Influence of Different Cover Crop Systems on Navel Orangeworm and its Natural Enemeis

Project No.:   **ENTO22.Wilson**

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A. Summary *(In laymen's terms – emphasize key findings and recommendations)*

A team of UC researchers are currently investigating the use of cover crops to help almond growers improve the overall health of their orchards. Specifically, the group is evaluating the use of a winter pollinator mix and a winter-summer soil mix compared to plots with bare-soil and/or resident weedy vegetation ground cover.

In IPM, the use of cover crops has traditionally focused on the ability to either (a) increase biological control by supporting natural enemies or (b) reduce pest densities by (i) acting as a trap crop or (ii) inducing changes in host-plant quality that make it less suitable for pest development. Unfortunately, the addition of a winter/spring cover crop in almond orcahrds will not likely enhance these processes enough to significantly increase regulation of navel orangeworm (NOW) populations below the extremely low damage thresholds (<2%) required for this commodity. These low thresholds are primarily due to the association between NOW and aflatoxin, which is heavily regulated in key export markets.

Alternately, it may be that the addition of winter ground covers influences NOW populations via impacts on sanitation and NOW mortality in mummy nuts. Sanitation of mummy nuts is the foundation of NOW management, and here the hypothesis is that the addition of ground covers could potentially have both positive and negative effects on this. The potential negative effect is that ground covers could harbor mummy nuts and generally interfere with sanitation efforts (i.e. reduce sanitation efficacy). The potential positive effect is that ground covers are thought to create an inhospitable environment for overwintering NOW that ultimately increases mortality due to changes in temperature, humidity and/or microbial community. Our goal is to better characterize these effects and quantify whether ground cover effects on mummies is a net positive or negative.

Broadly speaking, this cover crop project is unique in that it will evaluate the influence of cover crops on multiple ecosystem services such as pollination, water use, and soil quality – as well as control of pests. Here, we propose to determine the impact of these cover crop treatments on mummy sanitation and the mortality of overwintering NOW within those mummy nuts.

B. Objectives *(300 words max.)*

1. Specify the goal(s) and specific objectives of the proposal – if a collaborative effort, identify who is the lead for each objective

Goal: Determine the impact of cover crops on efficacy of mummy sanitation and the mortality of overwintering NOW within those mummy nuts.

Objective 1: Quantify influence of ground covers on sanitation efficacy

Objective 2: Determine influence of ground covers on mummy mortality

2. Identify annual outputs or milestones for each of the objectives

Oct-Nov 2019: Establish cover crop experiment at Westside Research and Extension Center (WREC) and at a commercial site near Arvin, CA.

Dec 2019 – April 2020: Quantify mummy abundance, NOW infest and mortality in experimental plots.

March-May 2020: Evaluate NOW egg deposition on sentinel nuts or egg traps placed in the cover crop, on bare soil, and in the tree canopy.

April 2020: Characterize microbial community on mummy nuts in the cover crop, on bare soil and in the tree canopy at the WREC site.

C. Annual Results and Discussion *(This is the core function of this report)*
1. Describe activities and outputs for each objective

Objective 1: Quantify influence of ground covers on sanitation efficacy

Objective 2: Determine influence of ground covers on mummy mortality

Activites are currently underway for both objectives. Cover crops were sown on approximately Nov. 1, 2019 at both the WREC and a commercial orchard in Kern County near Arvin. Wilson/Daane are overseeing monitoring at the WREC site while Haviland/Yaghmour are monitoring the commercial site with a reduced set of similar protocols.

> 2. Discuss significance of these in terms of progress toward goals, change in approach, next steps or other conclusions based on this year's results

This is a winter project, so the various cover crops were sown this fall in replicated experimental plots at the WREC and on commercial almond acreage in Kern County. Evaluations of sanitation efficacy and mummy mortality are currently underway and will continue through May 2020.

D. Outreach Activities
> 1. Please describe outreach activities including the event description (date, location, topic of the presentation, aprox number of participants and type of audience)

Presentations
Wilson, Daane "Influence of Cover Crops on NOW Management in Almonds"
UCCE / UC Davis Almond Cover Crop Field Day; 80 growers/PCAs in attendance, Mar. 21, 2019, Winton, CA

Posters
Wilson, Daane, Gaudin "Influence of Different Cover Crop Systems on Navel Orangeworm"
Almond Board of California Annual Conference; 100+ growers/PCAs viewed the poster, Dec. 10, 2019, Sacramento, CA

E. Materials and Methods *(500 word max.)*:
> 1. Outline materials used and methods to conduct experiment(s)

Objective 1: Quantify influence of ground covers on sanitation efficacy (commercial site)

Samples of mummy nuts will be collected before and after sanitation takes place in the commercial research block near Arvin, CA. No additional efforts will be made to sanitize in the ground cover plots relative to control plots.

1A - Mummy nut abundance
Mummy abundance quantified within a 25 x 25 cm quadrat placed in the row middle and on the burm. Five samples from each area will be taken in each plot in November, February and April.

1B - Mummy infestation rates
Ten sets of 25 nuts/plot (T=1000 nuts/treatment) will be separately collected from the (i) tree canopy, (ii) bare soil and (iii) ground covers and evaluated for NOW infestation

1C – Adult oviposition

In the spring, during the first flight of NOW, egg traps will be placed in the ground cover, on bare soil and in the tree canopy in all plots. Traps will be monitored weekly for NOW egg deposition through May 15.

Objective 2: Determine influence of ground covers on mummy mortality (WREC site)

The idea here is to seed mummies into the ground covers at different points in time to measure the effect of exposure time on NOW mortality. The almond orchard at the WREC is highly infested and has not been harvested, so there is a large reservoir of mummies available to pull from, as well as many mummies that remain in the tree canopy. In November, mummies were shaken from trees in bare soil plots outside the experimental area. These are the mummies that we'll use for these experiments.

2A – Mummy mortality
Each month (Dec.-Apr.) cohorts of mummy nuts will be placed into the ground cover (in treatment plots) and on bare soil (in control plots). In each plot, we will place 50 mummies each in 3 separate 25 x 25 cm quadrats in row middles (with or without ground cover, depending on the plot). At each mummy seeding event, 1000 mummies will also be collected from the reservoir and evaluated for NOW infest. Mummies will be placed out monthly and allowed to sit up until April, at which point all mummies from experimental plots will be collected and evaluated for NOW infest/mortality.

2B – Mummy oviposition rates
In the spring, during the first flight, sentinel nuts will be placed into ground covers, bare soil and in the tree canopy in order to evaluate adult NOW egg deposition in these different areas. There will be 4 traps in each location per plot (T=12 traps/plot). Sentinel nuts will be monitored weekly between April 1 – May 15.

2C – Environmental conditions in ground covers
Data loggers will be used to monitor temperature and relative humidity in different areas in the plot where mummy nuts are found. Following establishment of the ground covers, sensors will be placed within the ground covers, above bare soil, and in the tree canopy.

2. Note any challenges or unforeseen developments that were encountered resulting in change of methodogy, timeline, or scope of project

None to report.

F. Publications that emerged from this work
1. List peer review publications in preparation, accepted or published

None to report

2. Other publications (e.g. outreach materials)

"Cover Cropping in Almonds – Exploring Benefits and Tradeoffs" Oct. 2019 *West Coast Nut*
https://www.wcngg.com/2019/10/04/cover-cropping-in-almonds-exploring-benefits-and-tradeoffs/

"Winter Sanitation – Can Cover Crops Play a Role?" Nov./Dec. 2019 *ABC How We Grow*
https://www.e-digitaleditions.com/i/1187394-2019-nov-dec-how-we-grow/0?

       3. Please provide copies of publications

See links provided above