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RESEARCH ARTICLE

GROWTH STATUS OF THE LOCAL EARTHWORM *LAMPITO MAURITII* (KINBERG) CULTURED IN MUNICIPAL SOLID WASTE MATERIALS

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ABSTRACT

In every day dumping of municipal solid wastes (MSW) as a result of urban extension, over population, industrial developments and commercialization (vegetables, fruits and supermarket waste) caused a serious cause to the environment air, water (ground and stream water contamination) and land (soil pollution: heavy metals, heat generation). In the present investigation an attempt has been made to convert the municipal solid waste (MSW) into manure using the earthworm *Lampito mauritii* under cultured in conditions. The different experimental media were prepared on dry weight basis by mixing the municipal solid waste (MSW) and bedding material (BM); T_1 ratio – 20% BM + 80% MSW, T_2 ratio – 40% BM + 60% MSW, T_3 ratio – 60% BM + 40% MSW, T_4 ratio – 80% BM + 20% MSW, control (BM alone – C) were also maintained. The growth rate (biomass) and reproduction (number of cocoons and hatchlings) of *L. mauritii* was increased in all experimental media BM + MSW mixtures ($T_1 – T_4$ rtio) and control (C). The result showed that the unutilized and enormously available MSW can be vermicomposted to convert into valuable organic manure utilized for sustainable agriculture.

INTRODUCTION

The rapid urbanization and industrialization in developed and developing countries have led to the generation of large volumes of municipal solid waste (MSW). The waste generated is consequently released into the nearby environment (Sehker and Beukering, 1998) and the amount of MSW generated per capita is estimated to increase at a rate of 1-1.33% annually (Pappu *et al.,* 2007). The growth (biomass) and reproduction (cocoons and hatchlings) of earthworms in different culture media such as kitchen waste (Chaudhuri *et al*., 2000); leaf litter substrate (Karmegam and Daniel, 2009); water hyacinth (Gupta *et al*., 2006); baggase (Ananthakrishnasamy *et al*., 2007); different organic wastes (Aira and Dominguez, 2008) were studied. The data on growth (biomass) and reproduction of earthworms (cocoons and hatchlings number) are available more on organic wastes, but information about the growth and reproduction of earthworm on MSW is very least. Hence the present study was aimed to understand the growth and reproduction of earthworm *Lampito mauritii* cultured in MSW.

MATERIALS AND METHODS

Lampito mauritii were collected from the experimental agricultural fields in Annamalai University. The worms were stocked in cement tank and cow dung was used as substrate to maintain the earthworms. Moisture content of 60 - 70% was continuously maintained by sprinkling the water. This stock culture was covered with a moisture gunny bag and maintained at room temperature (27± 2^0C) inside the animal house, Department of Zoology, Annamalai University. MSW was collected from Sethiathope town Panchayat, Cuddalore District, Tamil Nadu, India. After removing the plastics, polythene, metal scraps and glass pieces MSW was dried and brought by using jute bags to the laboratory. Urine and straw free cow dung was collected from the dairy yard at the Faculty of Agriculture, Annamalai University. It was sun dried, powdered and stored in jute bags. The pressmud was collected from M.R.K Co-operative Sugar Mill, Sethiathope. The collected pressmud was cured for a month to remove the odour. Then it was used for the preparation of Bedding Material (BM).The cow dung and one month old cured pressmud was used for the preparation of bedding material and they were equally mixed on dry weight basis and kept as such for 15 days and used for the preparation of substrates for vermiculture (Table 1).

After the preparation of substrates in the above said different proportions, water was sprinkled and kept as such for thermophilic composting for fifteen days. After the completion of thermophilic composting, fifteen grams of sexually mature (adult), clitellate *Lampito mauritii* (approx. 65 days) were introduced in plastic troughs separately; containing 1 Kg substrate + 200 g of clay soil. Bedding material alone was used

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a control (C). Six replications in each experimental treatment have been maintained for 60 days. Earthworm's growth (biomass) and reproduction (Cocoons and hatchling numbers) were recorded in different time intervals like 15, 30, 45 and 60 days. Every time cocoons and hatchlings were counted by hand sorting and the biomass of worms were weighed using electronic balance and recorded.

Earthworm's mean biomass and reproduction (cocoons and hatchlings) standard deviation (SD), percentage increase or decreases (final biomass) over initial values were calculated.

RESULTS

The growth (Biomass), reproduction (Cocoon and Hatchling numbers) of earthworm (*L. mauritii*) were observed on 15th, 30th, 45th and 60th days in all the experimental media and controls. The observed results are presented in Tables – 2 to 4. The change in growth of *L. mauritii* is given in Table 2. On the 60th day maximum increase in weight was observed in T_4 and it was followed by C, T_3, T_2 and T_1. In the same way highest percentage change in the growth over the initial was also observed. Least biomass increased was observed in T_1 on the 60th day.

The cocoons productions of *L. mauritii* in different feed mixtures is given in table 3. The cocoons were observed on the 15th day and they were 8.7 in T_4, 7.1 in C, 6.7 in T_3, 6.1 in T_2 and 6.0 in T_1. The highest rate of cocoon production was found in T_4. Thereafter, the productions of cocoons were steadily increased on 30th, 45th and 6oth day. The commencement of cocoon production was more in T_4 (18.6), followed by C (16.2), T_3 (15.4), T_2 (14.3) and T_1 (13.1) respectively on 60th day. The highest total numbers of cocoons (51.8) were found in T_4 and lowest (36.1) in T_1.

Culture of *L. mauritii* in different feed substrates showed positive effect on production of hatchlings depicted in table 4. Hatchlings were observed on 30th day in all the treatments. The productions of hatchlings are steadily increased with increasing period of experiment depending on cocoon productions. During the experimental period the maximum number of hatchlings was found in T_4 (14.8) followed by C (12.1), T_3 (11.2), T_2 (10.2) and T_1 (9.3) on the 30th day. At the end of the experiment it was gradually increased and recorded as 23.6 in T_4, (20.1) followed by C, (18.0) in T_3, (17.2) in T_2 and (16.3) in T_1 on 60th day. The above results showed that the T_4 has the highest number of hatchlings whereas the lowest number was recorded in T_1.

Table 1. Preparation of different experimental media – with Bedding Material (BM) and Municipal Solid Waste (MSW)

S. No.	Experimental Proportions of Bedding Material (BM) + Municipal Solid Waste (MSW)	Weight of Bedding Material (BM) + Municipal Solid Waste (MSW)
C	BM alone (Control)	500g CD + 500g PM + 200g clay soil
T_1	20% + 80% (BM + MSW)	200g BM + 800g MSW + 200g clay soil
T_2	40% + 60% (BM + MSW)	400g BM + 600g MSW + 200g clay soil
T_3	60% + 40% (BM + MSW)	600g BM +400g MSW+ 200g clay soil
T_4	80% + 20% (BM + MSW)	800g BM + 200g MSW+ 200g clay soil

S. No – Serial No, C – Control, T_1 – T_4 – Experimental Substrates, g - Gram

Table 2. Growth of *L. mauritii* during the vermicomposting of MSW ($p<0.05$)

Substrate Proportions	*L. mauritii*				
	Vermicomposting Days				
	0 (Initial)	15	30	45	60
C	15.10±1.17	16.40±1.21 (8.61)	18.20±1.13 (20.53)	19.50±1.27 (29.14)	20.30±0.90 (34.40)
T_1	15.30±1.27	16.00±1.24 (4.58)	17.00±1.14 (11.11)	17.80±1.29 (16.34)	18.40±0.97 (20.26)
T_2	15.20±1.19	16.00±1.36 (5.26)	17.10±1.21 (12.50)	18.40±1.16 (21.10)	19.10±1.12 (25.66)
T_3	15.10±0.95	16.30±1.37 (7.95)	17.08±1.15 (13.11)	18.60±1.14 (23.18)	19.70±1.11 (30.46)
T_4	15.10±1.23	17.60±1.14 (16.56)	19.70±1.18 (30.46)	21.20±0.95 (40.41)	22.60±0.85 (49.67)

C – Control (BM alone), T_1– (20% BM + 80% MSW), T_2– (40% BM + 60% MSW), T_3– (60% BM + 40% MSW), T_4– (80% BM + 20% MSW)
Initial (0) – Worm unworked substrates, Mean ± SD of six observations. (+/–) – Percent change of increase or decrease over the initial.

Table 3. Cocoons laid by *L. mauritii* during the vermicomposting of MSW ($p<0.05$)

Substrate Proportions	*L. mauritii*					
	Vermicomposting Days					
	0 (Initial)	15	30	45	60	Total No. of Cocoons
C	-	7.1±1.06	8.9±1.25	12.0±0.95	16.2±1.23	44.2
T_1	-	6.0±0.85	6.3±1.13	10.7±1.07	13.1±1.24	36.1
T_2	-	6.1±0.90	6.8±1.27	11.5±1.16	14.3±1.18	38.7
T_3	-	6.7±0.93	7.2±1.19	12.3±0.87	15.4±1.20	41.6
T_4	-	8.7±1.22	9.8±1.11	14.7±1.21	18.6±1.12	51.8

C– Control (BM alone), T_1– (20% BM + 80% MSW), T_2– (40% BM + 60% MSW), T_3– (60% BM + 40% MSW), T_4– (80% BM + 20% MSW)
Initial (0) – Worm unworked substrates, Mean ± SD of six observations.

Table 4. Hatchlings of *L. mauritii* during the vermicomposting of MSW (p<0.05)

Substrate Proportions	*L. mauritii*				
	Vermicomposting Days				
	15	30	45	60	Total No. of Hatchlings
C	0	12.1±1.17	14.2±1.12	20.1±1.18	46.4
T_1	0	9.3±0.95	10.1±1.25	16.3±1.14	35.7
T_2	0	10.2±1.17	11.4±1.13	17.2±1.12	38.8
T_3	0	11.2±1.16	11.9±1.14	18.0±1.14	41.1
T_4	0	14.8±1.11	16.7±1.19	23.6±0.98	55.1

C– Control (BM alone), T_1– (20% BM + 80% MSW), T_2– (40% BM + 60% MSW), T_3– (60% BM + 40% MSW), T_4– (80% BM + 20% MSW)
Initial (0) – Worm unworked substrates, Mean ± SD of six observations.

DISCUSSION

In the present investigation, it was clearly observed that the highest growth (Biomass) and reproduction (Cocoons and Hatchling numbers) was observed in *L. mauritii* in T_4. The growth rates of earthworm fed with various organic wastes were reported in various earthworm species: *E. eugeniae, E. fetida* and *P. excavatus* on cattle dung (Reinecke *et al*., 1992), *L. mauritii* on cowdung (Kale and Bano, 1992). Growth and reproduction in earthworms require OC, N and P which are obtained from litter, grit and microbes (Edwards and Bohlen, 1996). Quality of organic waste is one of the factors determining the onset and rate of reproduction (Dominguez *et al*., 2000). Suthar (2007a) demonstrated that earthworm had a better weight gain as well as reproductive preference in the medium which contained higher nitrogen. In support of the above study the *L. mauritii* showed high biomass gain in T_4 ratio, which contained higher N_2 than any other media. Our present result was supported by the findings by Padmavathiamma *et al*. (2008) reported that due to the higher feeding rate of *L. mauritii* of 7 cocoons and 400 juveniles in 56 days. Suthar (2007c) stated that the N - content played a major role in the biomass gain and hatchlings success but do not affect the cocoon production. Senapati and Sahu (1993) found a positive relationship between the size of the adults and the cocoons produced by earthworms.

The above results clearly suggest that the incorporation of bedding material pressmud and cowdung (PM & CD) in an appropriate ratio not only increases the selective palatability but also enhances the growth and reproduction of earthworms. The mixing of BM increased the suitability of MSW as feed substrate for microbes and earthworms as stated by Kaur *et al*. (2010).

Conclusion

In India large amount of disposal of wastes like *i.e.* municipal solid waste (Degradable wastes) rich in organic nutrients are presented. Raw MSW cannot be consuming directly by earthworms due to its hard materials, offensive odour, heat *etc.* So the organic wastes such as d cattle waste (dairy farm waste) – cow dung and a agro sugar industrial waste pressmud and clay soil with rich nutritive contents were mixed in equal proportion and used as bedding material (BM). The growth rate (biomass) and reproduction (number of cocoons and hatchlings) of *L. mauritii* was increased in all experimental media BM + MSW mixtures (T_1 – T_4 and control C), particularly the maximum growth and reproduction were observed and recorded in founding in T_4 by *L. mauritii* (80% BM + 20% MSW).

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