The Biology of *Lissoderes pusillus* Hespenheide (Coleoptera: Curculionidae: Conoderinae) in *Cecropia* (Cecropiaceae) saplings

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INTRODUCTION


C. obtusifolia sapling

Species of *Cecropia* (Cecropiaceae) are among the most common and characteristic plants of early successional vegetation in the Neotropics. They are well known for their mutualistic relationship with certain species of *Azteca* ants (Formicidae: Dolichoderinae), whereby the tree provides nesting sites and Müllerian bodies (supplemental food) for the ant colony, and the ants patrol the plant, cutting off vines and driving away herbivores.

Cecropia stems consist of a series of hollow internodes, separated from one another by solid partitions (septa) at each node. *Azteca* queens colonize young plants by chewing their way through a thin area (prostoma) in the internode wall. At this stage a single internode can harbor numerous queens (sometimes of two *Azteca* species).

Young *Cecropia* saplings are also colonized by *Lissoderes* weevils, but the biology of this neotropical genus is poorly known. Our results suggest that *L. pusillus* is not only a parasite of *Cecropia*, but also of the mutualism between the plant and the *Azteca* ants.


Hollow internode

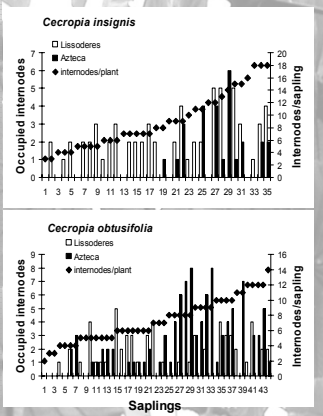
METHODS

Cecropia insignis (n= 35) and *C. obtusifolia* (n= 44) saplings under 1.5 m were collected at the Alberto Brenes Biological Reserve (10° 13' 12'' N, 84° 36' 6'' W; 850 m), Alajuela Province, Costa Rica. The site is in a premontane rain forest, with an average daytime temperature of 21° C and a yearly precipitation of 4000 to 5000 mm. Entire plants were removed and brought back to the laboratory. Each internode was split open with a longitudinal cut, and then examined individually under a dissecting microscope. Larvae, pupae, and parasitoids were reared on freshly cut internodes in plastic bags. To compare resource quantity between the two *Cecropia* species, the length of internodes occupied by larvae and the thickness of its parenchyma were measured. Interactions between weevil larvae and ants were observed by splitting open internodes containing one or more queens and placing a weevil larva within.

RESULTS AND DISCUSSION

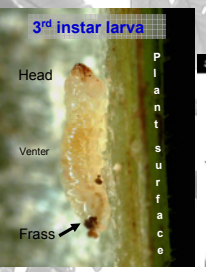
About 85% of the *Cecropia* saplings had at least one internode occupied by ants, weevil larva or both. Three species of *Cecropia* ants were found: *Azteca constructor*, *Azteca xanthochlora* and an undescribed species of *Pachycondyla*.

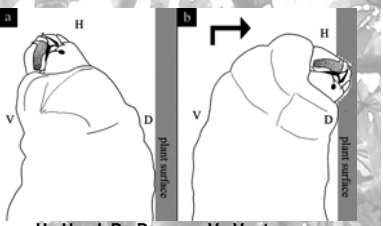
Azteca queens begin colonizing *C.obtusifolia* when the sapling has just four internodes whereas colonization of *C. insignis* does not begin until there are at least 8 internodes. Therefore, more *C. obtusifolia* saplings (27.3%) were found harboring only ants, compared with *C. insignis* (5.7%). However, a higher percentage of *C. insignis* (28.6%) contained only weevils compared with *C. obtusifolia* (15.9%).



The weevil larvae feed on the parenchyma that lines the inner wall of the internode and preliminary evidence suggests that *Azteca* queens also feed on this tissue. Larvae of all three instars feed and move lying on their dorsum ("upside-down").

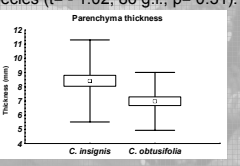

1st instar larva submerged in parenchyma

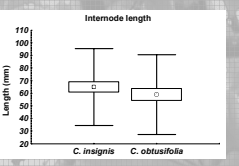




H= Head, D= Dorsum, V= Venter

Larvae are more likely to move to an adjacent internode in *Cecropia insignis* (by chewing through the septum). The parenchyma layer is thicker in occupied internodes of *C. obtusifolia* (8.4 ± 2.8 mm; t= -2.78, 86 g.l., p= 0.007) than in *C. insignis* (7.0 ± 2.0 mm), but the mean length of occupied internodes did not differ between *Cecropia* species (t= - 1.02, 86 g.l., p= 0.31).

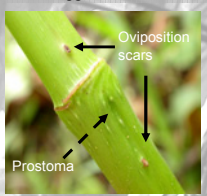


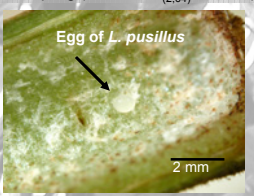


Thus, weevil larvae inhabiting *Cecropia* species with thinner parenchyma tend to feed in more than one internode.

Weevil larvae were very rarely present in internodes occupied by live *Azteca* queens. Usually, only one larva was found per internode. When two larvae were placed in the same internode, one killed the other.

Female weevils chewed through the wall of the internode and laid an egg on the inner wall of the chamber. In nearly all cases only one oviposition scar was observed in any one internode. It is possible that female weevils detect internodes occupied by weevil larvae or *Azteca* queens and avoid ovipositing in these internodes. The number of internodes and the number occupied by *Azteca* ants had very little influence on the number of internodes occupied by weevil eggs and larvae in each sapling ($r^2 = 0.1$, $F_{(2,64)} = 4.60$, $p < 0.014$).



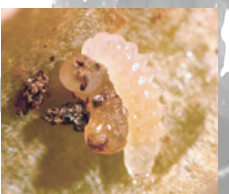


Pupa hanging in the upper portion of the internode

The larva pupates in the upper end of the internode by hanging itself freely inside the internode. Adults exit the stem by chewing a hole in the middle portion of the internode. In the field, they were seen resting on the undersides of leaves of *Cecropia* saplings.

Only one living weevil larva was found sharing an internode with live *Azteca* queens (the larva was hidden in debris at the bottom of the chamber). When weevil larvae were placed in chambers with *Azteca* queens, the latter often ignored the larvae. However, *Pachycondyla* queens and *Azteca* workers usually attacked the weevil larvae.

Among sapling internodes that harbored *Azteca* ants, 69% contained dead queens. The causes of this high mortality rate are mostly unknown, although at least 16 % of the internodes with dead or dying queens were parasitized by *Menozziola* sp. (Diptera: Phoridae). Nematodes were also seen on corpses of *Azteca* queens.



Two ectoparasitoids, *Neocatolaccus* sp. (Pteromalidae) and *Heterospilus* sp. (Braconidae) were obtained from mature last instar larvae and prepupae of *L. pusillus*.


Neocatolaccus sp.


Heterospilus sp.

Designed by J. Weng; Photos and drawings by K. Nishida