Life cycle of earthworms *Drawida nepalensis, Metaphire houlleti* and *Perionyx excavatus* under laboratory controlled conditions

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Received July 20, 2008

Abstract

Observations on the biology of *Drawida nepalensis*, *Metaphire houlleti* and *Perionyx excavatus* were made, which were reared in cow manure and oak litter under laboratory conditions over a period of 150 days. This study revealed that *D. nepalensis* can produce cocoons both sexually and parthenogenetically, while *M. houlleti* produces cocoons parthenogenetically and *P. excavatus* produces cocoons sexually. The maximum growth rate of 3.7 ± 0.05 mg/worm/day was observed in case of *P. excavatus*. A maximum of 51 ± 8.2 days were needed for development of clitellum in *M. houlleti*, while initiation of cocoon production was started after 37 ± 5.2 days in *D. nepalensis* and 70 ± 6.4 days in *M. houlleti* whereas, in *P. excavatus* only 24 ± 1.6 days were needed for cocoon production. Furthermore, the maximum cocoon production rate of 1.1 ± 0.05 cocoon/day was observed for *P. excavatus*. The minimum incubation period of 18.7 ± 1.5 days was observed for *P. excavatus*. [Life Science Journal. 2008; 5(4): 83 – 86] (ISSN: 1097 – 8135).

Keywords: *Drawida nepalensis*; *Metaphire houlleti*; *Perionyx excavatus*; growth rate; cocoons

1 Introduction

Information on the reproductive biology of the Indian earthworms is spasmodic and very important for both growth and development of vermiculture based biotechnology and for academics interest. Majority of the work done in this line is related to less than 5% of the total number of species so far reported. Reproductive process occupies the central position in the bio-management programs. An organisms could either be harmful as a pest or beneficial to man. Knowledge on the reproductive biology could help to curtail pest organisms and to enhance benefactors. Earthworms are hermaphrodite, produce both ova and spermatozoa. Exchange of sperms occurs during copulation of two mature worms and results in the production of cocoons. Biparental mode of reproduction is more common method in few earthworms. Uniparental parthenogenesis with self fertilization is also known in some earthworm species, where there is absence or retrogressi on of some secondary sexual organs like spermathecae and prostrates etc. Reproduction in earthworms is peculiar because of hermaphroditism (Kale *et al*, 1982; Julka, 1988; Kaushal and Bisht, 1992; Kaushal *et al*, 1995).

The present study provides a detailed account on life cycle of the three vermincomposting species of earthworm *viz. Drawida nepalensis* (*D. nepalensis*), *Metaphire houlleti* (*M. houlleti*) and *Perionyx excavatus* (*P. excavatus*) with an emphasis on the following three parameters: (1) Growth and maturation rate of *D. nepalensis*, *M. houlleti* and *P. excavatus*, (2) quantitative production of cocoons, and (3) the incubation time of cocoons of the three species under controlled conditions.

2 Materials and Methods

This study was conducted by using adults of *D. nepalensis*, *M. houlleti* and *P. exacavatus* used during the study, were brought from Narayankoti, Distt. Rudraprayag, Uttarakhand, India and cultured in the laboratory at 20 ºC – 25 ºC. The worms were kept in soil with a pH of 7 and a moisture content of 70% – 80%

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was maintained by regular watering. The worms were fed with cow manure and oak litter at every 15 days. The cocoons were incubated in Petri dishes using cow manure and fine oak litter as a substrate to maintain the hatchlings and growing worms.

To study the life cycle, newly hatched specimens were collected and placed in the pots singly and in batches of five and covered with plastic mesh (1 mm). Cow manure and oak litter were added to each container on a regular basis till the completion of the present study. The worms were weighed regularly and with each weighing, the worms were examined to determine the extent of maturation as indicated by clitellum development. In order to determine the onset of cocoon production, the substrates were examined under a magnifying glass, as soon as clitellate worms were observed in the substrates. The cocoons were counted, washed lightly in distilled water and then again incubated in Petri dish and the media used for incubation was again the fine cow manure and oak litter. The cocoons were observed after every 24 hr and hatchlings were removed daily.

3 Results and Discussion

3.1 Growth rate

The data on different parameters selected for studying the growth rate and maturation period of the selected species of earthworms *viz. D. nepalensis*, *M. houlleti* and *P. excavatus* have been presented in Table 1. It was observed that the earthworm species *D. nepalensis* can reproduce both sexually or parthenogenetically, while *M. houlleti* reproduces only parthenogenetically and *P. excavatus* reproduces sexually. During the entire study period for life cycle studies, earthworms were reared in cow manure and oak litter and the mean growth rate was 3.52 ± 0.07 mg/worm/day for *D. nepalensis* reaching a mean weight of 528 ± 24.3 mg, while it was 4.23 ± 0.85 mg/worm/day for *M. houlleti* reaching mean weight of 635 ± 32.6 mg and 4.51 ± 0.92 mg/worm/day for *P. excavatus* reaching a mean weight of 677 ± 35.8 mg, which is in accordance with the findings of Hartenstein and Hartenstein (1981). Patekar and Patil (1996) reported that growth and reproduction of exotic species such as *E. foetida* is rapid in cow dung supplemented with farm wastes as compared to other local species. On the other hand Kaushal *et al* (1994) have observed relatively a better growth rate of 5.07 mg/worm/day for *D. nepalensis*, when the worms were fed on the horse manure.

3.2 Maturation

During the present study it was observed that the first indication of clitellum development appeared at mean time of 26 days in *D. nepalensis*, 56 days in *M. houlleti* and 18 days in *P. excavatus*. Neuhauser *et al* (1979) reported that food availability and population density determine sexual maturation in earthworms. The development of clitellum in *D. nepalensis*, *M. houlleti* and *P. excavatus* during the present study falls in the range as has been reported by Kaushal *et al* (1995).

3.3 Cocoon production

Figures 1 to 6 showed the adult and cocoons of all the three species studied. Cocoons of earthworms were in general ovoid capsule, prolonged as processes at both poles, when fresh they are whitish in color and very soft jelly like and later become harder and theircolor varies from lemon yellow to olive green to pinkish red. In the present experiment, cocoon production started after 37 days in *D. nepalensis*, after 70 days in *M. houlleti* and after 24 days in *P. excavatus*. The cocoons of *M. houlleti* and *D. nepalensis* were almost similar having an irregular oval shape, one end being broader than the other. There were two sticky fibrous spines, one at each end of the cocoon, to which organic particles could adhere. The cocoons were soft and light yellow directly after laying in case of *M. houlleti* while light pinkish in

Table 1. Growth rate and maturation period of *D. nepalensis*, *M. houlleti* and *P. excavatus* (all values are mean of 6 observations ± SE)

Species	Parameter								
	Mode of reproduction	Growth rate (mg/worm/day)	Clitellum development (days)	Mean maturation weight (mg)	Initiation of cocoon production (days)	Rate of cocoon production (No./worm/day)	Cocoon mass (mg)	Incubation period (days)	Clitellate worms (%)
D. nepalensis	S & P	3.52 ± 0.07	26 ± 5.1	528 ± 24.3	37 ± 5.2	0.7 ± 0.01	0.25 ± 0.01	30 ± 2.5	100
M. houlleti	P	4.23 ± 0.85	51 ± 6.2	635 ± 32.6	70 ± 6.4	0.04 ± 0.002	0.32 ± 0.03	35 ± 5.2	100
P. excavatus	S	4.51 ± 0.92	18 ± 3.4	677 ± 35.8	24 ± 1.6	1.1 ± 0.05	0.29 ± 0.02	18.7 ± 1.8	88.6 ± 42.5

S: Sexually, P: Parthenogenetically.

case of *D. nepalensis*. The cocoons harden rapidly and the color changes to reddish brown, turning dark brown immediately before hatching. In the case of *P. excavatus* cocoons were lemon shaped, with one end broader than the other. They were soft and creamish yellow, transparent immediately after laying and harden later on and color changes to reddish brown before hatching. The mean weight of cocoons recorded was 0.25 ± 0.01 mg/cocoon for *D. nepalensis*, 0.32 ± 0.03 mg/cocoon for *M. houlleti* and 0.29 ± 0.02 mg/cocoon for *P. excavatus*. The rate of cocoon production was 0.7 ± 0.01/worm/day for *D. nepalensis*, 0.04 ± 0.002/worm/day for *M. houlleti* and 1.1 ± 0.05/worm/day for *P. excavatus*. Similar findings have been reported for *D. nepalensis* by Kaushal *et al* (1995), for *P. excavatus* by Kale *et al* (1982) and for *E. foetida* by Venter and Reinecke (1988). The mean cocoon production rate in *M. houlleti* was much lower than those reported for *E. foetida*, which was 0.5 cocoons/worm/day (Venter and Reinecke, 1988), for *E. eugeniae*, where it was 1.4 cocoons/worm/day (Hallet *et al*, 1990), *E. andrei* (0.21 and 0.27 cocoons/worm/day; Elvira *et al*, 1996), for *D. veneta* (0.74 cocoons/worm/day; Fayolle *et al*, 1997), but it falls within the range of *D. nepalensis* and *P. excavatus* as reported in the present study. Mating does not seem to be a prerequisite for cocoon production in *M. houlleti* and *D. nepalensis* as worms produced cocoons singly, which hatched successfully, the similar findings have been reported by Kaushal *et al* (1995). In case of *E. foetida* mating seems to be prerequisite for cocoon production (Venter and Reinecke, 1988). Evans and Guild (1948) found that cocoons produced by unmated sexually mature specimens of the genera Allobophora, Dendrobaena and Octolasion did hatched, while cocoons produced by unmated individuals of the genus Lumbricus and *E. foetida* did not hatche. Reinecke (1989) and Hallet *et al* (1990) reported similar results for *P. excavatus*. Viljoen and Reinecke (1989) have reported that *E. euginae* can produce cocoons without copulation,

Figure 1. *D. nepalensis* (Michaelsen)

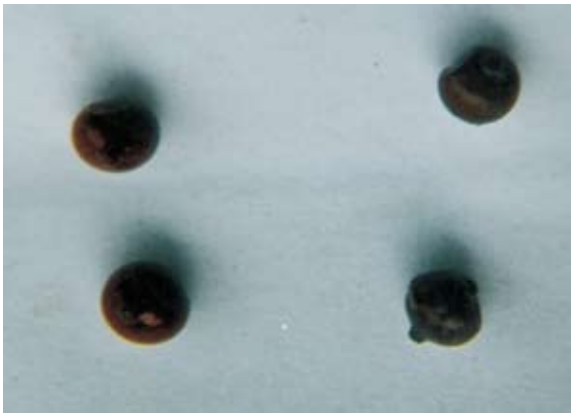

Figure 2. Cocoons of *D. nepalensis*

Figure 3. *M. houlleti* (Perrier)

Figure 4. Cocoons of *M. houlleti*

Figure 5. *P. excavatus*

Figure 6. Cocoons of *P. excavatus*

but these cocoons never hatched.

3.4 Incubation period

The mean incubation period for *D. nepalensis* was 30 ± 2.5 days, for *M. houlleti* it was 35 ± 5.2 days and for *P. excavatus* incubation period was 18.7 ± 1.8 days which was very similar to that reported for *D. nepalensis* 28.7 days by Kaushal *et al* (1995). *D. rubida* required 36.5 days as reported by Elvira *et al* (1996) while 43 – 90 days for *D. veneta* by Fayolle *et al* (1997).

Thus the present study shows that the growth rate and maturation period of the three Indian species studied, are more or less same as has been reported for other exotic species and that *P. excavatus* and *D. nepalensis* are the species which can be utilized for vermiculture.

Acknowledgments

We are extremely grateful to Dr. J.M. Julka for identifying the earthworm species and Dr. R.K. Maikhuri, Scientist, G.B. Pant Institute of Himalayan Environment and Development, Srinagar, for providing lab facilities.

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