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A COMPARATIVE STUDY OF VERMICOMPOST USING AGROWASTES

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Abstract–Agricultural waste disposal is a major problem in agricultural sector. The use of agricultural waste for making compost is a better way for waste management. On this aspect a study was conducted to make use of agricultural waste to a useful product that could be beneficial to agriculture. The experiment on vermicomposting using various agricultural wastes was performed to improve the quality of vermicompost. The effect of various agricultural wastes such as paddy straw T1, banana leaf T2 and banana pseudostem T3 wastes were determined. From the results of the study, it was found that vermicompost productivity was 58±1.3% in T1, 50.5±2.3% in T2 and 46.5±1.8% in T3. The result suggested that T3 (banana pseudostem + 30% cow dung) showed significantly higher NPK content (1.86±0.07, 0.88±0.02 and 1.74±0.02%) and short harvest period when compared to vermicomposting using paddy straw and banana leaf waste. The pH, EC and organic carbon were reduced in all the three (T1, T2 and T3) treatments. Hence from the current study, it was concluded that massive amount of banana pseudostem wasted after harvest can be used to make vermicompost with less effort and low cost with potential application in agriculture and thereby reduce air and land pollution.

INTRODUCTION

Agrowaste disposal is one of the major problems in waste management. Accumulation of agro wastes may cause health, safety and environmental issues. Proper management and disposal of agro waste is necessary to prevent various environmental issues. India is severely affected by improper waste collection, mismanagement (Akhila Agnes Mathew, 2018).

Banana is one of the mostly widely used fruit in India. India is the largest producer of bananas in the world, with a production of 297 lakh MT on 8.4 lakh hectares of land. During harvest of banana and paddy, most of the plant parts were thrown away as waste. One of the major problems in the agriculture sector is the disposal and wastage of agricultural waste. A huge amount of leaf waste of banana from markets, temples and marriage halls were thrown out in public areas, road sides and water bodies create land, water and air pollution. The wasted banana pseudostem can potentially be recycled through composting processes (composting and co-composting) that convert it into useful resources for plant nutrition and soil health. Rice is the most widely used crop in India but the left-over crop residue waste is one of the major wastes in agricultural field. Dumping and burning of straw causes loss of nutrition which also affects the physical, chemical and biological properties of soil (Pratibha Sharma, 2020).

Vermicomposting is stabilization and biooxidation of organic matter by the action of earthworms and micro-organisms. During the process of vemicomposting the earthworm eats the agrowastes and reduces the volume by 40 to 60% (Margit Olle, 2019). The earthworm converted vermicompost is rich in enzymes, vitamins, minerals, microflora, growth hormones, micro and macro nutrients. Vermicompost induces nutrient retention, water-holding capacity, aeration, improves soil texture and structure (Shrivastava, 2013). The C, H, O, N, P, Ca, K, Mg, S composition of vermicompost have significant effects on plant germination, growth, yield, flowering, fruiting and yields of crops.

MATERIALS AND METHOD

Vermicompost bed preparation

The vermicompost bed was prepared according to Ismail (2005) with some modifications. Vermicomposting was carried out in compost pits of 100×100 x 75 cm (L x B x W) in a shaded area. Earthworms were collected from agricultural field and kept on a perforated plastic bag containing moistened soil. The agro wastes such as rice straw, banana leaves and banana pseudostem were collected from different agricultural field and chopped in small pieces.

The floor bed was kept moist and cools throughout the process. The bottom layer of culture bed was prepared using pebbles and then a layer of sand upto 15 cm height to facilitate the effective water drainage followed by the layer consist of soil layer up to the height of 15 cm. Into this soil, 200 earthworms, *Eisenia fetida*, were inoculated and water was sprayed over it. Dried cow dung was then layered over the soil and agrowastes such as rice straw in treatment 1, banana leaves in treatment 2 and banana pseudostem in treatment 3. The different treatments with its composition are shown in the Table 1. And similarly, two more layers of agrowaste and cow dung were layered alternatively. Water was sprayed inorder to maintain moisture content. The compost pit was covered with a net to avoid birds and pests from earthworms. Turmeric powder was spread on the sides of the pit to avoid ants. The productivity of vermicompost was calculated using following formula.

Productivity of vermicompost (%) = Harvested vermicompost (kg)/ Total mass of feed(kg) × 100

Table 1. Composition of different treatments of vermicompost

Treatment	Content
T1	70% straw + 30% cow dung + 100 earth worm
T2	70% banana leaves + 30% cow dung + 100 earthworm
T3	70% banana pseudostem + 30% cow dung+ 100 earthworm

Physiochemical analysis

The following standard methods were followed to analyze the vermicompost samples. The pH was analyzed through pH meter and EC by conductivity meter in sample water suspension at 1:10 ratio (Falcon, 1987), Chromic acid wet digestion method was employed to analyze TOC (Walkley, 1934) and total Nitrogen was determined by Macro Kjeldahl method by Humphries (Humphries, 1956). Total phosphorous was analyzed by Van ado molybdate yellow color method and total potassium was analyzed by flame photometric method (Jackson, 1973).

RESULT

After 83 days of vermicomposting, agro wastes along with cow dung were turned to vermicompost. It was observed that T3 turned to vermicompost on 84th day which was much faster than T1 and T2. The combined action of microbes and the enzymes produced by earthworm quickly convert agrowaste to vermicompost and thus reduces the weight below 50%.The productivity was found as 58±1.3% in T1, 50.5±2.3% in T2 and 46.5±1.8% in T3. The number of worms in the compost in T3 was higher (2931.3±60) followed by T2 and T1 respectively. Table 2 shows the harvest data of different agrowaste treated vermicompost.

The pH of T3 reached almost neutral (6.8±0.15) and T1 and T2 showed slightly acidic pH. The chemical analysis showed T3 vermicompost has decreased electrical conductivity (3.7) organic carbon (35.75%) and C:N (6.1±0.42%) when compared to other treatments. Among the different treatments, T3 showed significant NPK value of1.86±0.07, 0.88±0.02 and1.74±0.02 respectively. Total organic carbon in T3 was 11.5±0.3 and it was 21.5±0.1 in T1 and 17.4±0.2 in T2. The chemical

Table 2. Harvest data of vermicompost

Parameters	Treatments		
	T1	T2	T3
Productivity	58±1.3%	50.5±2.3%	46.5±1.8%
Total no. of days	84.6±2.5	95±2.0	98.4±2
Total waste + cow dung introduced (kg)	20±0.00	20±0.00	20±0.00
Initial no. of worms	250±0.00	200±0.00	200±0.00
No. of worms at the time of harvest	2653±29	2770.6±26.3	2931.3±60

composition of vermicompost is shown in the Table 3.

DISCUSSION

After banana harvesting the wasted banana pseudostem can be recycled back to organic manure which can be used as biofertilizer and were found to be highly useful and economic for banana growers (Mukhopadhay *et al.,* 2008). Dignac *et al.* (2017) suggested that large scale use of compost is essential for long term fertility of soil. The composting activity of earthworm is dependent on the availability of microbial nutrient and non toxicity of the medium (Pratibha Sharma, 2018). Manuel Blouin in 2019 found that vermicompost increases commercial yield and total biomass and there markable effect of vermicompost on the growth of plant can be obtained at a concentration of 30 to 50% of the soil volume. The presence of lignin and cellulose degrading microbes in the cow dung degrades the agro-waste quickly(Akhila Agnes 2018). Banana pseudostem waste is a rich source of plant nutrients. But due to the lack of vast knowledge about the utilization of banana pseudostem waste, the farmers are not using it as organic manure. So the current study mainly focuses on the preparation of organic manure from agrowaste.

In the present study, the agrowaste along with earthworm and cowdung were turned into compost after 83days. The productivity of vermicompost T1, T2 and T3 was 58±1.3%, 50.5±2.3% and 46.5±1.8% respectively. Simillarly, Parmar *et al.* (2019) reported that vermicompost made of banana pseudostem + 5% cow dung showed recovery of 45%. Corresspondingly, Akhila Agnes Mathew in 2018 reported the reduction in weight reduced in banana leaf based vermicompost was 41 to 55%. In all the three treatments the vermicompost after harvest showed pH in the range of 6.5 to 6.8. The present data waslined with the study reported by Yvonne, (2018), where the pH of all the vermicomposts treated with sraw, cowdung and grass clippings were in the range of 6.5 –6.8. Dominguez *et al.* (2011) described that the pH of compost should be in the range of 5-9. In the current study, T3 showed lowest electrical conductivity and total organic content (11.5±0.3%) and C:N (6.1±0.42) of the compost was reduced significantly in T3 when compared to other treatments which indicates microbial oxidation of organic carbon. Corresspondingly, Akhila Agnes Mathew (2018) reported that EC was between 2.5 to 3.5 and TOC and C: N was reduced to 23.2 and 85.92% respectively in raw banana leaf based vermicompost.

The better outcome of the current study was the significantNPK levels (1.86±0.07, 0.88±0.02, 1.74±0.02) was observed in T3 which make the vermicompost most fertile. Parmar *et al.* (2019) reported that vermicompost made of banana pseudostem + 5% cow dung have significantly higher for N, P, K content (1.12, 0.397, 0.997) and the organic carbon was 12 %. Correspondingly, Achsah and Lakshmi Prabha in 2013 found that the banana peel based vermicompost have higher NPK level. The present was lined with the study reported by Vidhya *et al.* (2020) where the chemical parameter of vermicompost using banana waste was C-5.8, N - 0.74, P- 0.29 and K -0.56 and also it was suggested that vermicomposting of banana wastes with *Eisenia fetida* significantly reduces the time of composting. Similarly, Manveen Arora in 2019 reported NPK of rice straw based vermicompost was 017.27, 3.61, 24.05 % respectively. From the present study, it was identified that among various agro wastes the banana pseudostem based vermicompost posses significant NPK.

The banana pseudostem waste obtained after harveasting can be recycled back as vermicompost and can be used for the growth of banana as well as other crops. So it is sure that through the vermicompost farmers can get additional income,

Table 3. Chemical composition of Vermicompost

Parameters	Treatments		
	T1	T2	T3
pH	6.53±0.06	6.13±0.06	6.8±0.15
EC	3.6±0.1	3.6±0.11	3.2±0.15
Total organic carbon%	21.5±0.1	17.4±0.2	11.5±0.3
Total Nitrogen %	1.3±0.10	1.78±0.07	1.86±0.07
Total Phosphorous%	0.40±0.02	0.52±0.02	0.88±0.02
Total potassium%	1.42±0.01	1.65±0.01	1.74±0.02
C:N	16.6±1.3	9.8±0.38	6.1±0.42

save the expenditure for the fertilizer, improve the farmer's livelihood and ecofriendly disposal of banana pseudostem waste.

CONCLUSION

The conversion of agrowaste to vermicompost is an effective, profitable and agriculturally beneficial method. Vermicompost contains growth hormones, vitamins, micro and macro nutrients which are formed by the combined action of earthworm and the microbes of cow dung have a wide application in plant growth fruiting and flowering. In the current study the effect of different agrowaste such as rice straw, banana leaves and banana pseudostem were evaluated. It was found that the vermicompost made using banana pseudostem along with cowdung showed better NPK values, with reduced pH, total organic content and C: N ratio. Also, the earthworms were ridiculously increased in the pseudostem treated compost. It is evident from the study that banana pseudostem disposed as waste can be used to make vermicompost which can be applied to the agriculture and it will provide additional income for the farmers and provide alternate livelihood and also it will solve the disposal problem of banana pseudostem waste in an eco friendly manner.

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