

AN ATTEMPT TO INDUCE PUPATION IN
CARPENTERWORM LARVAE

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Larvae of the carpenterworm, *Prionoxystus robiniae* (Peck), form cells within the cambium of hardwood trees and grow to full size by the end of the 7th instar after 12 to 13 weeks of development, yet univoltine individuals undergo 8 to 15 instars and require at least 254 days to pupate (Solomon 1973). This phenomenon of stationary larval ecdysis also occurs in the southwestern corn borer, *Diatraea grandiosella* Dyar, and is a function of juvenile hormone (JH) titer in the haemolymph (Yin and Chippendale 1973). Stationary ecdysis occurs if the JH titer in diapausing larvae is high enough to prevent pupation and to periodically activate the prothoracic glands to secrete ecdysone. Presumably, JH titer is regulated by factors such as temperature, photoperiod, the host, and perhaps associated microorganisms. However, exposing mature carpenterworm larvae to various cold regimes after 13 weeks of development did not change significantly the time required for them to pupate (Solomon and Abrahamson 1976). The research reported here was conducted in an attempt to reduce their developmental time by rearing immature larvae under a variety of temperature and photoperiod regimes.

On April 1, 1982, 2 female carpenterworm moths were collected from a walk-in light trap at Gainesville, Florida and held in a square 280-liter plexiglass cage at $26 \pm 1^\circ\text{C}$ and $80 \pm 5\%$ RH with a 14-h photophase produced by white and plant lights (hereafter referred to as standard conditions). Larvae from eggs obtained during the next few days were immediately placed in 25-mm diam clear plastic vials filled to a depth of 10 mm with pinto bean/wheat germ diet (Leppla et al. 1975). After being established for 2 weeks under standard conditions, these larvae were transferred to individual 9-cm diam plastic petri dishes half full of diet and reared at 5, 10, and 15°C for 10, 20, 30, 40, or 50 days under continuous light (5 larvae/treatment) or continuous dark (10 larvae/treatment). Then they were given fresh diet and held for pupation under standard conditions for a total larval period of 168 days. Since none of the rearing regimes induced pupation, on September 15 the surviving larvae were randomly divided into 4 cohorts of 18, given fresh diet in new rearing containers, and placed back into a 5°C dark environment for 9, 120, 150, or 180 days. This 2nd cold period was followed by standard conditions until pupation occurred. The resulting pupae and emergent adults were held at ca. 26°C inside a square 280-liter aluminum screen cage placed near a source of moist air in a glass house.

Larvae reared in continuous light did not survive, primarily because fungus contaminated the diet, but rearing in darkness resulted in ca. 40% survival to 168 days regardless of temperature regime. Of the 72 mature larvae established on the 2nd regime, 21 pupated (beginning on March 9 after 313 days) and 20 emerged (12 males and 8 females), the same sex ratio as larvae reared on oak sawdust diet (Solomon 1966). Thus, the temperature and photoperiod regimes had no apparent effect on the timing of pupation and ultimately the developmental period was similar to the normal 9- to 11-month egg to adult univoltine cycle that occurs in nature (Solomon 1976). Unlike in nature, how-

ever, males emerged much sooner than females and, because it took nearly 2 months for all of the moths to emerge, their sexual activity was not well synchronized. The females actively called but apparently remained unmated since they oviposited only infertile eggs.

A question correlated with developmental time is what are the consequences of the male:female sex ratio shift from 5:1 to 1:2, respectively, in univoltine and bivoltine populations of the carpenterworm. In Mississippi the emergence period is from late April to mid July, the peak being influenced by the initiation of larval development, species of host tree, and ambient temperature (Solomon and Neel 1972). Most years, the peak occurs during a 4- to 5-week interval but unusually warm weather shifts it ahead by 2 or more weeks. The average number of days from April 1 to peak emergence for male and female univoltine and bivoltine moths is 63.9, 53.3, 70.0, and 60.3 days, respectively. Thus, considering differential mortality between the sexes and generations in nature, the effective sex ratio of interacting bivoltine males and females and univoltine males could be similar to that of the interacting univoltine males and females. The male biased sex ratio also could compensate for differential mortality of the relatively smaller males. It would be interesting to determine the proportion of univoltine and bivoltine males and females in different geographical locations and analyze the genetic basis for their voltinism and sex ratio shifts by rearing multiple generations of single types and their crosses on completely defined artificial diet.

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