Project Concluded: Final Report

Management of Bean Thrips

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Background: The bean thrips, *Caliothrips fasciatus* (Pergande), has been reported on more than sixty genera of plants in the state of California, including more than forty cultivated crops. Although early reports suggested that it could cause yield losses in alfalfa, beans, cantaloupes, cotton, lettuce, pears, and peas, it has not been reported as a pest of economic significance in California since 1940, suggesting that perhaps early reports overemphasized its importance. The region of origin of bean thrips is unknown but has been speculated to be California, Florida, or Brazil.

The bean thrips over-winters as an adult, and a favored over-wintering site in California is inside the navel of navel oranges. This insect is not considered an economic pest on citrus in California but it became a problem for California growers shipping navel oranges to Australia during the 1996-97 season when 28 of 982 shipments (estimated value of all 982 shipments was $6.9 million) from California were found infested. Infested loads were fumigated with methyl bromide, which is damaging to the fruit and costly to the importer, but a larger concern was potential loss of the Australian citrus market if interception levels were not reduced.

Mound and Houston (1987) reported two species of *Caliothrips* as present in Australia but to date, established populations of *C. fasciatus* have not been detected there. They indicated that there were 19 known species in this genus, seven from North America, and the majority of species are found in the tropics. Due to a long history of California citrus being sent to Australia, Hoddle et al. (2006) surveyed areas around airports, seaports, public recreational parks, and major agricultural areas in the states of Queensland, New South Wales, Victoria, South Australia, and Western Australia. Although a total of 4,675 thrips encompassing at least 76 species from 47 genera were detected, *C. fasciatus* was not found.

Starting in November 2002, USDA-APHIS imposed a "Bean Thrips Protocol for Shipment of Fruit to Australia" on all California growers shipping navel oranges to Australia. Each year the Plan is revised, and as part of the 2006-07 Plan (http://www.citrusent.uckac.edu/bean_thrips.htm), 50 fruit per grove, spread throughout the grove, must be cut in the field prior to harvest and any live bean thrips that are found disqualify fruit from that grove from possible shipment to Australia. In addition, green sticky cards must be used to monitor for bean thrips levels entering the block, using a minimum of four 3" x 4.5" cards per block (one card per 5 acres). Cards are hung on the outside row or one row in on all four sides of the block for a total of 28 ± 7 days over the period 6 September – 1 November 2006. If mean catch is greater than 20 bean thrips per card then fruit from that block cannot be shipped to Australia.

Recent Research Results: Research done initially in a series of trials on asparagus and then replicated in a massive study in two commercial navel orange blocks in the San Joaquin Valley (SJV) with high levels of bean thrips have determined what species of thrips might be captured on sticky cards during the fall (Fig. 1).

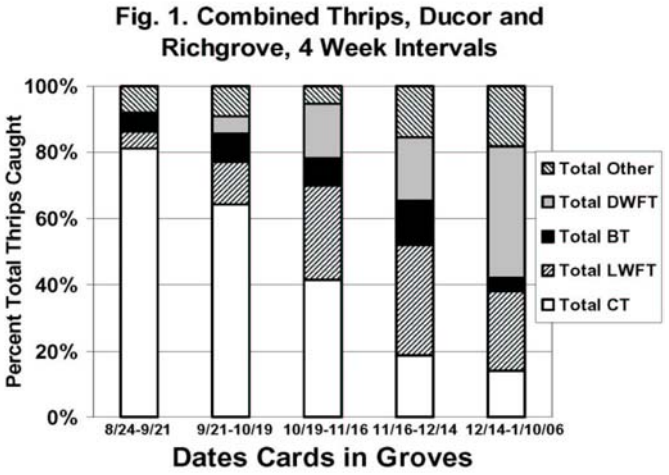

Fig. 1. Percent capture of various species of thrips during winter 2005-06 on green sticky cards at two navel orange field sites (Ducor and Richgrove combined) in the San Joaquin Valley. Other = other species of thrips, DWFT = dark colored western flower thrips which might be confused with bean thrips, BT = bean thrips, LWFT = light colored western flower thrips, CT = citrus thrips.

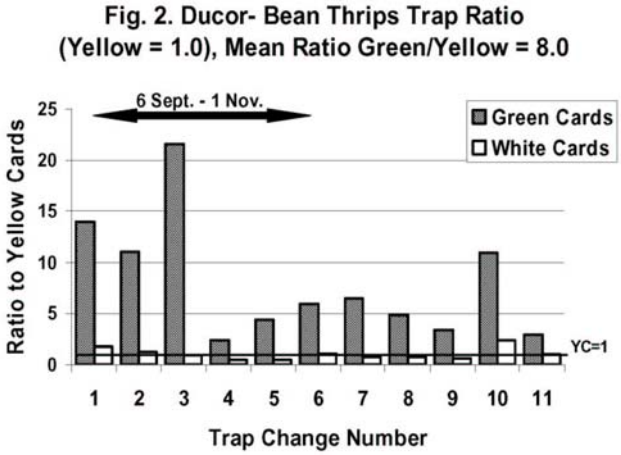

Figure 2. Ratio of the number of bean thrips captured on green and white sticky cards relative to yellow sticky cards (level on yellow cards was set to 1) at a navel orange grove near Ducor.

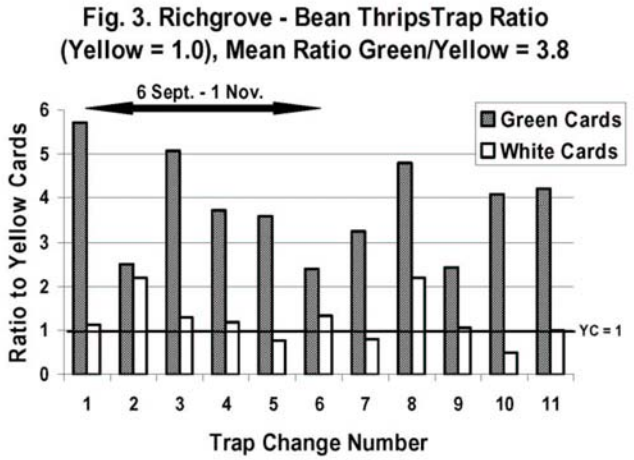

Fig. 3. Ratio of the number of bean thrips captured on green and white sticky cards relative to yellow sticky cards (level on yellow cards was set to 1) at a navel orange grove near Richgrove.

In addition, this research showed that green sticky cards are much more effective than yellow, white, or blue sticky cards (Harman et al. 2007, Figs. 2, 3). Results were presented to industry and USDA-APHIS at a bean thrips Australian export meeting put together by CCQC in Bakersfield on 25 May 2006, and APHIS decided to change the Australian Export protocol to use green cards for the 2006-07 navel export season.

Working with Julie Doctor, Sunkist Growers, Inc., and MGK Corp., we have run a series of 4 trials evaluating possible use of Turbocide for control of bean thrips in citrus packinghouses. Most of these trials were done inside a small temperature controlled room at Sunkist's Lindsay facility using navel oranges that we infested with bean thrips in Riverside.

Although efficacy was not as high as would be desired for a stand-alone post-harvest treatment, the 83.9% (low rate) to 94.2% (high rate) bean thrips mortality observed in our most recent trial suggests that we ought to proceed with a commercial trial. We have a cooperator lined up to do this study in January or February. IF efficacy of the treatment is demonstrated in the commercial packinghouse trial, we envision that Turbocide might be a future component of a "systems approach" for bean thrips management which includes (1) use of field sticky cards, (2) field fruit cutting, (3) packinghouse fruit cutting and inspection, (4) possible Turbocide or other post-harvest treatment (used or not based on what was seen in the previous systems components), (5) fruit warmed to 65°F for 8 hours prior to fruit washing, (6) lot labeling for traceback, and (7) pre-clearance inspection (or shipment to Australia without pre-clearance). All components listed except (4) are currently part of the Australian shipment protocol.

While traveling in Chile, Dr. Mary Lu Arpaia observed that 2,4-D treatments were being applied to reduce navel size in navel oranges. Based on her recommendations we applied 6 treatments to each of 2 navel orange varieties to see if navel size might be reduced, making it less attractive as an overwintering site for bean thrips. We will evaluate navel size with Dr. Arpaia in January.

In addition to bean thrips, mites are also a problem in Australia and probably lead to more methyl bromide fumigations than do bean thrips. Research on ozone fumigation is being done by Dr. James Leesch and Mr. Steven Tebbetts, USDA-ARS, Fresno, and we have provided them with three mite species for testing with ozone: two-spotted spider mite, *Tetranychus urticae*; citrus flat mite, *Brevipalpus lewisi*; and citrus rust mite, *Phyllocoptruta oleivora*. Based on their test results, ozone showed promise in control of two-spotted spider mite but was probably not sufficiently effective against either citrus flat mite or citrus rust mite to be of use.

Technology Transfer: Dr. Beth Grafton-Cardwell has been most helpful in posting pictures of thrips which might be confused with bean thrips on her citrus extension web site in addition to various types of information of interest to people working on bean thrips (where sticky cards may be purchased, a listing of the "8-point plan" required for growers shipping to Australia, details on the Australian Pre-clearance Program, etc.). She and Neil O'Connell set up a bean thrips field day at the Tulare Co. Ag building on 31 Aug. 2006. We discussed the current bean thrips mitigation plan for shipment of navel oranges to Australia (how to monitor field populations, the importance of removing weeds near the grove which might harbor bean thrips, use of color sticky traps – what color trap to use and when to monitor, etc.). Beth also set up and ran a bean thrips field day at a citrus grove near Ducor on 11 Sept. 2006.

Special thanks are due Rick Dunn (Badger Farming Co., Exeter), Julie Doctor (Sunkist Growers, Inc.), Beth Grafton-Cardwell, Wally Ewart (CCQC), and MGK Corp. for their assistance with or facilitation of our bean thrips research. Rick Dunn has been especially helpful in monitoring levels of bean thrips on various color sticky traps, in evaluating bean thrips levels on sticky traps used for California red scale male catch, and in providing several groves which could be used for various bean thrips studies.

Over the 4 years of this project, the Citrus Research Board has borne only 28% ($52,000 in total) of the direct costs of the bean thrips project whereas USDA has supported the remainder ($134,523 in direct costs, $166,096 in total). We are currently winding down this project with an eye towards writing up research results and finishing research on high priority objectives. One manuscript is in press with *Pest Management Science* and a second was recently submitted to *Crop Protection*. We have a large data set that is being analyzed in which we determined when during the fall / winter bean thrips could be caught on sticky cards, which of 4 color cards was most effective, and how card capture correlated with bean thrips levels in fruit. *More →*

Work Done During 2005-06: We made considerable research progress during 2005-06 as summarized below.

(1) Completed analysis of data comparing bean thrips capture on yellow, white, blue, and green sticky cards from a series of studies done on asparagus plants in Riverside and submitted a manuscript to Pest Management Science which is now In Press (Harmen et al. 2007a as listed above).

(2) Because we were concerned that results during summer on asparagus might be different than those on citrus during late fall and winter, we replicated this work with the 4 color of sticky cards at two citrus field sites in the San Joaquin Valley during late fall and winter 2005-06. At each site, 40 cards of each color (160 total) were used to monitor bean thrips every several weeks. Results on citrus were very similar to those on asparagus. The citrus data also provided data on what other species of thrips are caught on sticky cards and when during the winter bean thrips flight activity is high.

(3) We evaluated Turbocide as a possible post-harvest treatment for bean thrips control.

(4) Studies looking at two possible methods of non-destructive sampling of bean thrips levels in navel oranges (i.e. without cutting the fruit) were analyzed and submitted for publication in Crop Protection. Washing the bean thrips out of the navel with distilled water onto a screen for counting was just as effective as the use of a number of other washes and might be a method that could be used in a packinghouse if these were a need (if post-harvest Turbocide treatment is effective, this might not be worth the time and cost).

(5) We put on a large field trial with the assistance of Rick Dunn, Badger Farming Co., and Jim Stewart. Fifteen citrus plots were monitored for bean thrips flight activity by placing 10 green sticky cards in each plot. Results were used to set up a randomized complete block experiment in which two treatments (Surround at 75 lbs per acre versus hydrated lime at 150 lbs per acre) were applied to each of 5 plots compared to an untreated control to see if treatments might reduce the levels of bean thrips flying into citrus in the fall. The outside 5 rows of treated blocks were sprayed with the treatment and green sticky cards were hung in rows 2 and 7. Results suggest that neither Surround or hydrated lime reduce bean thrips movement into citrus.