

CITRUS RESEARCH BOARD

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Figure 1. An adult female bean thrips, shown here on a US penny, is a very small insect, about two millimeters in length, and is native to California.

North American Bean Thrips

A Perennial Export Problem for California Citrus Growers

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Project Summary

Bean thrips, native to California, are pests of quarantine importance for countries importing navel oranges and mandarins from California. Adult bean thrips hibernate in “navels” and may be accidentally exported within fruit. This project is investigating a “cold stress hypothesis” as one potential reason why bean thrips has failed to establish outside its native range. We also suggest that male bean thrips may release an aggregation pheromone¹, and weed control in orchards may reduce fruit infestation rates.

North American bean thrips (referred to here as bean thrips), *Caliothrips fasciatus* (Pergande) (**Figure 1**), are native to California with a natural range that reportedly extends north into western Canada, south into Mexico and east into Idaho and Florida (Mound et al. 2011; 2016). Evidence of established breeding populations of bean thrips in Hawaii and the Caribbean are lacking (L.A. Mound, Ph.D., CSIRO Australia, pers. comm. October 21, 2019 and C.A. O'Donnell, Ph.D., United States Department of Agriculture-Animal and Plant Health Inspection Service-Plant Protection and Quarantine, pers. comm. October 28, 2019). Additionally, the few reports from Brazil and Argentina likely are misidentifications by non-specialists as *C. phaseoli*, a common pest thrips, for which there are no voucher specimens available for examination (A. Cavalleri, Ph.D., Universidade Federal do Rio Grande do Sul, Brazil, pers. comm. October 22, 2019). In addition to *C. fasciatus*, two other species of *Caliothrips* are recorded from California, *C. marginipennis* (Hood) and *C. phaseoli* (Hood).



Figure 2. Dead bean thrips inside the “navel” of a navel orange.

The Quarantine Problem with Bean Thrips

The Australian Quarantine Inspection Service (AQIS) and Ministry of Primary Industries (MPI, New Zealand), have on numerous occasions found adult bean thrips overwintering in the “navels” of navel oranges and mandarins originating from California. Interceptions are of concern to AQIS and MPI because bean thrips were once considered a serious agricultural pest in California attacking tree crops (e.g., avocado, pear and walnut), row crops (e.g., bean, pea, cantaloupe, cotton and lettuce) and alfalfa. Bean thrips commonly infests numerous weed species (e.g., prickly lettuce, *Lactuca serriola*) and native plants (e.g., California poppy, *Eschscholzia californica*) that grow in and around agricultural areas (Bailey 1933; 1937; 1938). The pest status of bean thrips has declined in California since the 1930s. The reasons for this are unclear, but could be due to better integrated pest management practices, more efficacious pesticides, advances in irrigation technology, improved weed management and development of resistant cultivars.

Why Hasn't Bean Thrips Established Outside of Its Native Range?

One of the questions we are trying to answer with our Citrus Research Board-sponsored research is why bean thrips hasn't

established in Australia or New Zealand. We hypothesize thrips surviving transit inside navels may be weakened prior to harvest in California by accumulating cold stress. Cold stress resulting from winterization in fruit in the field, in addition to storage and shipping, may impact the fitness, including longevity and fecundity, of surviving thrips. Simply put, cold-weakened thrips that make it to Australia and New Zealand alive are unable to found viable populations.

We currently are testing the cold stress hypothesis in the lab. So far, we have exposed more than 2,500 thrips to these cool temperature regimens, and we have not recovered live thrips from dissected oranges (we readily recover dead thrips from navels [**Figure 2**]). If live thrips are recovered, we plan to put them individually onto bean leaves to see how long they live and, in the case of females, whether they can lay eggs that produce viable offspring. These larvae will be reared to adulthood to determine the sex of progeny. We plan to continue these cumulative cold stress experiments for another year to test more thrips and to better refine our experimental protocols.

Do Bean Thrips Use a Pheromone to Aggregate in Fruit?

An important question we will attempt to answer is: “how does more than one bean thrips ‘decide’ to collectively hibernate in a navel together when there are thousands of fruit hanging in trees that could be chosen?” We hypothesize male bean thrips may release an aggregation pheromone from sausage-shaped glands located on the underside of the abdomen (Figure 3). The aggregation pheromone entices male and female thrips to enter the navel to communally

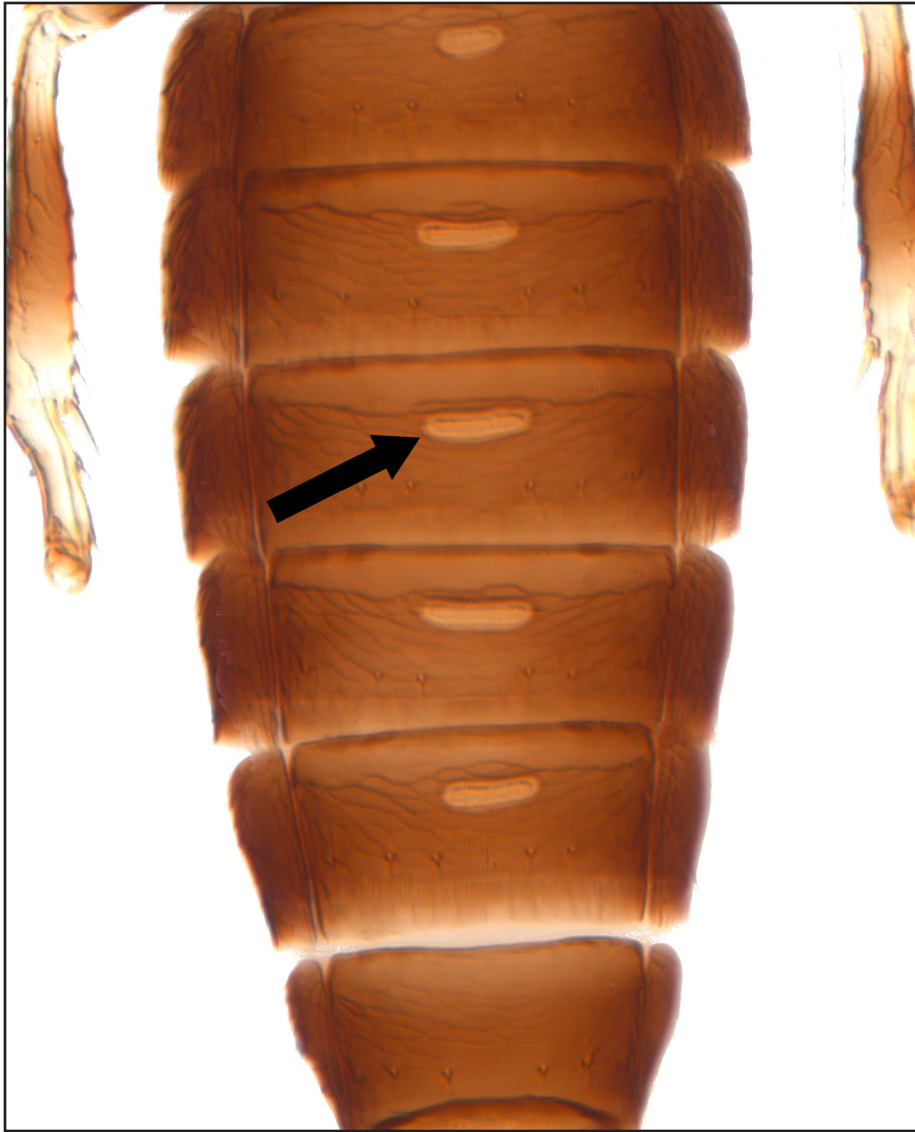


Figure 3. Sausage-shaped glands (indicated by arrow) on the underside of the abdomen of a male bean thrips that may release an aggregation pheromone.

overwinter. Thrips pheromones operate over short distances (i.e., a few inches) and not over long distances (i.e., hundreds of feet) like sex pheromones produced by moths. The possibility that bean thrips males produce an aggregation pheromone warrants investigation because, if it exists, a pheromone could provide new detection and management opportunities.

Where Do Bean Thrips That Infest Navels Come From?

Many potential feeding and breeding hosts are common weeds (e.g., tumbleweed and sow thistle) and native California plants (e.g., lupines and California buckwheat) that may be found in or around citrus orchards. Bean thrips are poor fliers incapable of controlled linear flight over

long distances. However, bean thrips infesting weeds on the orchard floor near trees bearing fruit simply may need to fly a few feet to find overwintering sites (**Figure 4**). Therefore, good weed sanitation both within orchards and beyond orchard border rows is an effective cultural practice to reduce the likelihood of adults reaching fruit. Orchards that have poor weed management tend to have high levels of bean thrips activity (Bailey 1933).

Conclusions

Bean thrips in California-grown navel oranges (and increasingly, mandarins with navels) that are exported, is a perennial quarantine problem for citrus growers. One potential reason bean thrips has failed to establish in countries that may have received California citrus with bean thrips may be because thrips have been debilitated by cumulative cold stresses that significantly reduce survivor fitness. The ability of bean thrips to form overwintering aggregations inside navels may be mediated by a male-produced aggregation pheromone. Identification and characterization of the function of a male-produced aggregation pheromone could provide novel detection and control tools. The severity of bean thrips infestations of citrus may be driven, in part, by weed abundance. Good weed abatement within and around orchards may reduce infestation risks to California citrus growers. 🌱

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Glossary

¹Aggregation pheromone: A chemical substance produced and released into the environment by insects that affects behavior (e.g., form groups or aggregates of individuals of one or both sexes of the same species).

References

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Figure 4. Bean thrips may fly from weeds growing on the orchard floor into overhanging citrus canopies to find overwintering sites (flight indicated by dotted arrow).

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