

The role of *Trigonoilulus lumbricinus* Gerst. (Diplopoda) in the decomposition of leaf litter in some plant communities of Cuba

By

M. POBOZSNY*, R. GONZÁLES OLIVER** and M. E. RODRIGUEZ**

Abstract. The litter consumption, transformation and utilization of *Trigonoilulus lumbricinus* GERST., a widely distributed millipede species in tropical areas was investigated under laboratory conditions. The *T. lumbricinus* specimens were fed during 10 day long feeding experiments with leaf litter of *Hibiscus elatus*, *Coffea arabica* and *Panicum maximum* respectively, and with the mixture of them. The studied specimens of *T. lumbricinus* preferred the exposed litter species in the order of *Coffea* > *Hibiscus* > *Panicum*. The amount of the litter consumed ranged from 83.4 to 149.2 mg/g dry body weight/day and their cast-productions from 35.5 to 138.5 mg/g d.b.w./day. During the experimental period the live body weight of the animals increased with about 2.23–4.10 per cent. The assimilation efficiency (A/C) values ranged between 17.23 (*Hibiscus* consumers) and 54.74 (*Panicum* consumers) per cent; the production efficiency (P/C) values between 12.95 (mixed litter consumers) and 21.20 (*Coffea* consumers) per cent.

From among the main groups of soil invertebrates taking actively part in the decomposition of dead organic materials diplopods can play a predominant role both in the natural forests and the agricultural plantations of Cuba (GONZÁLES OLIVER, 1984, 1989; GONZÁLES OLIVER & HERRERA MENDOZA, 1983 a, b, 1984; GONZÁLES OLIVER & LOPEZ CASTILLA, 1986 a, b; GONZÁLES OLIVER & al, 1986, 1987; RODRIGUEZ & REINES, 1985).

The aim of our investigations was to get an insight into the ecological behaviour and feeding activities of *Trigonoilulus lumbricinus* GERST., a cosmopolitan diplopod species widely distributed in tropical areas. We intend not only to contribute with our data to the knowledge on the biology of this interesting millipede species but also to obtain more information on particular organic matter decomposition processes taking place in the soils of Cuba.

Materials and methods

Trigonoilulus lumbricinus specimens were collected for food preference experiments in the garden of the Institute for Ecology and Systematic of the Cuban Academy of Sciences (La Habana, "La Chata"). From the same habitats the leaf litter of *Hibiscus elatus* SW., *Panicum maximum* KUNTH., and *Coffea arabica* L. was collected, too.

* Dr. Mária Pobožsny, ELTE Állatrendszertani és Ökológiai Tanszék, MTA Talajzoológiai Kutatócsoport (Department of Zoosystematics and Ecology of the Eötvös Loránd University, Section of Soil Zoology of the Hungarian Academy of Sciences), 1088 Budapest, Puskin u. 3, Hungary.

** Dr. Rafael González and Dr. Maria Estrella Rodríguez, Instituto de Ecología y Sistemática de Academia de Ciencias de Cuba (Institute of Ecology and Systematics of the Academy of Sciences of Cuba), La Habana, Cuba.

Petri dishes of 15 cm in diameter were used for feeding experiments. The leaf litter of the three plant species was placed in the dishes partly separated, partly mixed, after determining their dry weight. Every dish contained the same amount of litter, 3–3 weighed male and female specimens of *Trigonoilulus lumbricinus*. Every experimental combination was carried out in 5 repetitions and 5 controls without animals.

The dishes were held under laboratory conditions for 10 days at a temperature of 30 °C, from 28. September till 6. October 1990.

After ten days the weights of both the animals and the leaf litter were synchronously determined. The accumulated excrements were collected for studies twice: first on the fifth, second on the tenth day, hoping to avoid the increased microbial decomposition of the faecal matter.

From the data received the consumption, the excrement production, and the preference-order, were calculated. For the evaluation of the results common statistical methods were used.

Results and discussion

The laboratory conditions provided for the studied millipede specimens during the feeding experiments proved to be adequate since nearly 100 per cent of them survived the study period. Already during the feeding experiments it seemed to be evident, that these animals especially preferred the litter of coffee while they consumed only little amount of *Panicum* litter. On the basis of our data the preference-order was the following:

$$\text{Coffea} > \text{Hibiscus} > \text{Panicum}$$

Table 1 shows the data on the amount of the consumed litter and the produced faecal pellets. The values of the growth-rates are presented, too.

Table 1. The weight of the consumed leaf litter and the produced faecal matter furthermore the increase in the body weight (growth) of *Trigonoilulus lumbricinus* specimens during 10 days feeding experiments (SD)

Animals fed with	Consumption		Cast-production		Growth P/B	
	mg/g dry body weight/day				%	
<i>P(anicum)</i>	83.4	(34.5)	35.5	(13.4)	2.23	(0.63)
<i>H(ibiscus)</i>	100.2	(50.2)	92.5	(51.5)	3.34	(0.60)
<i>C(offea)</i>	123.8	(44.9)	91.7	(27.3)	4.10	(1.50)
PHC	149.2	(65.1)	138.5	(47.1)	3.66	(0.66)
[P	29.3	(18.2)				
H	37.4	(13.3)				
C	82.5	(60.6)]				

In all of our experimental combinations the body weight of the animals increased. It is interesting, that the largest value consumed could be measured on animals fed on mixed litter. In the latter experiments the distribution of the litter consumed was: *Panicum* 19.65%, *Hibiscus* 25.05% and *Coffea* 55.31%.

Unfortunately, there are only little data in the literature on the feeding biology of *Trigonoilulus lumbricinus*. Using similar methods of feeding, GONZÁLES OLIVER carried out laboratory experiments with *T. lumbricinus* specimens collected in Cuban plantations. His animals consumed from the exposed *Hibiscus elatus* litter between 6.52 and 66.52 mg/g dry body weight/day and simultaneously produced between 20.2 and 54.6 mg faecal matter/g/day (unpublished data). Although he found a wide range feeding activity with his animals our *T. lumbricinus* specimens consumed much more perhaps due to different experimental conditions.

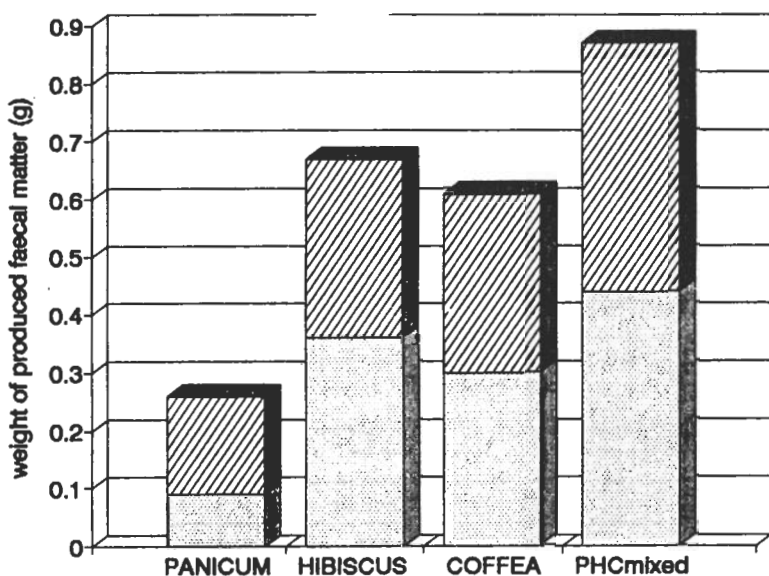


Fig. 1. The amount (in g) of the faecal pellets produced by *Trigonoilulus lumbricinus* specimens in the first five day period (lower columns) and in the second five day period (upper columns) of the experiment

Comparing the data about the weights of the consumed litter of the three plant species and that of the mixed litter, we can conclude that only the weights of the latter differed significantly from those of the consumed homogenous litters.

As it has been mentioned earlier faecal pellets were separated (dried and weighed) on the 5th and on the 10th day of the experiments. The similar amounts of the produced pellets (Fig. 1) show, that during this time the animal's activities were relatively undisturbed /the cast production and the consumption are linearly proportionated (DUNGER, 1958; POBOZSNY, 1985, 1988)/.

Regarding the animal's energy-balance the utilization of the consumed food seems to be the most important question. The assimilation efficiency values (A/C) can answer this question (Table 2). Animals fed with *Hibiscus* had the lowest A/C-values (17.3%) and it was the highest with those which were fed with *Panicum* (54.74%). This latter high value can be responsible for the significant differences among the assimilation efficiency values ($P=1\%$). STRIGANOVA (personal communication) determined an 81% A/C value for *Trigonoilulus lumbricinus* specimens collected in India.

Animals which consumed mixed litter transformed only little amount of plant debris into body tissues (P/C=12.95%). The transformation rate was the largest with the *Coffea* consumers (P/C=21.2%) (Table 2).

Summarizing our results we can state, that diplopods can considerably accelerate (about 2–20 times) destruction and degradation processes (Table 3) by consuming and comminuting (SZABÓ & al., 1992) leaf litter.

Taking into account the abundance values of *Trigonoilulus lumbricinus* in our sampling area (Table 4), we could calculate, that in the park of the IES, this diplopod species can daily consume 3.22 kg *Hibiscus*, 1.38 kg *Coffea* and 0.31 kg *Panicum* litter per hectare. Where the three plant species occur together, the consumption of the

mixed litter can be 2.49 kg. In the area of the *Hibiscus* plantation of Sierra del Rosario the *T. lumbricinus* population can consume 46.4 kg *Hibiscus* litter/ha/day. This fact clearly shows that millipedes play a very important role in the decomposition of organic debris in the soils of Cuba both under natural plant communities and plantations.

Table 2. Assimilation (A/C) and production efficiency (P/C) values (SD) — expressed in % — calculated for adult *Trigonoilulus lumbricinus* specimens fed with the leaf litter of different plants

Experiment	A/C %		P/C %	
<i>P(anicum)</i>	54.74	(15.78)	20.83	(6.26)
<i>H(ibiscus)</i>	17.23	(12.18)	19.90	(5.10)
<i>C(offea)</i>	23.67	(9.19)	21.20	(5.45)
PHC	20.57	(11.84)	12.95	(1.65)

Table 3. Decrease (in mg) in the weight of leaf litter of different plant species given to diplopods as food during the 10 days feeding experiments as compared with the loss in the weight of the control litter samples

	Controls	Experiments with animals
<i>P(anicum)</i>	277	577
<i>H(ibiscus)</i>	71	690
<i>C(offea)</i>	32	832
PHC	361	946

Table 4. Frequency of occurrence (number of specimens/m²) of *Trigonoilulus lumbricinus* in the litter layer of different plant communities in Cuba

Sampling sites	<i>Hibiscus elatus</i>	<i>Coffea arabica</i>	<i>Panicum maximum</i>	Mixed
Park of IES Sierra del Rosario	28 74.15	10	3.2	13.73

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