Statewide Monitoring Study to Determine Relationship between Navel Orangeworm (NOW) Egg and Male Moth Capture

Project No.: **13-RESEARCH1B-Tollerup**

Project Leader: Kris Tollerup
UCCE Advisor, IPM
9240 S. Riverbend Ave.
Parlier, CA 93648
559.646.6527
ketollerup@ucanr.edu

Project Cooperators and Personnel:
David Haviland, UCCE - Kern County
Joel Siegel, USDA-ARS, Parlier
Roger Duncan, UCCE - Stanislaus County
David Doll, UCCE - Merced County
Frank Zalom, Professor of Entomology, UC Davis
Dani Lightle, UCCE - Glenn / Tehama Counties

Objectives:

1. Evaluate navel orangeworm (NOW) population dynamics over the almond-production region of California from the southern San Joaquin Valley (Kern County) to the Sacramento Valley region (Glenn / Tehama counties).
    a. Determine biofix dates for egg-laying and male-moth capture at several sites throughout the almond-producing regions.
        i. Evaluate the relationship between egg-capture and male-moth capture biofixes.
        ii. Evaluate relationship between intra-season male-moth and egg-laying data.
    b. Evaluate applicability of the UC IPM navel orangeworm degree-day model using a male-moth capture biofix.

Interpretive Summary:

This project encompasses male moth and egg trapping data from 18 sites located in seven counties: Kern, Fresno, Madera, Merced, Stanislaus, Yolo, and Glenn. Trapping began between the first and third week of March at all 18 sites. We began capturing male moths within the first week that traps were placed in the orchards and therefore could not establish a biofix based on male moth capture (**Figures 1 - 4**). Interestingly, other researchers reported capturing male navel orangeworm from late 2013 and throughout early 2014 with only a two-week hiatus during mid-December when low temperatures dropped below freezing. Unlike many other lepidopterous pest species, navel orangeworm does not have a diapausing stage (Michelbacher, et al. 1961). The mild winter of 2013 -2014 likely played a role in not observing the beginning of male flight (i.e., a biofix). Although variable, egg capture tended to occur, but lagged behind, a capture threshold of ~15 – 20 males. This project is in the early stage and therefore, we do not have sufficient data for extensive analyses. However, we have conducted a tentative analysis using logistic regression (UCLA Institute for digital research and education

2014) and found a significant relationship between the number of male moths captured and the probability of capturing eggs. As this project continues, we will explore various models that could provide a tool for understanding this relationship – thus improving the use of pheromone traps in integrated pest management programs for navel orangeworm.

Materials and Methods:

Sampling Protocol

A. We will select two to three orchards in each of the four growing regions, southern, central, and northern San Joaquin Valley; and Sacramento Valley region for monitoring NOW monitoring using egg traps (ET) and pheromone traps (PT).
    a. ETs will consist of Trécé black NOW egg traps filled with whole almond meal purchased from an almond processor.
    b. PTs will consist of Suterra or Trécé white-top wing traps baited with a Suterra NOW sex pheromone lure.
    c. A monitoring set consists of four ET and a single PT.
        1. Within-set trap spacing will be 100 ft between traps and approximately 5 - 6 feet above the soil surface in an (ET PT ET ET) configuration. Monitoring sets will be placed within tree-rows.
        2. Total ET: (4 regions) x (3 orchards/region) x (3 monitoring sets/orchard) x (4 ET/set) = 144 ET.
        3. Total PT: (4 regions) x (3 orchards/region) x (3 monitoring sets/orchard) x (1 PT/set) = 36 PT
    d. Monitoring sets will be established in orchards by mid-February; we will count egg and moth numbers weekly from mid-February through August. Our goal is to monitor all orchard sites on the same week day.
        i. White-top wing trap bottoms will be replaced as needed.
        ii. Almond meal and pheromone lures will be replaced every four weeks.
    e. At each orchard site, a HOBO weather data logger will be placed within a monitoring set.
B. Data will be entered according to a SAS-readable format and sent to Kris Tollerup for analysis.

Results and Discussion:

Pheromone traps began capturing male moths at all 18 sites within the first week of being placed in orchards, therefore, we could not establish a biofix based on male moth capture. Biofix base on egg capture occurred at most of the 18 sites between mid and late April. Egg biofix (Zalom, et al. 2014) was established at most sites. Egg capture, for instance, did not occur at a site located in Fresno Co, where male capture has remained low in contrast to other sites (**Figure 4**).

For this annual report, we have included male moth and egg capture data from seven representative sites located in Glenn, Merced, Madera, and Fresno counties (**Figures 1 - 4**) along with degree day accumulation for each of the counties (**Figure 5**). With the exception of the more northern sites in Glenn Co, males of the overwintering generation (first flight) were captured up to mid-June (**Figures 1 - 4**). The subsequent second flight (first generation)

tended to occur at approximately the same period (**Figures 1 - 4**). Other than degree days accumulating more rapidly than in previous seasons, no degree day anomalies occurred in 2014 (**Figure 5**).

The initiation of egg laying in relationship to male flight was relatively consistent across sites. Tentative results suggest that eggs are more likely to be captured when orchard populations reach some threshold; in this case, indicated via male capture exceeding approximately 15 – 20 moths per trap during a two week duration. Additionally, egg capture tended to lag slightly behind upswings of male capture (**Figures 1 - 4**).

At this early stage in the study, data are not complete enough to determine a relationship between male moth and egg capture. However, to this stage in the study, the data suggest that a population threshold in the orchard must be exceeded and egg capture has a predictable lag period once the threshold is exceeded. A logistic model is one possible option that can provide a predictive tool. The benefit of this model is that several independent categorical variables can be employed (UCLA Institute for Digital Research and Education 2014) such as: geographical region, level of sanitation, and proximity to pistachio can be added. As this project progresses, we will explore how a logistic and or other models can be used.

Research Effort Recent Publications:

We do not have any recent publications.

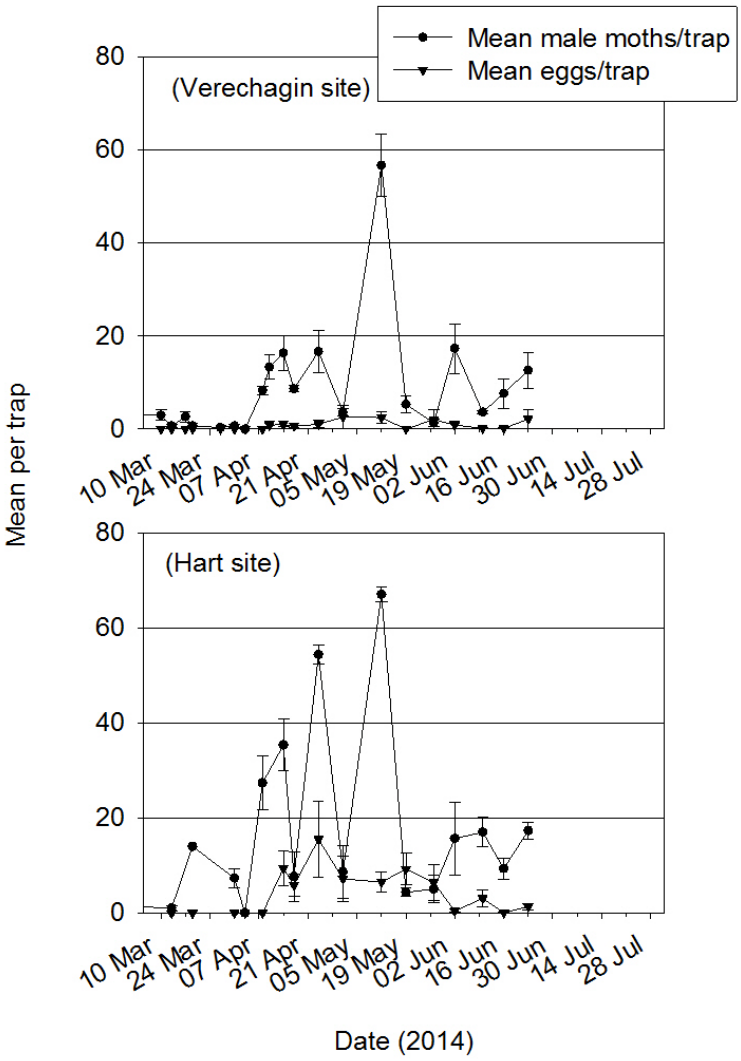

Figure 1. Mean male and egg capture at two sites located in Glenn County.

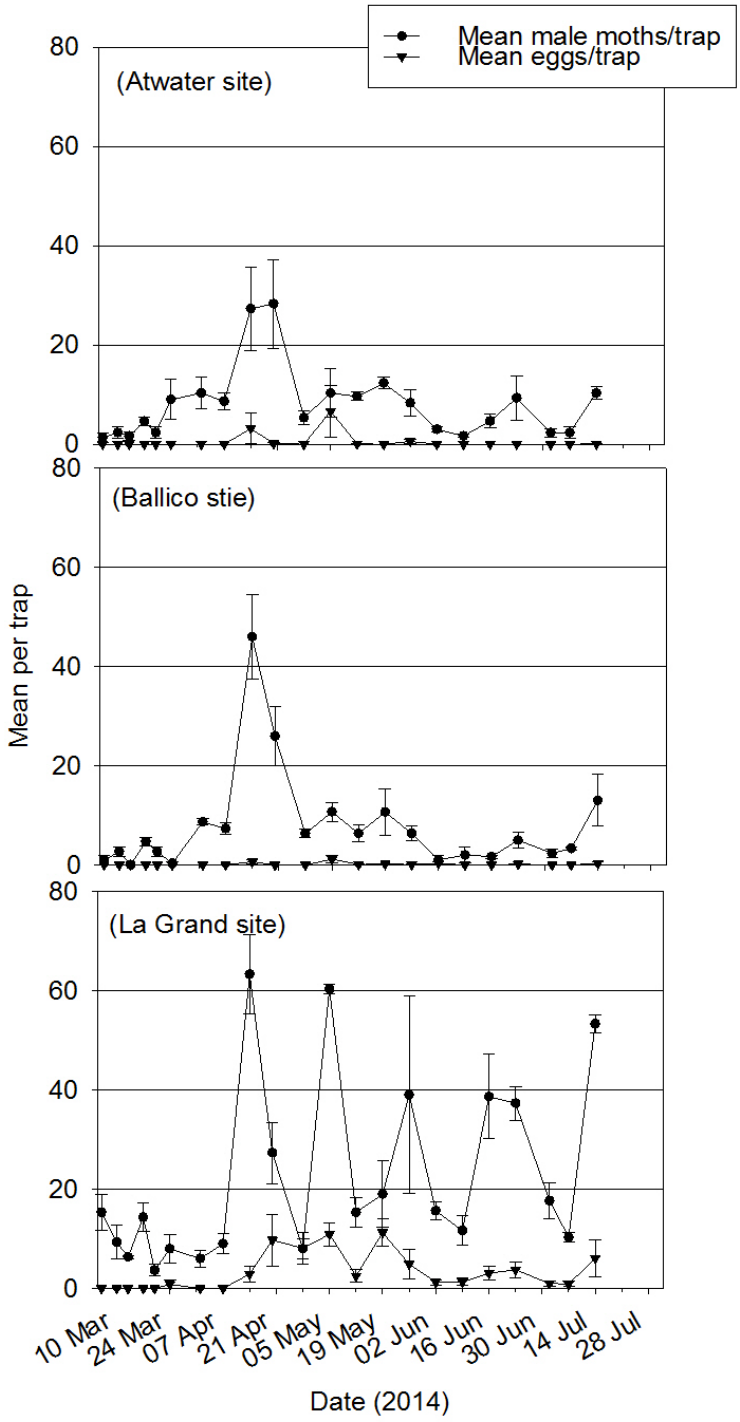

Figure 2. Mean male and egg capture at three sites located in Merced County.

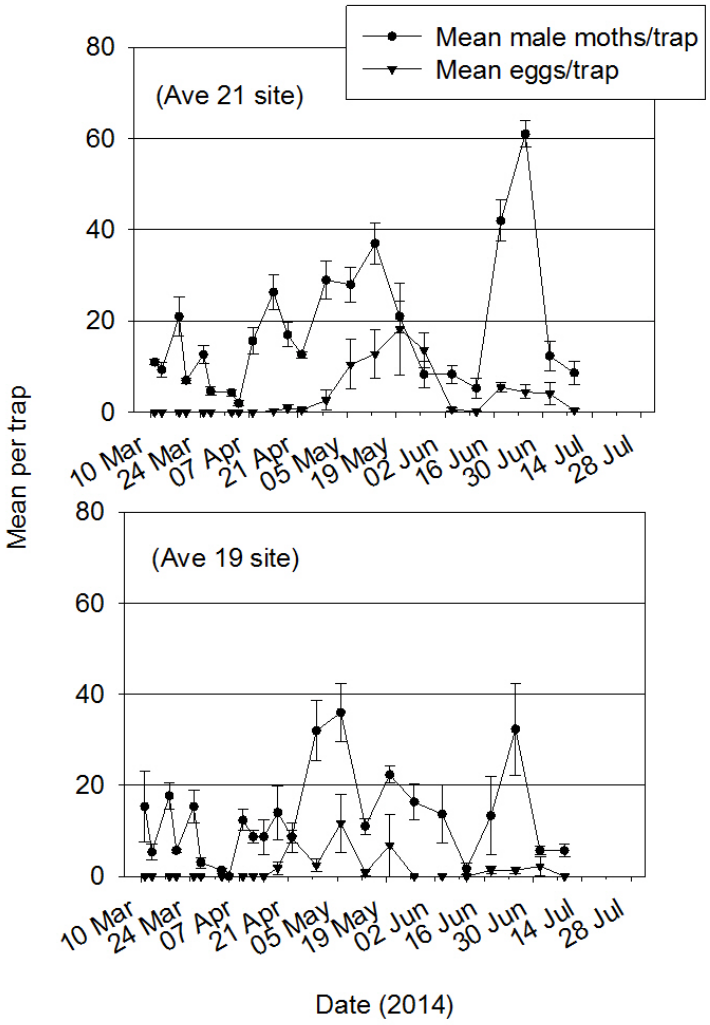

Figure 3. Mean male and egg capture at two sites located in Madera County.

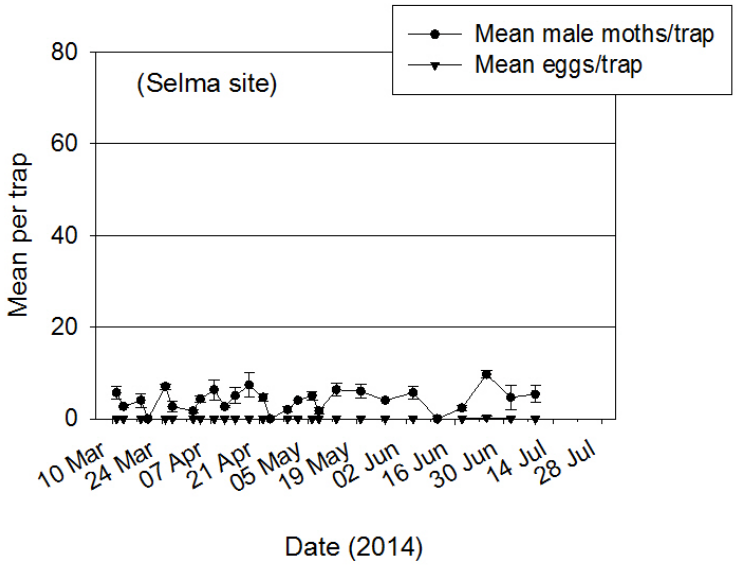

Figure 4. Mean male and egg capture at one site located in Fresno County.

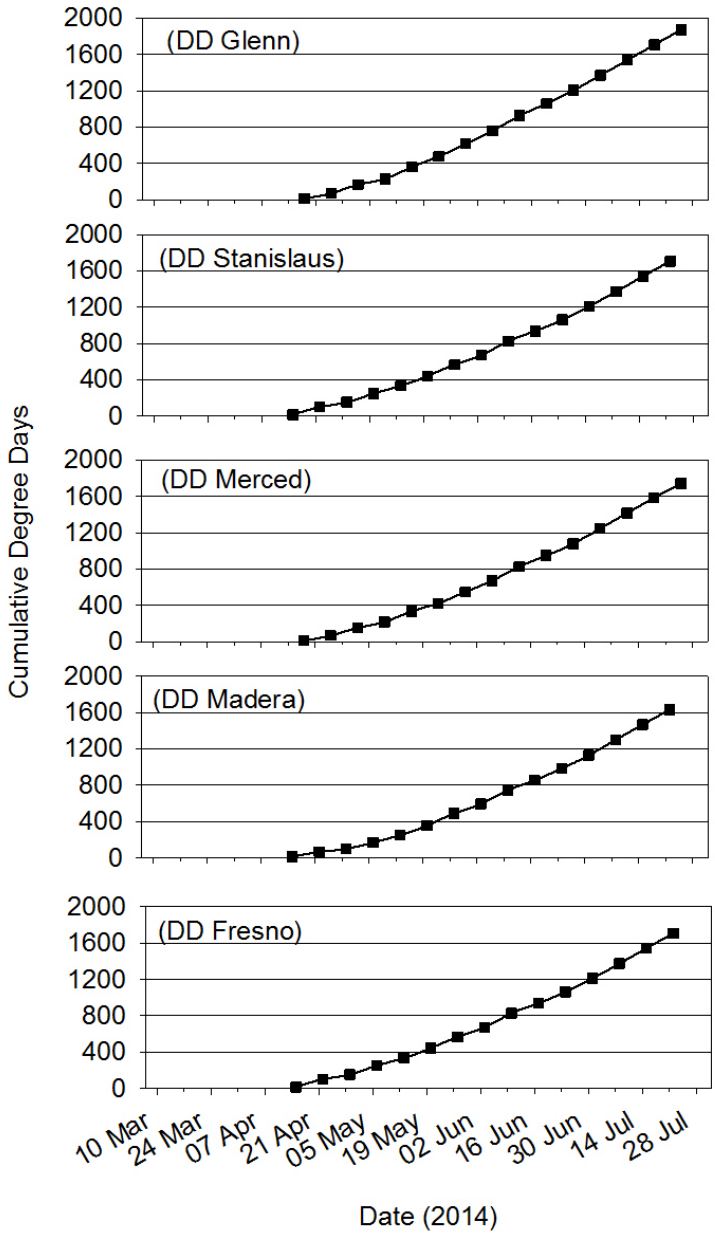

Figure 5. Cumulative degree days in five counties in which egg and male moth monitoring traps are located. Degree day accumulations begin at the approximate egg biofix date for sites located in the county.

References Cited:

Michelbacher, A. E., et al. 1961. The navel oragenworm in northern California. journal of Economic Entomology 3: 559 - 562.

UCLA. Institute for digital research and education 2014. Introduction to SAS. University of California, Los Angeles, http://www.ats.ucla.edu/stat/sas/seminars/sas_logistic/logistic1.htm.

Zalom, F., et al. 2014. UC IPM Online, UC IPM pest management guidelines: almond. U. C. Div. Ag. & Nat. Res. Publ. 3431, Sacramento, CA.