Assessment of a Non-pheromonal Lure System for Attracting Adult Tortricid Moths

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Fruit orchards are attacked by a number of tortricid pests (e.g., codling moth, oriental fruit moth, leafrollers) that are either key or important secondary pests directly damaging the fruit. Fruit growers can use sex pheromones to monitor male moth populations and to control pest species directly via mating disruption. Further improvement of monitoring and management tools for these pests might be achieved with traps and plant volatiles that are effective in tracking female moth activity in orchards. In this study, the attractiveness of candidate non-pheromonal lures to male and female codling moth (CM), oriental fruit moth (OFM), and red-banded leafrollers (RBLR) was evaluated in three commercial apple orchards in Massachusetts. The goal of this study was to identify at least one candidate lure that would attract females of these three economically important moth species.

Materials & Methods

This study was conducted from July 13 to September 14, 2019, in three commercial apple orchards in Massachusetts using orange Delta-shaped traps (Pherocon VI, Trécé Inc., Adair, OK). Four treatments (3 candidate lures = A, B, and C, and one control involving unbaited traps) were evaluated. Each treatment was replicated 10 times. Traps were deployed in groups (= blocks) of four traps/treatments, along perimeter-row trees. Traps were spaced 10 yards apart within each block and 25 yards between blocks.

All traps and lures were deployed on July 11, 2019. Traps were examined for captured moths beginning on July 20 and every 7-8 days thereafter for nine weeks until September 14. All lures were renewed on August 22, about mid-way through the experiment. At each trap examination, traps were switched one position clockwise within a block to minimize the effects of position. All plots received insecticide sprays or other control methods as deemed necessary by the grower. Traps baited with the synthetic sex pheromone of each species (CM, OFM, RBLR; one trap per moth species) were deployed at each orchard to monitor male populations. For CM, the pheromone-baited traps were deployed

View of trap deployment for the evaluation of candidate lures for attractiveness to adult codling moth, Oriental fruit moth, and red-banded leafrollers, conducted at three commercial orchards in Massachusetts.

from the onset of the study and the lures were renewed on 17 August- the date at which traps baited with the OFM and RBLR pheromone lures were deployed.

Data collection and analyses. All adult moths captured were identified according to species (i.e., CM, OFM, RBLR). Moths were not sexed for the first three weeks of the study. All adult moths were identified by sex starting on August 17.

Results

For the first trapping period (July 13 – August 5), and across all three orchards, lure A captured significantly more OFM (adults were not sexed) than any other lure (Figure 1A). Lure C was the second best-performing lure, which attracted about one-third of OFM when compared to lure A. Captures of CM were very low, and no differences among lures were noted. Captures of adult RBLR were greatest in traps baited with lure A, and lures B and C did not attract any moths of this species (Figure 1A).

Results from the second period (August 6-13) revealed that lure A continued to perform best at attracting OFM, although captures did not differ from those recorded with lure C. For this moth species, the least-performing lure was lure B. Of the 232 OFM that were captured in this period, seven moths (3%) were females and the vast majority (97%) were males. While the average captures of CM were slightly greater (97 CM were captured in all) than in period 1, no differences in attractiveness among lures were recorded (Figure 1B). Eleven percent of CM captured in this time period were females. Captures of RBLR were very low during this period.

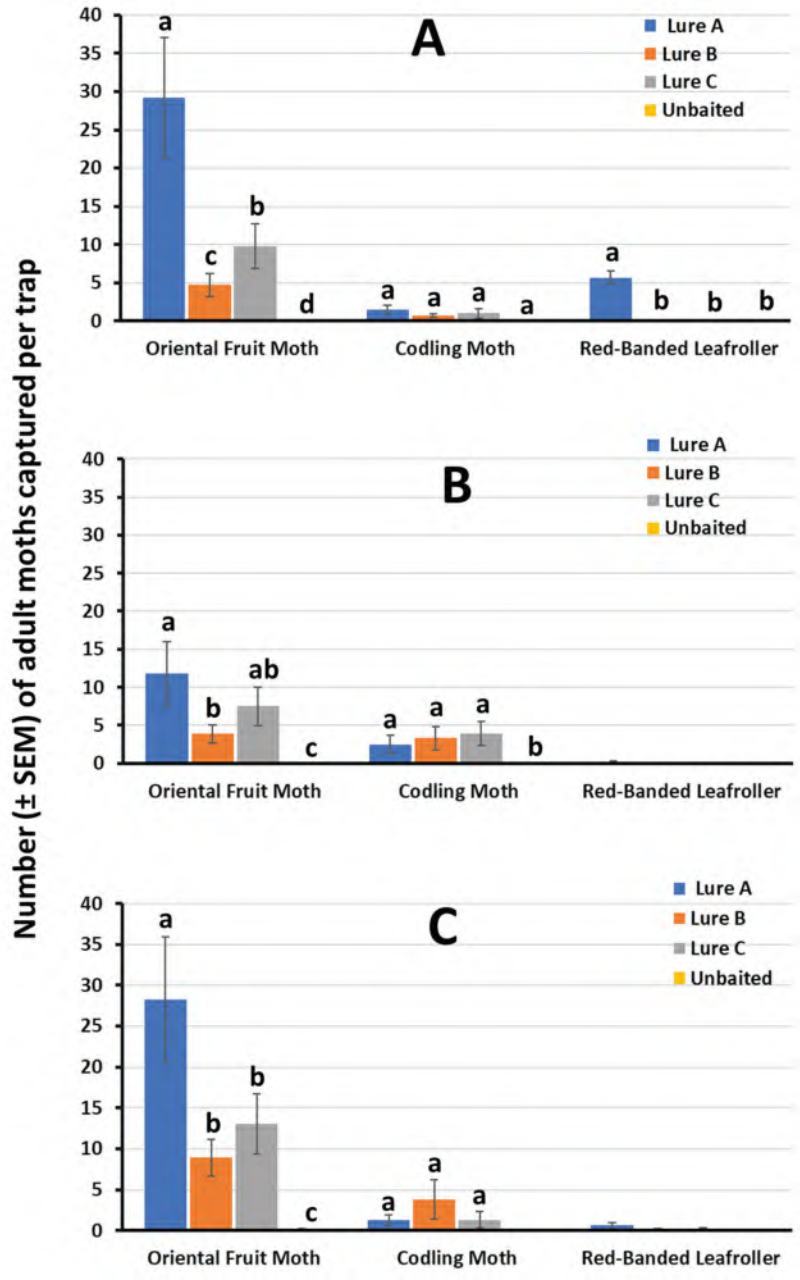

Figure 1. Captures (mean ± standard error of the mean [= SEM], *a measure of how precise the estimate is*) of adult (male and females combined) Oriental fruit moth, codling moth, and red-banded leafrollers captured by Delta-type traps baited with non-pheromonal lures according to trapping period. The study was conducted in three commercial orchards in Massachusetts from July 11 to September 14, 2019. For each moth species, means superscribed by the same letter are not significantly different at odds of 19:1.

For the third and last trapping period (Aug. 24 –

Table 1. Mean captures of oriental fruit moth, codling moth, and red-banded leaf-rollers in traps baited with either, experimental non-pheromonal lure A or sex pheromones, according to orchard and trapping date. Baited traps were deployed on July 13, 2019. N/A= For the first four trapping dates, no pheromone lures were present for OFM and OBLR.

Honey Pot Hill Orchards (Stow, MA)	**Jul. 20**	**Jul. 27**	**Aug. 5**	**Aug. 17**	**Aug. 23**	**Aug. 30**	**Sept. 14**
Oriental fruit moth - lure A	4.3	3.3	0.8	0.5	0.5	0.5	2.5
Oriental fruit moth - Pheromone trap	N/A	N/A	N/A	N/A	9	4	15
Codling moth - lure A	1.8	0.3	0	4	2	2	1.3
Codling moth - pheromone trap	1	1	1	16	15	14	9
Red-banded leafrollers - lure A	4.8	3	0	0	0	1	0
Red-banded leafrollers - Pheromone trap	N/A	N/A	N/A	N/A	10	11	6
Sholan Orchards (Leominster, MA)	**Jul. 20**	**Jul. 27**	**Aug. 5**	**Aug. 17**	**Aug. 23**	**Aug. 30**	**Sept. 14**
Oriental fruit moth - lure A	26	14	12.5	14.3	9	10.8	26.8
Oriental fruit moth - Pheromone trap	N/A	N/A	N/A	N/A	10	18	33
Codling moth - lure A	0.5	0.3	1	0.3	0	0	0
Codling moth - pheromone trap	11	0	0	9	2	0	1
Red-banded leafrollers - lure A	1	2.3	0.5	0	0.5	0	0
Red-banded leafrollers - Pheromone trap	N/A	N/A	N/A	N/A	36	14	11
Cold Spring Orchard (Belchertown, MA)	**Jul. 20**	**Jul. 27**	**Aug. 5**	**Aug. 17**	**Aug. 23**	**Aug. 30**	**Sept. 14**
Oriental fruit moth - lure A	1.5	5.5	17.5	6	4.5	17.5	43
Oriental fruit moth - Pheromone trap	N/A	N/A	N/A	N/A	13	19	119
Codling moth - lure A	0	0	0	0	0	0	0
Codling moth - pheromone trap	1	0	1	1	0	0	0
Red-banded leafrollers - lure A	3.5	2	0	0	0	0	1
Red-banded leafrollers - Pheromone trap	N/A	N/A	N/A	N/A	0	16	8

Sept. 14), lure A performed best at attracting OFM whereas lures B and C were similarly attractive (Figure 1C). For this time period, 503 OFM were captured by traps, and only 1.2% of OFM were females. No differences in attractiveness to CM among lures were recorded (Figure 1B). Of the 64 CM captured, 5 (7.8%) were females. Captures of RBLR were very low during this period.

Table 1 shows average captures of adult OFM, CM and RBLR in pheromone-baited traps and in traps baited with the experimental non-pheromonal lure A (the most attractive lure identified), according to orchard and date. Results show that OFM populations were higher in some locations (e.g., Belchertown) than in other locations, whereas CM was most abundant in the Stow location. While, as expected, captures of male

moths were consistently greatest in pheromone-baited traps, it was striking to note that lure A, which lacks moth pheromones, also attracted substantial numbers of moths. For example, in Sholan Orchards, OFM captures in traps baited with lure A approached those recorded in pheromone baited traps (26.8 vs 33 on September 14; Table 1). The number of adult OFM captured in the UMass Cold Spring Orchard on August 30 was similar in traps baited with lure A and traps with the OFM sex pheromone (17.5 vs. 19) (Table 1).

Conclusions

Results indicate that, under the conditions of this study, some of the experimental lures evaluated, in particular lure A, attracted substantial numbers of OFM, the most abundant moth species in this investigation. However, for both OFM and CM, most of the moths that were captured were males, which was not the target sex. Further evaluations ought to determine whether non-pheromonal lures can be optimized by adding selected plant volatiles, to attract more female moths to baited traps.

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