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

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Introduction

In September to October, adult leaffooted bug (LFB), *Leptoglossus zonatus* (Dallas) begin their overwintering cycle by moving out of almond and pistachio orchards to sheltered sites forming aggregations of 5 to 500 individuals (Daane et al. 2008b). Typically aggregations form under the bark of eucalyptus, in olive and pomegranate orchards, on the underside of palm fronds, and in Cyprus and juniper trees (Daane and Yokota 2008a). Although the existence of a male pheromone associated with mating and aggregation have been supported (Wang, et al. 2000), we do not fully understand the cues that initiate these behaviors. As early as late-February LFB begin dispersing from aggregations; however, the occurrence of warm temperatures likely play a major role (Daane, et al. 2007) so this could vary among years. During March the adults begin to disperse into almond just as nuts have reached the "pea-sized" stage. LFB feeding at that stage causes nuts to abort and significant economic damage can occur. Although the University of California has monitoring recommendations, such as visual inspection for adults, dropped nuts, and nuts with gummosis (Fig. 1), damage often occurs before LFB is detected. Essentially, no effective method exists to detect early-season infestations.

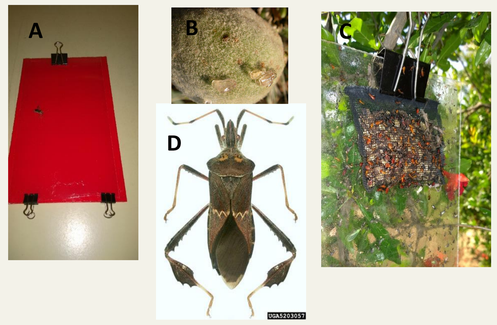

Fig. 1. A) red sticky trap, B) nut with feeding damage i.e. gummosis, C) LFB nymphs on bag containing whole ground pistachio nuts, and D) adult leaffooted bug.

Objectives

1. Develop indicators that provide an early-season mechanism for estimating LFB population densities.
   a. Continue work to determine minimum temperature survival threshold for LFB.
2. Develop an efficient and effective sampling method for LFB on almond.
   a. Determine effectiveness of color sticky traps as a method to monitor early-season dispersion of LFB into almond.
3. Determine if host-plat volatiles play a role in LFB aggregation behavior.

Evaluate and determine if specific host-plant volatiles can be employed for monitoring LFB.

Procedure

Cold cabinet. A replication consisted of 10 individuals at approximately a 50:50 male / female ratio placed in a plastic cup with a single green bean. We evaluated LFB survival after being exposed to temperature treatments of 32, 28.4, 26.6, 23, 21.2, 15 and 1.4 °F for periods of 3, 4, or 6 hours. For at least two hours prior to the cold treatments, bugs were kept at a control temperature of 45°F. After each cold treatment replicates were placed back in the control temperature and mortality evaluated after 24 h. Each treatment was replicated at least six times.

Monitoring traps. Sticky traps, were constructed from 6 x 8 inch Plexiglas sheets covered with clear sticky card (Alpha Scents, West Linn, OR). Ten red, green, white, yellow, or clear traps were constructed. Color traps were spray painted with Krylon (Cleveland OH). A single replicate consisted of five traps, one of each color, placed one per/tree in a tree-row of pomegranate. Within and between rows, traps were separated by approximately 60 and 300 feet respectively. The orchard had a heavy population of LFB and traps were checked bi-weekly from Mar – Jul.

Plant volatiles. Commercially available almond, avocado, coconut, peanut, and walnut oil were evaluated for attraction. Approximately 3 ml were placed on filter paper and placed in a small cage containing five, nymphs, and adult male and female LFBs. LFB were observed each ½ h over a period of four hours. Attractiveness was scored as LFB resting on the filter paper.

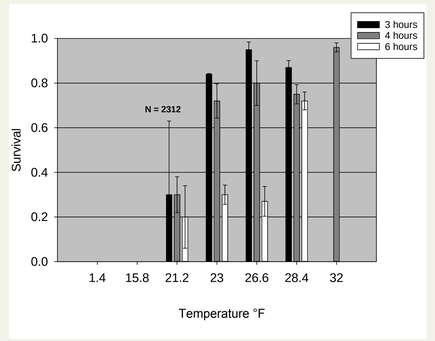

Fig. 2. Leaffooted bug survival when exposed to cold temperatures for 3, 4, or 6 hours.

Results and Discussion

Cold cabinet

- LFB survival did not significantly decrease at low temperatures between 32 and 28.4 °F for up to 6 hours; and to 26.6 or 21.1 F for up to 4 hours.
- Survival degreases to ~25% when exposed to 26.6 or 23 °F for 6 hours.
- Survival range between 30 and 20% when exposed to 21.2 for 3, 4, or 6 hours.
- Essentially no LFB survived at 15.8 or 1.4 °F (Fig. 2).

Color sticky traps

- No adult or nymphs were capture on any of the color sticky traps

Plant volatile

- Avocado, almond, coconut, peanut, or walnut oil did not attract adult or nymph LFB
- Whole ground pistachio attracted nymphs

Discussion. Early work by Daane et al (2007) suggested that LFB suffered significant mortality when temperatures fell below ~27 °F. They did not, however provide a temporal estimation of how long LFBs must be exposed to that temperature before mortality occurs. Our data suggest that cold temperature of ~27 °F can play a role in decreasing overwintering populations. This does not occur, although until they are exposed between 4 to 6 hours a condition that does not commonly occur within almond-growing areas. An important consideration of our results is the variation that can occur between laboratory and field conditions. During the winter of 2016, we will closely study LFB aggregations under field conditions. Although the color of sticky traps that we tested did not attract LFB, there may be other color or color combinations that attract LFB. For example, color could play a critical role in attracting LFB to pomegranate fruit. The commercial oil products that we tested did not provide any detectable level of attractiveness that could be utilized as a lure. One reason that this occurred is that processing the oil for human consumption may have modified and/or eliminated any attractive volatile compounds. The most encouraging result of our study was the strong attraction of LFB nymphs to whole-ground pistachio. Early-season monitoring for nymphs is not practical, since the presence of nymphs indicate that adults have been present for at least 7 to 10 days. If however, adult females are attracted and lay eggs near the pistachio food source. This could be a valuable tool for monitoring. In other words, a lure containing whole-ground pistachio volatiles could be used as a tool to monitor for females moving into almond via the appearance of egg-laying.

References

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Acknowledgements

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