Evaluation of Novel Kairomone-based Lures for Attracting Male and Female Tortricid Moths in Apple Orchards

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Apple orchards are often attacked by several tortricid (Lepidoptera) pests such as Codling moth (CM), Oriental fruit moth (OFM), Obliquebanded leafroller (OBLR), and Redbanded leafroller (RBLR) that are either, key or secondary pests that attack the fruit. Sex pheromone-based lures have been used to (1) monitor male moth populations and (2) control pest species directly via mating disruption. Increased captures of moths of both sexes by the addition of plant volatiles could improve the effectiveness of these systems. The goal of this study was to evaluate the performance of experimental lures with added plant volatiles at capturing males and females of multiple species of tortricids.

Materials & Methods

This field study was conducted from May 12 to September 18, 2020, in one commercial apple orchard in Massachusetts. Six olfactory treatments: (1) Pherocon® CML2-P, (2) Pherocon® Megalure CM 4K Dual, (3) Pherocon® Megalure CM 4K Dual + TRE2265, (4) TRE2266, (5) TRE2267 and (6) unbaited traps as control were evaluated in orange Delta-shaped traps (Pherocon® VI, Trécé Inc., Adair, OK). All lures were

Figure 1. Trap deployment on the perimeter of the orchard. There were 6 treatments and 8 replications.

provided by Trécé Inc. Each treatment was replicated 8 times. Traps were deployed along the perimeter of one apple block (Fig. 1). Each treatment was randomized within a replicate. Traps were 15 yards apart. Traps were examined beginning on May 19 and every 7 days thereafter until September 18. All lures and sticky liners were renewed every four weeks. Once a week, traps were switched one position clockwise within a replication to minimize the effect of position. The orchard received a standard insecticide spray regime.

Data collection and analysis: All captured adult moths were identified according to species (i.e., CM, OFM, RBLR) and dissected under stereomicroscope to identify their respective sex. No OBLR were detected in this orchard. Data were analyzed using proper statistical procedures.

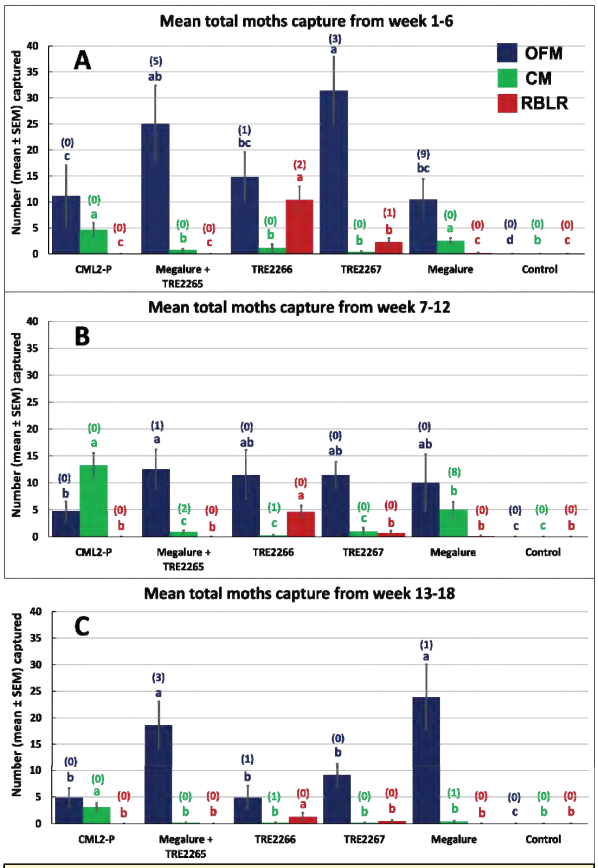

Figure 2. Captures of OFM, CM, and RBLR (males and female combined) by Delta traps baited with experimental lures, according to treatment: (A) early in the season (May 12-June 23), (B) in the mid-season (June 24-Aug 4), and (C) later in the season (Aug 5-Sep 8). The numbers in parentheses above bars denote the total number of female moths captured. Bars superscribed by the same letter are not significantly different at odds of 19:1.

Results & Discussion

For the first trapping period (May 12 - June 23), TRE2266 and Pherocon® Megalure CM 4K Dual+ TRE2265 captured significantly more OFM adults than any other lure (Fig. 2A). More OFM females (9 in all) were captured in traps baited with Pherocon® Megalure CM 4K Dual. Pheromone lure CML2-P and Pherocon® Megalure CM 4K Dual captured significantly more CM than any other lure.

As for RBLR, the lure TRE2266 captured significantly more moths than any other lure in this period.

Results from the second period (June 24 - August 4) revealed statistically similar captures of OFM adults among lures except for unbaited traps, which captured no moths (Fig. 2B). For CM, the lure CML2-P captured significantly more moths than any other lure. The second highest captures were observed in Pherocon® Megalure CM 4K Dual, which also attracted the highest number of CM females (8 in all) during that period. The lure TRE2266 continued to perform best at attracting RBLR adults.

In the third period (August 5 - September 18), traps baited with Pherocon® Megalure CM 4K Dual and with Pherocon® Megalure CM 4K Dual+TRE2265 captured significantly more OFM than any other lure (Fig. 2C). Again, the lure CML2-P captured significantly more CM adults in this period. Likewise, TRE2266 captured significantly more RBLR adults than any other lure. Overall, Pherocon® Megalure CM 4K Dual attracted 50% of all OFM females (n= 18; period 1) and 73% of all CM females (n= 11; period 2).

Temporal pattern of moth captures by Pherocon® Megalure CM 4K Dual and CML2-P lures. Early in the season (May 12 - June 23), captures of OFM (Fig. 3A) and CM (Fig. 3B) by traps baited with the pheromone lure (CML2-P) and the kairomone lure Pherocon® Megalure CM 4K Dual were similar. In the mid-season (June 24 - August 4), traps baited with Pherocon® Megalure CM 4K Dual captured twice as many OFM than CML2-P whereas there was a 3-fold increase in CM captures in traps baited with CML2-P compared to Pherocon® Megalure CM 4K Dual. Late in the season (August 5 - September 23), Pherocon® Megalure CM 4K Dual captured 3 times more OFM than CML2-P. At the beginning of the late season, CM captures were greatest in CML2-P and then captures declined.

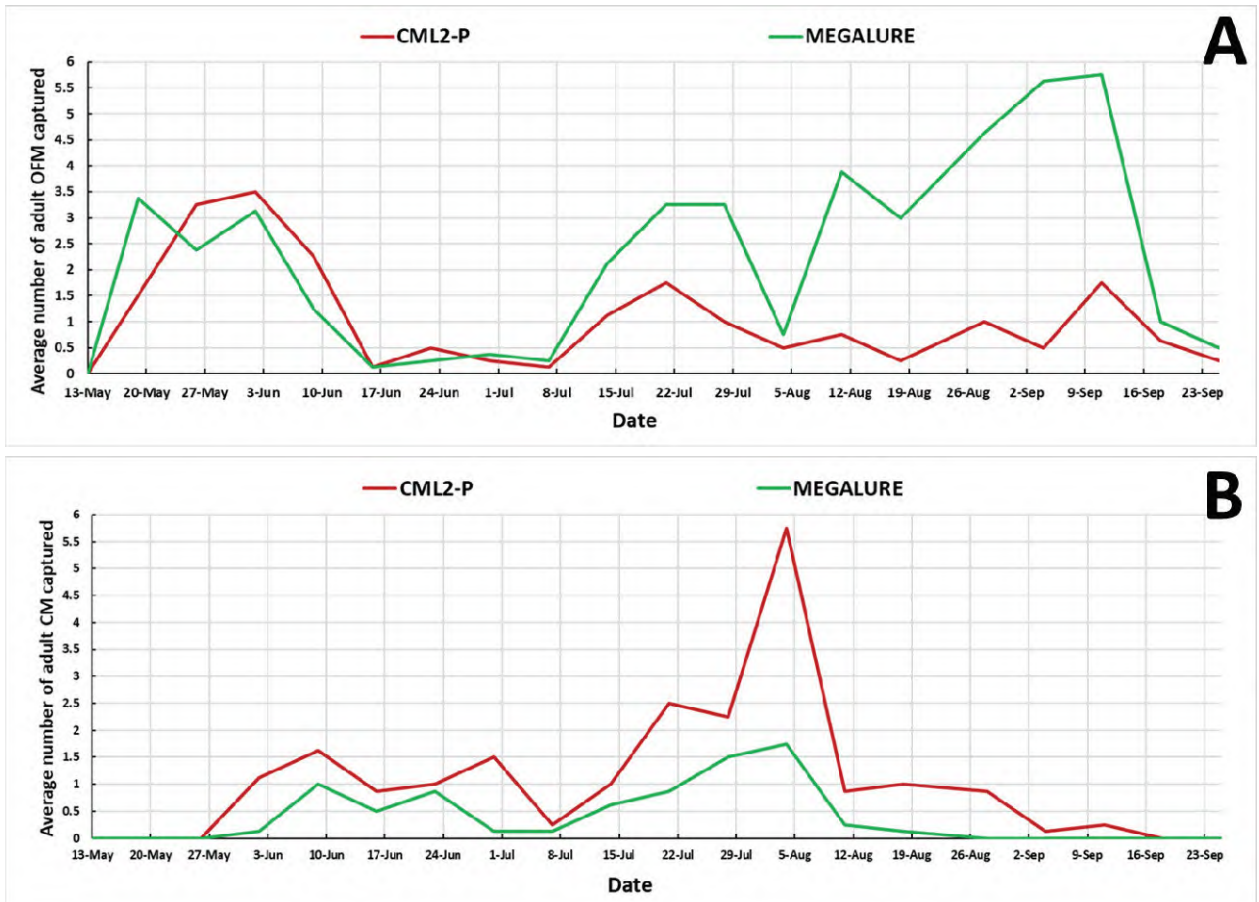

Figure 3. Seasonal pattern of captures of (A) Oriental fruit moth (OFM) and (B) Codling moth (CM) adults (both sexes combined) in traps baited with pheromone-based lure (CML2-P) and kairomone based lure Pherocon® Megalure CM 4K Dual.

Conclusion

Across the entire season, Pherocon® Megalure CM 4K Dual was as attractive or more attractive than the pheromone lure CML2-P to male OFM, revealing a benefit of using plant volatiles for enhanced moth monitoring. In contrast, CML2-P was numerically more attractive to male CM than Pherocon® Megalure CM 4K Dual. This lure attracted the most females of CM and OFM but the addition of plant volatiles (i.e., TRE2265) to Pherocon® Megalure CM 4K Dual did not improve female captures. The lures TRE2266 and TRE2267 performed well at attracting male RBLR and OFM.

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