
| 4 | T ₄ | 50% vermicompost +0 Neem Cake | 0.326 | 0.321 | 0.176 | 0.177 | 262.65 | 261.50 | 22.75 | 21.75 | 161.74 | 153.57 |
| 5 | T ₅ | 50% Vermicompost +50 Neem Cake | 0.328 | 0.323 | 0.153 | 0.154 | 262.45 | 261.25 | 22.85 | 21.50 | 165.33 | 157.16 |
| 6 | T ₆ | 50% Vermicompost +100 Neem Cake | 0.331 | 0.325 | 0.180 | 0.181 | 263.15 | 262.25 | 23.75 | 22.85 | 178.87 | 170.70 |
| 7 | T ₇ | 100% Vermicompost +0 Neem Cake | 0.333 | 0.328 | 0.163 | 0.164 | 263.75 | 262.65 | 23.50 | 22.06 | 154.88 | 146.80 |
| 8 | T ₈ | 100% Vermicompost +50 Neem Cake | 0.336 | 0.331 | 0.150 | 0.151 | 264.25 | 263.25 | 24.50 | 23.65 | 180.12 | 171.95 |
| 9 | T ₉ | 100% Vermicompost +100 Neem Cake | 0.338 | 0.334 | 0.181 | 0.182 | 264.45 | 263.50 | 24.82 | 24.15 | 186.58 | 178.41 |
| | | F-Test | NS | NS | S | S | NS | NS | S | S | S | S |
| | | C. D. at 5% | 0.014 | 0.015 | 0.007 | 0.006 | 15.47 | 10.750 | 1.195 | 1.036 | 8.958 | 7.267 |
| | | S.Em. (+) | 0.004 | 0.005 | 0.003 | 0.002 | 5.145 | 3.5712 | 0.397 | 0.344 | 2.795 | 2.414 |

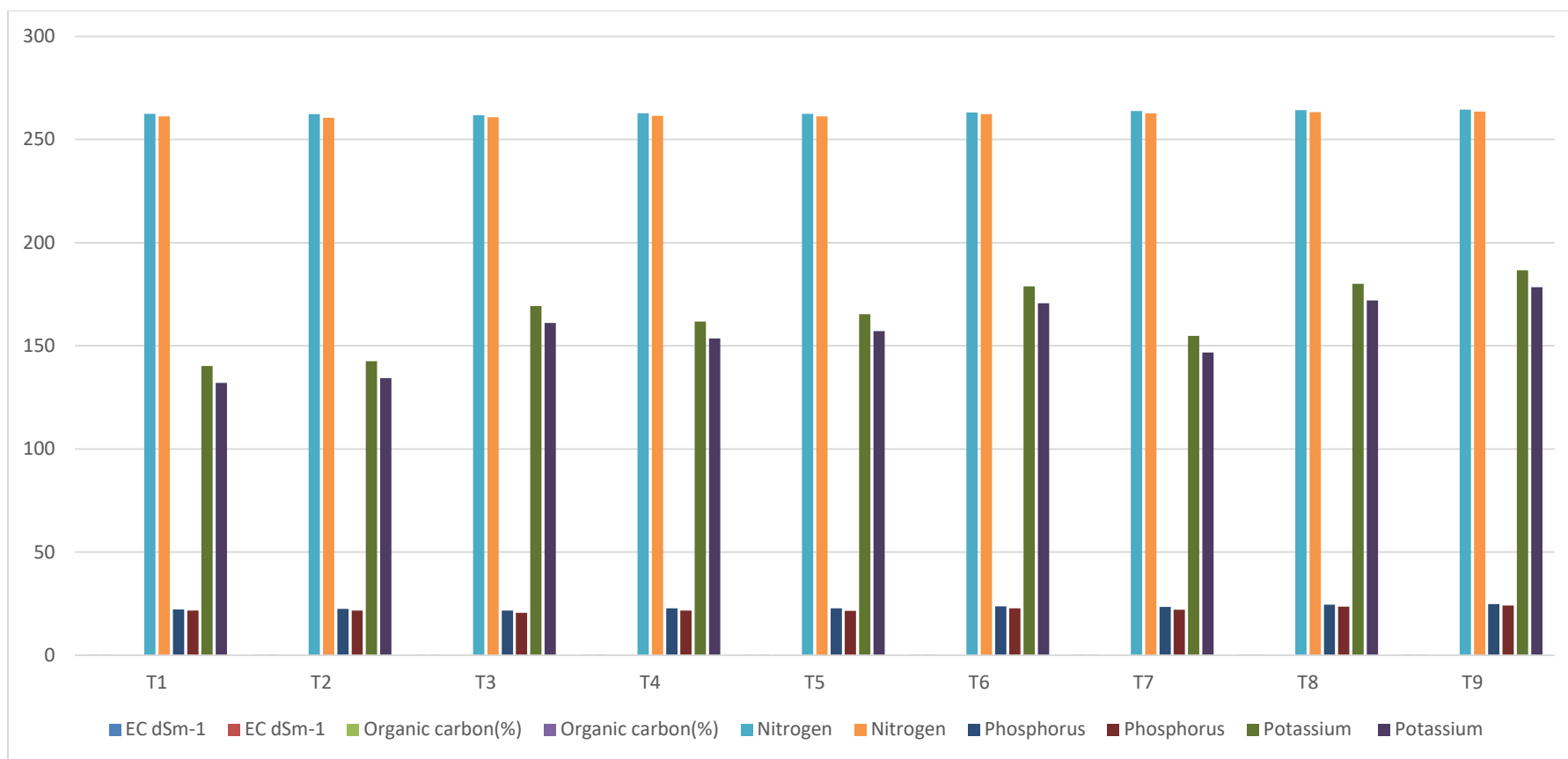
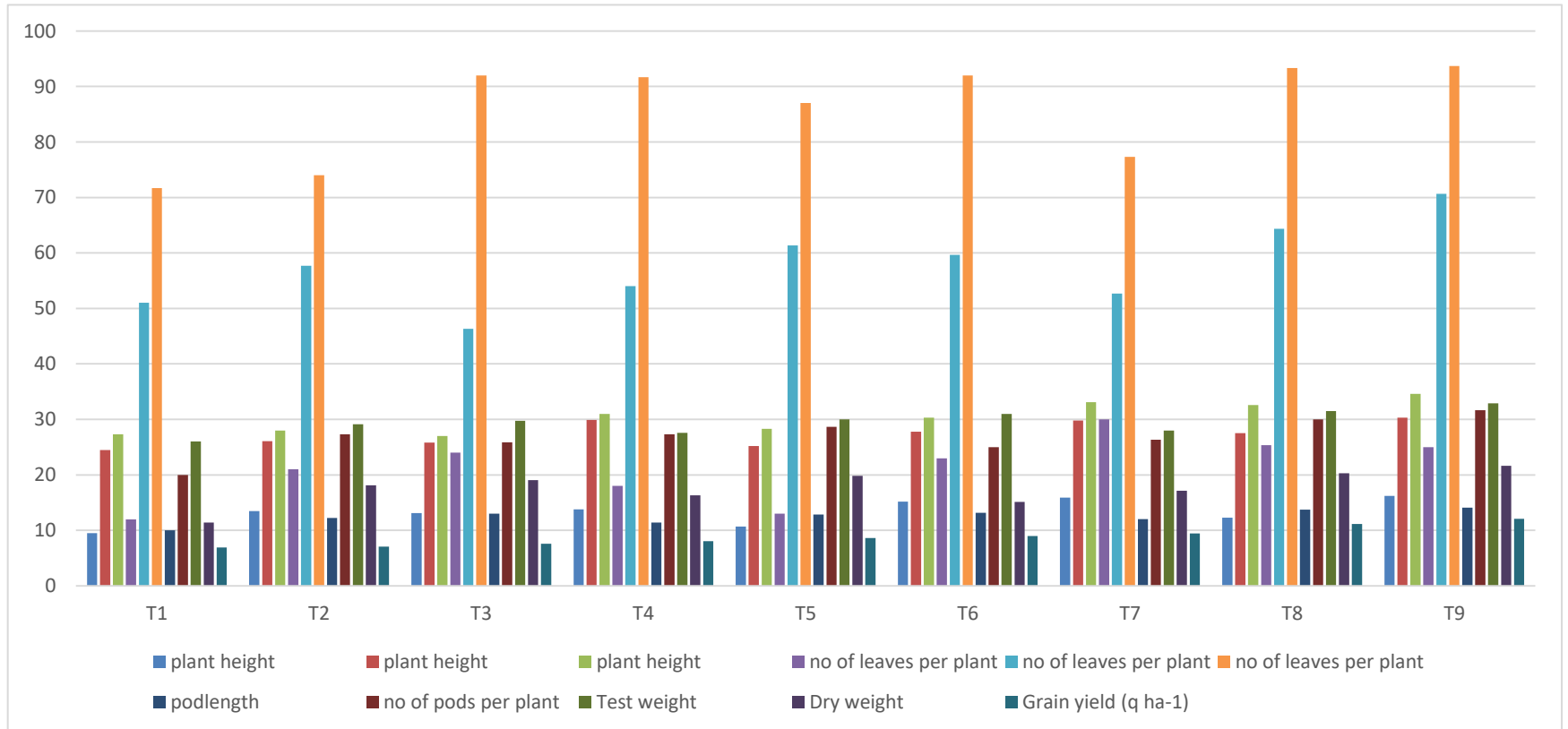


Fig . 2 Response of Bio-organics on physico-Chemical properties of Soil EC dSm⁻¹, Organic carbon(%),Nitrogen,

Table4: Response of Bio-organics on growth and yield parameters of Blackgram

| S.No | Treatment no | Treatment combination | Plant height(cm) | | | No. of leaves per plant | | | Podlength (cm) | No of pods per plant | Test weight (g) | Dry weight (g) | Grain yield (q ha ⁻¹) |
|------|----------------|----------------------------------|------------------|--------------|--------------|-------------------------|--------------|--------------|----------------|----------------------|-----------------|----------------|-----------------------------------|
| | | | 25 DAS | 50 DAS | 75 DAS | 25 DAS | 50 DAS | 75 DAS | 75 DAS | 75 DAS | 75 DAS | 75 DAS | 75 DAS |
| 1 | T ₁ | Control | 9.5 | 24.5 | 27.3 | 12.00 | 51.00 | 71.66 | 10.01 | 20.00 | 26.02 | 11.43 | 6.90 |
| 2 | T ₂ | 0% Vermicompost +50 Neem Cake | 13.5 | 26.1 | 28.0 | 21.00 | 57.66 | 74.00 | 12.24 | 27.33 | 29.10 | 18.10 | 7.05 |
| 3 | T ₃ | 0% Vermicompost +100 Neem Cake | 13.1 | 25.8 | 27.0 | 24.00 | 46.33 | 92.00 | 13.01 | 25.85 | 29.75 | 19.05 | 7.60 |
| 4 | T ₄ | 50% vermicompost +0 Neem Cake | 13.8 | 29.9 | 31.0 | 18.00 | 54.00 | 91.66 | 11.43 | 27.33 | 27.60 | 16.30 | 8.06 |
| 5 | T ₅ | 50% Vermicompost +50 Neem Cake | 10.7 | 25.2 | 28.3 | 13.000 | 61.33 | 87.00 | 12.86 | 28.66 | 30.02 | 19.83 | 8.62 |
| 6 | T ₆ | 50% Vermicompost +100 Neem Cake | 15.2 | 27.8 | 30.3 | 23.00 | 59.66 | 92.00 | 13.17 | 25.00 | 31.00 | 15.15 | 9.00 |
| 7 | T ₇ | 100% Vermicompost +0 Neem Cake | 15.9 | 29.8 | 33.1 | 30.00 | 52.66 | 77.33 | 12.04 | 26.33 | 28.00 | 17.12 | 9.44 |
| 8 | T ₈ | 100% Vermicompost +50 Neem Cake | 12.3 | 27.5 | 32.6 | 25.33 | 64.33 | 93.33 | 13.73 | 30.00 | 31.50 | 20.31 | 11.16 |
| 9 | T ₉ | 100% Vermicompost +100 Neem Cake | 16.2 | 30.3 | 34.6 | 25.00 | 70.66 | 93.66 | 14.11 | 31.66 | 32.88 | 21.65 | 12.09 |
| | | F-Test | S | S | S | S | S | S | s | S | S | S | S |
| | | C.D.at 5% | 0.389 | 1.432 | 1.102 | 1.034 | 2.285 | 2.739 | 0.504 | 1.234 | 1.256 | 0.712 | 0.385 |
| | | S.Em.(+) | 0.129 | 0.475 | 0.366 | 0.343 | 0.759 | 0.910 | 0.167 | 0.410 | 0.417 | 0.236 | 0.127 |



Response of Bio-organics on morphological parameters of Blackgram

4.0 CONCLUSION

On the basis of the findings it is concluded that the treatment combination 100%+ Vermicompost +100%Neemcake at 5t ha⁻¹ i.e, showed best result on physio-chemical properties of soil analysis after harvest of Black gram (*Vigna mungo*) in comparison to other treatment combination. Since the findings are based on the research done in one season further experiments will help to better understand the effect of integrated nutrient on soil health analysis of after crop harvest. The minimum bulk density (mg m⁻³), particle density (mg m⁻³), Water holding capacity, pH and EC dS m⁻¹ was noted in 100% Vermicompost +100%Neemcake @5 t ha⁻¹ which was significantly superior over T₀Control. Whereas the The maximum pore space (%), organic carbon, available nitrogen (kg ha⁻¹), available phosphorus (kg ha⁻¹) and available potassium (kg ha⁻¹), was noted in 100% Vermicompost +100%Neemcake@5t ha⁻¹ which was significantly superior over T₀ Control.

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