International Journal of Plant & Soil Science

Volume 35, Issue 18, Page 55-65, 2023; Article no.IJPSS.101252
ISSN: 2320-7035

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

Dosakayalapati Venkatagopalakrishna [a*], Narendra Swaroop [a], Tarene Thomas [a] and Satya Ranjan Mohanta [a]

[a] Department of Soil Science and Agricultural Chemistry, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh 211-007, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJPSS/2023/v35i183264

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/101252

Original Research Article

Received: 11/04/2023
Accepted: 13/06/2023
Published: 13/07/2023

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 b Neemcake 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

**Corresponding author: E-mail: venkatagopalakrishna555@gmail.com;*

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 (%) (0.181and 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.

Keywords: Soil nutrients; vermicompost; neemcake and blackgram.

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} [1]. 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 cultivatedfor 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 mixedcultivation it is planted on a rough seed bed as too much tilt encourages 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 [2]. 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% [3]. 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 [4]. 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 andIncreased microbial activity V. Saravana et al., [5].

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., [6].

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 $25^0 57^{"}$ N latitude, $81^0 59^{"}$ 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 Uttar Pradesh, 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*.,* [7] Particle Density (Mgm^{-3}) 1992Pore Space (%) muthuavel et al*.,(*1992)Water holding capacity (%) Muthuaval et al*.,* [7].

2.3.2 Chemical analysis

Soil pH and rest of the parameters were determined according to Jackson [8] ;EC (dS m^{-1}) by Wilcox [9]; Organi ccarbon (%) by Walkley and Black [10] ; Available Nitrogen (kg ha^{-1}) by Subbiah and Asija [11]; Available phosphorus (kg ha^{-1} by Olsen et al*.,* [12] and available potassium (kg ha^{-1}) by Toth and Prince [13].

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).

2.3.4 Data collected

The following data were collected on soil properties: bulk density, particle d ensity, 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.

Table 1. 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

Table 2. Response of Bio-organics on physico-chemical properties of soil BD, PD, % pore space, 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

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

S. No.	Treatments No.	Treatment combinations	EC (dS m^{-1})		Organic carbon (%)		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

Table 4. 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	13.00 0	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

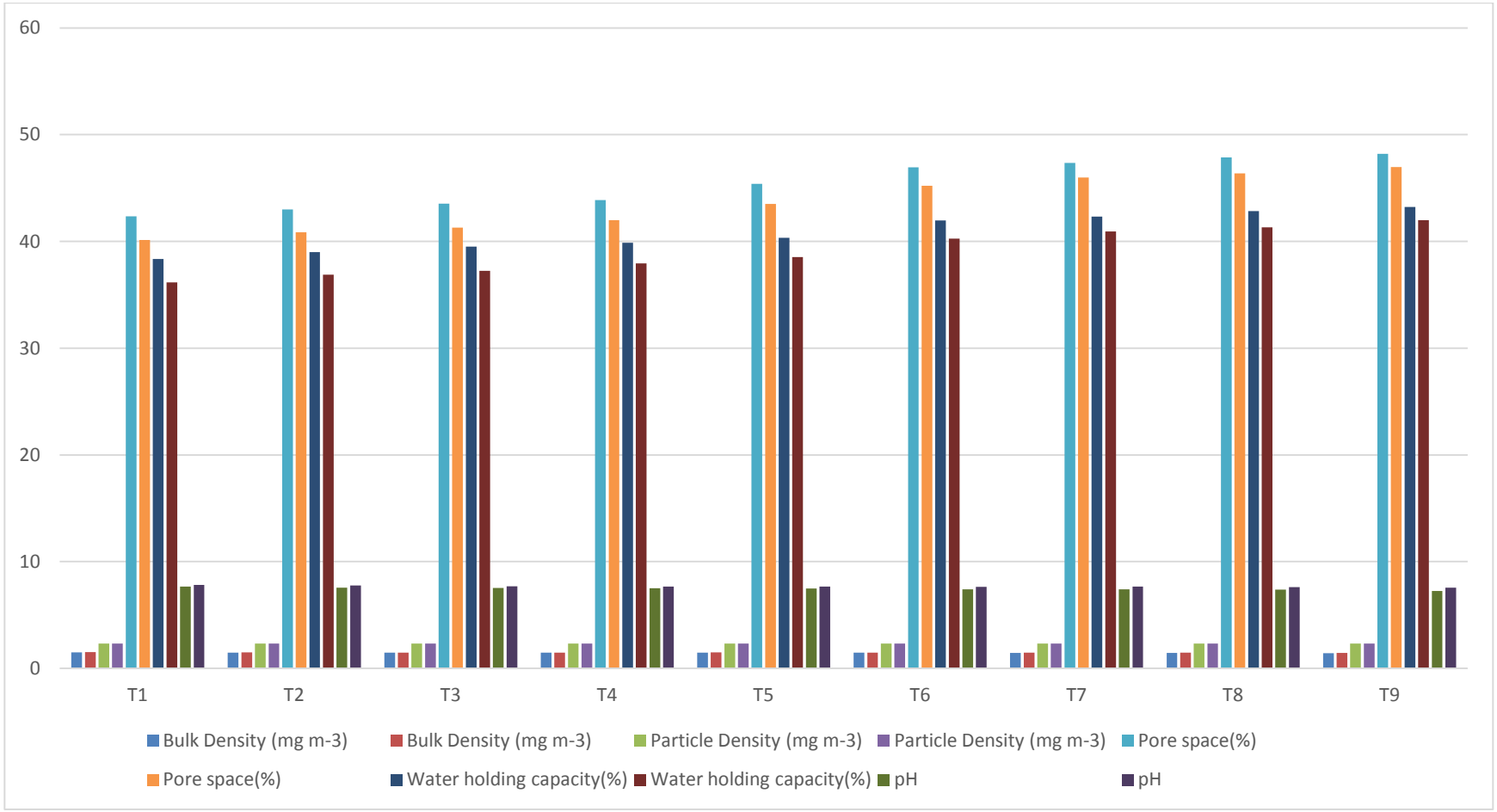

Fig. 1. Response of Bio-organics on physico-chemical properties of Soil BD, PD, Pore space, WHC and pH

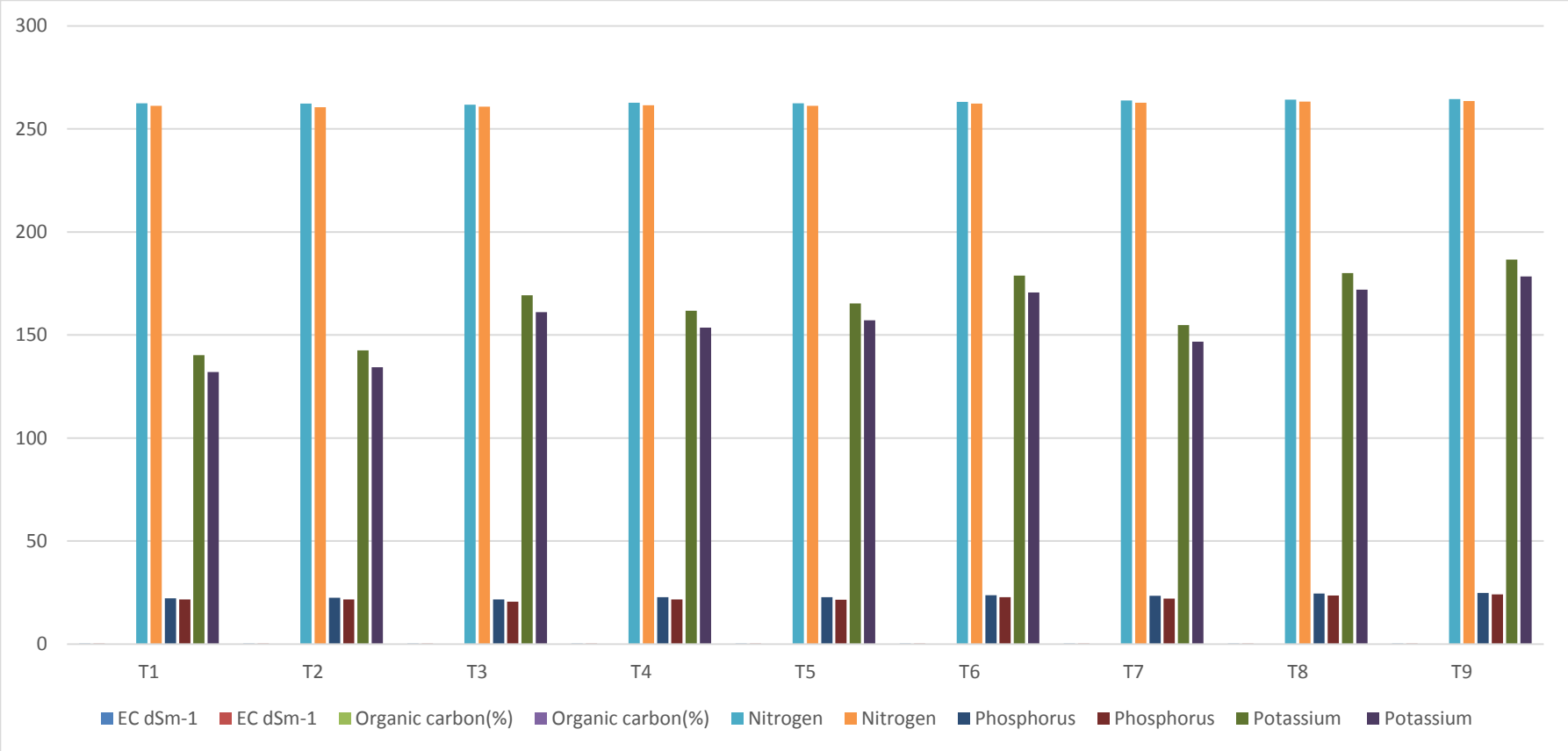

Fig. 2. Response of bio-organics on physico-chemical properties of soil EC dSm-1, organic carbon (%), Nitrogen, phosphorus and potassium

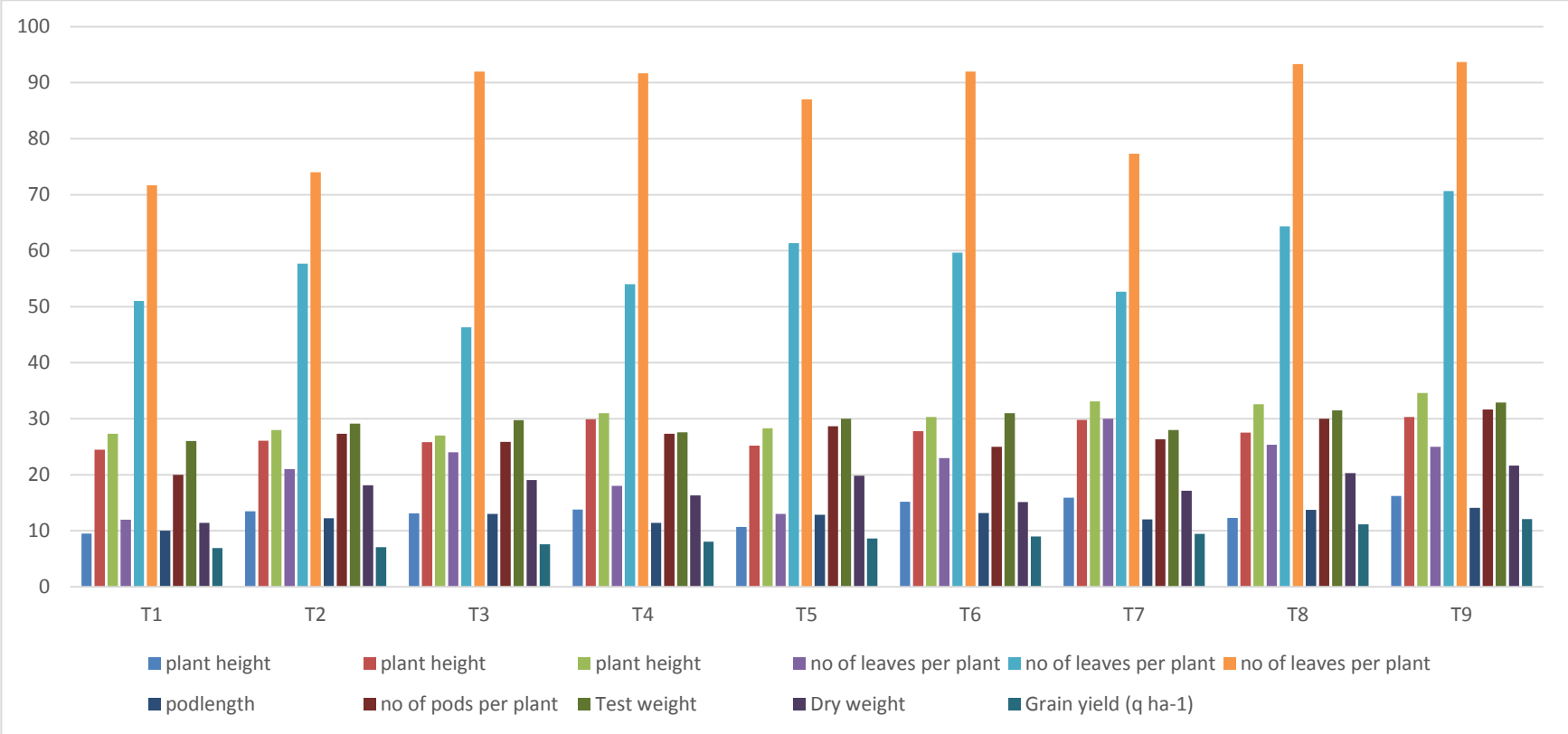

Fig. 3. Response of Bio-organics on morphological parameters of blackgram

3. RESULTS AND DISCUSSION

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 (Tables 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 T_9 100% Vermicompost +100%Neemcake @ 5 t ha^{-1} and maximum bulk density (mg m^{-3}) (1.49 and 1.51) was recorded in T_1.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 T_9. 5 t ha^{-1}However mimimum values are recorded in T_1 (Tables 2 and 3, Figs. 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_9. 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_9. 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 (Tables 2 and 3 Figs. 1,2).

3.3 Response of Bio-organics on Growth and Yield Parameters of Blackgram

It is indicated from Table (4) that nutrient souces significantly improved the growth and yield attributes of Black gram .Among the nutrient sources100%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).

4. CONCLUSION

On the basis of the findings it is concluded that the treatment combination 100%+ Vermicompost +100%Neemcake at 5t ha^{-1} i.e, showeds 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 T_0 Control. 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 T_0 Control.

ACKNOWLEDGEMENTS

Authors are highly acknowledged to the Department of Soil Science and Agricultural Chemistry, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, U.P. due to available the facilities of Soil Science farm and the Laboratory to conduct the research work.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. The Hindu. Special correspondent black gram, cultivations gains momentum; 2012.
2. FAO STAT. Food and Agriculture organization of United Nation (FAO); 2012. Available:http//Faost.org/site339/default.aspx
(Accessed on 15.02.2009).
3. Elzebrok Khan IA. Generation mean analysis of water stress tolerance in Green Gram (*Vigna radiata*). Pak. J. Bot. 2008; 41:195-205.
4. Nene YL. Indian Pulses through the millennia Asia Agriculture, History. 2006; 10:179- 20.
5. Saravana Kumar V, Renuka G, Kavino A, et al. Effect of vermicompost on growth, yield and nutrient uptake of black gram (*Vigna mungo*)". International Journal of Environmental Sciences; 2011.
6. Devi D, Chinnusamy P, Boominathan M. Effects of neem cake and chemical fertilizers on growth and yield of black gram (*Vigna mungo* L.). International Journal of Agricultural Sciences; 2015.
7. Muthuval P, Udayasoorian C, Nateson R, Ramaswami PP. The Laboratory manual on soil analysis for Physical and chemical characteristic of soil, introduction to soil analysis. Laser typesetting and off-set printing by scroll EDP, 68, D.B. Road, R.S. Puram, Coimbatore-641102; 1992.
8. Jackson ML. Soil chemical analysis Second edition Indian reprint, prentice hallof India, New Delhi; 1958;498.
9. Wilcox LV. Electrical conductivity Am. Water work Assoc. J. 1950;42:775-776.
10. Wakley A, Black IA. Critical examination of rapid method for determining organic carbon in soils, effect of variance in digestion conditions and inorganic soil constituents. Soil Science; 1947;632: 251.
11. Subbiah BV, Asija GL. A rapid procedure for the estimate of available Nitrogen in Soil Current Sci. 1956;25:259-260.
12. Olsen SR, Cole CV, Watnahe FS, Dean LA. Estimate of available phosphorus In soil by extraction with sodium bicarbonate US. Dept. Agricciric; 1954;939.
13. Toth SJ, Prince AL. Estimate of cation exchange capacity and exchangeable Ca, K, Na, content of soil by flame photometer technique Soil Sci. 1949;67:439-445.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/101252