

starvation because of declining numbers of woolly aphids.

One possible cause of establishment failure, low winter temperatures, should not have affected species already proven in the east, because in south coastal British Columbia and particularly on southern Vancouver Island, temperatures are milder. There may, however, have been difficulties with unfavorable weather at critical times, particularly with small delicate flies such as *A. thompsoni* and *C. nigrocellulata*.

Biological control of the balsam woolly aphid, which is difficult to control economically by other means, could still reduce aphid populations and damage if better species were discovered, or if releases were of larger numbers over a wider area, or if populations were protected by first releasing in cages. Also, if past releases were unsuccessful simply because of bad weather or a scarcity of woolly aphid populations, similar introductions could be successful given better conditions.

#### REFERENCES

- Chapman, J. A. and J. M. Kinghorn. 1957. Window flight traps for insects. *Can. Ent.* 87: 46-47.
- Clark, R. C., D. O. Greenbank, D. G. Bryant and J. W. E. Harris. 1971. *Adelges piceae* (Ratz.), balsam woolly aphid (Homoptera: Adelgidae): 113-127, In *Biological control programmes against insects and weeds in Canada 1959-1968*. Commonwealth Institute of Biological Control, Trinidad, Techn. Comm. No. 4.
- Franz, J. M. 1958. Studies on *Laricobius erichsonii* Rosen. (Coleoptera: Derodontidae) a predator on Chermesids. *Entomophaga* 3: 109-196.
- Harris, J. W. E. 1973. Tree and site characteristics relative to progressive balsam woolly aphid damage to *Abies* spp., British Columbia 1959-1970. Pacific Forest Research Centre, Victoria, Internal Rep. BC-46. 60 pp.
- Harris, J. W. E., J. C. V. Holms and A. F. Dawson. 1968. Balsam woolly aphid predator studies, British Columbia, 1959-1967. Forest Research Lab., Victoria, Inform. Rep. BC-X-23. 18 pp.
- McGugan, B. M. and H. C. Coppel. 1962. Biological control of forest insects — 1910-1958: 35-216. In *A review of the biological control attempts against insects and weeds in Canada*. Commonwealth Inst. of Biological Control, Trinidad, Techn. Comm. No. 2.
- Mitchell, R. G. and K. H. Wright. 1967. Foreign predator introductions for control of the balsam woolly aphid in the Pacific Northwest. *J. Econ. Ent.* 60: 140-147.

## OBSERVATIONS ON A TWIGMINER, *ARGYRESTHIA PSEUDOTSUGA* FREEMAN (LEPIDOPTERA: YPONOMEUTIDAE), IN DOUGLAS-FIR SEED ORCHARDS

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#### ABSTRACT

Studies on the twigminer, *Argyresthia pseudotsuga* Freeman, which kills new growth on twigs of Douglas-fir, showed that adults oviposited from mid-April until May on bud scales or on needles close to the buds. Eggs hatched in mid-May and larvae continued to mine in the new twigs until late fall or early winter. The insects pupated by the end of February in chambers at the bases of the twigs.

#### RÉSUMÉ

Les auteurs rapportent que les adultes de la Mineuse, *Argyresthia pseudotsuga* Freeman, qui tue la nouvelle croissance sur les ramules de Douglas taxifolié, pondent depuis la mi-avril jusqu'en mai sur les écailles des bourgeons ou sur les aiguilles près des bourgeons éclos. Les oeufs éclosent à la mi-mai et les larves continuent de miner sur les nouveaux ramules jusque vers la fin de l'automne ou au début de l'hiver. La pupation a lieu à la fin de février dans des loges aux bases des rameaux.

**INTRODUCTION**

Several species of insects mine twigs and shoots of Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) and, when numerous, may reduce the cone-bearing capabilities of trees in seed orchards. One of the twigminers, *Argyresthia pseudotsuga*, described by Freeman in 1972, has been observed for several years in seed orchards on the Saanich Peninsula of Vancouver Island. This paper presents information on the biology of the insect.

**LIFE HISTORY AND HABITS**

Adult moths emerge in the spring when Douglas-fir is flowering. In 1976, caged insects emerged from April 12 to 22. In 1977, moths were observed in the field from April 25 to May 2. Periods when the various life stages occur are shown in Fig. 1.

The moth lays eggs singly during April near the bases of buds (Fig. 2). Although more than 1 egg per bud may be laid, only 1 larva survives. When the egg hatches in mid-May, the larva makes a small channel 1.5 to 2 mm long, usually just above the node and beneath an elongated bud scale (Fig. 3). The larva moves toward the base of the twig, mining around the node, then moves toward the tip of the twig in a spiral fashion around the new wood. As feeding progresses, the larva mines the centre of the twig, forming a gallery (Fig. 4). Twenty-four galleries averaged 26 mm in length, ranging from 17 to 35 mm. The larva feeds until fall or early winter, moving to the base of the twig where it constructs a pupal gallery 10 to 18 mm long, just above the node (Fig. 5). The pupal chamber is walled off from the feeding gallery by tightly packed frass and boring dust, and an exit hole is

**TABLE I.** Head capsule widths of the larval instars of 845 *Argyresthia pseudotsuga* collected during 1976 and 1977 at the Tahsis Seed Orchard, Saanichton, B.C.

Instar	Sample size	Range (mm)	Mean (mm)	Std. Dev (mm)
I	120	0.15-0.23	0.19 ± 0.03	0.02
II	131	0.23-0.28	0.26 ± 0.02	0.01
III	165	0.28-0.37	0.32 ± 0.04	0.03
IV	232	0.37-0.52	0.42 ± 0.04	0.03
V	197	0.53-0.70	0.63 ± 0.06	0.04

**TABLE II.** Numbers of shoots on Douglas-fir trees infested by *Argyresthia pseudotsuga*, Tahsis Seed Orchard, Saanichton, B.C. (Upper four whorls only)

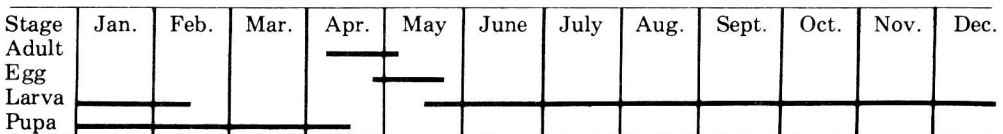
Whorl no.	1	2	3	4
Avg. no shoots	11	104	153	260
Avg. no infested shoots per whorl	0.6	2.2	5.5	8.2

cut below the wall. The larva then spins a cocoon below the exit hole. By November 5 and December 6, 8% and 33% respectively, of the larvae were at the base of the twig. By February 5, 72% and by March 7, 100%, had pupated. In 1976 and 1977, larvae were present from May 16 to February 5, completing their development in approximately 8 months.

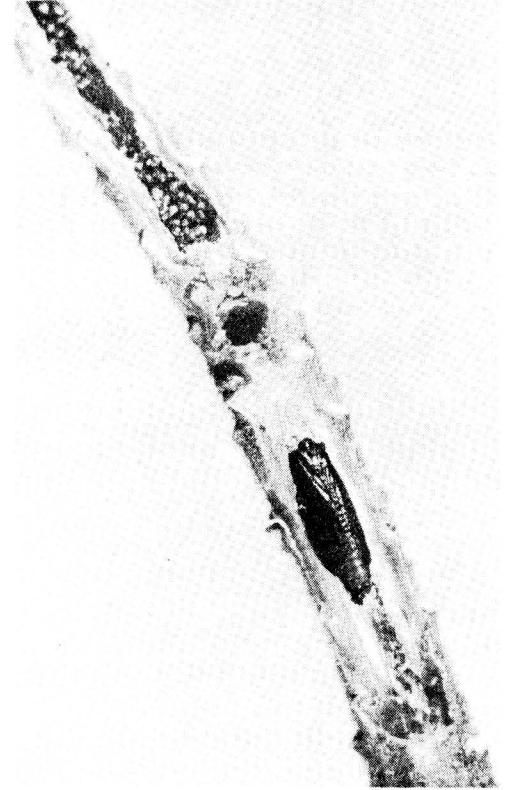
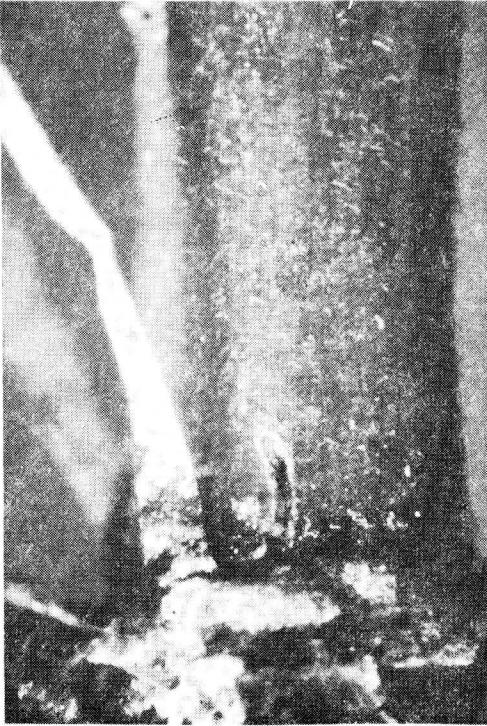
Head capsule measurements were from reared larvae for the first two instars and from field-collected larvae for the last three. Data in Table I provide information on larval head capsule sizes for the five instars.

**DESCRIPTION OF LIFE STAGES**

The adult has a wingspan of 9.5 to 10 mm and is pearly grey, with a yellowish tinge (Freeman 1972). The egg is 0.34 by 0.57 mm in size (avg of 7 eggs), is elliptical, cream-colored, and has a reticulate surface. The young larva is about 0.6 mm long and has a pale cream-colored body with a dark brown head capsule. The fully developed larva is 5.5 mm long. The pupa is black and is 6 mm long.



**Fig. 1.** Occurrence of stages of *Argyresthia pseudotsuga*, Saanichton, B.C.



**FIGURE CAPTIONS**

- Fig. 2. Egg of *Argyresthia pseudotsuga*, on Douglas-fir needle.
- Fig. 3. Channel made by *Argyresthia pseudotsuga* larva above node of Douglas-fir twig.
- Fig. 4. Larva of *Argyresthia pseudotsuga*, and mined Douglas-fir twig.
- Fig. 5. *Argyresthia pseudotsuga*, pupa, exit hole and mined section of Douglas-fir twig.
- Fig. 6. Douglas-fir shoots infested by larvae of *Argyresthia pseudotsuga*.



**DAMAGE**

Larvae kill the new shoots and reduce the number of potential cone-bearing twigs on trees. Soon after the insect begins to feed the shoot becomes flaccid (Fig. 6) and slightly lighter in color than normal foliage. By mid-July, the apical portion ( $\frac{1}{4}$  to  $\frac{1}{3}$ ) of the shoot is dead and dry; the remainder, although severely tunneled, is still succulent. By November, damage

becomes more obvious because of the pale green foliage; by spring, the twig has turned brown. To assess the damage caused by *A. pseudotsuga*, the number of attacked twigs was counted on each of the 4 whorls below the leader, on 24 trees which averaged 3.4 metres in height. The data in Table II show that although damage to current growth is not severe, the insect can destroy potential cone-bearing shoots.

**REFERENCE**

- Freeman T. N. 1972. The coniferous feeding species of *Argyresthia* in Canada (Lepidoptera: Yponomeutidae). *Can. Ent.* 104: 687-697.