Comparison of Navel Orangeworm Attractants

Project No.: **ENTO2.Burks**

Project Leader: **Charles Burks**
Address: Agric. Res. Serv., USDA, 9611 S. Riverbend Ave., Parlier CA 93648
Phone: (559)-596-2757
E-mail: charles.burks@usda.gov

A. Summary

Research in 2019 on monitoring for navel orangeworm (NOW) in the presence of mating disruption built on findings by this project in recent years; i.e., 1) phenyl propionate is generally superior to the five-compound kairomone blend for monitoring in the presence of mating disruption; 2) effectiveness of phenyl propionate can be augmented by adding a pheromone lure; and 3) phenyl propionate is a more effective NOW attractant when presented in open-sided traps, like wing traps, than in the close-sided delta traps preferred by the industry. An experiment in 2019 found that delta traps baited with phenyl propionate captured significantly more NOW in mating disruption than the near-zero adults captured with wing traps baited with pheromone alone. The number of NOW captured with phenyl propionate in delta traps was significantly increased by either addition of a pheromone lure or by modifying the traps with openings cut in the side. These changes were additive; i.e., more adults were captured with both modification and addition of a pheromone lure. However, even with both modifications, more NOW adults were captured in wing traps baited with phenyl propionate alone. A second experiment found little difference in the number of adults captured with PPO and phenyl propionate using variations of delta trap modifications. This experiment did, however, find that unmodified delta traps baited with phenyl propionate and a pheromone lure detected an monitored NOW more reliably than either egg traps or pistachio bait traps (a.k.a. Peterson traps). Future work will examine “quick-change wing traps” in an attempt to find an industry-accepatable wing traps; and will examine association of NOW counts in delta traps baited with PPO and subsequent NOW damage to almonds.

B. Objectives *(300 words max.)*

Main goals and milestones identified for 2019 were to test the concept of a new trap in the early season, and then test refined prototypes later in the seaon. In addition, as a result of feedback of industry reviewers, we compared phenyl propionate traps to egg traps, and traps baited with pistachio mummies (Peterson traps, https://petersontrapco.com/).

C. Annual Results and Discussion *(This is the core function of this report)*

Activities and outputs

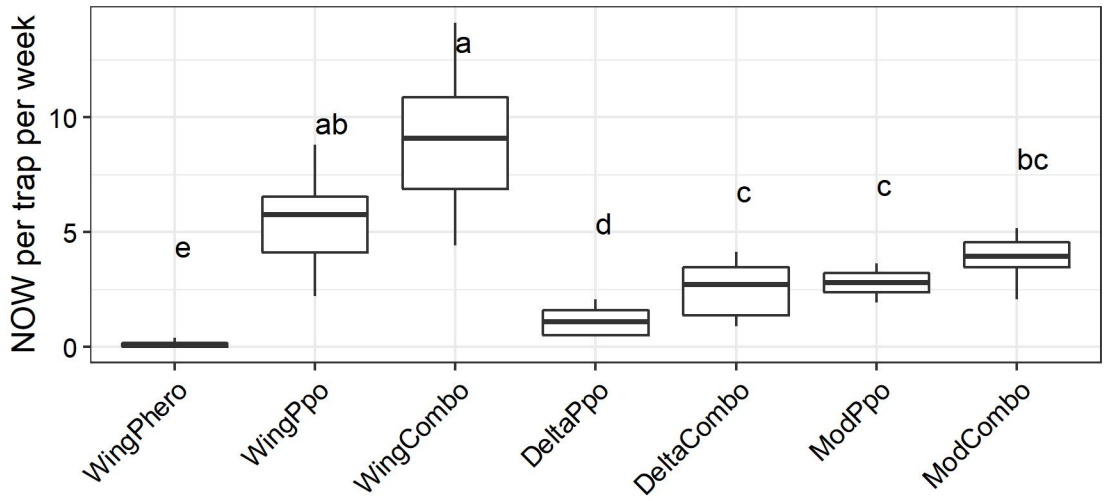

Fig. 1 Experiment 1--box plot showing the average weekly rate of NOW adults captured in sticky traps in an almond site under mating disruption, from May to July 2019. Traps used were standard wing traps, standard delta traps, or modified delta traps (ModPpo and ModCombo). Attractants used were a commercial pheromone lure (Phero) and phenyl propionate (Ppo). The suffix “Combo” indicates that Ppo was presented with a commercial pheromone lure as a co-attractant. Treatments within the same crop-MD combination with different letter superscripts are significant different (GLMM with negative binomial error distribution, n = 8, experiment-wise $P < 0.05$). Delta traps, preferred by the industry, captured significantly more adults than pheromone traps in the presence of mating disruption. The number of adults captured in delta traps was significantly improved with either the addition of a pheromone lure or by modifying the trap by opening the sides, and these improvments were additive. However, wing traps baited only with PPO captured significantly more adults than wing traps with both an added pheromone lure and open sides.

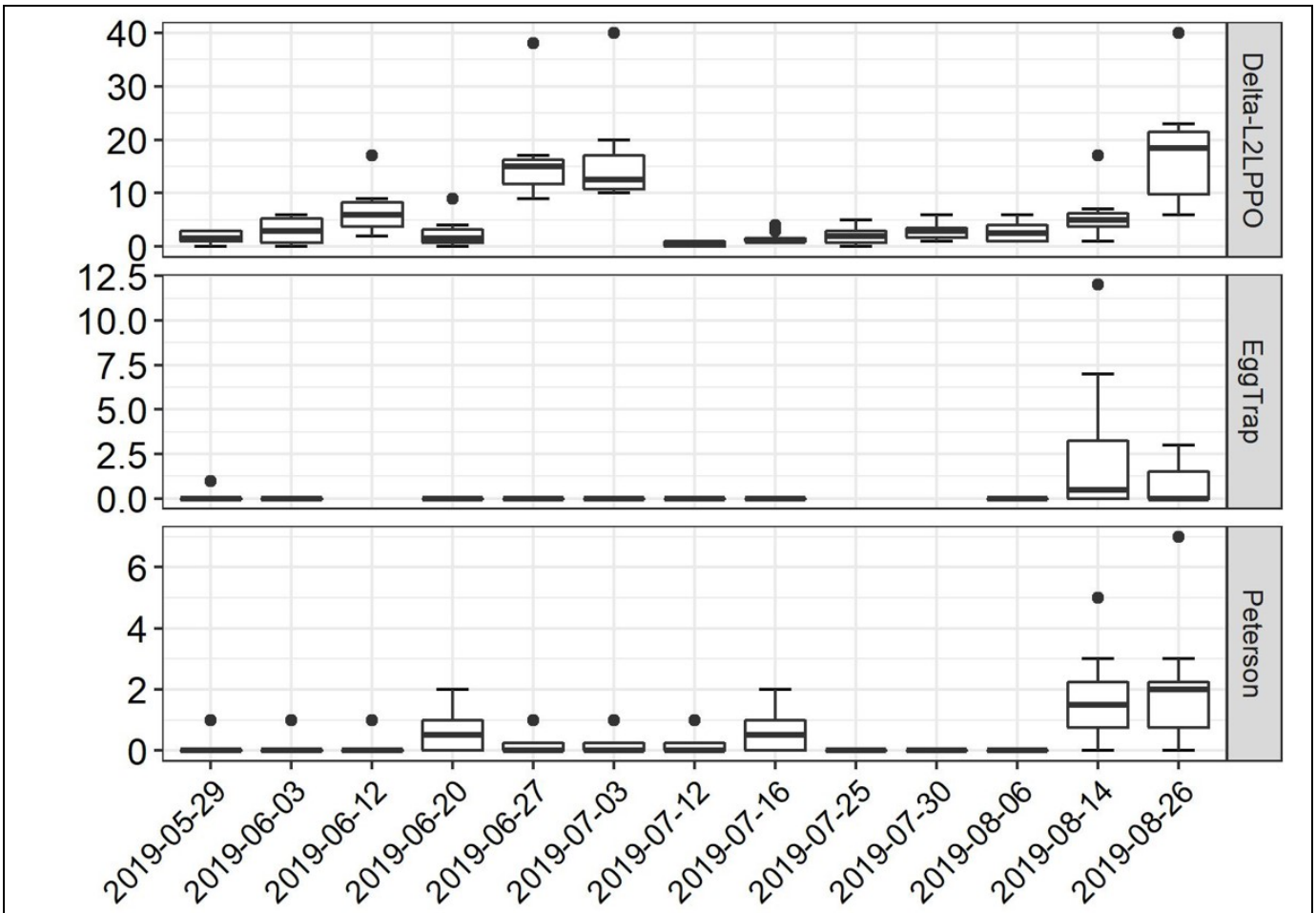

Fig. 2 Experiment 2--A version of the "DeltaCombo" treatment from experiment 1, provided by a commercial manufactuer of traps and lures (Trece Inc., Adair OK) is compared to standard egg traps (Trece Inc.) and pistachio bait traps for gravid females (Peterson Trap company). This trial was also in the presence of mating disruption. Noteable findings are that, within this experiment, practically no eggs were detected until August, well into the Nonpareil harvest. NOW adults were detected in pistachio bait traps in June, near flight 1 and hullsplit. However, most pistachio bait traps at this time contained 0 adults. In contrast, all "DeltaCombo" traps captured >0 adults in June 12, and this peak timing agreed with that obtained from an experiment with a larger number of egg traps (n = 144) in the same location at the same time.

Conclusions and significance

1. Common commercial NOW traps baited with phenyl propionate efficiently and effectively capture NOW in or near almond orchards treated with NOW mating disruption.
2. Phenyl propionate works more effectively when used with wing traps, but can provide adequate monitoring when used with standard delta traps. Moreover, delta trap performance can be improved marginally by addition of a pheromone lure or by opening the sides, and these improvements are additive.
3. A variety of variations of the open-sided delta trap, when used with both PPO and a pheromone lure, work equally well as the "ModCombo" in experiment 1. All leave

the trap liner more exposed to dirt than the unmodified delta trap, and no variation in the opening is significantly more effective for capturing NOW.

4. The “DeltaCombo” (an unmodified delta trap with a pheromone lure) detects NOW in the presence of mating disruption more reliably than egg traps or pistachio bait traps for females.
5. A commercial cooperator has produced a “quick-change wing trap”. A project with the California Walnut Board suggests that NOW capture profiles in PPO and Peterson traps (in the absence of mating disruption) resemble each other more than the profile of pheromone traps. This suggests that PPO trap counts might be more closely associated with damage compared to pheromone traps. Research in 2020 will involve obtaining pest control adviser (PCA) feedback on the quick-change wing trap, and trials to associate almond damage and counts in PPO traps.

D. Outreach Activities

1. *California Pistachio Commision NOW Research Meeting* June 5, 2019. Ag Expo Center, Tulare California. Approximately 200 growers and PCAs
2. *American Chemical Society Meeting*. August 25, 2019. San Diego Convention Cener, San Diego, CA. Approximatley 25 scientific peers attending a symposium on insect semiochemicals in pest management.
3. *Crop Consulting Conference*. September 27, 2019. Visalia Convention Convention Center. Approximately 300 growers and PCAs.
4. *Almond Conference*. December 10, 2019. CalAgExpo, Sacramento CA. Many hundreds of growers, PCAs, and members of allied industries.
5. *Orchard Pest and Disease Management Conference (OPDMC)*. January 8, 2020. Around 200 PCAs, ag suppliers, and extension personnel involved with tree, vine, and cane crops in the Pacific region and beyond.

E. Materials and Methods *(500 word max.)*:

Randomized complete block experiments were used to compare navel orangeworm adults captured between different attractant and trap desings. Traps containing attractants were placed in orchards under mating disruption midway between mating disruption dispensers; i.e., approximately 45 m between treatments within replicate blocks, and 90 m between replicate blocks.

Experiment 1. Treatments included: 1) a wing trap with a pheromone lure; 2) a wing trap with a PPO dispenser alone; 3) a wing trap with both a PPO dispenser and a pheromone lure; 4) a delta trap with PPO alone; 5) a delta trap with PPO and a pheromone lure; 6) a modified delta trap with PPO alone; and, 7) a modified delta trap with both a PPO dispenser and a pheromone lure. Trap types, placement of attractant, and modifications were as described for the previous experiments. The experiment was conducted from May 17 to July 20, 2019.

Experiment 2. A second experiment, conducted in a 160 acre block diagonally adjacent to experiment 1, examined field performance of new commercial PPO lure (Trece Inc.), examine relative performance of PPO and pheromone in prototype commercial

modifications of delta traps, and compare timing between the different attractants and bait traps for females. Eight replicates of the following treatments were included:

1. Pheromone lure (NOW Biolure) in a wing trap (Suterra orange). Should be a negative control in a disruption orchard
2. PPO (experimental pouch) by itself in a Suterra wing trap
3. Pheromone + PPO in a Suterra wing trap
4. Trece wing combo (NOW L2l and Pherocon PPO in Trece wing trap)
5. Trece stock NOW L2l and Pherocon PPO
6. Trece Delta design 259 with NOW L2l and PheroconPPO
7. Trece Delta design 260 with NOW L2l and PheroconPPO
8. Trece Delta design 261 with NOW L2l and PheroconPPO
9. Egg trap
10. Peterson trap

This experiment was conducted from May 22 to June 12, and then the following trap design changes were made:

6. New wing trap (spacers, gromets to hold the liner on the bottom)
7. Trece IIB design (closed sides, pull-down design)
8. Trece 280 (a revised delta trap re-design)

Data were summarized and visualized in R. Experiments were analyzed in SAS using a gernalized linear mixed model with a binomial error distribution, and a Tukey correction for multiple comparison.

F. Publications that emerged from this work

Burks, C. S., B. S. Higbee, and J. J. Beck. 2020. Traps and attractants for monitoring navel orangeworm (Lepidoptera: Pyralidae) in the presence of mating disruption. J. Econ. Entomol. [Accepted for publication].