



Response of Bio-Organics on Soil Fertility Status and Morphological Parameters of Green Gram (*Vigna radiata* L.) (var. PDM 139)

Ushana Bhavesh^{a*}, Narendra Swaroop^a, Tarence 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.

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ABSTRACT

An experiment was conducted during zaid (April- July) season 2021-22 to study " Response of Bio-organics on Soil Fertility Status and Morphological Parameters of Green Gram (*Vigna radiata* L.) (var. PDM 139) on central research farm department of Soil Science and Agricultural Chemistry, SHUATS, Prayagraj. The design applied for statistical analysis was carried out with randomized block design having two factors with three levels of @vermicompost 0,50and100% per ha, three levels of @FYM 0, 50and100% per ha. The best treatment T₉ (100%FYM+ 100%Vermicompost @10 t ha⁻¹) has effect on physical and chemical property of soil. The observed in post harvest soil resulted were significantly increased maximum values of percentage pore space (%) (47.90 and

*Corresponding author: E-mail: ushanabhavesh444@gmail.com;

45.90) at 0-15 and 15-30 cm soil depth, water holding capacity (46.06 and 43.56%) at 0-15 and 15-30 cm soil depth, organic carbon (%) (0.597 and 0.601%) at 0-15 and 15-30 cm soil depth, Nitrogen (kg ha^{-1}) (287.00 and 275.88 kg ha^{-1}) at 0-15 and 15-30 cm soil depth, Phosphorus (kg ha^{-1}) (26.35 and 23.41 kg ha^{-1}) at 0-15 and 15-30 cm soil depth and Potassium (kg ha^{-1}) (209.31 and 179.31 kg ha^{-1}) at 0-15 and 15-30 cm soil depth the plant height was at different DAS 30 and 60 (11.2, 38.9) No. of branches per plant 30 and 60 (3.9, 7.4) No. of nodules per plant (46.1) No. of pods per plant (19.40) Test weight (32.58) Grain yield (1357.6).

Keywords: Soil nutrients; FYM; vermicompost; greengram.

1. INTRODUCTION

"Pulses continue to be an important ingredient of human diet, especially for the large vegetarian population in the country. In the era of Green Revolution with major focus on staple food like rice and wheat, pulses were regulated to the marginal lands with least inputs. This, coupled with the increasing population, resulted in reducing per capita availability of pulses to the masses. It is also known as grain legumes, are next to cereals in terms of agricultural importance and have been considered best options for diversification and intensification of agriculture across the globe because of their intrinsic values such as Nitrogen fixing ability ($15\text{-}35 \text{ kg N ha}^{-1}$), high protein content and ability to thrive well in less endowed environment" (Kumar et al., 2018). "The present production of pulses in the country hovers around 19 million tonnes, which falls short of the present domestic requirement of around 21 million tonnes. This short fall in pulses is mainly due to near stagnation in production during the decade (1999-2009) on account of poor spread of improved varieties and technologies, abrupt climatic changes, complex disease-pest syndrome, emergence of new Biotypes and races of key pests and pathogens, and declining total factor productivity. In order to narrow down the demand supply gap, the country resorts to import pulses to the tune of 2-3 million tonnes every year. In order to ensure self-sufficiency, the pulse requirement in the country is projected at 39 million tonnes by the year 2050 which necessitates an annual growth rate of 2.2 per cent. Green gram is grown on about 3.70 million ha with annual production of 1.57 million tons. India is the largest producer of green gram and account for 54 per cent of the world production and covers 65 per cent of the world acreage. Green gram output accounts for about 10-12 per cent of total pulse production in the country. Pulses occupies 28.78 million ha. area and contributes 25.46 million tonnes in pulse production with productivity of 8.88 q ha^{-1} in the country" (GOI, 2021). "Green gram (*Vigna*

radiata L.), also known as mung, moong and green gram, is one of the most ancient and extensively grown leguminous crops of India. It is believed to be originated from India and mainly grown in East Asia, Southeast Asia and the Indian subcontinent in arid and semi-arid region. It is important short duration grain legume crop with wide adaptability, low input requirement and has the ability to improve soil fertility by fixing atmospheric Nitrogen well suited to small holder production under adverse climatic conditions" (Vijayalakshmi and Bhattacharya 2006). "It is grown in almost all parts of the country, stands third after chickpea. Indian farmers covered 30.84 lakh ha under pulses in which around 16.10 lakh ha was covered in green gram. The state of Rajasthan (18.30 lakh ha^{-1}), Maharashtra (3.28 lakh ha^{-1}), Karnataka (2.89 lakh ha^{-1}), Odisha (1.63 lakh ha^{-1}) and Telangana (0.70 lakh ha^{-1}) are major producer of green gram in India" [1].

Farm Yard Manure (FYM) can have several beneficial effects on green gram (also known as mung bean or moong bean) cultivation. Here are some potential effects of FYM on green gram. FYM is rich in organic matter, essential nutrients, and beneficial microorganisms [2-4]. When added to the soil, it enhances soil fertility by increasing the availability of nutrients, improving soil structure, and promoting microbial activity [5-7]. This can result in better nutrient uptake by green gram plants, leading to improved growth and productivity.

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 [8-11]. The increased nutrient availability can promote healthy growth and development of Green gram plants.

Enhanced soil structure: Vermicompost helps improve soil structure and texture. It improves

soil aeration, water-holding capacity, and drainage. Green 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 [12,13].

Enhanced water retention: FYM helps to improve soil's water-holding capacity. It increases the soil's ability to retain moisture, thereby reducing water stress on the green gram plants.

2. MATERIALS AND METHODS

The investigation on “Response of Bio-organics on Soil Fertility Status and Morphological Parameters of Green Gram (*Vigna radiata L.*) (var. PDM 139) Comprise of a field experiment on Soil Science Research Farm, Naini Agricultural Institute SHUATS, Prayagraj during *Zaid* season (april – June) 2022. 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 studies.

2.1 Experimental Site

The experiment was conducted at research Farm of Soil Science at Sam Higginbottom University of Agriculture Technology and Sciences, 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°05' E longitude and at the altitude of 98 meter above the sea level.

2.2 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 ranged between 20 to 94 percent. The average rainfall in this area is around 1100 mm annually

2.3 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 ($Mg\ m^{-3}$), 1992, Pore Space (%), Muthuavel et al.,(1992), Water holding capacity (%) Muthuaval et al., (1992).

2.3.2 Chemical analysis

Soil pH (1:2) Jackson (1958) ,EC ($dS\ m^{-1}$) ,Wilcox (1950), Organic carbon (%) Walkley and black (1947), Available Nitrogen ($kg\ ha^{-1}$), Subbiah and Asija (1956), Available phosphorus ($kg\ ha^{-1}$ Olsen et al.,(1954), Available potassium ($kg\ ha^{-1}$) Toth and prince (1949).

2.4 Statistical Analysis

The data recorded during the course of the investigation will subject to statistically analysis by randomized block design (RBD), for drawing conclusion. The significant and non-significant effect will judge with the help of “F” (variance ratio) table. The significant difference between the means will be tested against the critical difference of 5% level. For testing the hypothesis

Table 1. Treatment combinations of greengram

S. No.	Treatments No.	Treatment combinations
1.	T1	Absolute Control
2.	T2	0% FYM + 50% Vermicompost
3.	T3	0% FYM + 100% Vermicompost
4.	T4	50% FYM + 0% Vermicompost
5.	T5	50% FYM + 50% Vermicompost
6.	T6	50% FYM + 100% Vermicompost
7.	T7	100% FYM + 0% Vermicompost
8.	T8	100% FYM + 50% Vermicompost
9.	T9	100% FYM + 100% Vermicompost

3. RESULTS AND DISCUSSION

3.1 Response of Bio-Organics on Physical Properties of Soil after Harvest

Observation regarding the response of bio organics on soil fertility status and morphological parameters in FYM (0,50,100%) and Vermicompost (0,50,100%) affect the soil Bulk density($Mg\ m^{-3}$), particle density ($Mg\ m^{-3}$), pore space (%), water holding capacity(%) 0-15 and 15-30cm soil depth are given in table 2.3.The result of the data depleted that the minimum bulk density ($Mg\ m^{-3}$) (1.183,1.187) particle density ($Mg\ m^{-3}$) (2.094,2.097) at 0-15 and 15-30 cm soil depth after harvest was found in T₉ 100 % Vermicompost +100% FYM @10 t ha⁻¹ and maximum bulk density ($mg\ m^{-3}$) (1.291,1.295) particle density ($mg\ m^{-3}$) (2.262,2.265)was found in T₁.(control) respectively the maximum pore space (%) (47.90,45.90,) water holding capacity (%) (46.06,43.56) at 0-15 cm soil depth was found in T₉.100% Vermicompost +FYM@10 t ha⁻¹ However minimum values are detected in T₁.(control) 0-15 and 15-30 cm depth respectively (Tables 2,3 Figs. 1,2)

3.2 Response of Bio-Organics on Chemical Properties of Soil after Harvest

Observation regarding the response of Bio organics on soil fertility status and morphological

parameters in FYM (0,50,100%) and Vermicompost (0,50,100%) affect pH EC($d\ Sm^{-1}$) ,Organic carbon, Available Nitrogen ($kg\ ha^{-1}$) ,Available phosphorus ($kg\ ha^{-1}$), Available potassium ($kg\ ha^{-1}$). The results of data showed that the minimum pH (6.674,6.680) at 0-15 and 15-30 cm depth was found in T₉.100% Vermicompost +100%FYM @ 10 t ha⁻¹and maximum pH (6.835,6.839) soil depth was found in T₁. (control) and respectively. The maximum EC ($dS\ m^{-1}$) (0.233,0.237) Organic carbon (%) (0.597,0.601) Nitrogen ($kg\ ha^{-1}$) (287.0,275.88) phosphorus ($kg\ ha^{-1}$) (26.35, 23.41) potassium ($kg\ ha^{-1}$) (209.31,179.31) at 0-15 and 15-30 cm soil depth was found in T₉.100%Vermicompost + 100% FYM @10 t ha⁻¹.However minimum values are detected in T₁.(control) 0-15 and 15-30 cm depth respectively (Tables 2,3 Figs. 1,2)

3.3 Response of Bio-Organics on Morphological Parameters of Greengram

It is indicated from Table 4 that nutrient sources significantly improved the growth and yield attributes of Greengram. Among the nutrient sources100%FYM+100% Vertmicompost @10 t ha⁻¹ gave highest values of plant height at 60DAS (38.9cm),no.of branches per plant at 60DAS (7.4), no. of nodules per plant (46.1),no.of pods per plant (19.40), test weight (32.5g), grain yield q ha⁻¹ (1357.6).

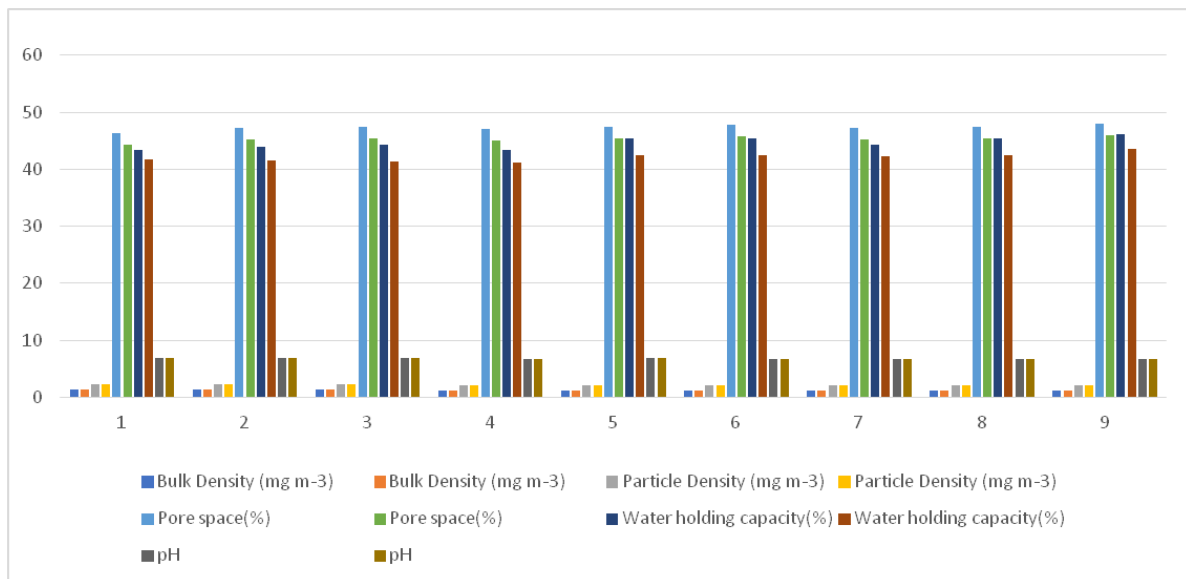


Fig. 1. Response of Bio organics on physico-chemical properties of soil BD, PD, porespace, WHC, pH

Table 2. Response of bio-organics on physico-chemical properties of soil on BD, PD % porespace, WHC, 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	Absolute Control	1.291	1.295	2.262	2.265	46.31	44.31	43.31	41.65	6.835	6.839
2	T ₂	0% FYM + 50% Vermicompost	1.290	1.293	2.264	2.269	47.20	45.20	43.87	41.54	6.867	6.872
3	T ₃	0% FYM + 100% Vermicompost	1.287	1.291	2.265	2.271	47.42	45.42	44.22	41.42	6.852	6.856
4	T ₄	50% FYM + 0% Vermicompost	1.230	1.236	2.141	2.144	47.09	45.09	43.43	41.09	6.741	6.744
5	T ₅	50% FYM + 50% Vermicompost	1.233	1.238	2.147	2.151	47.43	45.43	45.43	42.48	6.798	6.803
6	T ₆	50% FYM + 100% Vermicompost	1.237	1.241	2.149	2.153	47.79	45.79	45.48	42.46	6.789	6.795
7	T ₇	100% FYM + 0% Vermicompost	1.190	1.196	2.098	2.104	47.21	45.21	44.21	42.21	6.696	6.701
8	T ₈	100% FYM + 50% Vermicompost	1.193	1.199	2.095	2.099	47.48	45.48	45.46	42.43	6.663	6.668
9	T ₉	100% FYM + 100% Vermicompost	1.183	1.187	2.094	2.097	47.90	45.90	46.06	43.56	6.674	6.680
		F-Test	ns	ns	S	S	S	S	S	S	S	S
		C. D. at 5%			0.021	0.032	0.23	0.23	1.40	0.028	0.133	0.135
		S.Em. (+)			0.014	0.016	0.68	0.68	0.47	0.09	0.041	0.042

Table 3. Response of bio-organics on physico-chemical properties of soil EC (dSm⁻¹), organic carbon (%), nitrogen, phosphorus, 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	Absolute Control	0.207	0.212	0.467	0.472	252.50	231.54	22.08	18.72	182.38	152.38
2	T ₂	0% FYM + 50% Vermicompost	0.208	0.214	0.483	0.487	272.88	238.88	23.65	19.28	198.39	163.72
3	T ₃	0% FYM + 100% Vermicompost	0.210	0.216	0.487	0.492	279.64	258.54	24.76	20.74	200.33	169.67
4	T ₄	50% FYM + 0% Vermicompost	0.213	0.218	0.517	0.522	275.19	236.92	23.44	18.88	197.11	158.11
5	T ₅	50% FYM + 50% Vermicompost	0.217	0.223	0.527	0.533	280.32	260.33	25.18	21.61	201.17	170.17
6	T ₆	50% FYM + 100% Vermicompost	0.213	0.219	0.537	0.541	284.85	272.88	25.84	22.47	207.22	177.15

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
7	T ₇	Vermicompost 100% FYM + 0%	0.220	0.224	0.583	0.588	275.19	245.84	24.17	20.12	199.67	167.84
8	T ₈	Vermicompost 100% FYM + 50%	0.221	0.227	0.587	0.593	283.41	266.92	25.65	21.77	205.85	175.87
9	T ₉	Vermicompost 100% FYM + 100%	0.233	0.237	0.597	0.601	287.00	275.88	26.35	23.41	209.31	179.31
		F-Test	S	S	S	S	S	S	S	S	S	S
		C. D. at 5%	0.015	0.016	0.011	0.009	5.53	9.75	0.26	2.94	10.19	10.59
		S.Em. (+)	0.005	0.006	0.004	0.003	16.57	29.22	0.532	0.75	3.40	3.53

Table 4. Response of bio-organics on morphological parameters of greengram

S.No.	Treatment no	Treatment combination	Plant height		No of branches		No of Nodules		No of pods	Test weight	Grain yield
			30DAS	60 DAS	30 DAS	60 DAS	60DAS	60 DAS	60 DAS	60 DAS	60 DAS
1	T ₁	Absolute Control	9.0	22.0	3.0	6.7	40.7	12.03	12.03	31.16	551.3
2	T ₂	0% FYM + 50% Vermicompost	9.3	24.7	3.2	6.8	42.4	13.98	13.98	32.03	855.0
3	T ₃	0% FYM + 100% Vermicompost	10.1	26.4	3.8	7.0	43.9	15.77	15.77	32.31	962.4
4	T ₄	50% FYM + 0% Vermicompost	9.2	23.3	3.1	6.8	41.7	13.93	13.93	31.84	804.7
5	T ₅	50% FYM + 50% Vermicompost	10.2	29.7	3.6	7.1	44.8	15.80	15.80	32.33	994.3
6	T ₆	50% FYM + 100% Vermicompost	10.9	34.4	3.8	7.3	45.7	17.68	17.68	32.51	1127.6
7	T ₇	100% FYM + 0% Vermicompost	10.0	24.7	3.3	6.9	42.9	14.01	14.01	32.29	875.0
8	T ₈	100% FYM + 50% Vermicompost	10.8	30.7	3.7	7.2	45.2	17.20	17.20	32.42	1081.4
9	T ₉	100% FYM + 100% Vermicompost	11.2	38.9	3.9	7.4	46.1	19.40	19.40	32.58	1357.6
		F-Test	S	S	S	S	S	S	S	S	S
		C.D.at 5%	0.53	1.28	0.32	0.04	2.34	1.66	1.66	3.42	108.61
		S.Em.(+)	1.60	3.83	0.96	0.13	0.78	0.55	0.55	1.14	36.23

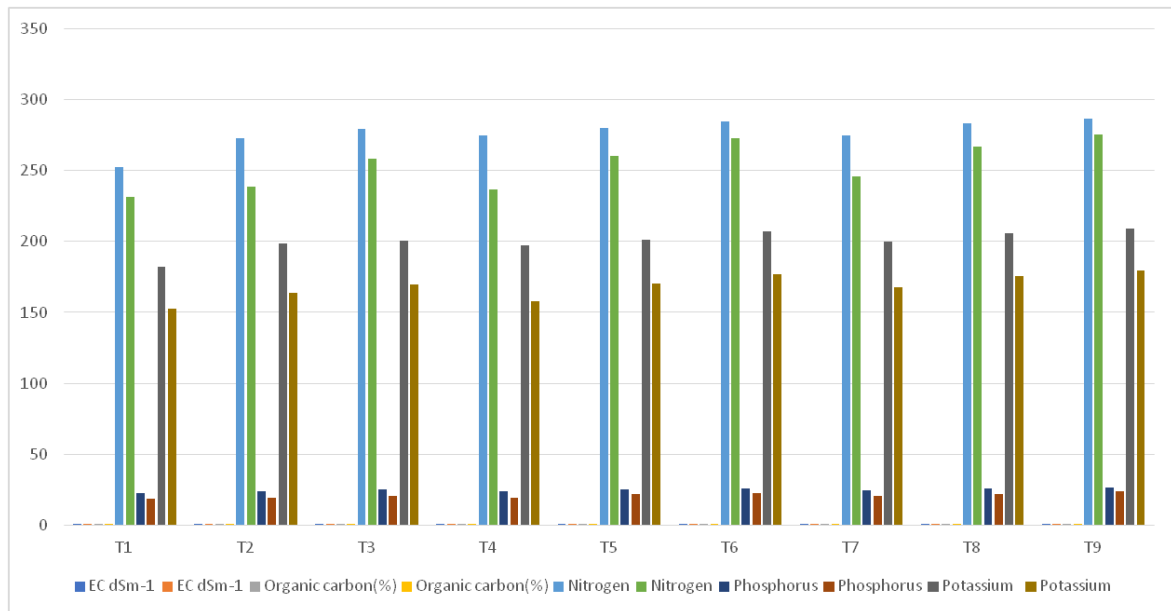


Fig. 2. Response of bio-organics on physico-chemical properties of soil EC (dSm⁻¹), organic carbon (%), nitrogen, phosphorus, potassium

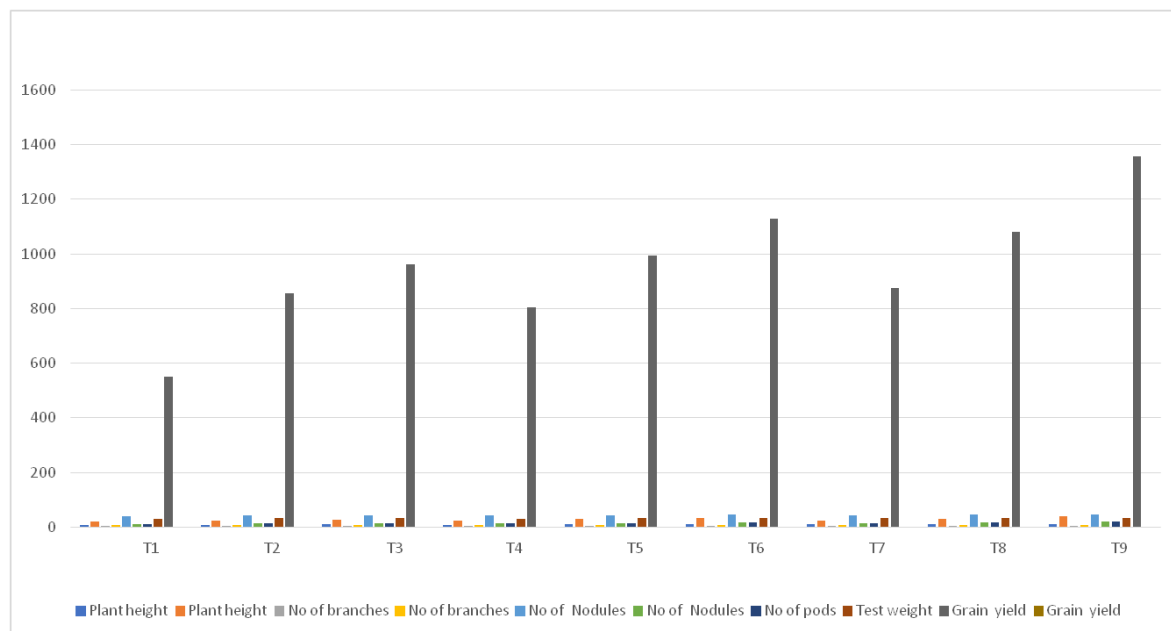


Fig. 3. Response of bio-organics on morphological parameters of greengram

4. CONCLUSION

On the basis of findings it is concluded that the treatment combination 100% FYM +100%Vermicompost @10t ha⁻¹ i.e, Treatment T₉ shows best result on physio-chemical properties of soil analysis after harvest of greengram (*Vigna radiata*) in comparison to other treatment combination. Since the findings are based on the research done in one of season

further experiments with more than one season will help in better to study the effect of integrated nutrient on soil health analysis of soil 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% FYM +100%Vermicompost @10 t ha⁻¹ which was significantly superior over T₀ 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% FYM +100%Vermicompost 10t ha⁻¹ which was significantly superior over T₀ Control.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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