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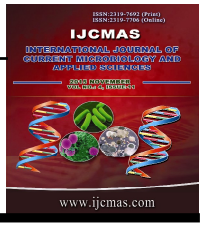

Original Research Article

Growth and Reproduction of *Eudrilus eugeniae* in Tendu (*Diospyros melanoxylon Roxb.*) Leaf Residues as Influenced by Feed Particle Size

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Keywords

Eudrilus eugeniae, Tendu leaf refuse, Vermi composting, Feed particle size

A B S T R A C T

The present study was carried out to work out the influence of feed particle size on the growth and reproduction of *Eudrilus eugeniae* grown in tendu leaf residues. Partially decomposed tendu leaf residues with different particle sizes as 1mm or less, 1-2 mm, 1-2 cm, 2-4 cm and more than 4 cm (unshredded) were used as feed. The experiment was performed in plastic pots in triplicates. Three juveniles of *Eudrilus eugeniae* were added to every pot and incubated at 25ºC temperature. The weight of the earthworm and the number of cocoons produced were assessed every week for a period of eight weeks. The earthworms attained maximum average weight (3774±11mg worm^{-1}) in feed with particle size of 1mm or less and this was significantly higher (250%) than in unshredded material (1415.0±13mg worm^{-1}).The maximum growth rate (68 mg worm^{-1}day^{-1}) and average maximum rate of cocoon production (3.83 ±0.01 cocoons worm^{-1} week^{-1}) of the worm were found in the feed with 1.0mm or less particle size. On a weekly basis the maximum average weight gain of the earthworm was 477 mg in ≤ 1 mm feed particle size. The study revealed that ≤ 1 mm particle size of the feed was optimum for vermicomposting of tendu leaf residues by *Eudrilus eugeniae.*

Introduction

Tendu (*Diospyros melanoxylon Roxb.*) leaf is widely used in India in the form of wrapper for making a crude smoking stick popularly called 'Beedi'. Solapur city of Maharashtra State has a large number of small scale Beedi making industries. Large quantities of waste from these industries in the form of pared off tendu leaves are just thrown away and it is one of the major causes of environmental pollution in the city area. The solid waste management of this tendu leaf waste by vermicomposting is proposed.

There are several reports on processing of various kinds of organic wastes such as sewage sludge (Lofs-Holmin, 1986), agricultural and domestic wastes (Kale, 1982; Frederickson, 1988), and industrial wastes (Nogales, 1997; Elvira, 1999) by vermicomposting. The rate of vermicompost output is likely to depend upon the

earthworm species and the feed (Gajalakshmi, 2001).The physicochemical properties of feed and environmental factors are known to affect the earthworm growth. Although there are a few studies on influence of feed particle size on certain earthworms (Bostrom and Lofs-Holmin 1986; Lowe and Butt, 2003), it is likely that the influence may vary with the type and nature of organic feed substrate and the earthworm species involved. The present study was undertaken to investigate the influence of particle size of tendu leaf residues on the growth and cocoon production by *Eudrilus eugeniae*.

Materials and Methods

Earthworm: Adult, clitellate worms of *Eudrilus eugeniae* were obtained from MPKV Regional Dry Land Agricultural Research Center, Solapur and maintained as stock in the laboratory at 28ºC temperature. Juveniles from this stock were used in the experiment.

Feed material used: Tendu (*Diospyros melanoxylon Roxb*.) leaf refuse was collected from a local household beedi making unit and shredded into small pieces of various sizes and stored for further use.

Supplementary feed used: A required quantity of cow dung was collected in disinfected plastic cans, tied with cloth and stored at refrigeration temperature until further use.

Experimental setup: Tendu leaf residues were shredded into small pieces of various sizes as 1.0 mm or less, 1.0–2.0 mm, 1.0–2.0cm, 2.0–4.0 cm with the help of scissors and the original residue (larger than 4.0 cm) was taken without shredding. The tendu leaf pieces so formed were collected separately in different plastic pots. Partial decomposition of these tendu leaf residues was carried out for 45 days after mixing with 1% seed material consisting of fertile soil, sewage sludge, and press mud. Cow dung was mixed separately with partially decomposed tendu leaf residues in each pot in the proportion of 10%. The experiment was performed in plastic pots in triplicates. 150 g of each mixture was added into respective plastic pots (14 cm diameter × 6 cm height).

Juvenile worms of *Eudrilus eugeniae* were washed with tap water and blotted with blotting paper. Three juveniles were added to every pot after recording their weights. All the pots were covered with a cotton cloth and closed with the perforated lids, and incubated at 25ºC temperature. The moisture content of each pot was maintained between 70-80% by sprinkling distilled water regularly during course of the experiment. Additional feed mixture was supplied to each pot whenever needed. The worms from each pot were removed after every week, washed with distilled water and blotted with blotting paper. Fresh weight of earthworms was noted; the number of cocoons produced by them in each pot was counted and the worms were released into their respective pots. The counted cocoons were separated each time and placed in a Petri plate with moist filter paper at the bottom. The weight of the earthworms and the number of cocoons produced were assessed every week for a period of eight weeks. The results of the experiment are expressed as the average value of a single measurement on each of the three replicates.

Results and Discussion

The growth rates of *Eudrilus eugeniae* in tendu leaf residues with different particle sizes are summarized in table 1 and figure 1. The earthworm attained maximum average

weight of 3774±11mg per worm in tendu leaf residues with particle size of 1mm or less at a growth rate of 68 mg per day. The minimum weight of 1415±13mg per worm was gained by the worm at a growth rate of 15.20 mg per day in unshredded residues with more than 4.0 cm particle size. At week seven, the mean individual biomass of *Eudrilus eugeniae* in 1.0 mm or less particle size (3774.0±11 mg per worm) was over 250% greater than in unshredded material (1415.0±13mg per worm).

In general, the mean individual biomass in *Eudrilus eugeniae* was found to increase with decreasing feed particle size. The growth rate of the worm also increased with decreasing the feed particle size. Thus inverse relationship between the feed particle size and biomass production as well as growth rate of the worm was observed during present experiment (Table 1 and Fig. 1).

The rate of cocoon production of *Eudrilus eugeniae* in tendu leaf residues with different particle sizes is given in table 2. The maximum rate of cocoon production by *Eudrilus eugeniae* was 3.83 ±0.01 cocoons per worm per week in the feed with 1.0mm or less particle size. The lowest rate of cocoon production by the worm was 0.29±0.01 cocoons per worm per week in the unshredded tendu leaf residues. The rate of cocoon production by the worm was also significantly affected by feed particle size and was found to be inversely proportional to the size of feed particle. The cocoon production rate in 1mm or less particle size material was more than thirteen times greater than in the unshredded material (Table 2). However, biomass production, growth rate and cocoon production rate by the worm in tendu leaf residues with 1–2 mm particle size also followed, though in a diminished form, the similar trend as in ≤ 1 mm particle size, giving growth rates of 58 mg per worm per day and cocoon production rate of 3.0 cocoons per worm per week (Fig. 1; Table 1 and 2).

Eudrilus eugeniae could gain highest biomass in tendu leaf residues with particle size ≤1mm while lowest biomass in unshredded tendu leaf residues. The results indicated that growth and biomass of *Eudrilus eugeniae* was significantly enhanced by decreasing feed particle size. These results corroborate to the earlier reports by Bostrom and Lofs-Holmin (1986) on *Aporrectodea caliginosa* and *Lumbricus terristris* in milled or chopped barly residues and of Lowe and Butt (2003) using *Allolobophora chlorotica* (Savigny) and *L. terristris*(L.) in separated cattle solids.

The results of the present study showed that the maximum weight gain of the worms was 477 mg per worm per week in ≤ 1mm feed particle size followed by 407 mg per worm per week in 1-2 mm feed particle size, compared to highest weight gains reported by other workers for *Eudrilus eugeniae* as 280 mgs per week (Dominguez *et al.*, 2001), 150 mg per week (Reinecke *et al.*, 1992) and as 202 mgs per week (Chaudhari *et al.*, 2003) using various feed materials.

The maximum rate of cocoon production by *Eudrilus eugeniae* was 3.83 ± 0.01 cocoons per week in ≤ 1mm particle size of tendu leaves followed closely by 3.0 ± 0.04 cocoons per week in 1-2 mm particle size of tendu leaves, as compared to 3.6 and 3.22 cocoons per week that was reported for *Eudrilus eugeniae* by Dominguez *et al.* (2001) and Reinecke *et al.* (1992) respectively during different investigations.

Although the biomass production by the worm (Fig. 1) in 1-2 cm feed particle size showed similar trend but of much lower level compared to that in 1-2 mm and ≤ 1 mm feed particle size, the rate of cocoon

production (Table 2) was significantly lower. The comparable growth rate (54 mg per worm) of *Eudrilus eugeniae* in 1-2 cm particle size feed might be due to the increased surface area of the feed particles.

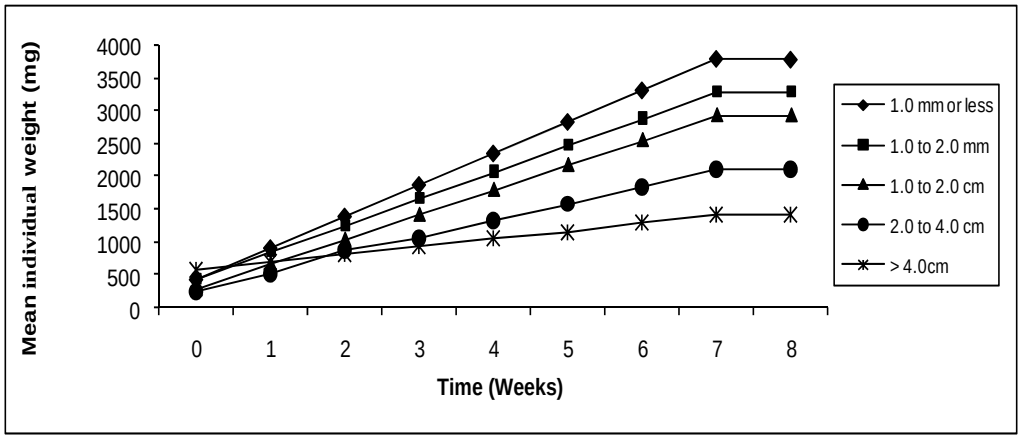
Table.1 Growth of *Eudrilus eugeniae* in tendu leaf residues with different feed particle sizes

Feed Particle Size	Initial fresh Mean weights (mg worm^{-1})	Maximum average weight achieved (mg worm^{-1})	Average gain in biomass (mg worm^{-1})	Average growth rate (mg worm^{-1} day^{-1})
1mm or less	434 ± 20	3774 ± 11	3340.0	68.0
1.0 to 2.0mm	437 ± 6	3283 ± 12	2846.0	58.0
1.0 to 2.0 cm	283 ± 17	2928 ± 14	2645.0	54.0
2.0 to 4.0 cm	245 ± 15	2108 ± 20	1863.0	38.0
> 4.0 cm	564 ± 20	1415 ± 13	851.0	15.0

Table.2 The rate of cocoon production by *Eudrilus eugeniae* fed on tendu leaf residues with different feed particle sizes

Feed particle size	Incubation period (weeks)	Cocoon production rate (Cocoons per worm per week)
1mm or less	8	3.83 ± 0.01
1.0 to 2.0 mm	8	3.0 ± 0.04
1.0 to 2.0 cm	8	1.29 ± 0.02
2.0 to 4.0 cm	8	0.75 ± 0.02
> 4.0 cm	8	0.29 ± 0.01

Fig.1 Growth of *Eudrilus eugeniae* in tendu leaf residues with different feed particle sizes



It is apparent that besides the capacity of the worm to ingest maximum size of the feed particle, the areas at the periphery of larger particles undergoing microbial decomposition might be creating smaller decaying pockets that the worm can ingest easily and thereby succeed in attaining higher growth rate. In the feed with > 2 cm particle size, however the total area exposed at the periphery may be less and therefore

resulted in decreased biomass production and cocoon production by the worm. Based on both the growth rate and cocoon production rate, the feed particle sizes in present studies that are larger than 2mm size were found unsuitable for vermicomposting of tendu leaf residues.

Results indicated that the optimum feed particle size for vermicomposting of tendu leaf residues is ≤ 1mm. However, significant biomass production and cocoon production was also observed in feed particle size between 1 to 2 mm. If a little delayed vermicomposting of the material is possible to be opted against the extra cost inputs required for shredding the feed material into pieces smaller than 1 mm size, the particle size up to 2 mm may be quite adequate for large scale vermicomposting of tendu leaf residues by *Eudrilus eugeniae.*

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