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UTILIZATION OF VERMICOMPOST OF ORGANIC WASTE FOR PLANT GROWTH

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ABSTRACT

Vermicomposting is the process of decomposing of an organic waste into an organic fertilizer using earthworms. The final product is enriched with nutrients like carbon, nitrogen and essential minerals. In this study work, earthworm - *Eudrilus eugeniae* (African night crawlers) was utilized to degrade the pretreated bagasse waste and waste papers. Waste paper was found to be degraded in 55-60 days, whereas bagasse took 70 days for degradation. Thus obtained vermicompost was used as fertilizer and tested against the plant (*Capsicum annuam*) and the growth was observed after 20 days. Vermicompost was found to influence the plant growth.

KEYWORDS: ***Eudrilus eugeniae*, plant growth, *Capsicum annuam*.**

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INTRODUCTION

The biological degradation of an organic waste into an organic fertilizer with the help of earthworm is known as vermicomposting, thus obtained product is known as vermicompost. It is the efficient method to convert the organic wastes (human waste, kitchen waste, animal waste etc.) into organic fertilizer. Edwards and Burrows [1] reported that vermicompost have a much fine structure than traditional composts and it contains nutrients which are readily available for plant uptake. Vermicompost is rich in both the bacterial composition [2] and fungal abundance [3] than the traditional compost even when the same organic waste is used as a feedstock material for both the process. The optimum temperature to improve vermicomposting productivity is 25°C with 75-80% moisture. Theoretically, vermicomposting or vermicasters do not produce odors if designed properly and activities of earthworms can reduce the fermentation process which could also prevent them from being harmed by anaerobic gases, methane, for instance[4].Earthworms can be cultured and used for various purpose viz. improving and maintaining soil fertility, conversion of organic waste into a useful manure, for livestock [5] and a bait for fish [6]. The compost and vermicompost can improve the growth of plant species by mycrorrhizal colonization, microbial activity and also supply nutrients when it is substituted instead of soil or when it is added with the soil [1,7,8,9,10,11,12,13]. In this study, decomposition of different substrate viz. waste paper and bagasse by earthworm - *Eudrillus eugeniae*, thus obtained vermicompost's effect was studied on different plant growth.

MATERIALS AND METHODS

Earthworm Chosen

Eudrillus eugeniae was obtained from Government solid waste management organization, Perungalathur, Kancheepuram District, Chennai - 601102, Tamil Nadu, India.

Collection of waste

Bagasse and waste paper were used in this study. The waste paper sample and the bagasse were collected around Chennai in polyethylene bags from local waste paper market and local sugarcane juice shops respectively.

Pretreatment of Samples

Bagasse was washed with tap water and dried under direct sunlight for 5-6 days. This dried bagasse was chopped into small pieces, whereas waste paper was soaked in water for few hours and dried under direct sunlight. These dried paper were torn into small pieces to ease the composting process. The samples were mixed with cow dung (dried) (5kg of cow dung/ 3kg of waste paper and 6kg of cow dung/ 4.5kg of bagasse) separately and properly before the start of vermicomposting process. Bottom up conversion process was done for first 5-10 days to reduce the high temperature (45-50°C)[14] from initial thermophilic reactions of organic substances while decomposing which could harm the earthworms [15]. This set up was kept for 10 days. The depth of wastes should not exceed up to 25-30 cm because it causes temperature raise from initial thermophilic stage of microbial decomposition which can harm the earthworms[16].

Composting Using E.eugeniae

The vermicomposting bed was prepared in the tank (size of 2*2feet) by layering up of coconut fiber (3.5 cm), small pieces of red brick (5cm), garden soil (2cm) to hold the water and to maintain the moisture, alternative layering of pretreated wastes and dried cow dung was set up in two different tanks and it was sprinkled with water at regular intervals (Fig.1). The earthworms were transferred into the tank one for vermicomposting and another tank was kept as such (without earthworm), which acted as control. Top of the tank was covered with soil or cow dung. 150 earthworms/liter of waste were released into the vermicomposting bed as reported by Chaoui [4].

Collection of compost

After the particular time of composting, the tanks were checked for complete degradation of wastes by the earthworms to form vermicompost. To collect the compost, the vermicomposting bed was semi dried for 2-3 days to make compost for easy shifting. The upper layer was separated as manure and the lower portion was sieved to separate the earthworms from the manure.

Measurement of E.eugeniae

At initial (day 1) there was totally 526 worms were accounted in waste paper treated tank and 633 worms were accounted in bagasse waste treated tank. After the incubation period (45 - 70days) the earthworm were collected and counted from both the treated tanks.

Utilization of compost on plant growth

After collection of vermicompost it was applied to the plant species to check the growth influence on the plants as follows *Capsicum annuam*, these plant seeds were collected from Arumugam Agro Foundation, Tambaram, Chennai - 600045 Tamil Nadu, India. This experiment was held for 20 days. Vermicompost were added to the garden soil at various ratio (0:5, 4:1, 3:2, 2:3, 1:4 and 5:0), total of 500g of these mixture was filled in each bag.4 seeds of C*.annuam* were sown in each bag. Rate of germination were noted from the 3rd day. It was monitored frequently and was watered regularly. After germination and followed growth, the plants root and shoot systems were measured. Rate of germination was calculated as follows

$$\text{Rate of germination} = \frac{\text{No. of seeds germinated x 100}}{\text{No. of seeds sown}}$$

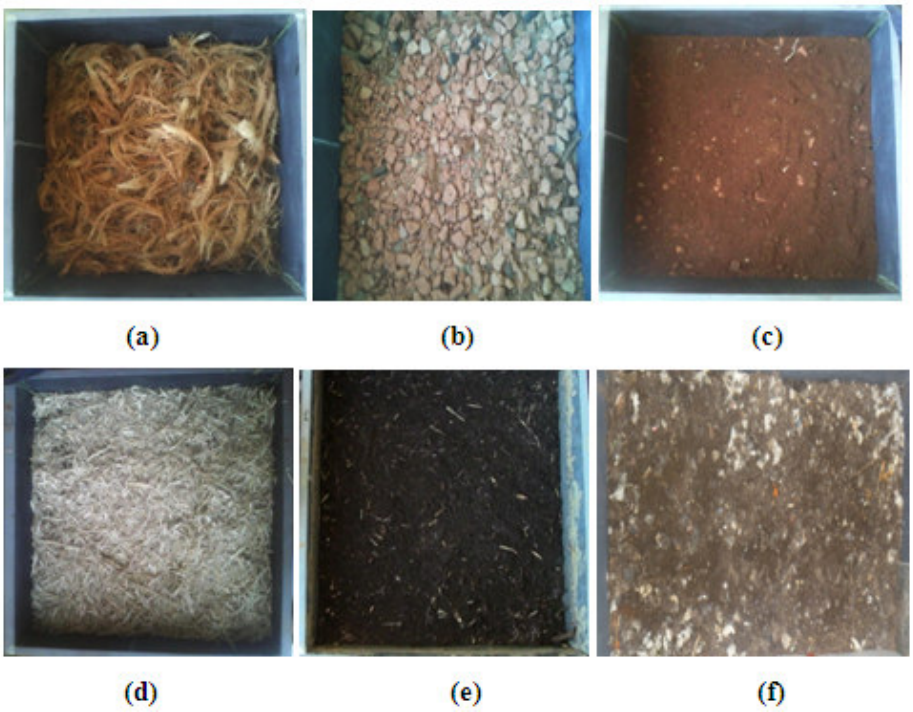
Soil test analysis

The control and final product of vermicomposting (vermicompost) were tested for their soil constituents at Bio Globe Scientific Park, Madipakkam, Chennai-600 091 Tamil Nadu, India.

RESULTS AND DISCUSSION

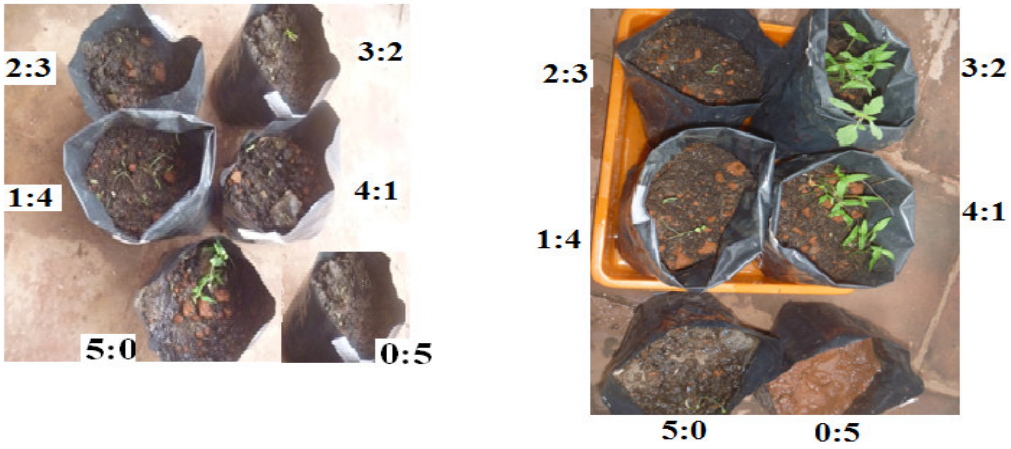
From this study, it has been noted that earthworms were multiplied enormously and the vermicompost has been formed in the tank (waste paper) after a time span of about 45 days and 60 days in the tank (bagasse waste) While the waste papers in control (without earthworms) tank took 60 days for decomposition and for bagasse in control (without earthworm) tank took 95 days for decomposition. Waste paper treated tank was found to have 914 earthworms and bagasse treated tank found to have 1017 earthworms after their respective incubation period. Gajalakshmi and Abassi [17] also found vermicomposting of papers in reactors to increase the vermicast from 72-81%. Bhandarkar et al[18] found *Eudilus eugeniae* to degrade 50% Bagasse waste into vermicompost. Table 1 and Fig.2 shows that *C.annuam* was well grown in treated waste paper sample at the ratio of 4:1and the height of the shoot and root system is 13.7 cm and 2.9cm. In untreated waste at the ratio of 5:0 shoot and root system were measured 12.2cm and 3.1cm. *C.annuam* was well grown in treated bagasse waste sample at the ratio of 4:1. The height of the plant shoot and root system is 16.6cm and 5.5cm. In untreated waste shoot and root system were measured 14.0cm and 4.1cm (Table 3, Fig.3). John and Prabha [19] also found vermicompost to influence the growth of *Capsicum annum* and showed the maximum root length, shoot length and leaf count. Lazcano et al[20] found vermicompost treatment to enhance the number of leaves, root volume and branching in tomato plants. In this study, it was found that there was an increase in pH, nitrate, phosphorus, potassium content in vermicompost (Table 3). Lazcano et al [20] also found the increase of nitrogen content, phosphorus, potassium content etc in vermicomposting. John and Prabha [19] found the increase of pH level, and they suggested that the pH increase might be due microbial action on wastes. Earthworm prefers to degrade in neutral pH [17]. Vermicompost are found to be increased with nitrogen content which may be due to the enzymes, hormones, nitrogenous excretory substances of organisms [19,21].

FIGURE 1
Preparation of vermicomposting bed



(a) Layer of coconut fibre (b) Layer of brick pieces (c)Layer of soil (d)Layer of molasses (e)Layer of cow dung(dried) (f)Layer of waste paper

FIGURE 2
C.annuam growth (untreated and treated-waste paper)



(a) *C.annuam*-untreated **(b) *C.annuam*-treated**

FIGURE 3
C.annuam growth (untreated and treated-bagasse)

(a): *C.annuam-un*treated (b): *C.annuam* treated

TABLE 1
Influence of waste paper compost on C.annuam growth

TOTAL NO. OF SEEDS	RATIO (compost : soil)	UNTREATED					TREATED				
		% of germination	10th DAY		20th DAY		% of germination	10th DAY		20th DAY	
			Shoot growth (cm)	Root growth (cm)	Shoot growth (cm)	Root growth (cm)		Shoot growth (cm)	Root growth (cm)	Shoot growth (cm)	Root growth (cm)
8	0:5	0	0	0	0	0	0	0	0	0	0
8	4:1	0	0	0	0	0	50	8.3	1.8	13.7	2.9
8	3:2	0	0	0	0	0	50	5.7	1.5	12.6	2.3
8	2:3	0	0	0	0	0	0	0	0	0	0
8	1:4	0	0	0	0	0	0	0	0	0	0
8	5:0	12.5	6	1	12.2	3.1	0	0	0	0	0

TABLE 2
Influence of bagasse waste compost on C.annuam growth

TOTAL NO. OF SEEDS	RATIO (compost: soil)	UNTREATED					TREATED				
		% of germination	10th DAY		20th DAY		% of germination	10th DAY		20th DAY	
			Shoot growth (cm)	Root growth (cm)	Shoot growth (cm)	Root growth (cm)		Shoot growth (cm)	Root growth (cm)	Shoot growth (cm)	Root growth (cm)
4	0:5	25	8.9	2.6	10.2	3.5	0	0.0	0.0	0.0	0.0
4	4:1	50	11.7	3.3	14.0	4.1	75	10.0	4.1	16.6	5.5
4	3:2	75	10.2	3.4	11.0	3.6	50	7.9	3.7	15.2	5.4
4	2:3	50	7.7	2.6	12.0	3.7	75	6.5	2.0	11.5	4.2
4	1:4	25	9.1	2.8	13.0	4.0	0	0.0	0.0	0.0	0.0
4	5:0	75	11.2	2.7	12.0	3.9	50	6.5	3.1	11.5	4.6

TABLE 3
Soil analysis

S.NO	PARAMETERS	UNTREATED (BAGASSE)	TREATED (BAGASSE)	UNTREATED (PAPER)	TREATED (PAPER)
1	pH	7	7.7	7.5	7.7
2	Moisture	48%	55%	3%	5%
3	Alkanity(bicarbonate& carbonate) ppm	165	380	200	240
4	Water holding capacity	67%	63%	48%	46%
5	Soluble calcium(ppm)	240	280	106	160
6	Total heterotropic bacteria (CFU/g)	4.3×10^9	7.6×10^9	3.6×10^9	3.8×10^9
7	Chloride	BDR	BDR	BDR	BDR
8	Nitrate (ppm)	0.01	0.03	0.02	0.05
9	Potassium (ppm)	0.04	0.07	0.04	0.08
10	Phosporous (ppm)	0.03	0.06	0.05	0.06
11	Oil & grease	NIL	NIL	NIL	NIL
12	Soluble magnesium (ppm)	224	292	220	202

CONCLUSION

In this study, bagasse waste and waste papers were degraded using *Eudrilus eugeniae.* Waste paper was degraded (55-60 days) faster than bagasse waste (70 days). Percentage germination by treated bagasse wastes was better than the waste paper compost against the plant (*Capsicum annuam*) used in this study.

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