THE ECOLOGICAL ROLE OF MILLIPEDES AND EARTHWORMS IN DECOMPOSITION OF LEAF LITTER OF HEVEA BRASILIENSIS

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Abstract: Millipedes and earthworm have great ecological significance and they play a crucial role in the decomposition of leaf litter and in the nutrient cycling within the soil. In the present study an attempt was made to understand and verify the ecological role and the significance of millipedes and earthworm on the decaying leaf litter of *Hevea brasiliensis*. Microcosm method was designed for the study. Soil, leaf and millipedes and earthworms were collected periodically from different places, and microcosms were prepared. The presence of millipedes has shown to increase the decomposition of litter. Action of millipedes was efficient in promoting the digestion and fragmentation of the plant materials. Compared to the control, there was a significant decrease in the volume of leaf litter, and is converted into compost formed by fecal pellets and fragmented parts. The presence of millipedes also promoted reduction in the initial volume compared to the control. The addition of earthworms has increased the speed of the process since they were the epigeic species.

Keywords: Millipedes, Earthworm, Decaying, Leaf Litter.

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Millipedes have a major role in decomposition of detritus and their indirect involvement in enhancing microbial activity. Action of soil fauna on leaf litter increases the surface area of leaf and this in turn increases microbial biomass Hanlon (1981a, 1981b). The presence of millipedes increases the decomposition of litter (Cárcamo et al., 2001). The course of litter through the oesophagus of macroarthropods can contribute to the proliferation of soil bacteria and this helps in speeding up the microbial process (Hanlon, 1981a, 1981b; Tajovsky et al., 1991; Maraun & Scheu, 1996). Millipedes also speed up the release of litter nutrients especially calcium and nitrates into the soil (Pramanik et al., 2001). Millipedes are however choosy about the leaves they consume (Lyford, 1943; Kheirallah, 1979; Cárcamo et al., 2000). Tian et al., 1993 reported that the chemical nature of leaf litter (lignin and nitrogen) could influence soil fauna. In the present study an attempt was made to understand and verify the ecological role and the significance of millipedes and earthworm on the decaying leaf litter of ***Hevea brasiliensis.***

Methodology: Microcosm method was designed for the study. Soil, leaf and millipedes were collected periodically from different places, and microcosms were prepared. We used transparent, rigid plastic boxes (18.5x13.5x7.5cm), for setting the microcosms (Fig 3.1). 125g of sieved soil was weighed and put to the containers and 5 grams of leaf squares were added to each microcosm representing a non-limiting quantity of food for the macrofauna. All the boxes were covered with a 2-mm s mesh screen to prevent the diplopods from escaping .Two types of leaves with different lignin /nitrogen ratio taken were air-dried. The dried leaves then cut into 3 x 3 cm squares to get an accurate idea of the consumption rate by millipedes and earthworms. Leaf litter was moistened with 2 ml of sterilized water every day to imitate the daily rainfall and to keep the microcosms moistened. Microcosms were kept in a non-regulated shaded greenhouse allowing for natural temperature variation. Weekly check for dead animals were done and dead ones were replaced with individuals of a similar species. Boxes were prepared with millipedes Giant Indian Black Millipede (*Spinotarsus sp*) and earthworm (*Eisenia foetida*) in different ratio. Each set comprised of seven boxes (Table 2.1).

Table 2.1: Container Inclusions of Microcosms

Container1	Control-Soil and fresh leaves
Container2	Soil and fresh leaves, two Millipedes
Container3	Soil and fresh leaves, four Millipedes
Container4	Soil and fresh leaves, five earthworms
Container5	Soil and fresh leaves, ten earthworms
Container6	Soil and fresh leaves, five earthworms, two millipedes
Container7	Soil and fresh leaves, ten earthworms,four millipedes

Leaves of *Hevea brasiliensis* (Rubber) were collected from plantations in Aluva were used as litter source. The plant species were chosen because of the frequent occurrence of millipedes in the place. The chemical parameters of the leaves were also analysed. Organic Carbon estimated using Walkley-Black Chromic acid wet Oxidation method (Bartlett et al., 1994; McLeod 1973; Allison, et al., 1965, Walkley and Black1934 and total nitrogen content calculated by Kjeldal method (Methods for Chemical Analysis 1979) and Lignin estimation carried out by ADL method (Acid detergent lignin procedure) (Official Methods of Analysis, 1990). The soil and compost samples were analysed for their pH, total carbon and total nitrogen. pH was estimated in a pH meter, total carbon and nitrogen (CHNS analyser).

Results & Discussion: ***Carbon, Nitrogen and Lignin Contents in leaves of Hevea brasiliensis***: The chemical parameters of the leaves were analysed in terms of carbon , nitrogen and lignin (Fig 3.1.1 & 3.1.2).

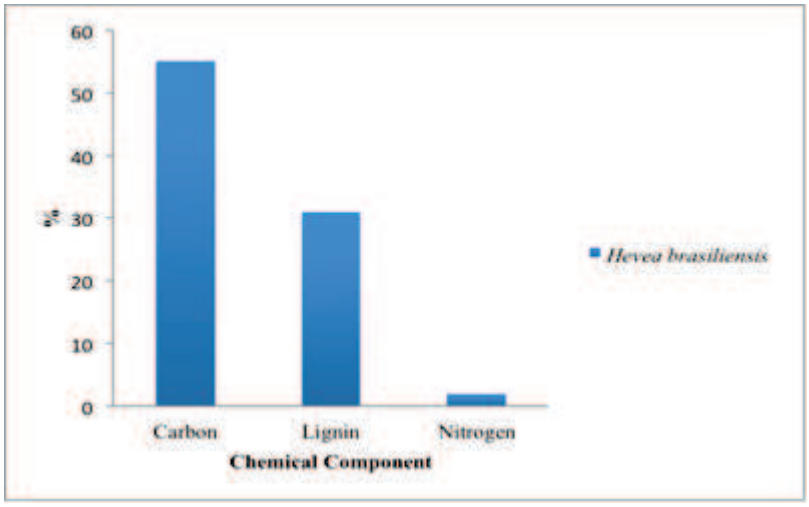

Fig 3.1.1 Initial Leaf Chemistry

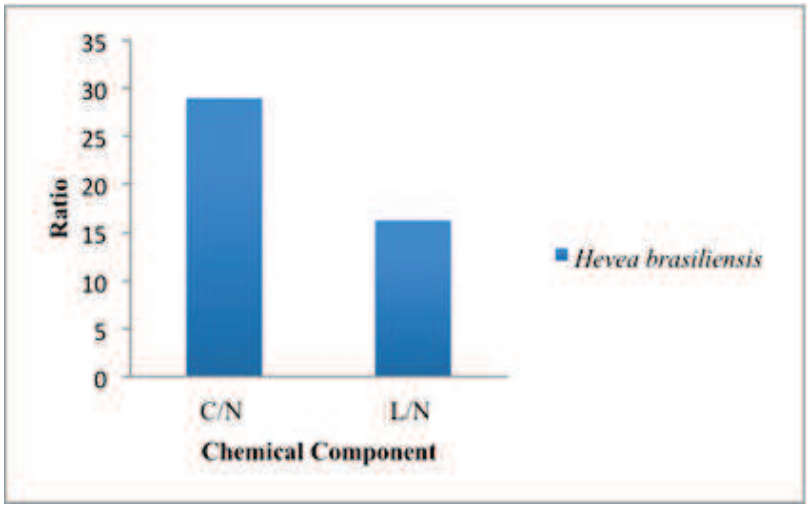

Fig 3.1.2: C/N and L/N Ratios of Hevea Brasiliensis

Soil and Compost Analysis and % of Leaf Consumption: The soil samples added initially to the microcosms as well as compost generated in each container were analysed for their pH, total carbon and total nitrogen content (Fig 3.2.1 & 3.2.2).

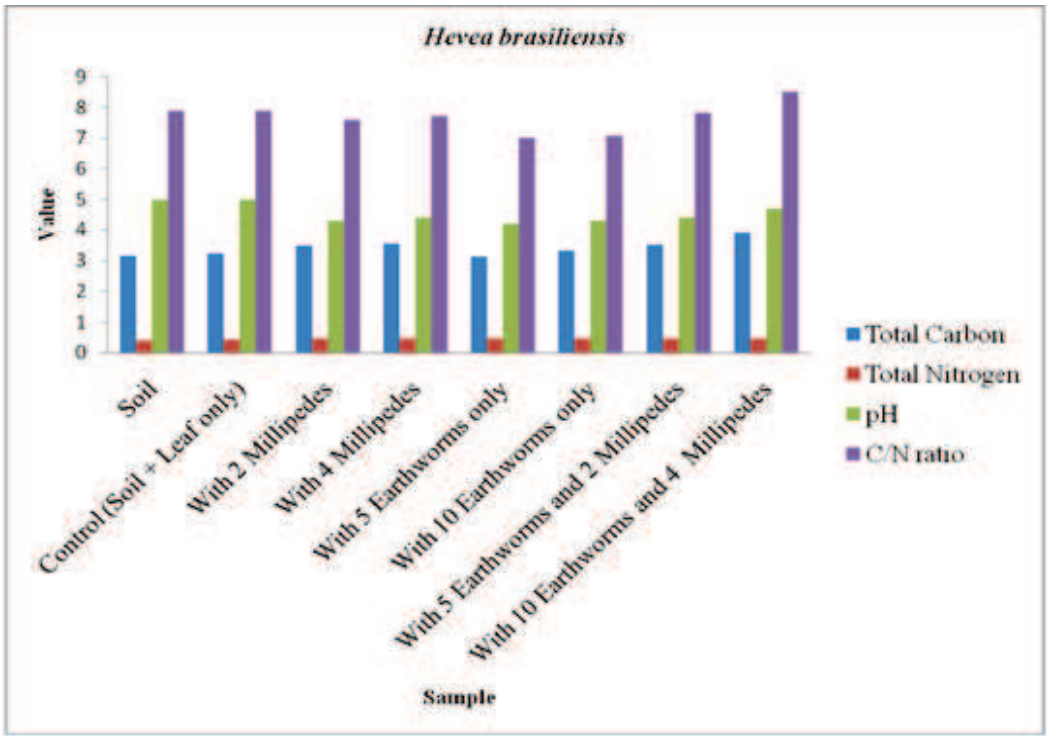

Fig 3.2.1 Soil and Compost Analysis

The activity of the Giant Indian Black Millipedes (Spinotarsus Sp.) was efficient in promoting the digestion and fragmentation of the plant materials. Compared to the control, there was a significant decrease in the volume of leaf litter, and is converted into compost formed by fecal pellets and fragmented parts. The presence of millipedes also promoted reduction in the initial volume compared to the control. The addition of earthworms has increased the speed of the process since they were the epigeic species.

The addition of larger volumes of millipedes resulted in changes in the chemical characteristics of the compost and an increase in the content of macronutrients, which is observable though increase in the percentage of carbon and nitrogen in soil after the treatment. Explanation for the increase in the nutrient content is that a larger volume of individuals represented greater activity from the microorganisms present in the intestine of the millipedes, thus mobilizing the nutrients trapped in the plant material and eliminating a portion in the feces. The pellets also contained a rich array of microorganisms whose tissues have high nutritional quality (Swift et al., 1979; Anilkumar et al., 2012; Ambarish & Sridhar, 2013).

The action of millipedes on the microcosms was constant and slow. They consumed almost all the provided leaf litter with minute differences. The leaf area remaining and were significantly affected by all three independent variables (litter species, millipede density, and the presence of earth worms. The highest density of millipedes (four individuals) had significantly less mass remaining than the litter from those microcosms less millipedes. The containers without millipedes remained almost the same in the amount of leaf litter even though slight consumption can be noticed by the presence of earthworms and soil microorganisms.

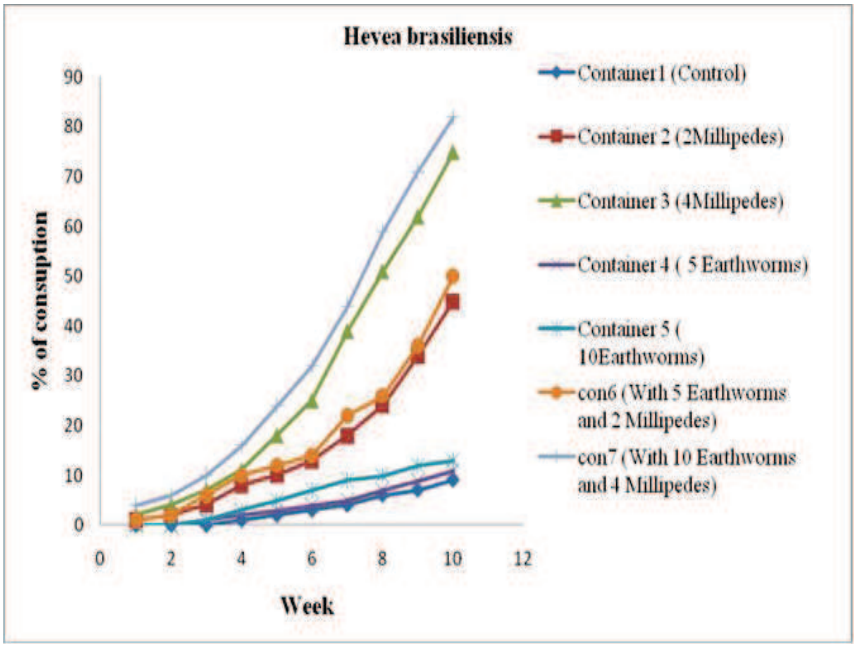

Fig 3.2.2 Leaf Consumption Rate Within Ten Weeks by Millipedes (Spinotarsus Sp)

Conclusion: It could be concluded that millipedes can effect leaf litter decomposition. The extent of their impact and action varies with their density as well as the quality of the substrate and lignin content of the leaf. We suggest that the consequences of this microcosm experiment with millipedes helps in further conforming and justifying the role of millipedes as vital components of soil ecosystems and nutrient release.

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