

DIFFERENCES IN THE MORPHOLOGY OF MALE AND
FEMALE PUPAE OF *PHYLLOCNISTIS CITRELLA*
(LEPIDOPTERA: GRACILLARIIDAE)

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The citrus leafminer, *Phyllocnistis citrella* Stainton (Lepidoptera, Gracillariidae) is a serious pest in most citrus growing areas worldwide (C.A.B.I. 1995, Garrido 1995a). Recent introductions of this pest into new areas has resulted in an increasing interest in biology and control strategies (Knapp et al. 1995, Sponagel & Díaz 1994). A common problem faced by researchers working on this species is the sexing of individual living moths because adults do not present any obvious external sexual dimorphism. Up until to now, observation of mating behavior was the only reliable way of differentiating sexes. The finding of an alternative to this laborious method has been the goal of this study.

According to figures presented by Clausen (1931), male and female pupae might be separated according to some morphological differences. These distinguishing features would be i) the coincidence of antennal and wing tips in males, ii) the coincidence of the tips of antennae and first pair of legs in females, and iii) a longer pygidium bearing two long hairs in males. Whether these characteristics could unambiguously be used to predict the sex of the adults was investigated.

Phyllocnistis citrella was reared in a climatic chamber on young shoots of potted orange rootstocks at $25\pm 2^{\circ}\text{C}$, $50\pm 10\%$ R.H., and a photoperiod of 16:8 (L:D). Infested leaves holding pupal chambers were randomly detached from the plants. Pupae were then removed from chambers under a binocular microscope and classified according to the three traits mentioned above. They were then individually deposited on a 1.5% agar (Agar Technical Unipath Ltd., Basingstoke, Hampshire, England) layer in a 5 cm diam Petri dish, and kept undisturbed at 25°C until emergence.

On the day of emergence, adults were macerated in chloralphenol (Stroyan, 1961) and their genitalia examined under a microscope. The presence of the signum of the bursa copulatrix identified females (Garrido, 1995b). Furthermore, females were invariably found exhibiting a small row of black scales at both sides of their pygidium (Fig. 1). This trait was easier to check and could be observed by using xylene instead of chloralphenol. Therefore this feature was preferred and ultimately used to ascertain sex of adults.

Based on the 110 pupae examined, adult emergence in this study appeared slightly lower than that under undisturbed rearing conditions: 81.8% versus more than 95% (unpublished results), respectively. Losses could presumably be attributed to injuries inflicted during manipulation. The sex ratio of these adults was 1.093 (male: female) which did not significantly deviate from 1:1 ($\chi^2=0.178$, $p=0.696$).

When actual sex (assessed from adults) was compared to that predicted by the three features considered in pupae, it was concluded that not all were reliable indicators of sex. Predictions from the relative length of wings and antennae led to erroneous sex classifications 58.9% of the times. When predictions were based on coincidence of tips of legs and antennae, the error rate reached 57.5%. Moreover, independently of sex, 84.4% of pupae checked presented non-coincident tips of legs and antennae, and 90% of them showed non-coincident tips of antennae and wings. However, prediction from the morphology of pygidium appeared robust. No erroneous classifications were

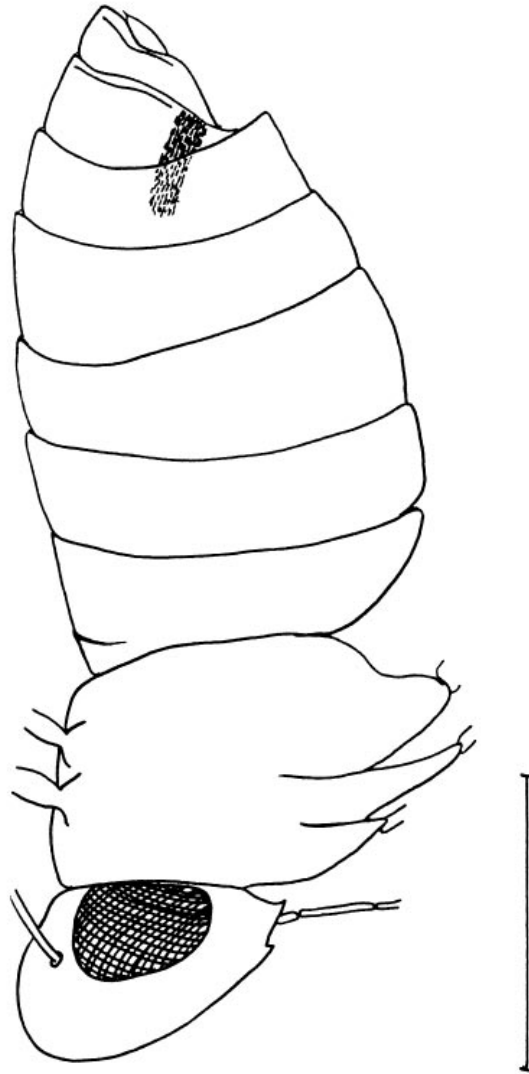


Fig. 1. Adult female of *Phyllocnistis citrella*. Notice the row of black scales extending on the seventh abdominal segment (line=0.5 mm).

made with this feature. Accordingly, male and female pupae of the citrus leafminer can unambiguously be sorted out based on the morphology of the last abdominal segment. Nevertheless, contrary to figures taken from Clausen (1931), it is the female pupae that shows a long last segment (presumably a fusion of segments IX and X) bearing two long hairs (Fig. 2A), whereas males exhibit a shorter pygidium without any hair (Fig. 2B).

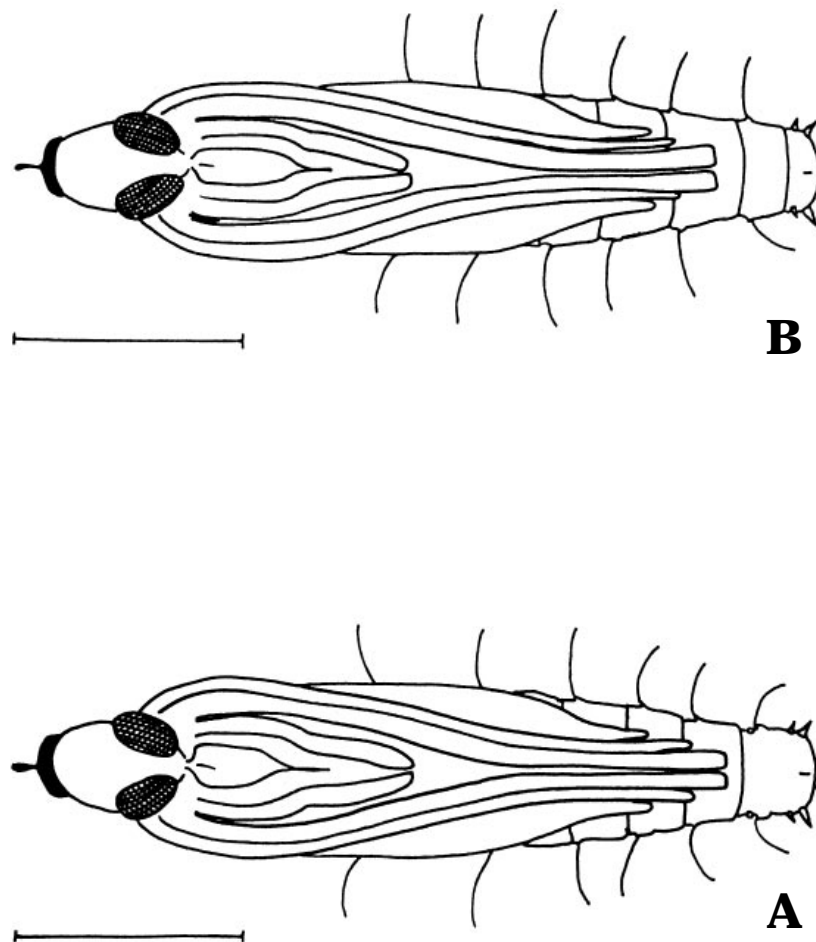


Fig. 2 Pupae of *Phyllocnistis citrella*. A. Female pupa. B. Male pupa. Female last abdominal segment is longer and bears two long hairs lacking in males (line=0.5 mm).

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SUMMARY

Male and female pupae of the citrus leafminer, *Phyllocnistis citrella*, exhibit a different pygidial morphology, which enables prediction of adult sex. The female pygidium is longer and bears two long hairs lacking in males.

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