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Physico-chemical and microbiological properties of soil composed with vermicompost

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ABSTRACT

In this study, physico-chemical and microbiological properties of soil composed with Vermicompost was studied. Analysis of soil composed with vermicompost revealed that compost treated soil underwent changes in all measured physicochemical and microbiological parameters like higher water holding capacity, moisture content, electrical conductivity, organic content and microbial populations, than the control soil. Nearly two fold higher microbial populations were observed in vermicompost soil than the control. Improved physicochemical and microbiological parameters in vermicompost soil is an indications of improvement of soil fertility

KEYWORDS

Vermicompost;
Physico-chemical and micro biological properties.

INTRODUCTION

One of the major concerns in today's world is the pollution and contamination of the soil. The use of chemical fertilizers and pesticides has caused tremendous harm to the the environment.Organic fertilizer differ from chemicals in that they feed plants while adding organic material in the form of biocompost and vermicompost to the soil. Biofertilizer or natural farming technology is necessary to support the developing organic, sustainable and non-pollution agriculture. These are cost effective and ecofreindly in nature Soil is an excellent natural media and soil enzymes play key biochemical functions in the overall process of organic matter decomposition in the soil system[1]. Addition of solid organic amendments increases the microbial activity of soils. Soil organisms and enzymes are highly involved in the degradation of soil organic matter and nutrient cycling. They catalyze several important reactions which are necessary for the life processes of microorganisms in soils and the stabilization of soil structure, the decomposition of organic wastes, organic matter formation and nutrient cycling[2]. The activities of these enzymes in soils undergo complex biochemical processes and play an important role in agriculture and particularly in nutrient cycling[3,4]. In soil, cellulose is available primarily in the form of litter (dead plant material) or lignocellulosic agricultural waste that is relatively recalcitrant due to the high lignin content of terrestrial plants. A lack of fixed nitrogen and other nutrients may secondarily limit microbial growth, and the low moisture content of soils[5]. The enzyme cellulase is a complex enzyme it play an important role in bioconversion of cellulose to simple soluble reducing sugars. The cellulose in soils are derived mainly from plant debris and incorporated into the soil, the limited amounts may also originate from fungi and bacteria in soils. Growth and survival of microorganisms important in most agricultural soils depends on the carbon source contained in the cellulose occurring in the soils whether in the form agricultural waste or cattle feed waste[7]. The phosphatase is extra cellular enzyme which hydrolysis the organic phosphates to inorganic phosphate and plays an important role between biologically unavailable phosphorus and available phosphorus[8]. The inorganic phosphorus availability was controlled by soil organic matter which is influence microbial activity. The phosphatase activity was correlated with organic phosphate and microbial populations[9]. It plays key role in soil ecosystem and it is good indicator of soil fertility[10]. The soil pH influences the release and stability of phosphatase[3,11]. An attempt was made in this study to observe the influence of vermicompost on soil physco-chemical, biological and enzyme properties.

MATERIALS AND METHODS

Collection of vermicompost sample

The vermicompost was collected from natural forming units near the local area of Tirupati, Andhra Pradesh, India. The soil without supplementation of vermicompost was treated control was collected from adjacent site of vermicompost and these two samples were air-dried and mixed thoroughly to increase homogeneity and shifted through < 2 mm sieve.

Analytical methods for characterization of soil

The physic-chemical properties of vermicompost and normal soil were analyzed by standard methods APHA[12]. Water holding capacity of soil sample were measured by finding amount of distilled water added to soil sample to get saturation point and then sixty per cent water holding capacity of soil sample was calculated by the method[13].

Enumeration of bacteria

Bacterial populations in control and test soils were enumerated from soil sample on nutrient agar medium with the following composition. (g/L):Peptone - 5.0, NaCl- 5.0,Beef extract- 3.0,Agar agar- 20.0, Distilled water- 1000 ml, PH- 7.2.. After preparation of medium, 20 ml of sterile medium was aseptically transferred to sterile Petri plates and allowed for solidification. After solidification of the medium 100μl aliquots of soil suspension was speeded uniformly with the help of sterile glass spreader. The plates were incubated in an incubator at 37 °C for 3days. After incubation, bacterial colonies grown on plates were counted by Queby colony counter. Bacterial colonies are sub cultured on nutrient agar slants for further studies.

Enumeration of fungi

Fungal populations in both control and test soils were enumerated on Czapeck-Dox agar medium. After preparation of medium, 20 ml of sterile medium was aseptically transferred to sterile Petri plates and allowed for solidification. After solidification of the medium 0.1 ml aliquots of soil suspension was speeded uniformly with the help of sterile glass spreader. The plates were incubated at room temperature (28°C±30°C) for 7 days. After incubated, fungal colonies grown on plates were counted[14]. The fungal colonies grown on the medium are sub cultured on the Czapeck-Dox agar slants for further studies.

RESULTS AND DISCUSSIONS

Physico-chemical properties vermicompost soil

Soil fertility mediated by microorganism is dependent on maintenance of physico-chemical and biological characteristics in soil. Analysis soil with vermicompost underwent changes in all measured parameters than control soil. Soil composed with vermicompost exhibited improved physical and chemical properties. This compost imports black colour to soil. Higher water holding capacity from 0.26 - 0.42ml/g, moisture content, and higher electrical conductivity 0.3.9-1.89 μMhos/cm were observed in the control and compost soil respectively. These improvements in compost soil may be due to the deposition of organic manure in the form of vermicompost. These results were confirmed by the previous studies[17-21] organic effluents had increased the electrical conductivity to the soil. Similar reports made Pradeep and Narasimha 2011 (Leather effluents)[22], Radha et al 2012,(Abattoir)[23] disposal effluents from Leather and Abattoir wastes improved the physicochemical properties of soil. In contrast, soil polluted with cement industries had low water holding capacity and electrical conductivity[24]. Slightly improved condition of Ph (7.21) in compost soil was recorded in the present study. Similarly, Lalithakumari *et al.*[25], Sparling *et al.*[17] and Nizamuddin, *et al.*[21], reported that discharges of dairy products like milk residues from dairy industry increased the soil pH. In contrast, Zande *et al.*[26], reported that the discharges of cane sugar residues from sugar cane industry reduced the soil pH. Higher organic matter content (8.9%) measured in vermicompost soil than the control with 5.4. Higher organic content of soil may be due to the decomposed form of vermicompost in the soil. Zande *et al.*[26], Dodor and Tabatabai[27], Nizamuddin *et al.,*[21] made similar reports on the discharge of organic effluents like, dairy effluents, increase of organic matter. Improvement in total contents of nitrogen (0.6-1.14) phosphorous (49-119) organic carbon (5.2-9.5) and potassium (211-318) in observed in compost than the control (TABLE.1). Higher contents of these chemical properties of vermicompost may be due to the decomposed compost soil. Similarly, Narasimha *et al.,* (cotton ginning industry)[18], Kaushik *et al.,* (Distillary)[28] made similar reports on the discharge effluents from agro based industries were improved the soil total phosphorous in contaminated soil. Nizamuddin[21], reported that discharge of effluents from sugar and dairy industry enhanced the potassium content and nitrogen content in the soil.

TABLE 1 : Pysico-chemical properties of Vermicompost and normal soil.

Properties	Control soil	Vermicompost soil
Color	Grey	Black
Ph	6.8	7.12
Electrical conductivity (µ Mhos/cm)	0.39	1.84
Water holding capacity (ml/g of soil)	0.26	0.42
Organic matter (kg/g of soil)	5.4	8.9
Total nitrogen (Kg/h)	0.6	1.15
Phosphorus (kg/h)	49	119
Carbon (Kg/h)	5.2	9.5
Potassium (kg/h)	211	318

***Values represented in the figure are mean of two separately conducted experiments.**

Microbial properties

The microorganisms play a vital role in nutrient cycling and soil fertility. Bacteria and fungi synthesize and secrete soil enzymes such as phoshatase, cellulase, protease, etc extracellularly. These enzymes constitute an important part of the soil matrix as extra cellular enzymes[29]. Micro flora of vermicompost soil was enumerated and listed in the TABLE 2. Higher microbial populations in compost were noticed and counted in terms of colony forming units. In the present study, number of bacterial (99×10^4) and fungal (11×10^4) population were observed in the compost soil than the control soil. The higher bacterial and fungal population may be due to suitable pH and deposition of decomposed organic matter in the soil. In contrast irrigation of soil contaminated with effluents from agro based industries such as dairy, sugar cane and cotton mill industries improved the soil microbial population[17,18,21,30].

TABLE 2 : Microbial population in vermicompost and control soil

Parameter	Control soil (CFU/g soil)	Vermicompost soil (CFU/g soil)
Bacteria	46 X 10^4	$99x10^4$
Fungi	5 X 10^4	$11x10^4$

***Microbial population was counted in the form of CFU/g soil.**

CONDLUSIONS

Analysis of soil with vermicompost improved the physicochemical, biological and parameters like water holding capacity moisture content, PH, electrical conductivity, organic contents and microbial populations including bacteria and fungi than the control soil. Improved physic chemical and microbial population in vermicompost treated soil is an indication of improvement in soil fertility.

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