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QUALITY OF VERMICOMPOST IN RESPONSE TO THE VARIATIONS IN INPUTS

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Abstract

Vermicompost consists of several phytohormones, macro as well as micronutrients that absorbed by the roots of the plants. They are well decomposed manures that are released after undergoing digestion in the guts of earthworms. This humus like manures acts as booster for providing health to plants and maintaining sustainability. In the experiment, vermicompost was prepared using 5 different ingredients with main components as crop residues, legumes, press mud and weeds.Quality in terms of available nitrogen, available phosphorus and available potassium was analyzedafter harvesting. Required quantity of samples collected from the harvested and dried vermicompost and was used for determining these nutrients. It led to the conclusion that vermicompost prepared from legumes was recorded with the best chemical parameters (pH, EC, OC, N, P and K) that was followed by the vermicompost prepared with green manures.

Key words: Vermicompost, Earthworms, Sustainability, Organic farming

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Introduction

Vermicomposting is a non-thermophilic decomposition of raw materials carried out predominantly by the earthworms along with the microbes. Substances after getting metabolized in the gut of the earthworms are excreted out in the form of globular castings that are rich in different kinds of nutrients, phytohormones, vitamins etc. The essential phenolic acids like, humic acids, fulvic acids etc make the vermicompost very rich source of soil amendment factors that builds up the soil chemistry and improves the soil texture. Soil porosity, bulk density, water holding capacity and soil organic matter content improves resulting in an excellent buffering capacity. Vermicompost acts as the inoculum of diverse groups of microorganisms that accelerates the microbial activity near the root zones of plants. These microbes have the potential to build up the soil fertility status of soil by accelerating the nutrient cycles, viz, nitrification, nitrogen fixation, phosphate mineralization, phosphate mobilization etc. thereby resulting in deficiency alleviation and stress tolerance against the weather and soil aberrations. The antagonistic effect of a population of microbes present in vermicompost has the ability to suppress the population of the pathogenic microbes thus reducing the soil borne diseases of plants. Vermicompost is rich in several phytohormones that can make the plants resistance to stress, inhibit abscission, and enhance seed germination and plant growth and development. The enzymatic activities, as characterized by the microbial diversification and dominance, get accelerated in the vermicompost because of the abundance of the organic substrates. Wormcasts consist of higher activities enzymes such as of amylase, invertase, cellulase, peroxidase, urease, protease, dehydrogenase and phosphatase (Sharpley and Syers 1976; Edwards and Bohlen 1996).

Vermicompost have been used by the farmers through the globe under almost all the soil conditions to enhance the soil productivity and sustainability. It is prepared at different scales through pit or bed method using diverse kinds of the raw materials ranging from crop residues to the shredded kitchen waste. The raw materials act as the substrate to the earthworms while the rate of formation and quality of the vermicompost depends on several other factors including species of earthworms, amount and variations in the ingredients, temperature, moisture etc. Similarly, the population and diversity of microbes, enzymes and enzymatic activities are also directly proportional to the kind of substrates and the environment. The study was undertaken to understand the impact of different substrates on the quality of vermicompost and seed germination and root: shoot growth.

Materials and Methods

Bed Preparation of Vermicompost

Vermicomposts was prepared through the standard bed methods in portable beds of sizes4m x 4mx 2m.The sources of different raw materials taken on was chopped rice crop residues (CR); legumes, press mud (PM), weeds and control. Cowdung (CD) and shredded leaves (SL) was the constant ingredients in all the beds. Thus the treatments were: T_1- CR + CD +SL; T_2: Legumes+ CD+ SL; T_3- PM+ CD+ SL; T_4- weeds +CR+SL and C- Control (C). Weeds that were collected were grasses, sedges as well as grass leaved weeds. On dry weight basis, 5kg of the ingredients and 5 kg of shredded leaves and 10 kg of cowdung was taken in each of the beds to attain a constant ratio for the variable ingredients: cowdung: shredded leaves as 1:2:1. For control only cowdung and shredded leaves were taken in ratio 3:2. These materials were stacked on the bed layer by layer while ensuring the topmost layer to be cowdung for the better interaction with earthworms. The bed was kept under shade away from direct sunlight or rain.
The species of earth worm chosen was *Eisenia foetida* commonly called redworms, which are epigenic and voracious feeders, idle for converting the waste into compost in cool and moist condition. 100-120 earthworms were added on the top of the bed after which the bed was covered with gunny bags. Care was taken to avoid any insect breeding. In order to maintain a cool and damp condition, frequent sprinkling of water was done twice a week.

Temperature of 20-25 degree Celsius with relative humidity of 70%-75% was maintained. Initial pH of the cowdung added was measured to be 4.5 through pH meter. An approximate time taken by the vermicompost to get ready was 2 to 2.5 months owing to the different raw materials. Harvesting of vermicompost was done by collecting further which it was sieved out. Intitial dry weight was measured after which it was dried in oven at 60 degree Celsius for 24 hours to take the further readings.

Study After the Vermicompost Preparation

The level of pH, EC was studied with the help of pH meter and EC meter respectively.Available nitrogen (Subbiah and Asija, 1956), available phosphorus (P_2O_5) (Olsen's method) and available potassium (K_2O), Organic content (%) was analyzed for the samples.

Statistical Analysis

The research was conducted in completely randomized block design experiment where the vermicompost beds were laid out 4 replications making it a total of 20 treatments. Data analysis was performed by using one way ANOVA followed by the Duncan's multiple range test to compare the means.

Results and Discussion

pH

Data pertaining to the observed parameters suggested that pH of T_2: Legumes+ CD+ SL was found to be significantly highest (7.14) that wasfollowed by the treatment T_3:PM+ CD+ SL among the other treatments while that of C- control was found to be the lowest (5.03). Increased pH in vermicompost added with legumes might be due to the formation of alkaline forms of nutrients like ammonia on effective conversion of N (Mistry *et al.*, 2015; Cohen and Lewis, 1949), which could not have been possible in the vermicompost added with only cowdung and shredded leaves. With the digestion of the organic materials, the pH of the final vermicomposts tends to lean towards the neutral pH due to the various kinds of organic acids present in it.

Electrical Conductivity (EC) (dS/m)

Electrical conductivity (EC) (dS/m) of the compost was also significantly impacted due to the variation in the resources. Among all the treatments, T_2: Legumes+ CD+ SL was found to have significantly higher EC (0.54 dS/m) that was followed by the treatment T_3:PM+ CD+ SL (0.50 dS/m), whereas significantly lowest was found in C- control (0.35). The increases EC in the vermicomposts is probably due to the range of acids and as a result the cations and anions present in vermicompost (Pattnik and Reddy, 2009). Minerals such as exchangeable Ca, Mg, P and K also lead to the higher EC. The results are in conformity to the Tognetti *et al.*, 2005; Guoxue*et al.*, 2001.

Organic Carbon Content (OC) (%)

Organic carbon content (OC) (%) was also significantly impacted due to the raw materials, where significantly higher OC was observed in the treatment T_2: Legumes+ CD+ SL (7.88%) that was followed by the treatment T_3:PM+ CD+ SL (7.74%). Significantly lower value was found in control (6.79%). Higher organic content in the vermicompost was observed due to the increased microbial action and as a result increased humification of the materials as a result of proper decomposition under aerobic condition (Dominguez and Edwards, 2004).

Available Nitrogen (kg/ha)

Data related to available nitrogen (kg/ha) suggested that treatment T_2: Legumes+ CD+ SL resulted in significantly higher available nitrogen in vermicompost (248 kg/ha) whereas significantly lowest was found in C-control (198.75 kg/ha). The trend in descending order was found to be: T_2: Legumes+ CD+ SL (248 kg/ha) >T_3- PM+ CD+ SL (226.25 kg/ha) >T_1- CR + CD + SL (205.75 kg/ha) >T_4- weeds +CR+SL (201.50 kg/ha) > C-control. Higher available nitrogen in the case of legumes could be due to the increased protein content of the legumes, presence of rhizobium nodules and better mineralization of the nutrients. The results are in

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conformity of Lazcano *et al*. 2008; Albanell*et al*. 1988; Chan and Griffiths 1988; Subler et al. 1998).

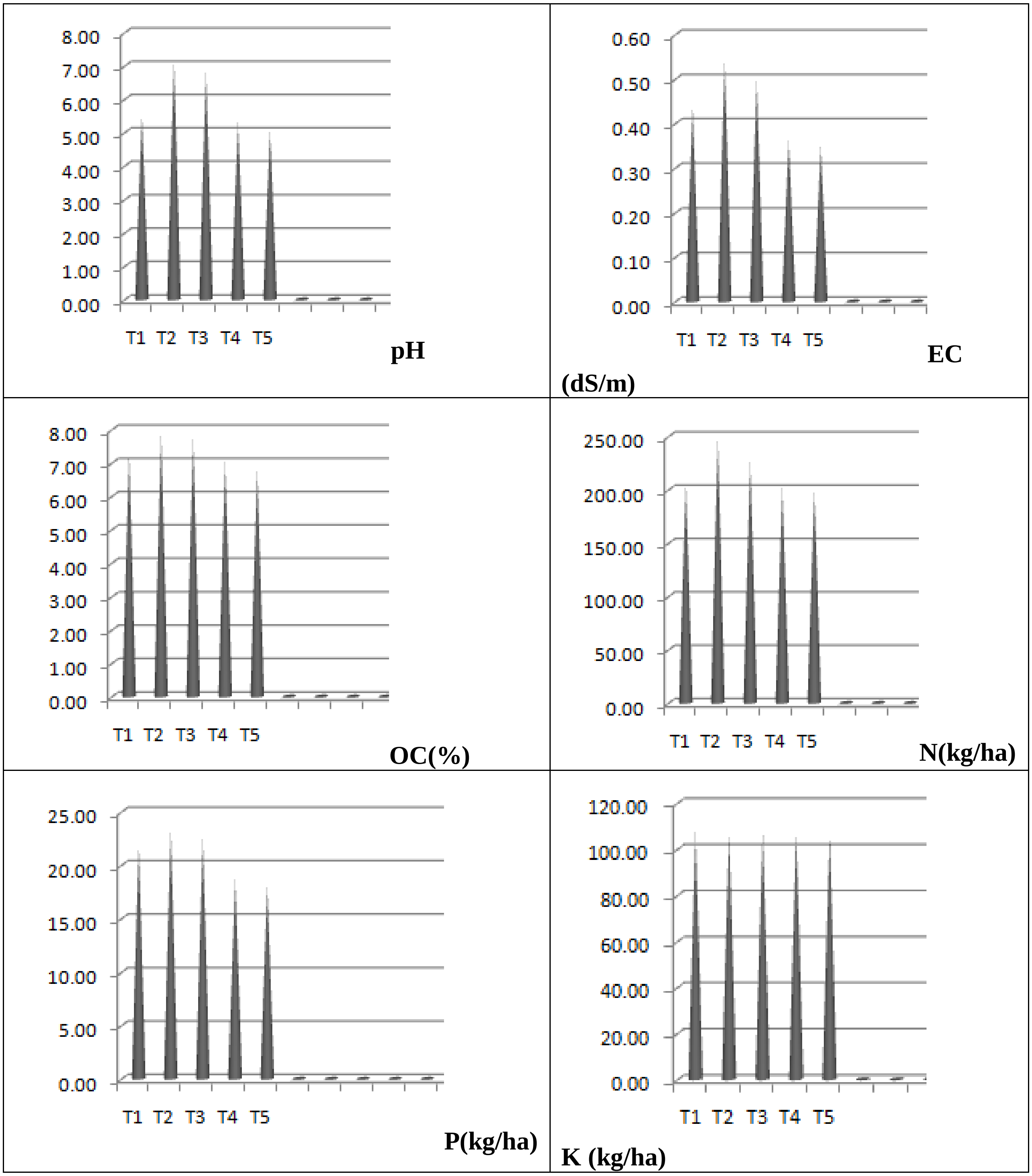

Figure-1. Graph representing the parameters as impacted by the variation in raw materials

Available Phosphorus (kg/ha)

Similar trend was observed with the available phosphorus (kg/ha), where significantly higher value was recorded in the treatment T_2: Legumes+ CD+ SL (23.28 kg/ha) that was followed by the treatment T_3:PM+ CD+ SL (22.49 kg/ha) and significantly lower value was obtained for C- control (18.04 kg/ha). Like nitrogen, the phosphorus content was higher in case of legumes which could be due to the increased nutrient content in legumes as compared to the other raw materials. The mineralization as a result of assimilation of the organic raw materials could have helped in better P mobilization and hence the presence of phosphorus in available forms. Zhang et al. (2000); Lee (1992) reported the similar finding where it was found that the residues on passing through the gut of earthworms releases phosphoric substances.

Exchangeable Potassium (kg/ha)

Exchangeable potassium was also found to be significantly impacted due to the variations in the raw materials. Significantly higher value was obtained in the treatment T_2: Legumes+ CD+ SL (107.36 kg/ha) whereas C-control was recorded with significantly lower value (105.88 kg/ha). The increased amount of exchangeable K could be due to the release of the fact that vermicompost act as a good buffer and has a good water holding capacity, capable of holding the potassium in available forms. The better decomposition of the organic matter could have released potassium that was held in the vermicompost. Similar findings have been reported by Kaviraj and Sharma (2003).

Table-1: pH, EC (dS/m), OC (%), Available nitrogen (kg/ha), phosphorus (kg/ha) and exchangeable potassium (kg/ha) as impacted due to the variation in raw material in vermicompost preparation

Treatment	pH	EC(dS/m)	OC (%)	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)
T_1	5.52	0.44	7.27	205.75	21.88	106.91
T_2	7.14	0.54	7.88	248.00	23.28	107.36
T_3	6.82	0.50	7.74	226.25	22.49	107.09
T_4	5.28	0.36	7.04	201.50	18.69	106.41
C	5.03	0.35	6.79	198.75	18.04	105.88
C.V	1.80	0.02	0.33	1.89	1.05	0.55

Conclusion

Application of legumes has the ability to accelerate the microbial properties in compost because of the rhizobium bacteria present in the root nodules that act as inoculums. This further accelerates the conversion of different organic residues into the minerals that are essential to plants and are present in available forms. Legumes are known to be storehouse of excellent amount of N compounds, proteins, oils etc and so the chemical parameters were found to be high in legumes. This was followed by the vermicompost prepared from press mud that is also a rich source of different nutrients. Converting press mud into vermicompost can be an efficient way to reduce waste as well as generate income to the farmers engaged in sugarcane farming. Lowest chemical parameters as observed from the vermicompost obtained only from cow dung and shredded leaves could be due to inefficient release of nutrients from them.

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