Plant Archives Vol. 20, Special Issue (AIAAS-2020), 2020 pp. 183-187 ***ISSN 0972- 5210***

INFLUENCE OF VERMICOMPOST ON PHYSIOCHEMICAL PROPERTIES OF SOIL IN WHEAT FIELD OF WESTERN UTTAR PRADESH

Deo Kumar[1], Arbind Kumar Gupta[1,*], Sanjeev Gupta[2], Jitendra Singh[3] and Mohan Singh[4]

[1]Department of Soil Science, BUAT, Banda

[2]BAU Sabour, Bihar

[3]Directorate of Extension, CSAUAT, Kanpur

[4]Soil Science, Krishi Vigyan Kendra, Bilari, Moradabad, SVPUAT Meerut

Abstract

A field experiment was conducted at SVPUAT, Meerut during 2005-06 and 2006-07 to evaluate the effect of vermicompost on physico-chemical properties of soil in wheat field. The Experiment was arranged in randomized block design (RBD) with three replications. There were 10 treatments. The result showed that the application of vermicompost 3 tonnes ha^{-1} and 100% NPK of RDF (T_{10}) significantly increase the organic carbon (OC), available nitrogen, phosphorus and potassium compared with control plot (T_1). The soils treated with vermicompost had significantly less EC in comparison to control plots. The addition of vermicompost in soil resulted in decrease of soil pH. The physical properties such as bulk density (BD) in soil amended with vermicompost were improved. The results of this experiment revealed that addition of vermicompost had significant ($P < 0.05$) and positive effects on the soil chemical, physical properties and yield of wheat crop.

Key words: Vermicompost, Soil properties, Nutrient, Earth worm, Manure and Wheat crop.

Introduction

The long-term use of chemical fertilizers without organic inputs deteriorate the physical, chemical and biological properties of soil and causes environmental pollution (Albiach *et al*., 2000). Organic manures act not only as a source of nutrients and organic matter, but also increase size, biodiversity and activity of the microbial population in soil, influence structure, nutrients turnover and many other related quality parameters of the soil (Albiach *et al*., 2000). Addition of organic matter *i.e.* vermicompost enhance the quality parameter of soil. There is a good evidence that vermicompost promotes growth of plants and it has been found to have a favourable influence on all yield parameters of crops like, wheat, paddy and sugarcane (Ansari, 2007). Different raw materials like wheat straw, paddy straw, moong straw, pressmud used and mixed with dung in the ratio of 2:1 and only buffalo dung will be used to prepare the vermicompost. The nutrient status will differ from each other raw material; this status of nutrients will be determined from all type of raw materials as well as prepared vermicompost. Vermicompost contains many times more N, P and K content than compost. Application of vermicompost as organic manure in soil built-up organic carbon, improve nutrient status, enhance cation exchange capacity (CEC), microbial activities, microbial biomass carbon and enzymatic activities (Kumar *et al*., 2018). The present work was carried out to study both the combined effect of vermicompost and inorganic fertilizer on physicochemical property soil in wheat crop.

*Corresponding author Email: arbind4gupta@gmail.com

Material and Methods

Preparation of Vermicompost from different organic waste

There are five types of raw material *i.e.* wheat straw, paddy straw, moong straw, press mud and dung was used for preparation of vermicomposting. The ratio of raw material and buffalo dung was 2:1 for better growth of earthworm and microbes. The available macro and micro nutrient along with pH, EC, OC and BD was determined before and after preparation of vermicompost. Well mixed materials are filled in separate vermibed with definite ratio. The size of vermibed should be 6x3x1 feet.

After escaping heat from raw material, earthworms were released on each vermibed @ 150gm. The vermibed was covered with Jute bag or dry grasses to protect from birds, insect and direct sun light. Water was sprinkled through Hazara on each vermibed to maintain the moisture (35-40%) for good growth of earthworms. The material was turned upside down weakly without disturbing the basal layer (Vermibed). The most popular spp. of earthworm *i.e. Eisenia foetida* was used for vermicomposting. They can survive in long range of temperature *i.e.* 15-48°C. Turning of material was done at 15, 30 and 50 days after releasing of worms. At the time of maturity, watering was stopped before 4-5 days and sieve in alternate days. The compost was harvested at 75-90 days. The vermicompost sample was collected from each unit and analyzed them. The mixture of press mud and buffalo dung was the highest macro and micronutrient containing vermicompost among all raw materials. This vermicompost was used for the effect on physic-chemical properties of soil.

Experimental Site and Design

An experiment was conducted in SVPUAT, Meerut during 2005-06 and 2006-07 to evaluate the effect of vermicompost on physico-chemical changes of soil in wheat field. The Experiment was laid out in randomized block design with three replications. Wheat (*Triticum aestivum*) was grown as test crop. The treatment detail of experiment is given in table 1.

Analysis of physico-chemical properties

The surface soil (0-15cm) samples were collected from wheat field at different growth stages. These samples were prepared and analyzed for different physical and chemical properties. Physical properties of the soil *i.e.* bulk density was determined by core sampler, soil texture by Brady (1996). Chemical parameters like soil pH and electrical conductivity (EC) were determined by Rechard (1954) by using digital pH and conductivity meters. Organic Carbon (OC) was estimated by following the procedure of Walkley and Black (1934), available nitrogen, phosphorus and potassium were estimated by alkaline potassium permanganate method of Subbiah and Asija (1956), Olsen *et al*. (1954) and neutral normal ammonium acetate method of Standford and English (1949) respectively. The detail analysis of soil is depicted in table 2.

Result and Discussion

Effect of different treatments of vermicompost on physico-chemical properties of soil

The effect of vermicompost on physic-chemical properties of soil is depicted in table 3. Bulk density is an indicator of compactness and looseness of soil. The results of several long-term studies have shown that the addition of compost improves soil physical properties by decreasing bulk density and increasing the soil water holding capacity (Weber, 2007). It was significantly increase at harvest from initial value. The lowest BD was observed in T_{10} during 2005-06 and 2006-07 at 30 DAS of wheat crop. The density of soil was increased with passage of time and highest was recorded during harvest.

Soil pH range between 6.0-7.0 seems to promote the availability of nutrients to the plants (Brady, 1988). Soil pH was influenced by different treatments. It was slightly saline to alkaline in reaction. The value of Soil pH was increased as increasing the time except T_5, T_8, T_9 in 2005-06 and 2006-07. The highest pH (8.59) was observed in T_1 at harvest in 2005-06. Electrical conductivity (EC) was significantly influenced by vermicompost under both the years. The soil samples were non saline in nature. Organic carbon is an indicator of soil fertility. The deficiency in OC reduces the storage capacity of soil nutrients and reduction in soil fertility (Kale *et al*., 1992). In addition of vermicompost in different treatments, the drastic change of organic carbon was observed. It was highest in 30 DAS and decreased progressively. It might be due to decomposition of organic matter in initial days (30 DAS) and thereafter, utilization and oxidation of OM during harvest. The highest organic carbon content was found in T_{10} at 30 DAS in 2005-06 and 2006-07. Adugna (2016) reported that the addition of mature compost increase SOM much better than fresh and immature composts due to their higher level of stable carbon.

Available Nitrogen, Phosphorus and Potassium

Available nitrogen (Kg ha^{-1}) content in soil was significantly affected by different treatments at 30 days interval (Table 4). The highest available nitrogen in soil was observed at 30 DAS and decline gradually with the advancement of crop growth. Treatment T_{10} was found maximum nitrogen in soil among all the treatments in both the years and minimum was observed in treatment T_1. Manivannan *et al*., 2009; Lim *et al*., 2015 also reported that the application of vermicompost increases the N content in soil significantly. Phosphorus is present in soil as an organic and inorganic form. The available phosphorus content in soil was highest in initial days (30 DAS) of wheat and decreased thereafter (Table 5). The maximum available phosphorus content was recorded in T_{10} (18.01 Kg ha^{-1}), (18.56 Kg ha^{-1}) and minimum in T_1 (10.67 Kg ha^{-1}), (10.69 Kg ha^{-1}) in 2005-06 and 2006-07 respectively. The reduction of available phosphorus might be due to precipitation of P with calcium carbonate and high soil pH. Azarmi (2008) observed that addition of vermicompost enhance the phosphorus and potassium content significantly. Available Potassium was significantly influenced by different treatments like Nitrogen and Phosphorus (Table 6). Highest value of available Potassium was also observed during initial day of crop (30 DAS) and decline gradually with the advancement of crop growth. Treatment T_{10} was significantly higher (248 Kg ha^{-1}) among all the treatments during 2005-06 and same trend observed in 2006-07.

The present investigation is concluded that the available nutrient content *i.e.* N, P and K in soil was significantly higher than other ones. The highest available N, P, K was recorded in T_{10} where 100% NPK with vermicompost @ 3 t/ha was applied and it was found significantly higher than the rest of the treatments during both the year while in T_7 (where 75% NPK with 3 t/ha vermicompost) was found significantly at par with T_{10} during both the year. Thereafter 25% (NPK fertilizer) can be save by the application of 75% NPK with 3 t/ha vermicompost instead of 100% NPK with 3 t/ha vermicompost.

References

Adugna G (2016). A review on impact of compost on soil properties, water use and crop productivity. *Academic Research Journal of Agricultural Science and Research,* **4(3):** 93-104.

Albiach R, Canet R, Pomares F and Ingelmo F (2000). Microbial biomass content and enzymatic activities after application of organic amendments to a horticultural soil. *Bioresour. Technol.*, **75:** 3-48.

Ansari A (2007). Urban planning and environment strategies and challenges Macmillan India PLtd., New Delhi, pp. 277-279.

Azarmi R, Giglou MT and Taleshmikail RD (2008). Influence of vermicompost on soil chemical and physical properties in tomato (*Lycopersicum esculentum*) field. *African Journal of Biotechnology*, **7(14):** 2397-2401.

Kumar A, Prakash CHB, Brar NS and Kumar B (2018). Potential of Vermicompost for Sustainable Crop Production and Soil Health Improvement in Different Cropping Systems. *International Journal of Current Microbiology and Applied Sciences*, **7(10):** 1042-1055.

Lim SL Wu TY Lim PN and Shak KP (2015). The use of vermicompost in organic farming: overview, effects on soil and economics. *Journal of Science and Food Agriculture*, **95(6):** 1143-1156.

Manivannan S, Balamurugan M, Parthasarathi K, Gunasekaran G and Ranganathan LS (2009). Effect of vermicompost on soil fertility and crop productivity - beans (*Phaseolus vulgaris*). *Journal of Environment Biology*, **30(2):** 275-281.

Table 1: The treatment details of experiment

S No.	Treatments	Symbol
1	Recommended Dose of Fertilizers (RDF) (150: 60:40)	T_1
2	1 tonnes vermicompost + 50 % NPK of RDF	T_2
3	2 tonnes vermicompost + 50 % NPK of RDF	T_3
4	3 tonnes vermicompost + 50 % NPK of RDF	T_4
5	1 tonne vermicompost + 75 % NPK of RDF	T_5
6	2 tonnes vermicompost + 75 % NPK of RDF	T_6
7	3 tonnes vermicompost + 75 % NPK of RDF	T_7
8	1 tonne vermicompost + 100 % NPK of RDF	T_8
9	2 tonnes vermicompost + 100 % NPK of RDF	T_9
10	3 tonnes vermicompost + 100 % NPK of RDF	T_{10}

Table 2: Physico-chemical properties of experimental soil and methods used for analysis

S. No.	Characteristics	Values	Reference
A. Physical Characteristics			
1	Textural class	Sandy loam	Brady (1996)
2	Bulk density (g/cc)	1.71	
B. Physico-chemical characteristics			
1	pH (1:2.5 Soil : water)	8.73	Richard (1954)
2	EC_e (dSm^{-1}) (1:2.5	0.513	Richard (1954)
C. Chemical characteristics			
1	Organic carbon (%)	0.302	Walkley and Black (1934)
2	Available nitrogen (kg ha^{-1})	157.1	Subbbiah and Asija (1956)
3	Available phosphorus (kg ha^{-1})	11.7	Olsen *et al.,* (1954)
4	Available potassium (kg ha^{-1})	117	Standford and English (1949)
5	Iron (ppm)	53.7	Lindsay and Norvell (1978)
6	Manganese (ppm)	24.64	
7	Zinc (ppm)	7.4	
8	Copper (ppm)	4.27	

Table 3: Effect of different treatments on physico-chemical properties of soil

Treatments	2005-06								2006-07							
	30 DAS				At harvest				30 DAS				At harvest			
	BD	pH	EC	OC	BD	pH	EC	OC	BD	pH	EC	OC	BD	pH	EC	OC
T_1	1.64	8.53	0.427	0.316	1.67	8.59	0.435	0.301	1.62	8.47	0.429	0.317	1.66	8.53	0.433	0.315
T_2	1.59	8.15	0.339	0.416	1.64	8.22	0.417	0.321	1.52	8.13	0.338	0.423	1.63	8.19	0.415	0.323
T_3	1.45	7.72	0.238	0.571	1.57	8.13	0.388	0.338	1.4	8.04	0.235	0.573	1.54	8.13	0.384	0.34
T_4	1.39	7.7	0.218	0.611	1.46	7.87	0.348	0.38	1.37	7.69	0.216	0.618	1.44	7.84	0.344	0.384
T_5	1.59	8.39	0.337	0.421	1.64	8.15	0.419	0.321	1.53	8.16	0.335	0.424	1.62	8.13	0.417	0.325
T_6	1.46	8.07	0.24	0.569	1.57	8.1	0.385	0.34	1.42	8.05	0.238	0.573	1.55	8.09	0.367	0.342
T_7	1.38	7.71	0.215	0.618	1.45	7.81	0.341	0.381	1.36	7.68	0.212	0.623	1.44	7.79	0.336	0.383
T_8	1.6	8.25	0.34	0.419	1.64	8.18	0.39	0.322	1.56	8.22	0.339	0.458	1.63	8.17	0.412	0.327
T_9	1.46	8.07	0.237	0.568	1.56	7.87	0.383	0.34	1.43	8.06	0.235	0.575	1.54	7.85	0.379	0.343
T_{10}	1.37	7.72	0.214	0.619	1.45	7.8	0.345	0.382	1.35	7.7	0.209	0.627	1.44	7.79	0.34	0.387
CD at 5%	0.02	0.33	0.004	0.008	0.02	0.04	0.023	0.002	0.03	0.18	0.004	0.033	0.02	0.06	0.014	0.012

Table 4: Effect of different treatments of Vermicompost on available nitrogen in soil (Kg ha^{-1}) during 2005-06 & 2006-07

Treatments	2005-06				2006-07			
	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest
T_1	163.33	150.56	140.40	140.35	162.67	150.57	140.05	139.04
T_2	180.63	168.09	156.80	154.29	181.08	168.12	156.95	154.54
T_3	205.74	194.46	181.88	180.63	206.31	194.53	182.00	180.99
T_4	218.27	200.02	188.16	185.65	218.33	200.24	190.16	186.03
T_5	184.39	170.59	159.30	156.82	184.49	170.61	159.64	157.11
T_6	209.64	189.42	179.37	176.87	209.90	189.57	179.49	177.12
T_7	222.11	208.24	194.43	193.16	222.45	208.80	196.12	195.19
T_8	188.40	178.16	165.58	163.06	188.33	179.46	165.77	163.12
T_9	213.23	199.45	190.66	188.17	213.61	199.77	190.90	188.54
T_{10}	225.78	210.75	198.19	195.67	226.47	211.63	200.85	197.79
CD at 5%	2.34	1.90	2.19	1.70	1.29	2..09	3.13	2.08
SEm ±	0.78	0.63	0.73	0.56	0.43	0.07	1.05	0.70

Table 5: Effect of different treatments of Vermicompost on available phosphorus in soil (Kg ha-1) during 2005-06 & 2006-07

	2005-06				2006-07			
Treatments	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest
T_1	10.67	8.90	7.66	7.25	10.69	8.88	7.64	7.20
T_2	11.93	10.79	9.88	9.34	12.17	11.13	10.26	9.44
T_3	13.99	11.61	10.54	10.08	14.26	12.17	11.03	10.29
T_4	15.59	13.88	12.57	12.09	16.04	14.45	13.03	12.28
T_5	12.98	11.12	10.05	9.53	13.32	11.61	10.51	9.70
T_6	14.79	12.05	10.90	10.29	15.03	12.75	11.16	10.46
T_7	17.13	15.38	14.22	13.26	17.66	16.02	14.53	13.62
T_8	13.28	11.92	10.40	9.86	13.61	12.08	10.83	9.98
T_9	15.15	12.61	11.03	10.59	15.23	13.00	11.25	10.73
T_{10}	18.01	15.93	14.47	13.77	18.56	16.45	14.69	14.03
CD at 5%	2.58	2.64	2.67	2.46	2.77	2.91	2.71	2.50
SEm ±	0.86	0.88	0.89	0.82	0.92	0.97	0.91	0.84

Table 5: Effect of different treatments of Vermicompost on available phosphorus in soil (Kg ha-1) during 2005-06 & 2006-07

	2005-06				2006-07			
Treatments	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest
T_1	170.67	165.67	160.67	157.67	170.00	164.33	160.00	156.00
T_2	194.33	173.33	166.67	161.33	196.67	175.33	168.33	162.67
T_3	220.00	203.67	193.67	185.00	222.33	207.33	196.00	187.67
T_4	238.67	220.67	199.67	198.67	239.67	222.67	202.33	200.33
T_5	196.00	174.67	166.33	161.33	197.67	176.33	168.33	162.67
T_6	229.33	207.33	196.33	186.67	231.00	210.33	198.33	188.33
T_7	242.33	224.33	202.67	203.00	244.00	227.00	204.67	202.00
T_8	199.00	183.00	171.67	168.33	200.33	185.33	173.67	169.33
T_9	233.33	212.33	198.33	193.00	235.67	214.33	200.00	194.33
T_{10}	247.67	227.00	208.33	202.33	250.67	229.33	210.00	206.00
CD at 5%	1.94	1.75	3.31	3.69	2.77	2.70	3.18	2.82
SEm ±	0.65	0.59	1.10	1.23	0.93	0.90	1.06	0.94