SEX ATTRACTANTS FOR TWO SPECIES OF WESTERN SPRUCE BUDWORM, *CHORISTONEURA BIENNIS* AND *C. VIRIDIS* (LEPIDOPTERA: TORTRICIDAE)

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Abstract

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Field trials were conducted in British Columbia and Oregon in 1972, which demonstrated that *trans*-11-tetradecenal, a sex attractant for male *Choristoneura fumiferana* and *C. occidentalis*, is also a sex attractant for male 2-year-cycle spruce budworm, *C. biennis*, and that *trans*-11-tetradecenyl acetate is a sex attractant for male green budworm, *C. viridis* Free.

Introduction

Field trials and laboratory bioassays of six closely related species of budworm moths (*Choristoneura*) indicated that three species, *C. fumiferana* (Clem.), *C. occidentalis* Free., and *C. biennis* Free., apparently share the same or similar sex pheromones. Two others, *C. orae* Free. and *C. pinus* Free., share another pheromone, while the sixth species, *C. viridis* Free., has an apparently distinct pheromone with some affinity for the *C. orae* – *C. pinus* group (Sanders 1971). A sex pheromone of *C. fumiferana* was subsequently identified as *trans*-11-tetradecenal and shown to be a powerful attractant for both *C. fumiferana* and *C. occidentalis* males (Weatherston *et al.* 1971). Adults of the 2-year-cycle budworm, *C. biennis*, were not flying in 1971; hence, tests of field attraction had to wait until 1972. These are reported here.

EAG studies, which proved to be of great assistance in determining the sex pheromone of *C. fumiferana* (Weatherston *et al.* 1971), were also conducted with *C. viridis* by W. L. Roelofs, Cornell University, Geneva, N.Y. Excised male antennae were subjected to various mono-unsaturated C-14 aldehydes, alcohols, and acetates. Maximum response occurred with the *cis*- and *trans*-isomers of 11-tetradecenyl acetate (W. L. Roelofs, pers. comm.) suggesting that one or both of these compounds might be an attractant for male *C. viridis*. Field attraction trials, reported here, were therefore conducted in 1972.

Methods and Results

The chemicals used in the trials were obtained from Chemical Samples Co., Columbus, Ohio. Specifications of the aldehyde were less than 3% of the *cis*-isomer, and less than 0.05% of the *trans*- and *cis*-isomers of the corresponding alcohol. Purity of the acetate was unspecified.

(1) ***C. biennis.*** Field trials were conducted in two areas in British Columbia:

(A) Numa Creek, Kootenay National Park. White Sectar 1* traps were used in these experiments. There were four treatments: (*a*) polyethylene caps

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containing 0.1 mg *trans*-11-tetradecenal, (*b*) caps containing 1.0 mg *trans*-11-tetradecenal, (*c*) cages containing four virgin female *C. biennis*, (*d*) empty control traps. Each treatment was replicated 10 times. The experiment was begun on 19 July and ended on 28 July, at which time all females were still alive. Total catches of male *C. biennis* by treatment were 3, 15, 12 and 1, respectively. Thus, the catches, though low, demonstrate that male *C. biennis* were attracted by *trans*-11-tetradecenal.

(B) North White River, Nelson Forest District. Green Sectar 1 traps were used, with three treatments: (*a*) polyethylene caps containing 0.1 mg *trans*-11-tetradecenal, (*b*) cages containing two female *C. biennis* pupae, (*c*) empty control traps. Each treatment was replicated five times. The traps were put out on 11 July and collected on 13 August, at which time the females were dead; counts were recorded for only those traps in which a female had emerged.

The results (Table I) indicate that *trans*-11-tetradecenal is a potent attractant for male *C. biennis*. No conclusions can be drawn from the tests concerning the competitiveness of the chemical with the virgin females because of variations in the number of females and their longevity. However, the preliminary indications are that even at the low concentrations used, the chemical may outcompete females.

(2) ***C. viridis.*** Trapping was carried out near Lakeview, Ore., using white Sectar 1 traps. In a preliminary experiment, the baits were: live *C. viridis* virgin females, 10 mg of *trans*-11-tetradecenal, 10 mg of *trans*-11-tetradecenyl acetate, or 10 mg of *cis*-11-tetradecenyl acetate in polyethylene caps. Only two replicates were used for each and the catches per trap were: 13.5, 1.0, 20.5, and 2.0 male *C. viridis*, respectively, indicating the attractive properties of the *trans*-acetate. In a subsequent trial four different concentrations of the *trans*-acetate were tested, 10, 1, 0.1, and 0.01 mg per polyethylene cap, with virgin females and empty traps as controls. The experiment ran from 3 August to 15 August. The tests (Table II) indicated increasing catches with increasing concentration. Since the females were not replaced and died before the end of the experiment, it is difficult to assess the competitiveness of the synthetic acetate with a virgin female. Considering the time the traps were exposed in relation to the seasonal flight period, however, it is probable that polyethylene caps baited with 10.0 mg of *trans*-11-tetradecenyl acetate are at least as attractive as virgin females. The flight period was essentially terminated by 15 August, and the virgin females should have suffered only minor losses in their attractiveness through 12 August. Sanders and Lucuik (1972) showed that *C. fumiferana* females remain attractive for at least 14 days in the field with only minor loss of potency through the ninth day.

Table I. Numbers of male *C. biennis* captured in traps baited with *trans*-11-tetradecenal (tdal) in polyethylene caps, compared with catches in traps containing caged female pupae at the start of the experiment and unbaited controls. Each treatment was replicated 5 times except where noted

Bait	Catch/trap
0.1 mg tdal	51.8 ±2.08[a]
Virgin female *C. biennis*	45.7[b]±6.36
Control	0.2 ±0.30

[a]1 standard error.
[b]Average of three traps from which adult females emerged.

Table II. Numbers of male *C. viridis* captured in traps baited with four different concentrations of *trans*-11-tetradecenyl acetate (tdacet) compared with catches by virgin females. Each treatment was replicated 5 times

Bait	Catch/trap
.01 mg tdacet	3.2±1.20[b]
.1 mg tdacet	6.2±1.56
1.0 mg tdacet	9.4±2.77
10 mg tdacet	20.2±1.46
Virgin female *C. viridis*[a]	14.5±2.72
Controls	0

[a]Replicated four times.
[b]1 standard error.

Discussion

Demonstration that *trans*-11-tetradecenal is an attractant for male *C. biennis* is not surprising, since virgin female *C. fumiferana*, *C. occidentalis*, and *C. biennis* all attract male *C. fumiferana* (Sanders 1971) and presumably have a major component of their sex pheromone communication system in common.

C. viridis virgin females, on the other hand, do not attract male *C. fumiferana* (Sanders 1971), and since male *C. viridis* are not strongly attracted to *trans*-11-tetradecenal, presumably it is not part of the pheromone communication system of this species. However, *C. viridis* is taxonomically closely related to *C. fumiferana*, *C. occidentalis*, and *C. biennis*, and it is logical that its sex pheromone is *trans*-11-tetradecenyl acetate, which is closely related chemically to that of the other species. Moreover, it has been reported that *trans*-11-tetradecenyl acetate inhibits the response of male *C. fumiferana* to *trans*-11-tetradecenal (Sanders *et al.* 1972); other instances have been recorded of sibling species having mutually inhibiting sex pheromones (Roelofs and Comeau 1969). Probably this phenomenon is widespread, since it would tend to prevent hybridization.

References

Roelofs, W. L. and A. Comeau. 1969. Sex pheromone specificity: Taxonomic and evolutionary aspects in Lepidoptera. *Science* **165**: 398–400.

Sanders, C. J. 1971. Sex pheromone specificity and taxonomy of budworm moths (*Choristoneura*). *Science* **171**: 911–913.

Sanders, C. J., R. J. Bartell, and W. L. Roelofs. 1972. Field trials for synergism and inhibition of *trans*-11-tetradecenal, sex pheromone of the eastern spruce budworm. *Can. Dep. Environ., Bi-mon. Res. Notes* **28**: 9–10.

Sanders, C. J. and G. S. Lucuik. 1972. Factors affecting calling by female eastern spruce budworm, *Choristoneura fumiferana* (Lepidoptera: Tortricidae). *Can. Ent.* **104**: 1751–1762.

Weatherston, J., W. Roelofs, A. Comeau, and C. J. Sanders. 1971. Studies of physiologically active arthropod secretions. X. Sex pheromone of the eastern spruce budworm, *Choristoneura fumiferana* (Lepidoptera: Tortricidae). *Can. Ent.* **103**: 1741–1747.

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