The Great Lakes Entomologist

Volume 21
Number 4 - Winter 1988 *Number 4 - Winter 1988*

Article 3

December 1988

Attraction of Acorn-Infesting *Cydia Latiferreana* (Lepidoptera: Tortricidae) to Pheromone-Baited Traps

J. W. Peacock
USDA Forest Service

S. L. Wright
USDA Forest Service

J. R. Galford
USDA Forest Service

ATTRACTION OF ACORN-INFESTING *CYDIA LATIFERREANA* (LEPIDOPTERA:TORTRICIDAE) TO PHEROMONE-BAITED TRAPS[1]

J. W. Peacock[2], S. L. Wright[2] and J. R. Galford[2]

ABSTRACT

Males of acorn-infesting *Cydia latiferreana* are attracted to an equilibrium mixture of the four isomers of 8,10-dodecadien-1-ol acetate, the virgin female-produced pheromone. Trap height relative to the height of trees in which traps are placed seems to be a significant factor influencing moth catches at attractant-baited traps. In an oak woodlot and in an oak nursery, catches of male moths were greater in traps placed near the upper periphery of the canopy than at traps deployed at lower levels in the tree. Practical application of pheromone-baited traps in a forest situation will require further study on lure formulation and on trap deployment under forest conditions.

The filbertworm, *Cydia latiferreana* (Walsingham), is a pest of several tree species in western North America. It destroys filberts in Washington and Oregon (Dohanian 1940); in California, it is a pest on walnuts (Michelbacher and Hitchcock 1955) and pomegranates (Davis et al. 1983). This insect has been reported to occur extensively in the Western States and British Columbia in acorns and oak galls (Keen 1958).

In the eastern United States, *C. latiferreana* is a pest on acorns of several species of oak, including bur oak, *Quercus macrocarpa* (Gibson 1971), white oak, *Q. alba* (Gibson 1972), red oak, *Q. rubra* (Gibson 1982), and black oak, *Q. velutina* (Galford, unpublished). Damage to white oak acorns appears to be the most significant, with infestation levels as high as 32% in some collections (Gibson 1972).

Walsingham (1879) described *C. latiferreana* as *Carpocapsa latiferreana* from specimens infesting *Prunus lyonii,* the Catalina cherry. The species was placed in *Melissopus* by Riley (1881). *Melissopus* was first synonymized with *Cydia* by Walsingham (1914), who discarded the use of secondary sexual characters for defining genera.

Murtfeldt (1894) described seven forms, and stated that *C. latiferreana* appeared to be "breaking up into several races or even species." She speculated that there were originally two species, an eastern one and a western one, which "have interbred to produce intermediate forms." Murtfeldt reared both the western (California, Washington, and Oregon) and the eastern (Pennsylvania, Missouri, Florida, and Mexico) forms from acorns. *C. latiferreana* adults are extremely variable in color, size, and structure of the genitalia. Heinrich (1926) studied the species complex and described genitalic differences among varieties "A-G" of the complex. A revised synonomy of *Melissopus* and *Cydia* was reported by Brown (1983), based on a reanalysis of differential characters.

The biology of *C. latiferreana* has been described as it occurs on several hosts, including filberts (Dohanian 1940), walnut (Bacon et al. 1948, Michelbacher and Hitchcock 1955), and bur and white oak (Gibson 1971, 1972, respectively). The

[1]This paper reports the results of research only. Mention of a proprietary product does not constitute an endorsement or a recommendation for its use by the USDA or the Forest Service.

[2]USDA Forest Service, Northeastern Forest Experiment Station, Delaware, OH 43302.

influences of environmental factors on diel flight behavior of *C. latiferreana* were described by AliNiazee (1983a).

The sex attractant for the filbertworm contains the female-produced compounds (E,E)- and (E,Z)-8, 10-dodecadien-1-ol acetate (Davis et al. 1984), which occur in a 1:4.3 ratio in extracts of female abdominal tips. In field tests in filbert orchards of various ratios of E,E:E,Z, the ratio found in the abdominal tip extract attracted the most males. In tests in pomegranate orchards (Davis et al. 1983), a concentration of 0.64 mg/dispenser (rubber septa) of E,E,8,10–12:Ac captured significantly more male moths than lesser concentrations, and traps positioned at a height of 2.4 m caught significantly more moths than those placed lower. In tests in filbert orchards, AliNiazee (1983b) determined that of several trap designs, the Pherocon 1C trap captured the most male moths, and traps were most effective when placed in the top of the tree canopy, or just above it. Significantly more moths were captured in traps deployed at 4-4.8 m above the ground than at lower heights. Relatively few moths were captured in traps placed at distances of 10 to 50 m from the filbert orchard.

Prior to 1985, all studies of *C. latiferreana* attractants were conducted in filbert or pomegranate orchards in the western United States. A pheromone-trapping system could have significant practical value in studies on acorn-infesting *C. latiferreana* in oak forests in the eastern United States. In 1985, we evaluated *C. latiferreana* attractants in field tests in three areas in Ohio. This paper reports the results of those field studies.

METHODS AND MATERIALS

Study sites. Three sites were included in this study: (1) an 80-yr.-old, mixed hardwood forest in Hocking Co., OH; (2) a 7-ha, mixed hardwood woodlot in Delaware Co., OH; and (3) a 20-yr.-old nursery of northern red oak (*Q. rubra*) at the USDA laboratories, Delaware Co., OH.

The Hocking Co. site was located on an upland ridge; tree species growing on the ridge included hickory (*Carya* spp.), maple (*Acer* spp.), and several oak species (including *Q. alba, Q. rubra, Q. velutina, Q. coccinea,* and *Q. prinus*). This aspect of the study was designed to evaluate the use of attractant-baited traps under forest conditions.

In the Delaware Co. woodlot, a moist, lowland site, tree species included hickories, maples, and black walnut (*Juglans nigra*), along with several oak species (*Q. alba, Q. rubra,* and *Q. palustris*). The purpose of the woodlot trapping study was to assess the importance of trap height in attraction and capture of moths.

At the USDA nurseries, the oaks were planted on a spacing of 3 m between trees and between rows, and were 5-8 m in height. These nursery trees first produced acorns in 1982. The objective of the nursery study was to compare three attractant sources: red septa (see below), gray septa, and virgin female moths.

Attractants. The chemical attractant (provided by Zoecon Corp., Palo Alto, CA) consisted of an equilibrium mixture of 8,10-dodecadien-1-ol acetate; the mixture contained 9.4% ZE, 68.0% EE, 19.7% EZ, and 2.9% ZZ. The attractant was added to each of two types of rubber septa (West Co., Phoenixville, PA) at a concentration of 0.5 mg in 100 µl dichloromethane (Davis et al. 1983). The septa used were: red natural rubber, (size 1F) and gray halo-butyl isoprene blend elastomer, (size 1F).

At the USDA nursery site, the number of captures at traps baited with synthetic attractants was compared with captures at female-baited traps. Virgin female moths were reared from naturally-infested acorns collected in the nursery in the fall of 1984. Acorns and duff containing overwintering larvae were stored in total darkness in a refrigerator at 3°C and 40–50% RH. After 8 months of cold treatment, the larvae were returned to a room maintained at 20°C on a 16-8 (L-D) cycle until adult emergence. For field-trapping studies, one newly emerged female was placed in a 4 × 6 × 12-cm screen cage; food/moisture was provided as a 5% sucrose solution contained in a glass vial-wick device.

Traps and trap deployment. Pherocon 1C® traps (Zoecon Corp., Palo Alto, CA) were

https://scholar.valpo.edu/tgle/vol21/iss4/3
DOI: 10.22543/0090-0222.1653

used in the study, based on the findings of AliNiazee (1983b). Rubber septa were suspended above the sticky bottom with a paper clip. A paper clip was likewise used to attach cages containing virgin females to the upper inside surface of the trap.

At the Hocking Co. site, 18 traps were deployed, one per tree, in five species of mature oak. Half of the traps were baited with gray septa, and half with red. The traps were raised with a long pole and suspended from branches at a height of 8-10 m. In most cases, the traps were positioned at about a third of the tree height, and were located next to the bole. The spacing between traps was approximately 25 m. Traps were deployed on 24 July and removed on 26 September.

In the Delaware Co. woodlot, four oaks were used as trap sites. Traps on two of the trees were baited with gray septa; the other two trees were baited with red septa. Three traps were deployed in each tree, one at 3 m, one at 8–13 m, and one at 16–22 m. The height of the trees ranged from 20–28 m. The traps at the 3 m level were positioned with the aid of a long pole; positioning of traps at the two higher levels was with the aid of a hydraulic "cherry picker" (Friday Tractor Co., Inc., Hartford, MI) outfitted with a 6-m boom. All traps were hung as close as possible to the outside edge of the crown. Spacing between the four trees was approximately 50 m. Traps were installed on 19 August and removed on 30 September.

At the USDA nursery, traps were hung within 1–2 m of the tops of the red oaks. Fourteen traps were deployed: three baited with gray septa, three with red septa and eight with virgin female moths. There was one trap per tree and in all cases the traps were on the periphery of the crown. Average trap height was approximately 5–7 m; spacing between traps was 10–15 m. The trapping period was 30 July–27 September. Traps baited with virgin female moths were monitored every 2–3 days. Where necessary, dead females were replaced with live ones; the sugar solution in the vials was replenished as needed.

Collection and analysis of data. At the Hocking Co. forest site, traps were serviced four times: 7 and 20 August, 4 September, and at the conclusion of trapping on 26 September. Traps in the Delaware Co. woodlot were serviced on 3 September, 2 weeks after the start of the study, and were removed on 30 September. At both sites, captured moths were removed from the traps and tallied on each service date.

In the USDA nursery, traps were serviced every 2–4 days, depending on weather conditions; captured male moths were recorded on each service date. At all three sites, missing lures were replaced with lures of the same type and age. A random check of a subsample of captured moths from all sites indicated that all were males.

Differences in moth catches at three trap heights in the oak woodlot were analyzed using a one-way ANOVA, following transformation of the data ($\sqrt{x+0.5}$). The same procedure was used to analyze for differences in catches at the two types of rubber septa. Where significant differences occured, means were ranked using Duncan's multiple range test.

RESULTS AND DISCUSSION

Trap catches in the mixed-hardwood woodlot. Of the 28 moths captured in the woodlot, significantly more (22) were taken on traps that were 16–22 m above the ground (Table 1). Twelve of the 28 were on a trap located at 16 m near the top of the crown of the white oak at the periphery of the woodlot. No moths were captured at traps located at the lowest height (3 m) on each of the four trees. Six were captured at the intermediate height of 8–13 m. Trap height clearly influenced moth captures in this woodlot.

Trap catches in the mixed-hardwood forest. Only 48 *C. latiferreana* were captured during approximately 9 weeks of trapping in the Hocking Co. forest. Twenty-one moths were captured on traps baited with the red septa, while 27 moths were taken on traps baited with the gray lures. The low per-trap captures make it impossible to arrive at any conclusions concerning the trapping of *C. latiferreana* under forest conditions. One possible explanation for the low catches in the southern Ohio forest is that the acorn crop in this area was very poor in 1984, resulting in a low population of *C. latiferreana* in

Table 1.—Captures of male *Cydia latiferreana* at pheromone-baited traps deployed at different heights in a mixed hardwood woodlot, Delaware Co., OH—1985.

Trap height (m)	No. of traps	No. of moths captured	Mean catch per trap[a]
3	4	0	0.71[a]
8-13	4	6	1.08[a]
16-22	4	22	1.68[b]

[a]Means represent transformed date ($\sqrt{x+0.5}$). Means followed by the same letter are not significantly different ($P<0.05$; Duncan's multiple range test).

1985. A sampling of acorns collected in the trapping area in 1985 yielded few moths. Another explanation could be that catches were low because traps were placed on lower branches on the trees (at ca. 8–10 m), and moth captures appear to be greater in the upper, outer crown.

Responses of male moths in an oak nursery. Significantly fewer moths were captured at traps baited with females than at septa-baited traps in the nursery study. Unaccountably, only two of the 87 moths captured at the 14 traps deployed in the nursery were at the eight traps baited with females. Condition of the female moths probably was not a factor in the low level of attraction recorded at female-baited traps. Traps containing virgin females were monitored every 2–3 days during the 58-day trapping period, and there was a living female in each female-baited trap most of the time. Likewise, these females had a continuous supply of food (sugar solution). No attempt was made to observe females for calling behavior, and at no time was a calling posture observed in any of the females. It does seem likely, though, that during the time when moths were being captured at septum-baited traps, at least some of the females were producing attractant. Perhaps the cage-trap system in some way prevented or reduced pheromone production.

More moths were captured at traps in the nursery baited with red lures than at those baited with the gray septa. This result is similar to the finding in the oak woodlot, but in contrast to that recorded in the Hocking Co. forest, where the gray lures were somewhat more attractive. However, there were no significant differences in catches between the two types of lure at any of the sites.

Average captures of moths at traps baited with synthetic attractant in the oak nursery ($\bar{x}=14.2$ moths; 0.24 moth/trap/day) outnumbered those in either the Delaware Co. woodlot ($\bar{x}=5.5$ moths at high traps, $\bar{x}=2.3$ for all traps; 0.07 moth/trap/day for all traps) or the Hocking Co. forest ($\bar{x}=2.0$ moths; 0.03 moth/trap/day). It may be that catches were greater in the oak nursery because all of the traps were located within 2 m of the top of the tree, and all were on the outer perimeter of the canopy.

Our data suggest that trap height and placement in the upper periphery of the canopy is a significant factor in the attraction and capture of *C. latiferreana* at pheromone-baited traps deployed on oaks. Traps deployed at heights of greater than 15 m captured significantly more moths than traps at lower levels in the oak woodlot, particularly on a white oak located on the perimeter of the study area. In the oak nursery, where all traps were in the upper, outer canopy, catches far exceeded those in either of the other two test sites. Trap height could have been a factor in the very low catches of moths at the Hocking Co. site, where all traps were deployed in the lower third of each tree at a height of approximately 6–8 m.

Our findings are in agreement with those from trapping studies in filbert and pomegranate orchards, although we trapped fewer moths in our studies. In filbert trees that were about 4.7 m tall, the greatest number of moths were captured at traps deployed at 4-4.8 m (AliNiazee 1983b). Traps at ground level and at 1, 2 and 3 m caught significantly fewer moths. In a pomegranate orchard (Davis et al. 1983), traps positioned at 2.4 m in trees that were 2.7 m tall captured significantly more male moths than traps positioned at 1.2 and 1.8 m.

https://scholar.valpo.edu/tgle/vol21/iss4/3
DOI: 10.22543/0090-0222.1653

Our studies have demonstrated that males of acorn-infesting *C. latiferreana* are attracted to an equilibrium mixture of the four isomers of 8, 10-dodecadien-1-ol acetate. Further research is required to determine the relative attractancy of lures and virgin females before the pheromone-trapping system can be used to monitor populations of acorn-infesting *C. latiferreana*. Research is also needed to determine the cause of the relatively low catches of moths in forested areas in southeastern Ohio, one area where a trapping system could have potential practical application. Although it is likely that low catches in this area were the result of low level trap placement, other factors such as the size of the acorn crop in the previous year and the timing of trap deployment could be involved.

Studies are also needed to ascertain the relative attractancy of different pheromone blends and dosages using pheromone produced by acorn-infesting *C. latiferreana*. It is possible that there is a difference in pheromone composition between the form (Murtfeldt 1894) of acorn-infesting *C. latiferreana* in the eastern United States and the filbert-infesting form on the West Coast. Brown (1983) suggested that voucher specimens of trapped moths are needed to compare potential differences in varieties of *C. latiferreana* that are attracted to pheromone-baited traps. Because of the presence of sticky material on moths removed from traps in this study, no attempt was made to prepare voucher specimens from trapped moths. Davis and McDonough (1981) and AliNiazee (1983b) likewise did not prepare voucher specimens from males captured in their studies. Consequently, nothing is known concerning which moth varieties were attracted to pheromone-baited traps in any studies to date.

ACKNOWLEDGMENTS

We thank Harry G. Davis and Leslie M. McDonough for technical advice and for providing pheromone-baited septa; Robert D. Ford and Ann Korte Daugherty for assistance in conducting the tests and collecting the data; and Harry G. Davis and Steven M. Eshita for useful manuscript reviews.

LITERATURE CITED

AliNiazee, M. T. 1983a. Influence of environmental factors on daily flight activity of the filbertworm, *Melissopus latiferreanus* (Lepidoptera, Olethreutidae). Ecol. Entomol. 8:241–248.

AliNiazee, M. T. 1983b. Monitoring the filbertworm, *Melissopus latiferreanus* (Lepidoptera:Olethreutidae), with sex attractant traps: Effect of trap design and placement on moth catches. Environ. Entomol. 12:141–146.

Bacon, O. G., A. E. Michelbacher and W. H. Hart. 1948. Catalina cherry moth attacks walnuts: Control of infestations in Sacramento Valley studied. Diamond Walnut News 33(5):10.

Brown, R. L. 1983. Taxonomic and morphological investigations of Olethreutinae: *Rhopobota, Griselda, Melissopus,* and *Cydia* (Lepidoptera: Tortricidae). Entomography 2:97–120.

Davis, H. G. and L. M. McDonough. 1981. Sex attractant for the filbertworm, *Melissopus latiferreanus* (Walsingham). Environ. Entomol. 10:390–391.

Davis, H. G., L. M. McDonough and G. Richardson. 1983. Sex attractant of the filbertworm moth: Tests in pomegranate orchards. Southwest. Entomol. 8:137–139.

Davis, H. G., L. M. McDonough, A. K. Burditt, Jr. and B. A. Bierl-Leonhardt. 1984. Filbertworm sex pheromone. Identification and field tests of (E,E)- and (E,Z)-8,10-dodecadien-1-ol acetates. J. Chem. Ecol. 10:53–61.

Dohanian, S. M. 1940. *Melissopus latiferreanus* as a pest of filberts in the northwest. J. Econ. Entomol. 33:852–856.

Gibson, L. P. 1971. Insects of bur oak acorns. Ann. Entomol. Soc. Am. 64:232–234.

Gibson, L. P. 1972. Insects that damage white oak acorns. USDA For. Serv. Res. Pap. NE-220, 7 p.

Gibson, L. P. 1982. Insects that damage red oak acorns. USDA For. Serv. Res. Pap. NE-492, 6 p.

Heinrich, C. 1926. Revision of the North American moths of the subfamilies Laspeyresiinae and Olethreutinae. U. S. Nat. Mus. Bull. 132:i–v, 1–216.

Keen, F. P. 1958. Cone and seed insects of western forest trees. USDA Tech. Bull. 1169, 168 p.
Michelbacher, A. E. and S. Hitchcock. 1955. Outbreak of the filbertworm on walnuts in northern California. J. Econ. Entomol. 48:340–341.
Murtfeldt, M. E. 1894. Acorn insects primary and secondary. Insect Life 6:318–324.
Riley, C. V. 1881. Descriptions of some new Tortricidae (leaf-rollers). Trans. St. Louis Acad. Sci. 4:316–324.
Walsingham, Lord (Thomas DeGrey). 1879. Illustrations of typical specimens of Lepidoptera Heterocera in the collection of the British Museum. Part IV. North American Tortricidae, p. 70. Brit. Mus., London.
Walsingham, Lord. 1909–1915. *In:* Godman and Salvin. Biologia Centrali-Americana. Insecta. Lepidoptera-Heterocera, 4. (Olethreutidae *sensu* Walsingham, p. 224–267, April, 1914). Dulau and Co., London.