

Maintenance of Fruit Insect Cultures at Vincennes, Indiana

MERRILL L. CLEVELAND, Entomology Research Division,
Agr. Res. Serv., U.S.D.A., Vincennes, Ind.¹

Introduction

It is my intent in this paper to consolidate into one report the methods employed by personnel at the Vincennes fruit insects laboratory to maintain cultures of various fruit insects important to the deciduous fruit growers of Indiana. Culturing insects in large numbers is becoming more and more important in all research leading to insect control. At the Vincennes laboratory supplies of codling moth (*Carpocapsa pomonella* (L.), red-banded leaf roller (*Argyrotaenia velutinana* (Walker)) and the two-spotted spider mite (*Tetranychus telarius* (L), sufficient to meet testing needs at the laboratory, are reared under constant temperature and humidity. Larvae of the codling moth and red-banded leaf roller are now reared exclusively on artificial diets. Two-spotted spider mites, both phosphate-resistant and nonresistant strains, are maintained on lima bean foliage. Recent experiments concerning an artificial diet to support populations of the lesser peach tree borer (*Synanthedon pictipes* (Grote and Robinson)) have proved partially successful. The details of the rearing procedures for the above insects follow.

Codling Moth

The basic artificial diet used for rearing codling moth was developed by Robert E. Redfern (1964-b), formerly of the Vincennes staff. The constituents of this diet, sufficient for 150 cups, follow:

Apple seeds	30 g.	Ascorbic acid	10 g.
Dried apple	60 g.	Linseed oil	10 ml.
Sugar	60 g.	Agar	20 g.
Soybean protein	60 g.	Water (140° F.)	1,100 ml.
Wessons' salt	12.5 g.	Vitamin solution	12.5 ml.
Yeast	12.5 g.	(Vanderzant & Davich (1958))	
Glycine	1.25 g.		
Cysteine	0.625 g.	KOH (10% sol.)	37.5 ml.
Cholesterol	.625 g.	Mold inhibitor	22.5 ml.
Alphacel	30 g.	(Redfern 1963)	

After mixing these ingredients in a high-speed blender, $\frac{1}{4}$ ounce of the medium is dispensed into a 1-ounce plastic cup. Before the medium has solidified, three apple seeds are placed in each cup. After the medium has cooled at room temperature overnight, two newly-hatched codling moth larvae are transferred to it; a pasteboard cap is placed on the cup, and the cups are stored in a rearing room maintained at a temperature of $80^{\circ} \pm 2^{\circ}$ F. and a relative humidity of $55\% \pm 5\%$. The room is continuously lighted by four 40-watt fluorescent bulbs. After approximately 28 days, caps are removed to allow

¹ In cooperation with the Indiana Agricultural Experiment Station.

adult emergence. Currently, from 60 to 70% of the larvae placed on the medium emerge as adults. Eggs are obtained by confining 100 adults (random collection of males and females) in waxed cylindrical pasteboard cartons. These "oviposition cages" measure 3 x 6 inches. Moisture is provided by inserting a cotton-plugged 1-inch shell vial filled with water into the side of the cage. Three fresh pear twigs ($\frac{1}{2}$ x 5 inches) are placed in each cage to provide a resting place and increased oviposition area. Moths are removed after 5 days, and the cages and twigs are then refrigerated at 48° F. Hatch of the oldest eggs deposited occurs within 3 hours after removal from the refrigerator.

Red-Banded Leaf Roller

The diet we are currently using to rear the red-banded leaf roller was described by Redfern (1964-a) and represents a simplification and improvement of a medium which he described earlier (Redfern 1963). The constituents of this diet, sufficient for 320 cups, follow:

Alfalfa meal	250 g.
Agar	20 g.
Mold inhibitor	52 ml.
Vitamin solution	24 ml.
Water	2,000 ml.

The mixing procedure is similar to that used for codling moth medium. After the medium is placed in 1-ounce plastic cups, it is marked with a dissecting needle to afford the leaf roller larvae a hiding place. When this mixture has cooled and dried overnight, four newly hatched leaf roller larvae are placed on each cup and the cups capped. They are then placed in a rearing room, maintained at the same temperature and humidity given for the codling moth. Four days after the first pupation is noted, caps are removed for adult emergence. Approximately 44 days are required from egg deposition to the adult stadium. About 75% of the larvae placed on the medium emerge as adults. The techniques we use to obtain red-banded leaf roller eggs are similar to those for codling moth.

Two-Spotted Spider Mite

The techniques we use to rear two-spotted spider mites at this laboratory were given by Cleveland (1960). Baby Fordhook lima beans are grown in sand-filled plastic cups, approximately $2\frac{1}{2}$ inches in diameter and 3 inches high. The plants are watered lightly each day, but no nutrients are added. The cups are perforated on the bottom to avoid excess water accumulation. In the rearing room in which these plants are kept, the temperature is maintained at $82^\circ \pm 2^\circ$ F. and relative humidity at $65\% \pm 5\%$. The walls and ceilings are painted white. The room is continuously lighted with 18 40-watt fluorescent tubes. The bean leaves used at this laboratory will support a population of more than 500 mobile mites for a short time. Under these conditions, the mites complete a life cycle in 9 to 12 days.

Lesser Peach Tree Borer

In preliminary experiments we have successfully reared larvae of the lesser peach tree borer to adulthood on an artificial diet consisting of the basic codling moth diet described above, with the addition of alfalfa meal and peach wood shavings. Data are incomplete at this time, but we are currently realizing about a 50% return of adults from larvae fed on this diet. The temperature-humidity conditions are approximately the same as those used with codling moth. Newly-hatched larvae have been collected in the field for most of these tests. On three occasions eggs deposited by females in the laboratory hatched, and the resultant larvae were fed on the medium. To date, we have encountered no diapause problems.

In the near future we anticipate studying diets to maintain stink bug, plum curculio (*Conotrachelus nenuphar* (Herbst)), apple maggot (*Rhagoletis pomonella* (Walsh)), oriental fruit moth (*Grapholitha molesta* (Busck)), and, perhaps, apple aphids. We thus hope to have supplies of different insects available so we can study the ones of importance to the deciduous fruit industry of this area.

Literature Cited

1. Cleveland, M. L. 1960. Laboratory rearing and testing technique for the two-spotted spider mite. Proc. N. C. Branch E.S.A. XV:66-7.
2. Redfern, R. E. 1963. Concentrate media for rearing red-banded leaf roller. J. Econ. Entomol. 56(2): 240-1.
3. Redfern, R. E. 1964-a. An improved medium for rearing red-banded leaf roller. J. Econ. Entomol. 57(2):296-7.
4. Redfern, R. E. 1964-b. Concentrate medium for rearing the codling moth. J. Econ. Entomol. 57(4):607-8.
5. Vanderzant, E. S. and T. B. Davich. 1958. Laboratory rearing of the boll weevil; A satisfactory larval diet and oviposition studies. J. Econ. Entomol. 51(3):288-91.