Biomass and vermicompost production by the earthworm *Eudrilus eugeniae* (Kinberg)

Caroline C. Mba,
Department of Soil Science, University of Nigeria, Nsukka, Nigeria.

(Rec. 17-VI-1988. Acep. 22-VIII-1988)

Abstract: *Eudrilus eugeniae* (Kinberg) was cultured in plastic pots containing ground *Paspalum digitatum* (L) grass (Dollis grass). This medium was toxic to the worms, if not fermented. Fermented and aerated grass were palatable. The worms fed and grew on the fermented-aerated grass and voided black colloidal casts (vermicompost), similar to the casts normally voided on cassava peel diet. Transit of grass through the gut was rapid and varied with age: 4.5, 5 and 6 hours for hatchlings, juveniles and adults, respectively. The rate of cast and biomass production (worm/day) was high and varied with developmental stage. Biomass and casting production was higher with both juveniles and hatchlings. Fermented-aerated and non-fermented grass were toxic to the cocoons. Cocoon coagulation took place within 3 days of exposure with moist ground grass, fermented-aerated or unfermented, while Dallis (worm castings) compost allowed normal development and hatching of the cocoons.

Studies on *Eudrilus eugeniae* and *Pontoscolex corethrurus* (Mba 1978, 1982) proved that the grasses including Panicum sp., *Paspalum* sp. and *Pennisetum* sp. could constitute suitable sources of food for earthworms.

Earth-worm protein is used by the animal feed industry and secondly for plant growth media. Grass grows abundantly year round and in contrast with cowdung, is readily available. Grazing is mostly extensive. In the south, cattle rearing is not very lucrative because of cattle pests. Traditionally, people prefer fish and poultry meat to beef, although vegetarian foods are becoming more popular. *Paspalum* grass favoured worm growth, when applied to the soil, but resulted in relatively poor fecundity despite prompt and abundant cocoon production Mba (1982). The present study investigates biomass and castings (vermicompost) production by *E. eugeniae* on a *Paspalum* grass diet.

MATERIAL AND METHODS

Experiment 1

Utilization of grass

The worms were isolated from soil-*Paspalum* grass culture. Ground Dallis grass: (a) air dried, or (b) fermented and aerated (Table 1), was moistened to 75% field capacity and potted, 10 g per plastic bowl (20 cm diameter by 6 cm depth) or 2 g per petri dish (9 cm diameter). Fermented and aerated Dallie grass was prepared by soaking the grass for 7 days followed by 3 days of air drying. Worms were weighed and introduced singly to the containers: clitellate adults, and juveniles to the bowls, and hatchlings to the petri dishes. All media were maintained at 75 % field capacity, in the dark at 26 ^{o}C. Treatments were replicated 12 times for each age. When all the diet was used the worms were sorted, wighed and returned to the containers. Further weighings were at 3 day intervals until live weight became constant of slightly

decreased. Subsecuently, the cast in each container was collected, weighed and then oven dried at 110 °C. Dry biomass was determined by air drying the earthworms and then oven drying at 50 °C. Duration of growth and food consumption was taken as the time interval between the innoculation and the time that maximum biomass was attained.

Experiment 2

Activities

0-2 day old cocoons were collected. Eight cocoons of similar age were placed in a petri dish containing one of the following treatments in 3 replications; (a) moist ground air dried nonfermented Dallis grass; (b) fermented-aerated Dallis grass; (c) moist red soil; (d) moist worm casts (Dallis grass vermicompost).

The number of days to hatching and the number of the new hatchlings per dish were recorded.

Experiment 3:

Transit time

Fermented-aerated grass was prepared as for experiment 1. Worms from the grass culture were placed for 2 days in moist red soil so that the gut was completely filled up with red soil. The worms were weighed and introduced singly to container. Worm activities were observed during the first 30 minutes. After 2.5 hours, observations were made at 30 min intervals to monitor the first ejection of coloured cast. Treatments were replicated 12 times and incubated in the dark at 26 °C - 28 °C.

RESULTS

Results of this investigation are summarized in Tables 1-2. Initially, the worms burrowed into the 2 Dallis grass diet and ejected casts within 1 minute. After 1 minute, however, worms emerged from the unfermented Dallis grass and moved away from it. After 3 hours, exposed worms from the unfermented diet were rinsed several times with distilled water. Despite this, 70 % of them died the following day, the rest within 4 days.

Fermented-aerated diet on the other hand was very palatable. Worms fed and frew on this diet (Table 2). Rates of consumption and production of cast followed similar trends and were very high. Both rates increased with age. The ratio of cast productions/g live weight/day was 7:2:1 for hatchlings: juveniles: adults; while the ratio of biomass production/g live weight was 14:4:1. The rate of biomass production increased with age but was similar for juveniles and adults. As for productivity and consumption, the hatchlings proved most efficient. Hatchlings produced 3 times their live weight of dry vermicompost, juveniles, their own weight and adults 37 % of theirs.

Consumption followed quantitatively similar trends. Efficiency in transformation of diet into biomass and castigns was high. Castings constituted 80% on the average, biomass 4.9 % ; 1 % and 2.4 % of the ingested dry matter for hatchlings, juveniles and adnults respectively.

Gut-transit time varied with age. Observations were allowed by the translucent hind gut. *E. eugenieae* when newly introduced into culture pots normally ejected casts when they started burrowing and ingesting food material. In this study, all worms burrowed into the fermented grass and within a minute ejected red, soil-coloured casts. Transit time of the diet through the gut was 4.5 hours, 5 hours, and 6 hours for hatchlings, juveniles and adults respectively.

Both fermented and non-fermented grass were toxic to *E. eugeniae* cocoons, coagulation occuring within 3 days of exposure to the media. The cocoons darkened at the contact area, which appeared as a hardened dark bluish coloured egg mase under microscopic observation. Cocoons incubated on grass castings hatched normally within 21 days. There were 2-3 hatchlings per cocoon, similarly to numbers obtained from moist red soil. Cocoons in newly inoculated culture surrounded by a film of water were deposited on the inside of the plastic cover away from the Dallis diet. This behaviour persisted until all the grass became virtually transformed into castings.

DISCUSSION

Non-fermented Dallis grass was toxic to *E. eugeniae* whereas fermented and aerated Dallis graes was palatable and nutritious. This underlines the importance of microbial activity for the survival and nutrition of earthworms. Both grass treatments were toxic to the cocoons.

This explained the low fecundity of *E. eugeniae* noted in another investigation despite prompt and abundant cocoon production, following frequent application of undecomposed Dallis grass to *E. eugeniae* culture. Dallis grass casting were favourable to normal cocoon development. This implied that *E. eugeniae* detoxified the ingested grass diet and rendered it safe for normal cocoon development and hatching. This in fact is a homeostatic mechanism. Kretschmar (1983) observed that by binding organic and mineral fractions earthworms created conditions favourable to their survival. Kaplan *et. al.* (1980) however observed that castings appeared to be toxic to earthworms.

Gut transit time in this study varied from 6 to 4.5 hours depending on developmental stage. Parle (1963) estimated a gut transit time of 20 hours for temperate earthworms. This study indicated that *E. eugeniae* was very efficient both in biomass and cast production.

Hatchlings were most efficient both in biomass and in castings production. Satchell (1967) estimated that *Lumbricus terrestris* consumed 10-10 % of their live body weight per day. In this study, *E. eugeniae* consumed 47 % to their live body weight per day, produced 1-15 % of their live body weight as biomass and 37-260 % as castings.

REFERENCES

Kaplan, D.L., R. Hartenstein & E.F. Neuhauser. 1980. Coprophagic Relations among the Earthworms *Eisenia fetida, E. eugeniae* and *Amynthas* spp. Pedobiología 20: 74-84.

Kretzschmar, A. 1983. Soil Transport as a Homeostatic Mechanism for Stabilizing the Earthworm Environment, p. 59-66. *In* J.E. Satchell (ed.). Earthworm Ecology. Chapman and Hall, London.

Mba, C.C. 1978. Influence of Different Mulch Treatments on Growth and Activity of Earthworm *Eudrilus eugeniae* (Kinberg) Z. pflanzenernahr. Bodenk. 141: 453-468.

Mba, C.C. 1982. Dietary Influence on the Activity of Two Nigeria Oligochaetes: *Eudrilus Eugeniae* and *Pontoscolex corethurus.* Pedobiologia 23: 244-250.

Parle, J.N. 1963. Micro-organism in the Intestines of Earthworms. J. Gen. Microbiol. 30: 1-11.

Satchell, J.E. 1967. Lumbricidae, p. 259-322. *In* A. Burges and F. Rad (eds). Soil Biology. Academic Press, London and New York.