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A LOW COST AND LABOR EFFICIENT METHOD FOR REARING BLACK CUTWORMS (LEPIDOPTERA: NOCTUIDAE)[1]

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The black cutworm, *Agrotis ipsilon* (Hufnagel), has been and continues to be the subject of many biological and control studies in the north-central states. Interest in this insect can often be traced to its status as a major, but sporadic pest of field corn in the region.

In order to conduct studies on the black cutworm, entomologists have often relied on laboratory-reared insects. Previous attempts to mass rear black cutworm larvae on plant parts such as red clover leaves have met with high rates of mortality (40–50%) due to cannibalism and disease (Harris et al. 1958). Rearing this species individually on insect diet (Reese et al. 1972), however, is very labor-intensive. Thus, over the past five years we have attempted to develop a procedure to rear black cutworms with a minimum investment of labor and low rate of mortality. This work began at the Ohio Agricultural Research and Development Center, Wooster, but the method was perfected by the senior author at the Illinois Natural History Survey, Champaign. With this method of culturing, 1st through 3rd or 4th instar larvae are reared on corn seedlings and the resulting older larvae are transferred to diet to complete larval development. This procedure has the added advantages that larvae reared partially on corn and used in research studies, appear to make the transition to corn seedlings more easily than larvae reared completely on artificial diet, and diet costs are greatly reduced.

METHODS AND MATERIALS

Rearing was conducted in a 27 ± 1°C, 70 ± 5% RH, and 16:8 h photoperiod room. A culture was started in spring 1979 from adults collected in Champaign County, Illinois. Ten moths (ca. 50:50 sex ratio) were placed in each of several 31 × 15 × 61-cm plastic bags (8-cm pleats) supported by a 22 × 22 × 22-cm wire frame and closed with a twist tie. Approximately 20 small holes were punched in each bag for ventilation. The cages were provided with a 60-ml plastic cup containing cotton soaked with 10% honey solution and one sheet of paper toweling. Towels were checked 3 times weekly for eggs. Groups of eggs were cut from the paper sheet, placed in 0.5-liter plastic cups with plastic lids (5 pin holes were made in the lid to provide ventilation), and placed in a 10°C refrigerator until ready for use. Eggs were stored for up to one month without loss of viability. When larvae were needed, the plastic cups containing the eggs were transferred to the rearing room. Several leaves from young corn seedlings (2–4 leaf stage plants) grown in flats in a greenhouse were placed in these containers to provide food for newly-emerged larvae. Containers were checked daily and new leaves added when the old ones had either dried out or been consumed. When most of the eggs had hatched (ca. 4–5 days), larvae were transferred en masse to large plastic containers (ca. 0.03 m^3), lids of which were fitted with a 2 × 5-cm section of fine mesh screening. During very early larval development, most of the screened area was covered up with a petri dish top to maintain high humidity levels, but as larvae became larger (>2nd instar), this cover was removed. Fresh corn leaves were added to the containers and decaying plant material was removed from the containers as needed. Several hundred larvae could be reared communally with this technique. We have found that we can rear larvae up to the

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Table 1. Developmental time in days of black cutworm life stages under culture conditions outlined in text.

Life stage	Developmental time (n)[a]
Egg	3.0 ± 0.0 (6 groups)
Egg hatch to 3rd molt	6.9 ± 0.3 (28)
Egg hatch to 4th molt	10.4 ± 0.4 (28)
Larva (including pre-pupal stage)	31.4 ± 0.6 (95)
Pre-pupa	2.2 ± 0.1 (95)
Pupa	13.2 ± 0.1 (95)
Adult female, pre-ovipositional period	2.9 ± 0.1 (8)
Complete life cycle (oviposition to oviposition)	50.5

[a] $\overline{X}$ ± SE(n).

3rd or 4th instar without significant cannabilism or outbreaks of disease. Larvae for on-going studies were easily removed with flexible-tipped forceps.

To maintain the colony, approximately 75 3rd or 4th instar larvae were removed from the "communal" container on a weekly basis and individually reared on plugs of a meridic diet (Nielsen et al. 1980; 3 ml of mold inhibitor was used per batch of diet rather than 4% by weight, as specified by Nielsen et al.), placed in 35-ml capped plastic cups. The plastic lining on the caps was oriented outward to prevent larvae from chewing through this moisture barrier. Larvae completed their development without further attention. Diet was made in quantity and frozen until needed. On a weekly basis, pupae were removed from the diet cups, washed free of debris with water, and placed en masse in a 0.5-liter plastic cup lined with a paper towel. Five pin holes were made in the plastic lids of these containers to provide ventilation. Pupae were stored in a 10°C refrigerator until ready for use. When adults were needed, the plastic cups containing the pupae were transferred to the rearing room. Cultures were renewed with feral adults or larvae collected in corn fields at least once a year.

RESULTS AND DISCUSSION

Table 1 presents the developmental times of the life stages of the black cutworm under the culture conditions outlined above.

We estimate that more than 90% of the larvae transferred to diet successfully pupated and emerged. This procedure has been used at the Illinois Natural History Survey and the Ohio Agricultural Research and Development Center since 1979; during this time no disease outbreaks have occurred. With this procedure, less than 7 h/wk are required to rear a thousand or more larvae for biological and control studies. Space requirements with this method are also minimal; a medium-sized incubator could be used in place of a rearing room.

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