REARING THE DOUGLAS-FIR CONE MOTH, *BARBARA COLFAXIANA* (KEARFOTT), ON AN ARTIFICIAL DIET IN THE LABORATORY

D. S. RUTH and A. F. HEDLIN[1]

ABSTRACT

The Douglas-fir cone moth, **Barbara colfaxiana** (Kearfott), can be reared satisfactorily in the laboratory. Methods for handling all stages and rearing larvae on a wheat germ diet are described.

Introduction

Under natural field conditions adults of the Douglas-fir cone moth, *Barbara colfaxiana* (Kearfott) (Lepidoptera: Olethreutidae) emerge in the spring when Douglas fir is flowering. The female deposits her eggs on the exposed portion of the cone bract. The eggs hatch in 2 to 3 weeks, and the larvae commence tunneling into the cone. Upon reaching the center they feed on the cone scales and seeds. By mid-July the insect has finished feeding and pupates adjacent to the cone axis.

In years when there are few cones many pupae remain in prolonged diapause for a year or more. In an attempt to obtain more information on conditions initiating diapause, *B. colfaxiana* larvae were reared in the laboratory. An artificial diet was necessary since the insects' natural food, immature Douglas-fir cones, cannot be maintained at rearing temperatures in condition suitable for the larvae, particularly in first and second instar. Use of an artificial medium allows rearing of several generations per year.

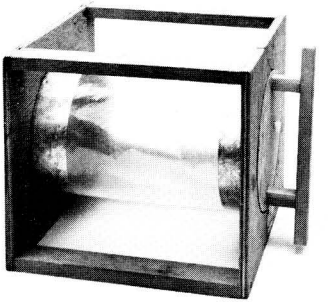
Little information is available concerning the rearing of cone insects in the laboratory. Ebel (1959) developed a technique for rearing *Dioryctria abietella* Denis and Schiffermuller (Lepidoptera: Pyralidae) in the laboratory with host cones. Artificial nutrient medium was used by Barras and Norris (1965) for rearing another olethreutrid, *Eucosma* sp., from cones of *Pinus resinosa* Aiton, and Hedlin (1964) reared three species of cone insects, *B. colfaxiana*, *Laspeyresia youngana* (Kft.) and *L. piperana* (Kft.) on an artificial diet. This paper discusses in further detail the technique for *B. colfaxiana*.

Rearing Methods

Adult moths are obtained from infested Douglas-fir cones collected the previous year. Cones are stored outside until March, and then moved to a refrigerator and held at 32° F until moths are required. The cones are placed in screen cages at room temperature and emergence commences in 4 to 5 days. Twenty males and 20 females are placed in oviposition cages in an outdoor shade house to obtain field conditions for mating and oviposition. Under natural conditions mating takes place at dusk when temperature is between 50 and 65° F.

Other designs of oviposition cages were tried, but the drum-shaped cage (Fig. 1) was superior (Knott *et al.*, 1966). When cages were placed on their sides moths laid eggs at random across the upper inner surface (Fig. 2). When the eggs are nearing eclosion, determined by their orange color and visible black larval head capsules, the wax paper is removed. Small sections of wax paper with eggs are placed in a one-gallon jar with a wax paper lid. Development is observed and larvae transferred to medium soon after hatching, thus reducing mortality. Moistened cloth placed in the jar prevents egg shells

[1] Forest Research, Dept. Fisheries and Forestry, Victoria, B.C.



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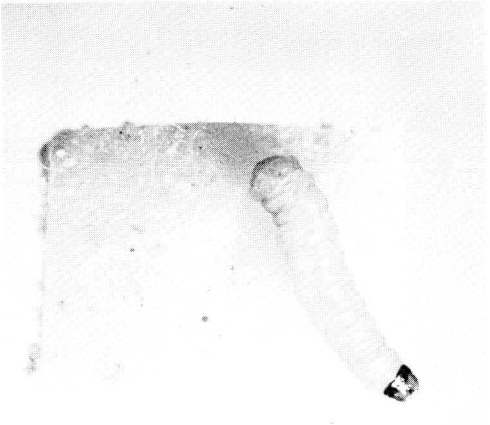

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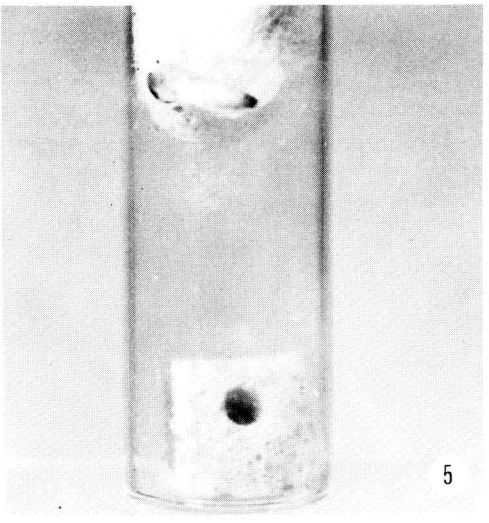

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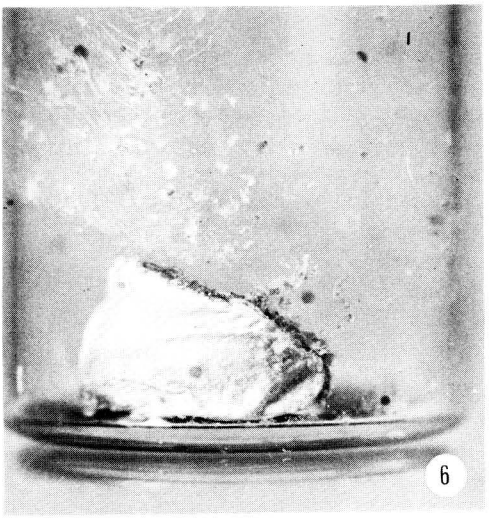

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Figs. 1-6. **Barbara colfaxiana** (Kft.) (1) Oviposition cage. (2) Eggs on inner surface of cage. (3) Fourth instar larva feeding on medium. (4) Pupa. (5) Cocoon in cotton plug. (6) Cocoon against base of vial.

from becoming hard and hindering larval emergence.

The artificial diet is the same as that used by McMorran (1965) for spruce budworm. When the wheat germ medium has been mixed and is still liquid, it is poured into 3½-inch square plastic trays which may be refrigerated until ready for use. These are stored upside down to prevent moisture collecting on the surface of the medium. When cooled and solidified, some of the medium is cut into squares, which are placed individually in the bottom of sterile one-dram vials. The vials are plugged with non-absorbent cotton and refrigerated.

In establishing larvae on the McMorran medium, a hole is punched into the block of medium and the larva placed inside to facilitate feeding. Extreme care must be exercised when establishing larvae to ensure that they are able to move freely. If stuck to the medium, they are unable to feed and soon die. The vial is stored with the plug down until the second instar, since larvae have a tendency to move upward and become entangled in the cotton plug. If first instar larvae are reared individually, the tendency to move upward is considerably reduced and vials may be stored upright. During the first instar two larvae may be placed in one vial but, because of cannibalistic tendencies which become more pronounced as the insect develops, larvae must be reared individually after the second instar.

Early larval growth is rapid. Observations made daily ensure that the medium does not become dry and trap the larva feeding in the block. Rearing at temperatures of 80° F and higher, the medium must be replaced every second or third day, particularly when insects are small. The second-instar larva is in less danger of becoming trapped in or on the medium. Prior to each moult the larva spins a delicate protective case in or beside the block of medium and should not be disturbed at this stage unless there is danger of the larva becoming trapped within the medium as it hardens.

When the larva has reached the fourth and final instar, the vial is placed on its side and the block of medium moved to the center (Fig. 3). If vials are stored upright the larva has insufficient space between the vial and the block of medium in which to pupate. Some larvae will pupate without spinning cocoons, others spin against the side of the vial or on the cotton plug (Fig. 4-6).

Naked pupae are stored individually in gelatin capsules to give protection against mites and drying. The pupa is placed on absorbent cotton to prevent adherence to the side of the capsule should the capsule become damp.

At the Summerland Entomological Laboratory, a medium which consists mainly of sawdust and whole wheat flour is being used for the mass rearing of codling moth larvae.[1] The Douglas-fir cone moth belongs to the same family (Olethreutidae) and has similar feeding habits so it was thought that larvae might adapt to similar rearing techniques. However, at the temperatures in which some of our rearing was done, many first-instar larvae became trapped in the excess moisture which collected on the sides of the container and surface of the medium. Even when the larvae reached second instar, losses due to cannibalism were high.

Discussion

Difficulties associated with rearing the Douglas-fir cone moth in the

[1] Proverbs, M.D. Personal communication, Entomology Laboratory, Summerland, B.C.

laboratory are numerous. Since some female moths do not oviposit well in cages, a large number of moths must be reared to obtain a good population of larvae. Mortality is high in the larval stage, particularly in the first instar. The small larvae are unable to free themselves from the moist surface of the medium. At higher temperatures the medium dries and shrinks rapidly; young larvae are unable to feed and those tunneling inside the medium become entrapped and die. Insects will not survive if allowed to pupate beside or inside a block due to its shrinkage. Because of these problems, considerable time and labor are required to rear an appreciable number of insects from egg to pupa. An optimum rearing temperature is about 75° F., but even under good rearing conditions only about 30% of the larvae obtained from eggs can be reared through to the pupal stage. However, our technique does allow the rearing of an insect of specialized feeding habits, under completely artificial conditions.

Acknowledgments

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BRACHYCORYNA HARDYI CROTCH AND *MICRORHOPALA CYANEA* (SAY), TWO HISPINAE RARE IN BRITISH COLUMBIA (COLEOPTERA: CHRYSOMELIDAE)

JAMES GRANT[1]

On 12 July, 1958, I collected two chrysomelid pupae in small blotch mines in leaves of *Ceanothus sanguineus* Pursh near Wynndel, B.C. An adult which emerged 24 July, 1958, was identified as *Brachycoryna hardyi* Crotch by W. J. Brown of the Entomology Research Institute, Ottawa, who noted that there were no Canadian specimens in the Canadian National Collection.

An adult of the dark blue chrysomelid *Microrhopala cyanea* (Say) was collected 20 July 1958, on the open slopes north of St. Mary River at St. Eugene Mission near Cranbrook, B.C., by sweeping miscellaneous ground cover. Two more adults were collected at the same locality 22 July 1959, on golden aster, *Chrysopsis villosa* (Pursh) Nutt. W. J. Brown supplied the determination. *Chrysopsis* is probably the host for this species, as an empty, inflated mine found on a leaf in this vicinity closely resembled those formed by larvae of other members of the genus in leaves of *Aster* and *Solidago*.

[1] Forest Entomology Laboratory, Department of Fisheries and Forestry, Vernon, British Columbia.