



# Another Look at Pheromonal or Related Attractants for Leaf-footed Bugs Infesting California Nut Crops

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## Introduction:

Leaf-footed (LFB) bugs are a chronic problem in California nut crops, and there are currently no cost-effective methods of monitoring these species, especially early in the season. The problem is exacerbated by the tendency for large numbers of bugs to move into a crop rapidly, so that infestations can go from negligible to problematic within a few days. Previous research has shown that these bugs use pheromones in a number of contexts, from alarm to aggregation and mating. We propose to have another detailed look at two species, *Leptoglossus zonatus* and *L. clypealis*, under both summer and fall conditions, to see whether we can sort out the chemical or other signals that the bugs might be using to create the rapid crop infestations in summer, and the overwintering aggregations in the fall. It is likely that the chemical signals used in these two different contexts will be different. If we can gain a better understanding of bug behaviors during different periods of the year, and the signals controlling these behaviors, we may be able to develop pheromone-based methods for monitoring purposes.

## Summary of previous work (Wang and Millar 2000):

- Both sexes of LFB produce defensive compounds from metathoracic glands. These include short-chain aldehydes and esters.
- Males appear to attract females from a distance, then actively court females.
- Adults take ~2 weeks to become sexually mature, and then mate multiple times.
- Adult males have sex-specific ventral abdominal glands, which produce benzaldehyde and benzyl alcohol. These compounds act as short-range aphrodisiacs, but are not attractants.



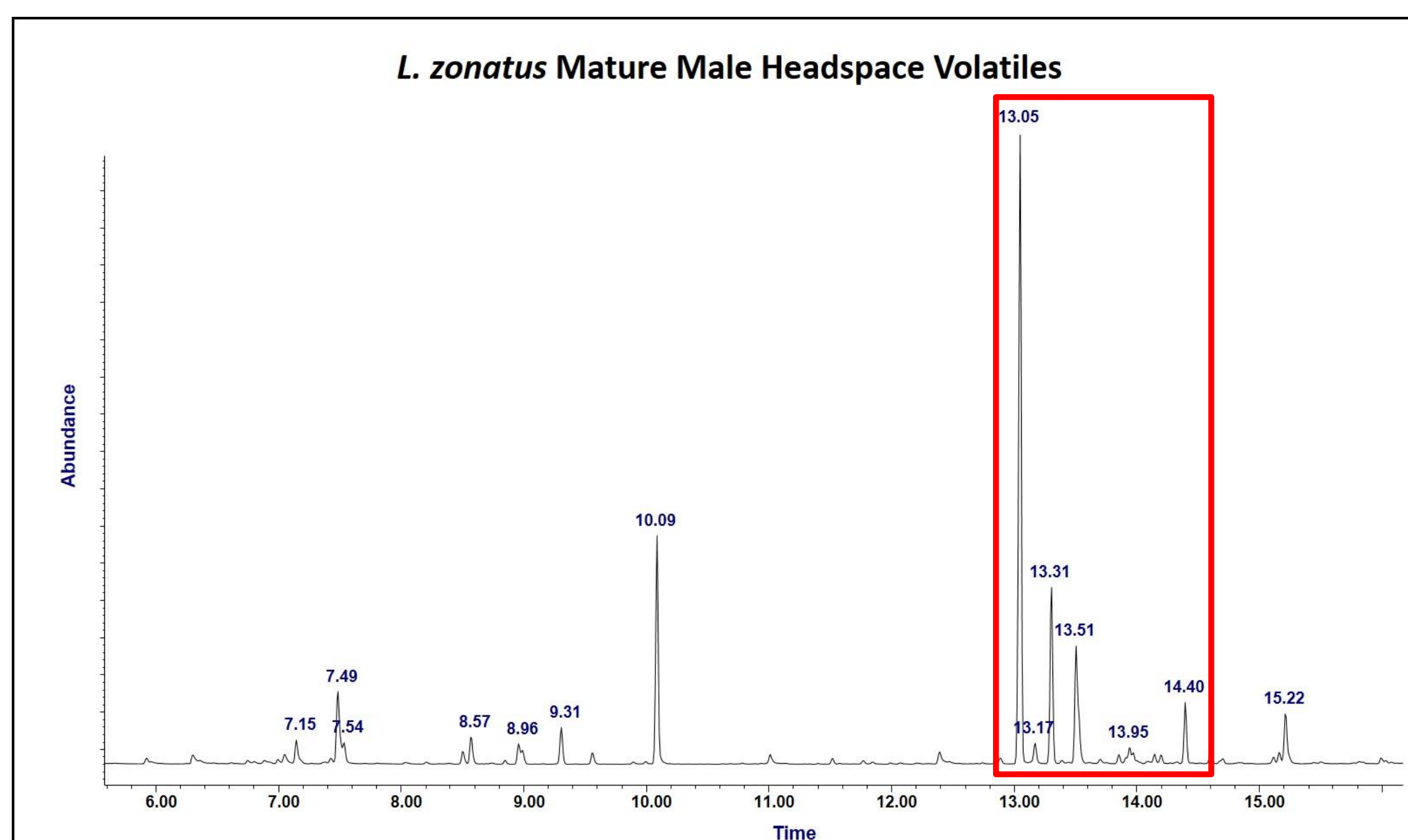
Leaf-footed bug damage to almonds and pistachios



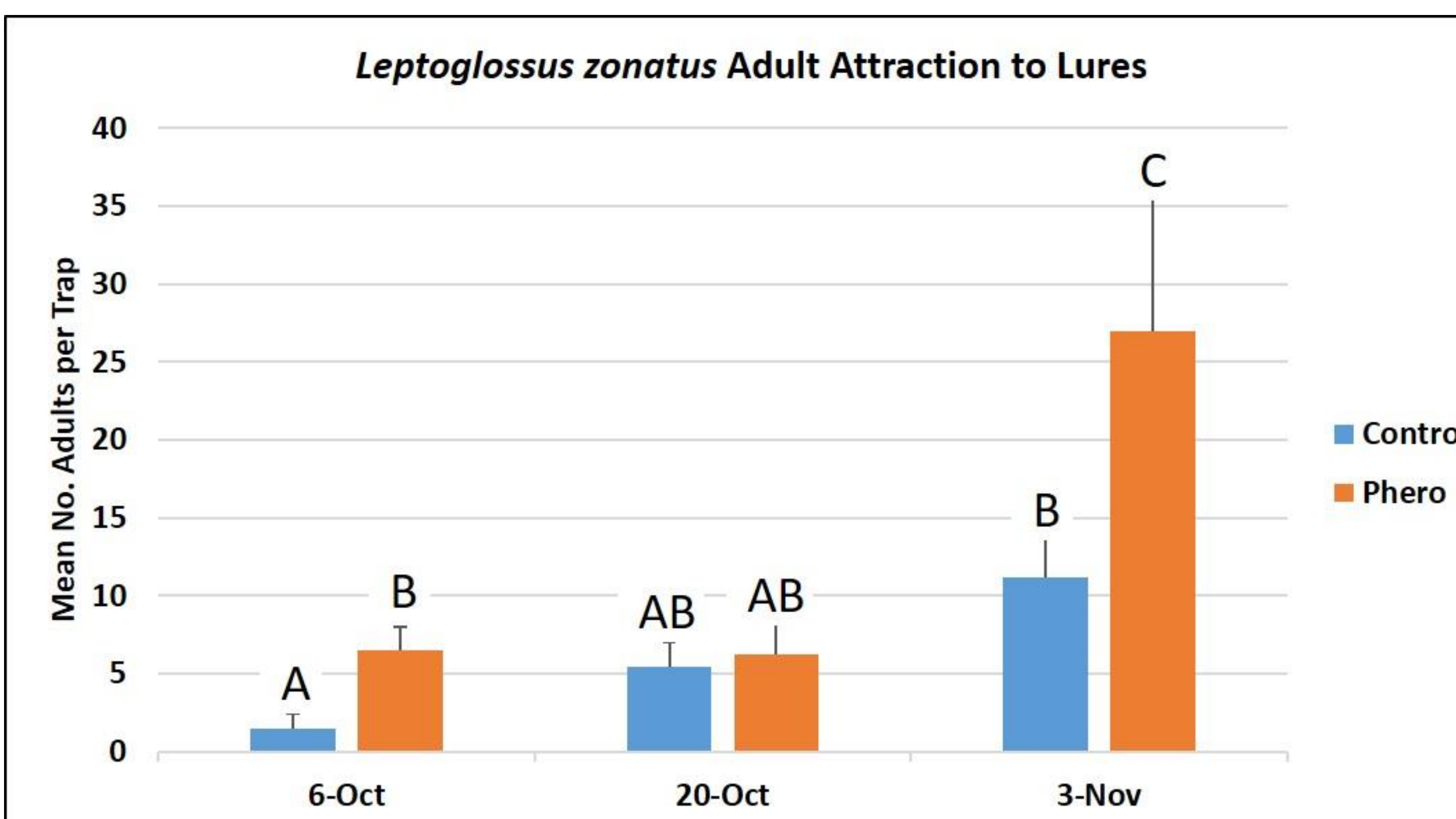
Leaf-footed bugs in olives

## Current Objectives:

- Field test attraction of adults (*L. clypealis* and *L. zonatus*) of both sexes to caged males and caged females, under both summer and fall conditions.
- Identify/verify the metathoracic gland contents of both sexes (the likely alarm and defense compounds), and the contents of the male-specific ventral abdominal glands, some of which might be involved in attraction.
- Analyze volatiles emitted by sexually immature adults, and sexually mature adults, both virgin and mated, under long-day summer conditions when adults would typically be feeding and mating, and under short-day fall conditions, when adults would typically be forming overwintering aggregations.
- Analyze the cuticular lipids of adults of both sexes, which may help to keep overwintering aggregations together.



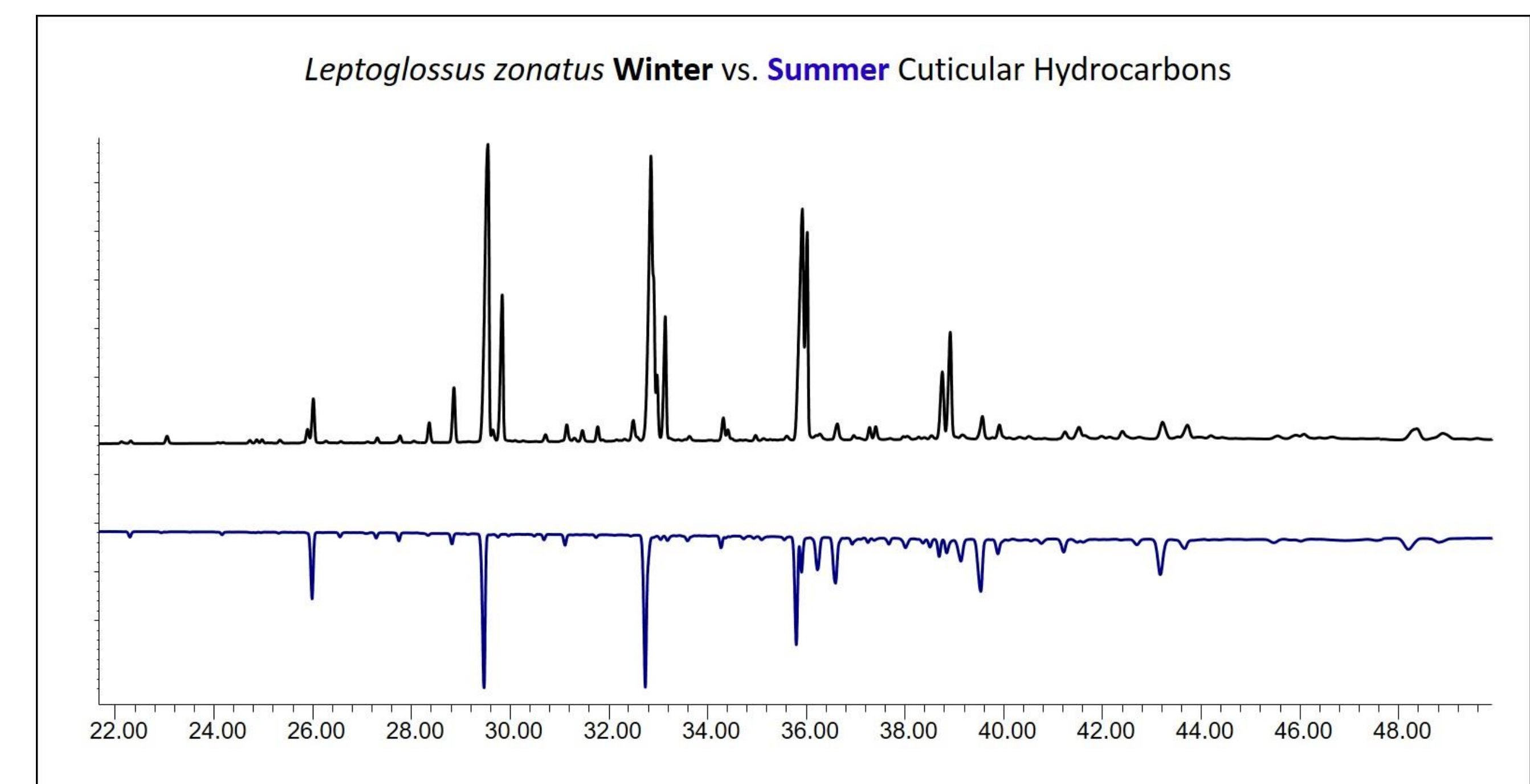
**Figure 1:** Gas chromatography analysis of odors produced by sexually mature male *L. zonatus*. A group of male-specific compounds are highlighted; these are likely involved in the formation of aggregations.



**Figure 2:** Field trapping data from using cross-vane intercept traps baited with lures containing the highlighted compounds in **Fig. 1**. Traps were placed in an unused field adjacent to an unmanaged pomegranate grove. Different letters indicate significant differences among treatments and time points at  $P < 0.05$ .

## Progress to date:

- Colonies of *L. zonatus* & *L. clypealis* established at Berkeley and Riverside.
- Analyzed defensive secretions of adult *L. zonatus* of both sexes, as baseline data, nothing new found.
- Conducted comprehensive analysis of odors from summer-form male and female *L. zonatus* (**Fig. 1**), and preliminary collections of winter-form *L. clypealis*.
- All compounds in the male *L. zonatus* blend have been identified, and synthesis of the major compound has been carried out.
- Carried out preliminary field trapping bioassays of *L. zonatus* (**Fig. 2**).
- Analyzed cuticular lipids of summer and winter-form adult *L. zonatus* and winter-form *L. clypealis*. Comparisons of summer and winter-form cuticular lipids may allow identification of compounds that help hold aggregations together (**Fig. 3**).



**Figure 3:** Gas chromatogram overlay of hexane body washes of *L. zonatus* winter (top line) and summer-form (bottom line) adults. Differences in the presence/absence of cuticular hydrocarbons as well as ratios of hydrocarbons to each other may play a role in winter aggregation behavior.

## References:

Q. Wang and J.G. Millar. 2000. Mating behavior and evidence for a male-produced sex pheromones in *Leptoglossus clypealis* (Heteroptera: Coreidae). *Ann. Entomol. Soc. Am.* 93: 972-976.

## Acknowledgments:

We gratefully acknowledge funding from the Almond Board and the Administrative Committee for Pistachios for financial support of this work.

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