# Improving Leaffooted Bug Management in Almond by Enhancing Monitoring Tools

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## Introduction

The use of weather data may provide a tool for predicting the severity of leaffooted bug (LFB) population densities. Daane et al. (unpublished data) analyzed average weekly minimum temperatures and in years where temperatures dropped below ~ 27°F, LFB pressure was low during the following spring and growing season.

Starting in September, adult leaffooted bug begin moving out of almond and pistachio orchards to overwintering sites and form aggregations of just a few to several hundred individuals (Fig 1). Aggregations can form on plats such as citrus, Cyprus, olive, palm (Fig. 2), persimmon, pomegranate, and walnut. Also, LFB can form aggregations on protected non-plant substrates such as wood piles and pump house structures.

As early as March adult LFB can begin moving into almond just as nuts reach the "pea-sized" stage. The UC Statewide IPM Pest Management Guidelines recommend monitoring for LFB by visually inspecting for gummosis on nuts during March and April. Early in the season, during March, the most efficient sampling method is the presence of gummosis on nuts in the tree and dropped nuts. The drawback to the method is that damage can occur quickly and a considerable amount can occur before LFB is detected. A tool such as a trap could greatly improve LFB monitoring enhancing its detection as they first move into almond in March.

## 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 green, red, yellow, and white sticky and bucket traps baited with whole-ground almond (WGA), whole-ground pistachio (WGP), or peanuts (P) to monitor early-season movement of overwintering adults into almond.
   b. Determine if leaffooted bug egg-laying in almond can be monitored during March using modified navel orangeworm traps (MNT) (Fig. 3) baited WGA, WGP, or P.

## Acknowledgements

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Fig . 1. Large leaffooted bug aggregation on walnut, early October.

Fig . 2. Large leaffooted bug aggregation on palm, late Nov.


Fig. 3. Adult leaffooted bug on a navel orangeworm trap baited with whole-ground almond (A). Leaffooted bug nymphs on a navel orangeworm trap modified by attaching a bamboo shish kabob skewer and baited with whole-ground almond. The skewer provided an egg-laying substrate (B).

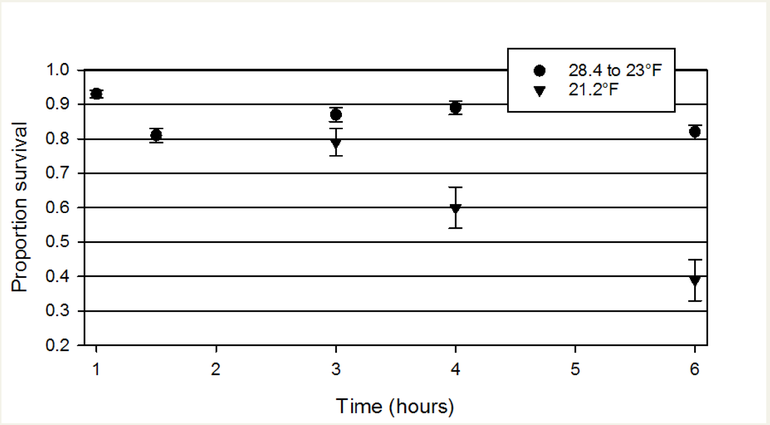


Fig. 4. Proportion survival of adult male and female (50: 50 ratio) when exposed to cold temperatures for 1, 1.5, 2, 4, or 6 hours. Leaffooted bug were collected from field aggregations during Oct and Nov of 2015 and 2016. Approximately 6,600 individual leaffooted bug were used.

## Procedure

Objective 1. Using a growth chamber, exposed leaffooted bug to temperature treatments of 14, 15.8, 19.4, 21.2, 23, 25, 26.6, 28.4 and 32° F for periods of 1, 1.5, 2, 3, 4, or 6 hours. Each treatment was replicated at least six times using 10 adult bugs at a ~50: 50 male to female ratio. The 32° F treatment was used as a control.

Objective 2a. Evaluate various trap designs. Bait traps with whole-ground almond (WGA), whole-ground pistachio (WGP), or peanuts (P) placed in almond, pistachio, and pomegranate trees at mid-canopy 1 to 2 m (3.3 to 6.6 ft.) above the soil surface. A complete randomized block design was used. Trap treatments were placed in orchards by March 5th and checked weekly through Aug.

Objective 2b. Modified navel orangeworm egg traps (Fig. 3, B) baited with WGA, WGP or P, were used to determine if LFB laied eggs on or near the modified trap.

## Results and Discussion

Results of cold cabinet experiments conducted on field-collected LFB during 2015 and 2016 showed that adult survival fell to approximately 60 and 40% when exposed to 21.2°F for four and six hours respectively (Fig. 4). During our experiments from 2015 and 2016 we exposed just over 6,600 adults; of those exposed to temperatures between 0 (control) and 23°F no statistical difference occurred among the exposure time periods. These results differ from trials conducted on field-collected LFB from 2014 in which approximately 75% mortality occurred at 26.6°F exposed for six hours. In 2014, LFB were collected in Sept and kept in the laboratory for 14 to 28 days while trials were being run. In contrast, 2015 and 2016 trails were run one to seven days after LFB were collected. The relatively long exposure to ambient laboratory temperatures may have negatively affected the cold-hardiness of LFB.

In previous experiments, green, red, yellow, or, white color sticky traps did not trap adults, however when baited with WGP nymphs were observed on the bait and stuck on the trap. During the spring of 2017, we will reevaluate sticky traps using different bait and colors.

LED-lighted bucket traps were not effective. Only five adults were captured between March and Aug 2016 at one site in pistachio.

Beginning in April, LFB started aggregating on MNTs; however only at the pomegranate orchard site known to have an infestation of LFB. Significantly more LFB aggregated on the MNTs baited with WGA then the other plant materials evaluated. We did not detect eggs laid on or near the MNT.