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Effect of *Trichoderma resii* and earthworm co-inoculation on organic matter, carbon and NPK content in market compost

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Abstract

Large quantities of wastes from different sources were accumulated biosphere. Although, they are excellent source of plant nutrient they are present in unavailable form. Further, they need to the properly recycled through improved composting and vermicomposting technique in order to achieve the maximum benefits from then. Keeping this view, the present study was undertaken to develop suitable technology to manage market wastes. The Organic matter content and Organic carbon were almost reduced to 60 % by Vermicomposting. The treatment T_4 (Market waste + Cow dung +*Trichoderma resii* + Earthworm) showed maximum reduction when compare with Market waste + Cow dung + *Trichoderma resii* (T_3) and Market waste + Cow dung (T_2). The macro nutrients like Nitrogen, Phosphorous and Potassium (NPK) content was increased in all the treatment T_2, T_3, and T_4.

Keywords: vermicomposting, market waste, earthworm, cow dung, *Trichoderma resii*

Introduction

The vermicompost is an aerobically degraded organic matter the gut of worms and so also of enzymes of the associated microbial populations. The vermicompost is stable, stability of which is due to the coatings of mucopolysaccharides of microbes and earthworms. These stable pockets of organic manure because of their structural stability have good water holding capacity and also provide way for good aeration when mixed with soil in the field. The vermicomposting involved in the degradation of organic matter and its stabilization, reducing in odors and manufacture of auxins, which created more favorable conditions for some bacteria such as Acetobacters, Actinomycetes, butyric acid forming bacteria of the *Clostridium*, type and some of the cellulose secreting species (Frank Carmody, 1979) [2]. Vermicomposting is a mesophilic process of ingestion digestion and adsorption of organic waste carried out by earthworms followed by excretion of castings through the worm's metabolic system, during which their biological activities enhance the level of plant nutrients of organic waste (Swati Pattnaik and Vikram Reddy, 2010) [8].

Materials and Methods

1. Collection of Market wastes and Cow dung

Market wastes including Vegetables and Fruits was collected from the Central market of Tirupattur district, Tamil Nadu, India, which was used as substratum for the Vermicomposting. The market wastes were chopped each into 5 to 10 cm and then used as inoculant. The cow dung from the cattle farm was collected and used after preliminary treatment.

2. Inoculants used

The fungus *Trichoderma resii* was also employed for pretreatment after partial degradation with cow dung flora. The Sorghum grain based fungal inoculums of *Trichoderma resii* called Spawn was prepared and used for the composting.

3. Earthworms

The earthworms belonging *Lambido maurtii* and *Eisenia foetida* collected from Department of Zoology, College of Basic Science and Humanities, Bangalore, Karnataka, India has been used for the study.

4. Treatment methods

The treatment methods including Market waste alone (T_1); Market waste and Cow dung (T_2); Market waste + Cow dung + *Trichoderma resii* (T_3) and Market waste + Cow dung + *Trichoderma resii* + Earthworm (T_4). After two weeks of pre-treatment, *Lambido maurtii* and *Eisenia foetida* was added of about 100 per 10 kg of substrate. During the Sixty days of composting the moisture was maintained at 65 – 75 % and the temperature was maintained by turning the compost twice a week.

5. Effect of Physico-chemical analysis

The Market wastes treated with Cow dung and Earthworms were analysed for physico-chemical properties following standard procedures. Soil chemical parameters were determined using standard analytical techniques (Jackson, 1973) [4]. Soil pH was recorded in a 1:2.5 soil: water

suspension based on Potentiometry, Electrical conductivity (EC) based on Conductometry. Soil Organic carbon (OC) was determined following Walkley and Black wet digestion method. Available Nitrogen was estimated using Kjeldahl Nitrogen distillation apparatus following alkaline permanganate method as outlined by Subbaiah and Asija (1956) [7]. Bray's No.1 extractant was used for Phosphorous extraction and Phosphorous was estimated by Spectrophotometry (Bray and Kurtz, 1945) [1]. Available Potassium was extracted using neutral normal ammonium acetate followed by estimation using Flame photometry.

Results and Discussion

The effect of composting on carbon content was presented in Table - 1. During composting process, the carbon content was almost reduced to 50 % with incubation of 75 days. The treatment T_4 showed maximum of 41.46 % reduction which was followed by treatments T_3 and T_2. The nitrogen content of market waste composting was presented in Table - 2. The initial nitrogen content of market waste was 0.55 and it was increased with period of incubation. The treatment T_4 showed of 1.28 percent which was almost 53.15 percentage increase than the control. The treatments T_4 (Market waste + Cow dung + Earthworm + *Trichoderma resii*) was followed by T_3 (Market waste + Cow dung + *Trichoderma resii*) and T_2 (Market waste + Cow dung).

The phosphorous content of market waste composting was presented in Table – 3. The initial phosphorus content of market waste was 0.15 and it was increased with period of incubation. The treatment T_4 showed maximum of 0.30 percent which was almost 43.67 percentage increase than the control. The treatment T_4 was followed by T_3 and T_2. The potassium content of the market waste *viz*., T_1 (Market waste alone) T_2 (Market waste + *Trichoderma resii*), T_4 (Market waste + Cow dung + *Trichoderma resii* + Earthworm) was 0.16, 0.17, 0.18 percent respectively (Table - 4). The treatment T_1 recorded the percentage of 7.02 in Potassium content. It was followed by T_2 (11.29), T^3 (15.19) and maximum increased percentage of T_4 (18.74).

Table 1: Effect of pretreatment on the Carbon content during Market waste composting

Treatments	Sampling time in days						Percentage decrease after Composting (%)
	0	15	30	45	60	75	
T_1	33.12	33.16	32.18	31.16	30.18	29.06	46.18
T_2	33.32	29.48	28.17	24.28	23.06	21.26	44.16
T_3	33.32	28.16	27.26	23.26	23.86	20.18	44.46
T_4	33.32	27.43	25.63	21.16	19.48	17.16	41.46

Table 2: Effect of pretreatment on the Nitrogen content during Market waste composting

Treatments	Sampling time in days						Percentage increase after composting (%)
	0	15	30	45	60	75	
T_1	0.55	0.58	0.62	0.63	0.65	0.69	17.00
T_2	0.56	0.70	0.74	0.84	0.91	1.01	41.12
T_3	0.55	0.72	0.76	0.85	0.93	1.07	45.15
T_4	0.55	0.73	0.77	0.87	0.95	1.27	53.15

Table 3: Effect of pretreatment on the Phosphorous content during Market waste composting

Treatments	Sampling time in days						Percentage increase after composting (%)
	0	15	30	45	60	75	
T_1	0.15	0.16	0.18	0.19	0.20	0.20	20.85
T_2	0.14	0.17	0.19	0.22	0.23	0.24	37.00
T_3	0.15	0.18	0.21	0.25	0.25	0.27	39.86
T_4	0.15	0.22	0.25	0.27	0.28	0.29	43.67

The data pertaining the bacterial population of market waste compost was presented in Table- 5. The maximum number of colonies was observed in the treatment T_4 (Market waste + cow dung + *Trichoderma resii* + earthworm) and recorded the value of 38.33 it was followed by the treatment T_3 and T_2. The lowest number of colonies was observed in the treatment T_3 and T_2. The number of colonies was observed in the treatment T_1 and obtained the value of 22.33. The treatment T_4 the maximum colony was observed on 60 days of incubation rather than 75 days of incubation due to the maturity of compost, there are no carbonic compounds to be break down and used for inoculated metabolism. But in other treatments T_1, T_2, and T_3 there was increasing trend was observed showing that the process was not yet finally matured.

Table 4: Effect of pretreatment on the Potassium content during Market waste composting

Treatments	Sampling time in days						Percentage increase after composting (%)
	0	15	30	45	60	75	
T_1	0.15	0.13	0.15	0.18	0.19	0.19	7.02
T_2	0.16	0.14	0.15	0.19	0.19	0.20	11.29
T_3	0.17	0.15	0.16	0.20	0.20	0.21	15.19
T_4	0.19	0.16	0.17	0.21	0.23	0.22	18.74

Table 5: Effect of pretreatment on the Bacterial population (10^6) during Market waste composting

Treatments	Sampling time in days					
	0	15	30	45	60	75
T_1	12.66	16.00	17.33	18.66	20.33	22.33
T_2	12.33	20.33	28.00	33.66	35.33	35.00
T_3	13.00	22.66	32.66	36.66	37.33	36.00
T_4	13.33	23.66	36.33	40.66	43.33	38.33

In this present research, the treatment T_4 showed best results during Market wastes compost. Similarly, there was increase in N, P and K content was observed and the treatment T_4 recorded maximum value. The plant N, P, and K content was increased by Vermicompost application (Zaller, 2006) [10]. The enhanced nutrient uptake may be due to the readily available forms such as nitrates, exchangeable phosphorous, potassium, calcium in the vermicompost (Orozco *et al.*, 1996) [6]. Total microbiota *viz.*, Bacteria, Fungi and Actinomycetes were also enhanced with the age of degradation process especially during initial stages (Falcon *et al.*, 1987) followed by gradual decrease in later period (Hassen *et al.*, 2001) [3]. In the present study, the bacterial population alone studied and the results showed to similarly. Plant growth stimulation by vermicompost is not only by physical and chemical properties of vermicompost but also by indirect effects via inhibition of plant pathogen nitrate uptake kinetics (Muscolo *et al.*, 1999) [5], effect on beneficial microorganism and plant growth stimulators and regulators (Tomati *et al.*, 1988) [9].

Conclusion

Results of the present study showed a great increase in the macro nutrients like Nitrogen, Phosphorous and Potassium content due to the treatment with Cow dung and the Vermiculture. The fermentation due to the microbial actions, the combined actions of Market waste + Cow dung + *Trichoderma resii* + Earthworm performed well and resulted in the increase of macro nutrients. Application of these combined treatment helps in improvement of required macro nutrients in the field applications.

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