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ORIGINAL RESEARCH ARTICLE

Field Trial on Overdosed Organic Manures on Chemical Properties of Soil

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ABSTRACT

In this present study, the field experiment was conducted to evaluate the overdosed effect of organic manures on chemical properties of soil under potato cultivation field. The experimental plot was divided into 15 sub-plots with size of 5m x 5m of which 5 sub-plots each allotted for compost, vermicompost and vermileachate treatment and one sub-plot of vermileachate was kept as control. Compost and vermicompost were applied with increasing concentration of 10 tonne/ha to 60 tonne/ha in the interval of 10 tonne/ha of potato field. Vermileachate was prepared at different dilution of water via 25%, 50%, 75% and 100% (v/v) and irrigated at the rate of 3L/5sq.m at 15days interval. At the end of experiment, chemical properties *viz*., pH, EC, organic carbon and available N, P and K of post-manure soils were estimated. As the application of organic manures increases carbon level in the soil, it improves the soil fertility as well as offset CO_2 level from atmosphere.

Key words: Compost, Vermicompost, Vermileachate, Soil, Organic manure and Potato.

1. INTRODUCTION

The health and quality of natural resources especially soil and water under intensive human management is severely affected throughout the world. The pressure to sustain modern agricultural systems causes a progressive degradation of soil health as a result of organic matter reduction [1]. As a consequence, the arable lands need, continuously, nutritional substances to maintain its fertility. The numerous reports confirmed that organic manures of different sources are enhancing soil quality, which includes pH, nutrient availability and bulk density [2,3,4]. Organic manures affect almost all characters of the soil [5]. Organic manures especially compost and vermi-compost possess diverse of beneficial microorganisms, which affects soil fertility and suppress plant diseases to promote plant growth [6]. Vermicompost is reported to be rich in plant nutrients [7,8] and has plant growth influencing substances like growth hormones and humic acids, which are contributing to higher growth and yields [9,10]. The objective of the present study was attempted to evaluate the effect of over dose of organic manures on chemical properties of potato cultivated soil.

2. MATERIALS AND METHODS

2.1. Study area

A study was conducted under potato cultivation during in the month of October – December, 2009 at Forest Research Centre, Mandar, Jharkhand (N 23^0 27' 41.3" and E 0850 05' 57.0") at an altitude of 703m above mean sea level, having an annual average rainfall of 1400mm; humid to sub humid tropical type of climate. Annual temperature ranges from maximum 42 to 20^0C during summer and 25 to 4^0C during winter season. Soil of study site was lateritic in nature.

2.2 Experiment

The research field was divided in to 15 equal sub-plots (5m x 5m) of these 5 sub-plots each allotted for compost and vermi-compost equally. Compost and vermi-compost were applied on the soil and incorporated well by hand hoeing @ 10tonne/ha (T_{10}), 20tonne/ha (T_{20}), 40tonne/ha (T_{40}), 50tonne/ha (T_{50}) and 60tonne/ha (T_{60}). Potato crop was sown in month of December 2009 with sparings 1 x 1.5 ft in 6 rows. The liquid collected from vermi-composting bed called as Vermi-leachate (VL). The VL was prepared in different dilutions with irrigation water *viz*., 25% VL(T_1), 50% VL (T_2), 75% VL (T_3) and 100%

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VL (T_4) and applied the same on one month old potato seedling as foliar spray at the rate of $3L/5m^2$ in 4 sub-plots separately. One plot was treated as control for all treatments. Crop protection measures and watering were done as per the recommendations.

2.3 Analysis of soil samples

Representative soil samples were collected from the pit, (30 x 30 x 30cm depth) at the study site before (Control) and after the treatment. Samples were brought to the laboratory and air dried ground through Cyclotech sample mill and screened through 2 - mm sieve as per standard procedure, and chemical characteristics (pH, EC, organic carbon, available phosphorus, and potassium of all processed soil (< 2mm) were determined as per methods described by Jackson (1967)[11]. The available nitrogen was estimated as described by Subbiah and Asija (1956)[12].

3. RESULTS AND DISCUSSION

3.1. Soil pH

The soil pH was significantly reduced in all treated field when compared to that of the control (**Table 1 & 2**). The pH reduction was due to the release of different organic acids and production of CO_2 by microbes from applied organic manures, compost which leads to the increase in acidity of the soil, [13, 14].

3.2. Soil EC

The soil electrical conductivity was significantly increased in all treated field when compared to that of the control (**Table 1& 2**). This may be due to the accumulation of soluble salts into the soil. The maximum accumulation was found in vermileachate treated soil.

3.3. Chemical properties of organic manure soils

3.3.1. Soil Carbon.

The total organic carbon content in all the treated soil nearly increased 18 – 20 times than the control (**Table 1 & 2**) as the result of reduction of decomposition rate by microbial activity at low pH and accumulation of over dosed effect of carbon [15].

3.3.2. Soil Nitrogen content.

The soil available nitrogen content present in the treated soil varies significantly than the control (**Table 1 & 2**).

3.3.2.1. Nitrogen content in Compost treated soil.

The available nitrogen content gets reduced due to the direct influence of increased acidity on the microbial activity of the compost treated field. On the other hand, the available nitrogen content showed twofold increase in the vermi-composted field. This was due to the metabolic activity of diverse population of microbes and mortality of earthworms which contains high amount of ammonical nitrogen in their tissues as described Suthar (2007)[16].

3.3.2.2. Nitrogen content in Vermicompost treated soil.

The impact of increased acidity on the vermi-compost field wasn't shown any significant effect on nitrogen availability. This may be due to the presence of wide range of acid tolerant microbes in the vermi-compost.

3.3.2.3. Nitrogen content in Vermi leachate treated soil.

The soil available nitrogen content present in the treated soil varies significantly than the control (**Table 1 & 2**). The availability of nitrogen in vermi leachate treated field showed similar effect as in the compost treatment. Vermi leachate contains *Acetobacter*, *Agrobacterium*, *Rhizobium* and phosphate solubilizing microbes which make available inorganic form of nitrogen, amino acid and other inorganic phosphates to plants through ammonification and nitrification processes Jambare *et al.* (2008)[17]. Likewise, Prabu (2006)[18] reported presence of large number of beneficiary microorganism which helps in plant growth and protects it from a number of infestations.

3.3.3. Phosphorus content in treated soil

The phosphorus availability gets slightly reduced in all treated plots, which correlates with the soil acidity. This may be due to the phosphate fixation by Fe^{3+} and Al^{3+} at the range of pH 4.5 – 7.5. Similarly, Ndegwa *et al.* (2000)[19] reported that the shifting of pH could be related to mineralization of nitrogen and phosphorus into nitrites/nitrates and ortho – phosphates and bioconversion of organic material into intermediate species of organic acids.

3.3.4. Potassium content in treated soil

The availability of potassium gets increased manifold in all the treated soil. This was due to the synergetic effect of earthworm and microorganism [20] and influenced by the release of fixed K^+ ion by the hydronium of organic acids.

Table 1: Effect of compost (C) and Vermicompost (VC) on chemical properties of soil

Organic Treatment	C	VC	C	VC	C	VC	C	VC	C	VC	C	VC
	pH (1:5)	pH (1:2.5)	EC (1:5, mS/cm)		OC (%)		Available (ppm)					
							N	N	P	P	K	K
Tc	6.15		0.24		0.73		396.3		2.07		26.9	
T_{10}	5.8	4.95	0.46	0.39	13.2	13.5	169	780	0.45	0.34	49	69
T_{20}	4.75	4.1	0.52	0.45	14	13.9	156	800	0.43	0.24	523	329
T_{30}	4.35	4.15	0.63	0.52	14	13.8	148	800	0.43	0.3	370	180
T_{40}	4.06	4.22	0.68	0.55	14	13.7	134	803	0.44	0.34	180	329
T_{50}	4.94	4.8	0.68	0.57	13.9	13.6	168	802	0.48	0.39	324	380
T_{60}	5.6	4.72	0.72	0.57	14.2	14.1	185	807	0.4	0.45	161	368
Mean	4.917	4.49	0.615	0.51	13.883	13.77	160	798.67	0.438	0.34	267.833	275.83
Sd	0.68	0.37	0.33	0.07	0.35	0.22	17.92	9.50	0.03	0.07	197.56	124.07

Tc = control; T10= 10t/ha; T20= 20t/ha; T30=30t/ha; T40= 40t/ha;T50t/ha; T60 = 60t/ha

Table 2: Effect of vermileachate (VL) on chemical properties of soil

Treatment	pH (1:5)	EC (1:5, mS/cm)	OC (%)	Available (ppm)		
				N	P	K
Tc	6.15	0.24	0.73	396.3	2.07	26.9
T_1	4.09	0.73	13.8	178	0.27	334
T_2	4.8	0.75	14.1	207	0.44	340
T_3	3.83	0.79	14	164	0.33	277
T_4	3.8	0.82	13.8	158	0.45	358
Mean	4.13	0.7725	13.925	176.75	0.3725	327.25
Sd	0.46526	0.0403	0.15	21.8384	0.0873	35.01785

Tc = control; T1=25%VL; T2=50%VL; T3=75%VL; T4 = 100%VL

4. CONCLUSION

From the present study, it is concluded that acidity and electrical conductivity of the soil were reduced significantly by addition of organic manure. Most interesting finding of the study was that soil organic carbon is increased manifold of the initial carbon level. Thus organic manure plays vital role in enhancing carbon sequestration and soil organic matter improvement. The available N was improved by the addition of vermicompost. Available P content was reduced in all treated soils, whereas available K content improved in the treated soil. Thus, application of organic manures especially vermicompost help not only in the improvement of soil health and fertility but also helps in off-setting atmospheric CO_2 through enhancement of soil organic carbon.

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