OCCURRENCE OF APPLE LEAF ROLLERS (LEPIDOPTERA: TORTRICIDAE) AND THEIR PARASITES IN THE OKANAGAN VALLEY, BRITISH COLUMBIA

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ABSTRACT

Seven species of leaf rollers feed on apple in the Okanagan Valley. Five of them, including two of the three most common species, were not previously recorded as feeding on apple there. Six of the species have alternative host plants of which rose is the most important. A short key to final instar larvae of six of the species is included. Thirty-seven species of parasites were reared, of which eight may have some significance in control.

Introduction

Apple-feeding species of leaf rollers in the Okanagan Valley were investigated in 1972. The species, their food plants, and their natural enemies are listed here; aspects of their ecology are discussed elsewhere (Mayer and Beirne, in press).

The Leaf Rollers

Seven species were found feeding on apple in the Okanagan Valley, between Kelowna and Okanagan Falls. An earlier survey by Venables (1924) revealed four species of which two were not found in the 1972 survey. All seven are univoltine. *Archips argyrospilus* and *A. rosanus* overwinter as eggs which hatch when apple is in the one-half-inch green bud stage of development. The newly-hatched larvae disperse, often windborne. The five other species overwinter as larvae. All seven species reduce potential fruit set by feeding on the developing buds and leaves. Blossom feeding is common. On apple the larva rolls a single leaf, often attached to a fruit. On plants with smaller leaves such as privet two to five leaves may compromise the nest. The seven species in approximate order of economic significance to apple are as follows.

(a) *Archips argyrospilus* (Walk.), the fruit-tree leaf roller, has been the dominant leaf roller on apple in the Okanagan Valley since the early 1920's. It was still dominant in 1972, comprising from 19 to 99% of the apple leaf rollers in different localities, although it was exceeded in numbers by *A. rosanus* and by *Pandemis limitata* in locations near Summerland. Apple, followed by rose and antelope bush (*Purshia tridentata* (Pursh)), are the primary host plants. Other food plants are birch (*Betula* sp.), squaw current (*Ribes cereum* Dougl.), Oregon grape (*Mahonia nervosa* (Pursh)), Russian olive (*Eleangus angustifolia* Pall.), walnut (*Juglans regia L.*), and willow (*Salix* sp.). Feeding tests showed that the larvae will feed on leaves of almost any available shrub or tree rather than starve. This species is closely related to *A. rosanus* but repeated laboratory attempts to interbreed them resulted in a single mating but no eggs. Twenty species of parasites were reared.

(b) *A. rosanus* (L.), the European leaf roller, was common (25 to 80%) on apple in the Summerland district in 1972 but was not previously recorded on that plant in the Okanagan Valley. The usual primary host plant is privet (*Ligustrum vulgare* L.).

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Other primary host plants are rose and red-osier dogwood (*Cornus stolonifera* Michx.). It was also found feeding on alder (*Alnus* sp.), chokecherry (*Prunus virginiana* L.), hawthorn (*Crataegus douglasii* Lindl.), maple (*Acer* sp.), Russian olive, walnut, and willow. It was not found feeding on currant though this is a host plant in Eastern North America (Whitehead 1926). Twenty-eight species of parasites were reared.

(c) *Pandemis limitata* Rob., the three-lined leaf roller, was common (2 to 42%) on apple in the Summerland district in 1972 though not recorded previously as feeding on it in the Okanagan Valley. Other primary host plants are rose and dogwood. It was also found feeding on birch, maple, and willow. Though univoltine in the Okanagan Valley it is bivoltine about 300 miles south in Washington State. The feeding habits differ from those described for Eastern North America. In the Okanagan Valley the larva first feeds on the undersurface of a leaf under webbing and later does not roll leaves; usually it is found on leaves not fed upon by other species of leaf rollers. In the East (Hall 1929, Gilliatt 1932) the early instar larva establishes feeding-sites in leaves rolled and partly fed upon by other species of leaf rollers. Nine species of parasites were reared. In one locality larvae were found to be infected with a granulosis virus that killed them in the final instar.

(d) *Platynota idaeusalis* (Walk.), the tufted apple bud moth, was not common (3%). Apple and rose are primary host plants and it was also found feeding on willow. In New York the larva overwinters as two different sizes (Chapman and Lienk 1971) but only as one in the Okanagan Valley. One parasite species was reared.

(e) *Syndemis afflictana* (Walk.), the fall dead-leaf roller, was found only on apple (2%). It overwinters as a final-instar larva, whereas the other species that do not overwinter as eggs do so as partly-grown larvae. The majority of the larvae were found in living rolled leaves whereas in New York (Chapman and Lienk 1971) most of the larvae construct nests from dead leaves or cause a living leaf to die by partly severing the petiole.

(f) *Choristoneura rosaceana* (Harr.), the oblique-banded leaf roller, was the dominant species on apple in the Okanagan Valley up to the 1920's (Venables 1924) but it is now rare. It was found in 1972 in a single location near Okanagan Falls and only in trace amounts, feeding on apple.

(g) *Argyrotaenia dorsalana* (Dyar), was found, infrequently (1%), on apple and rose. The recorded host plants are Pinaceae (Powell 1964) and oak (Freeman 1958).

Parasites

The following parasites were reared from leaf-rollers in the Okanagan Valley. The host species, when identifiable, are indicated by the letters in parenthesis, which are from the list above. Only eight of the 38 species (marked with asterisks below) were reared more than five times and are therefore of possible control significance.

Ichenumonidae: **Itoplectis quadricingulata* (Prov.) (a,b,c); *Hercus pleuralis* (Prov.) (b); *Scambus tecumseh* (Harr.) (b); *Exochus nigripalpis tectulum* Townes (a); *Phytodietus* sp. (b); *Glypa* sp. (c); *Acropimpla albortica* (Cress.) (b); **Diadegma* sp. 1 (b,c,d); *Diadegma* sp. 2 (a); *Gelis* sp. (a); *Pimplinae* (b).

Braconidae: **Microgaster epagoges* Gahan (a,b,c); **Apanteles cacoeciae* (Riley) (a,b,c,g); **Habrobracon xanthonotus* (Ashm.) (a); *Onco-*

phanes americanus (Weed) (b); *Agathis annulipes* (Cress.) (a,b); *Agathis* sp. (b); *Apanteles* sp. No. 49 (b).

Trichogrammatidae: *Trichogramma minutum* Riley (a,b,).

Chalcididae: *Spilochalcis albifrons* (Walsh) (b); *Brachymeria ovata ovata* (Say) (b,c).

Eulophidae: *Eulophus anomocerus* (Crawf.) (a); *Sympiesis marylandensis* Girault (b); *Elachertus aeneoniger* (Girault) (b); *Elachertus cacoeciae* (Howard) (b); *Elachertus* poss. n. sp. (a); *Dicladocerus westwoodii* Westwood (a); *Pediobius* sp. near *lonchaeae* Burks (a).

Elasmidae: *Elasmus atratus* Howard (a,b).

Pteromalidae: *Dibrachys cavus* (Walk.) (a); *Dibrachys* poss. n. sp. (b); *Habrocytus phycidis* Ash. (a,b,c); *Catolaccus aeneoviridis* (Girault) (a,b).

Tachinidae: * *Nemorilla pyste* (Walk.) (a,b); *Compsilura concinnata* (Mg.) (b); **Hemisturmia tortricis* (Coq.) (a,b,c); *Eumea caesar* (Ald.) (a,b); **Pseudoperichaeta erecta* (Coq.) (a,b,c).

Associated Lepidoptera

The apple leaf rollers recorded from the Okanagan Valley by Venables (1924) but not found in the 1972 survey were *Acleris maximana* (Barnes & Busck) and *Aphelia alleniana* (Fern.).

In the 1972 survey three species of leaf rollers were found on primary host plants of apple-feeding species but not themselves on apple: *Acleris forbesana* (McD.) and *Acleris* sp. near *bowmana* (McD.), on dogwood, and *Croesia albicomana* (Clem.), on rose.

Species of Lepidoptera other than leaf rollers that were found feeding on foliage of apple were: *Epinotia rectiplicana* Walsm., *Epinotia* sp., *Hedia ochroleucana* Hbn., and *Exartema punctanum* Walsm. (Olethreutinae); *Filalima demissae* Kief. and *Trachoma walsinghamiella* Busck (Gelechiidae); and *Lithophane georgii* Grt. (Noctuidae).

Key To Leaf Rollers

Key to final-instar larvae of six leaf rollers on apple in the Okanagan Valley, B.C.

1. Body light green, head darker green 2
—. Body dark green or brownish green, head reddish brown, dark brown, or black 3
2. Full-grown at about end of apple bloom; relatively sluggish; usually scarce. . . . . **Argyrotaenia dorsalana**
—. Full-grown two or three weeks after end of apple bloom; very active; often frequent. . . . . **Pandemis limitata**
3. Head brown to black, body dark green; usually common 4
—. Head reddish brown to brown, body brownish to brownish green; usually scarce . . . 5
4. First thoracic legs brown, remainder green; never on privet . . . **Archips argyrospilus**
—. All thoracic legs greenish; often common on privet . . . . . **Archips rosanus**
5. Body brownish, sometimes with two dark brown stripes; full grown late in summer or early in fall . . . . . **Syndemis afflictana**
—. Body brownish-green, not with stripes; full-grown late in spring or early in summer. . . . . **Platynota idaeusalis**

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INFLUENCE OF STREAM SEDIMENTS ON DISTRIBUTION OF MACROBENTHOS[1]

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ABSTRACT

Studies were conducted in the laboratory and field to determine the substrate relationships of five species of stream insects representing the orders Ephemeroptera, Plecoptera, Trichoptera and Diptera. Various combinations of pebble and sand were tested in the presence or absence of cobbles. Substrates with cobble were generally preferred over substrates without cobble. The preference for cobble generally increased as the sediments around the cobble decreased in size. Substrates with unembedded cobble were slightly preferred over half-embedded cobble; completely embedded cobble in fine sand proved unacceptable to most species. Three types of substrate-distribution patterns are recognized; stream insects which inhabit substrate surfaces; interstices; and both substrate surfaces and interstices.

Introduction

Sediment pollution is of increasing concern to stream ecologists. Excessive accumulations of sediment in mountain streams as a result of agricultural practices, logging, road construction, dredge mining, etc. can have serious detrimental effects on the stream biota. The role of sediments in the distribution and abundance of stream benthos has been reported by Pervical and Whitehead (1929), Cummins (1964, 1966), Scott (1966) and others. This paper is concerned with substrate relationships of insects, but we recognize that other trophic levels are also affected by sediments. Influence upon any one trophic level may cause profound side effects on other components in the ecosystem.

This paper attempts to clarify the substrate relationships and ecology of five stream insects studied in the laboratory and field and suggests reasons for specific affinities for certain substrate conditions.

Materials and Methods

Insect-substrate relationships were studied in the laboratory in artificial streams similar to one described by Brusven (1973). Temperature was

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