Developing an Early-Season Monitoring System for Leaffooted Bug on Almond

Project No.: **13-RESEARCH1A-Frost/Tollerup**

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Objectives:

1. Short-term
    a. Evaluate indicators that may provide an early-season mechanism for estimating leaffooted bug (LFB) population densities (i.e., traps).
    b. Evaluate the effect of temperature on LFB mortality.
2. Long-term goal is to develop an efficient and effective sampling method for LFB and stink bugs on almond.
    a. Continue work on better understanding the aggregation cues of LFB.
3. Evaluate effectiveness of various insecticides as potential tools to manage big bugs on almond/pistachio.
    a. Determine longevity of various insecticides under field-weathered conditions.
    b. Under laboratory conditions, determine if any of the evaluated insecticides have feeding deterrence or repellency activity.

Interpretive Summary:

We were not able to fully initiate this study in time during the 2013-14 winter to monitor for LFB aggregations or other large bug species this season. One of our goals is to determine if cold winter temperatures, below 32°F, adversely affect overwintering populations of LFB and thus reduce infestation levels in almond (and pistachio) the following season. Though we did not yet sample orchards, pest control practitioners, growers, and UCCE Advisors reported extremely low LFB damage this 2014 season. Considering the low temperatures that occurred during December of 2013, such observations support the position that LFB pest pressure is considerably reduced due to cold winter temperatures.

Insecticide evaluations using field-weathered nuts and leaves indicated that many of the new non-pyrethroid insecticides do not have sufficient residual contact activity against LFB. Only Brigade (bifenthrin) provided substantial control over the duration of the experiment. However, in direct contact spray assays, the non-pyrethroids insecticides Belay (clothianidin), Bexar (tolfenpyrad), and Exerel (cyantraniliprole) caused 95%, 100%, and 100% mortality respectively after 24 hours.

Materials and Methods:

Objective 1

Aggregation Sampling

In mid-February, we will begin locating LFB aggregations near almond orchards within the San Joaquin Valley. To facilitate locating aggregations, we will select orchards that have a history of LFB damage. Each aggregation that we locate will be flagged and the number of individuals counted.

Orchard Sampling

Over the period from March – July orchards will be sampled weekly. Samplers will conduct visual counts of LFB on 10 groups of 4 - 5 nuts per tree. March sampling will be conducted along one or two edges nearest the location of a LFB aggregation. Fifty trees in each of four tree-rows located at 0, 3, 5, and 7 tree-rows from the orchards' edge.

From April through June, we will sample weekly. Samplers will conduct visual counts of damaged nuts using gummosis as a criterion. Ten groups of 4 - 5 nuts per tree will be sampled on 50 trees in each of four tree-rows. During this period we will sample two rows at the orchards edge (3 and 5) and within two tree-rows at the interior of the orchard.

Statistical Analysis

Collected data will allow us to make general conclusions regarding the pest pressure of LFB in the in relationship to the number of aggregations observed near the monitored orchards. If enough sites are monitored, we can analyze the data using a regression analysis to develop a relationship between aggregation density and LFB damage. In addition, we will analyze the data using an analysis of variance to determine if a greater amount of LFB damage occurs at the orchard's edge versus the interior.

Objective 1b

Growth Chamber

We will conduct a series of low-temperature growth chamber experiments using adult LFB. A single replication will consist of an aggregation of 10 individuals at approximately a 50:50 male/female ratio placed on an arena constructed either of live Cyprus clippings or artificial plant material. We will evaluate LFB mortality after being exposed to temperature treatments of 15, 20, 25, 30, or 35° F for periods of 2, 4, and 6 hours. Each treatment will be replicated five to 10 times.

Objective 2

Improving Sampling

Developing an efficient and effecting sampling plan of LFB and the other large bug pest is a long-term goal of my program. I will make field observations in order to develop a better understanding of large bugs. Also I will begin planning and designing experiments to evaluate aggregation cues and behavior. My goal is to establish a strong working relationship with Jocelyn Millar, in the Department of Entomology, UC Riverside.

Objective 3

Insecticide Evaluation

We will conduct experiments both in the laboratory and in the field. Experiments will be conducted in a pistachio orchard located at the University of California Kearney Agricultural and Extension Center (KARE), in Parlier. Our goal for the laboratory experiments will be to evaluate each insecticide for feeding deterrence and repellency.

Insecticide Efficacy Trials, Field

At KARE we will use plots, consisting of four adjacent pistachios trees, treated with a single insecticide; this will be done to reduce cross contamination of insecticides treatments. We will apply treatments in early June. Each plot will have a one or a two-tree buffer to reduce cross contamination. Treatment will consist of: an untreated control, Brigade WSB (32 oz/A), Warrior II (2.56 oz/A), Belay (4 oz/A), Bexar 15SC (27 oz/A), Sivanto 12 oz/A), Beleaf (2.8 oz/A), Exirel (20 oz/A), and Closer (4.5 oz/A). At 24 hours after treatment, we will select and label four 30- to 50-nut clusters on each four-tree plot. Each cluster will be covered using a perforated plastic bag and four single adults, 2 male and 2 female, bugs placed inside. Mortality will be assessed at 24 h, 48 h, and 7 days. To determine the efficacy of the insecticide treatments, we will repeat this process at 7, 14, 21, and 28 days after treatment. Prior to placing cages over clusters, all damaged nuts will be removed at each post-treatment time. At harvest, we will collect all treated clusters, and evaluate the nuts using the criteria: 1) puncture wounds, 2) epicarp lesions, and 3) kernel necrosis.

Results and Discussion:

A key part of this project, proposes to determine if overwintering LFB populations experience high mortality due to temperatures below freezing. Daane et al. (unpublished data) reported that LFB pressure was low during the season of 2007 which followed an exceptionally cold winter. The winter of 2013 - 2014 was mild except for a two week period in mid-December when low temperatures consistently reached well below 32°F. Pest control practitioners, growers, and UCCE Farm Advisors, have reported extremely low LFB pressure this current season, supporting the theory that populations are adversely affected by cold temperature. This project was not initiated at an early enough date to monitor for leaffooted bug aggregations or begin monitoring orchard populations in March. However, as part of another proposal we have tentatively scheduled times to monitor adjacent plantings of almond and pistachio, using the protocol described above, in Kern County before and after harvest. Though later in the season than proposed, this will provide data for determining how the low temperatures during the 2013 - 2014 winter affected LFB populations.

We have not initiated growth chamber experiments due to the experiment requiring 250 to 500 adult LFB. Currently individuals from our laboratory colony are needed for insecticide evaluations. Although native populations are likely low, we hope to collect a sufficient number of LFB this fall to support our growth chamber experiments.

Over the past few months, we have conducted field and laboratory experiments evaluating the efficacy of several insecticides. This has been a collaborative effort including David Haviland (UCCE) and Brad Higbee (Paramount Farming). Their work concentrated on almond while

my effort focused on pistachio but is directly applicable to almond. Although we have focused our efforts on LFB, other large bug species will be evaluated.

In field residual contact experiments, Belay, Bexar, Sivanto, Beleaf, Exirel, and Closer, did not perform well. By day 28, the two pyrethroids, Brigade and Warrior II performed best causing approximately 85 and 50% mortality respectively. Beleaf (flonicimide) causes cessation of feeding in some insect species; this did not occur to the extent that LFB died. Evaluation of treated nuts will provide data if this insecticide significantly affected feeding. Laboratory residual contact bioassay experiments using field-weather leaves and nuts were conducted with a similar outcome. Direct spray contact experiments began on 22 July and include Belay, Bexar 15SC, Exirel, Beleaf, Dimilin (evaluating nymphs), and Doubletake (Diflubenzuron and Lamda-cyhalothrin). Of the non-pyrethroids Belay (clothianidin), Bexar (tolfenpyrad), and Exirel (cyantraniliprole) caused 95%, 100%, and 100% mortality after 24 h respectively.

Research Effort Recent Publications:

No manuscripts have been published or submitted.

References Cited:

None.