MONITORING AND THE USE OF MASS TRAPPING OUTSIDE THE ORCHARD TO CONTROL CONSPERSE STINK BUG (*EUSCHISTUS CONSPERSUS* UHLER) IN PEAR ORCHARDS

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ABSTRACT

Consperse stink bug (*Euschistus conspersus*) (CSB) is the most commonly noted stink bug pest of pears in California. Though considered a localized pest, it can cause great damage to fruit if unmanaged, and is of major concern in fruit destined for canning. Like other true bug pests, its presence has increased since the advent of mating disruption for codling moth control due to reduced organophosphate use. Management is generally accomplished by visually monitoring the presence of CSB in vegetation outside the orchard in the spring, and then CSB presence and damage within the orchard during the summer, followed by treatment with broad-spectrum materials if necessary. Timing applications can be problematic due to the uncertainty of determining the timing of nymphal hatch and development and insect movement from external weed hosts into the orchard. In 2002, research was initiated in one orchard in the northern Sacramento Valley to test a degree day model developed for tomatoes. The Zalom-Cullen model appeared to accurately predict the hatch of the first summer generation in the orchard. In 2005 research continued in four orchards in Lake County. In addition to continued testing of the Zalom-Cullen model, four trap and lure combinations (two trap and two lure types) were compared to determine which best tracked seasonal CSB phenology. The two trap types were the double-cone trap used in tomato research in California and the Intercept® Pyramid cone trap developed by WSU and Applied Plant Technologies, Inc. (APT). The APT lure caught significantly more adult CSB than the Trece lure but there was no significant difference between the two trap types. Damage was highest in the proximity of the traps and decreased as the distance from the traps increased. Peak adult trap catch occurred later than the model predicted. In 2006, four double cone/APT traps were placed every 75 feet along the perimeter **outside** the same four orchards, with two inside, to determine if CSB could be lured out of the orchard. Average seasonal trap catch was equal both inside and outside the orchard, suggesting it might be possible to deploy traps solely outside the orchard to trace flights. Damage was again mainly restricted to trap trees or those immediately adjacent. Peak adult catch coincided well with the model's theoretical peak 1-3rd nymphal hatch at 558°D. In 2007, the number of both inside and outside traps was increased. Half the inside traps were empty to discern whether CSB would be caught without a lure; no CSB were caught in lureless traps. Average per trap catch was generally higher in outside traps, again suggesting CSB could be lured outside the orchard. Marked CSB will be used to further study this possibility in 2008. Nymphal presence in traps coincided well with predicted nymphal hatch (around June 14).

INTRODUCTION

True bugs, e.g. stink bugs, boxelder bugs, and lygus bugs, while historically pests in some pear orchards, can be even more problematic in mating disrupted orchards due to the reduced use of broad spectrum insecticides which (at least moderately) control them. The most effective material traditionally used to control them, dimethoate (e.g. Cygon®), is quite disruptive to natural enemies, and also is now an unallowable material in orchards with fruit destined for certain processing uses (i.e. baby food).

Consperse stink bug (CSB) is only one of several stink bugs found in pear orchards. Another one somewhat less commonly found is Conchuela (*Chlorochroa ligate*). Complete details on the identification and life cycle of stink bugs, as well as other true bugs in pear orchards can be found in *Integrated Pest Management for Apples and Pears, 2nd edition* (UCANR Publ. #3340) and the UC IPM Pest Management Guidelines: Pear, revised September 2002 (available on the website *www.ipm.ucdavis.edu*). Briefly, there are three stages of CSB: eggs, nymphs, and adults. They overwinter as adults in or near orchards. Favorite host crops include wild mustard, wild rose, common mullen, and dock, but also many others. In late March through early April they mate and lay eggs; some may move into the orchard at bloom if it is warm. First generation nymphs mature in June and move into the orchard as weed hosts dry. They then feed on the developing crop as well as orchard weeds, mate and lay eggs. Second generation nymphs mature from late June through October, and leave the orchard to start the cycle again.

Insecticide treatments have targeted 1) overwintering sites prior to movement into the orchard, and 2) orchard populations from late spring to pre-harvest. Timing is often difficult due to the need for time-consuming searches and unpredictable, spotty distribution. There is also increasing resistance to spraying riparian vegetation with disruptive insecticides such as dimethoate and formetanate hydrochloride (Carzol®), and more recently, pyrethroids (e.g. Danitol®) due to negative water quality effects.

Pheromone-base monitoring is being researched on the West Coast by Dr. Jocelyn Millar (UC Riverside), Dr. Jay Brunner (WSU Wenatchee) and Dr. Frank Zalom (UC Davis). Dr. Zalom has developed a degree-day-based phenology model for use in processing tomatoes, which combined with commercially available CSB lures (Trece, Inc., Adair, OK) in double cone traps, enables one to more exactly track the population dynamics and time treatments. This is important because newer selective materials must be timed more accurately to achieve good results. The degree-day model/trap system is also potentially more efficient than relying solely on visual search, beating tray, and sweep net sampling.

The Zalom-Cullen phenology model (developed with his graduate student Eileen Cullen), sets biofix when the first adult CSB are caught in a double cone trap in the orchard. The minimum temperature threshold is 53.6° F (12° C) with no established maximum. After peak adult emergence in June, peak first generation summer nymphal emergence should occur at about 558 °D. Nymphs can also be caught in the traps, but this is less likely as they tend to disperse and are more attracted to the crop. A second emergence occurs in late August to early September but will be less pronounced as adults leave the orchard. The model and traps are supplemented by beating tray samples (and shaking in tomatoes) and visual searches. A complete description of the phenology model and double-cone traps can be found in the UC IPM Pest Management Guidelines: Tomato (available at *www.ipm.ucdavis.edu*).

While the degree-day model was developed for processing tomatoes, it was deemed worthwhile to test it in pears. Data from several lower Sacramento Valley tomato fields was compared to a pear test site in Marysville in 2002; similar trap catch occurrence to tomatoes indicated that the system could be transferred to pears.

In addition to the double-cone trap system used in California, the yellow Intercept® Pyramid trap baited with an aggregate pheromone lure (Advanced Pheromone Technologies, Marylhurst, OR) was successfully tested in North Central Washington in 2001.

In 2005, four trap and lure combinations were tested in four Lake County orchards to compare efficacy, ease of use, and cost. The Zalom-Cullen °D model was run in conjunction with trapping to determine if it accurately predicted CSB phenology. Results showed the double cone/APT lure combination as the most effective, as well as economical option. Adult trap catch occurred much later (745°D) than predicted; this was likely due to the very late spring.

In 2006, double cone/APT traps were placed along the perimeter **outside** the same four orchards as in 2005 plus one more (total of five orchards), with fewer traps placed inside the orchard. The goal was to determine if CSB could be "lured" out of the orchard into the perimeter traps. The Zalom-Cullen model was again run, and damage assessed and mapped at harvest.

In 2007, a series of double-cone traps were again placed inside and just outside the edge of five locations in four orchards. Three of the orchards were the same as in 2006, and two locations were added in one additional orchard. At each of these sites, 10 traps were placed inside and 8 outside the orchard. Half (5) of the inside traps contained an APT lure while half were empty. In the remaining previously-trapped orchard, two traps with lures were placed inside the orchard as in 2006, and one trap with lure along distant corridor to the east. Goals in 2007 were to 1) again, determine if multiple traps could be used to draw CSB out of the orchard and 2) confirm the APT was the source of attraction rather than the double-cone trap itself. The Zalom-Cullen model was again run and damage assessed and mapped.

PROCEDURES

Trap locations and degree days (Figures 2a - 6a)**:**

In five orchard locations (#2-5), eight traps with lures were placed 25 meters (75 feet) apart along vegetative perimeter **outside** the orchard. Another five traps with lures plus five traps without lures (total of 10) were placed **inside** the orchard in the same location as in 2006. In one more orchard (#1), two traps were placed in the inside row in the vicinity of historical damage (in this case, the CSB were known to be living year round inside the orchard, versus the other four, where they were primarily entering from external habitat). One trap was placed along an outside border quite a distance from the site of historical damage, as there was no nearby available perimeter vegetation. Traps were checked weekly from April 9 - October 2 for male and female adults and nymphs, and lures changed every 45 days. The Zalom-Cullen degree-day model was run as in previous years.

CSB presence and damage:

Bin damage was evaluated in three orchards (one orchard was unfarmed and one was unexpectedly harvested before sampling could be completed) and damage pattern mapped to assess relationship to outside and inside trap location.

RESULTS AND DISCUSSION

CSB phenology and degree days (Tables 1-2) (Figures 1a – 6c)**;**

Biofix was set on April 17. Average peak adult catch occurred June 19 (644 °D) in Orchards 2-5, and on May 2 (80 °D) in Orchard 1. There were no CSB caught in any traps without lures, thus, data was only analyzed and presented for those traps with lures (8 outside and 5 inside). Outside traps caught more CSB except in Orchard #1 where inside traps caught more and earlier. There were 19% more females caught than males, 71% more outside and 5% more inside. Nymphs were trapped in four locations in 2007. They accounted for 14% of total catch: 23% of outside and 10% of inside catch. Nymphal presence in traps coincided with predicted peak nymphal harch in two of the three orchards where they were trapped.

Two orchards (#1 and #5, Kelseyville) were treated specifically for CSB. Orchard #1 was treated on May 31 (398 °D) and Orchard #5 on June 19 (644 °D). The latter treatment coincided with predicted nymphal hatch and appeared to have reduced subsequent catch. Catches trended lower after June 19, with a second peak around September 11 (2007 °D). Harvest occurred September 15-22, depending on location.

Bin damage in relation to trap location (Table 3)

As in 2005 and 2006, damage in 2007 was worst in the trap trees and dramatically decreased with distance. Given the similar pattern of trap catch between inside and outside traps, it again appears that if enough traps are placed outside the orchard, they may act to "lure" CSB away from fruit. This next step will be further explored in 2008 using marked CSB adults.

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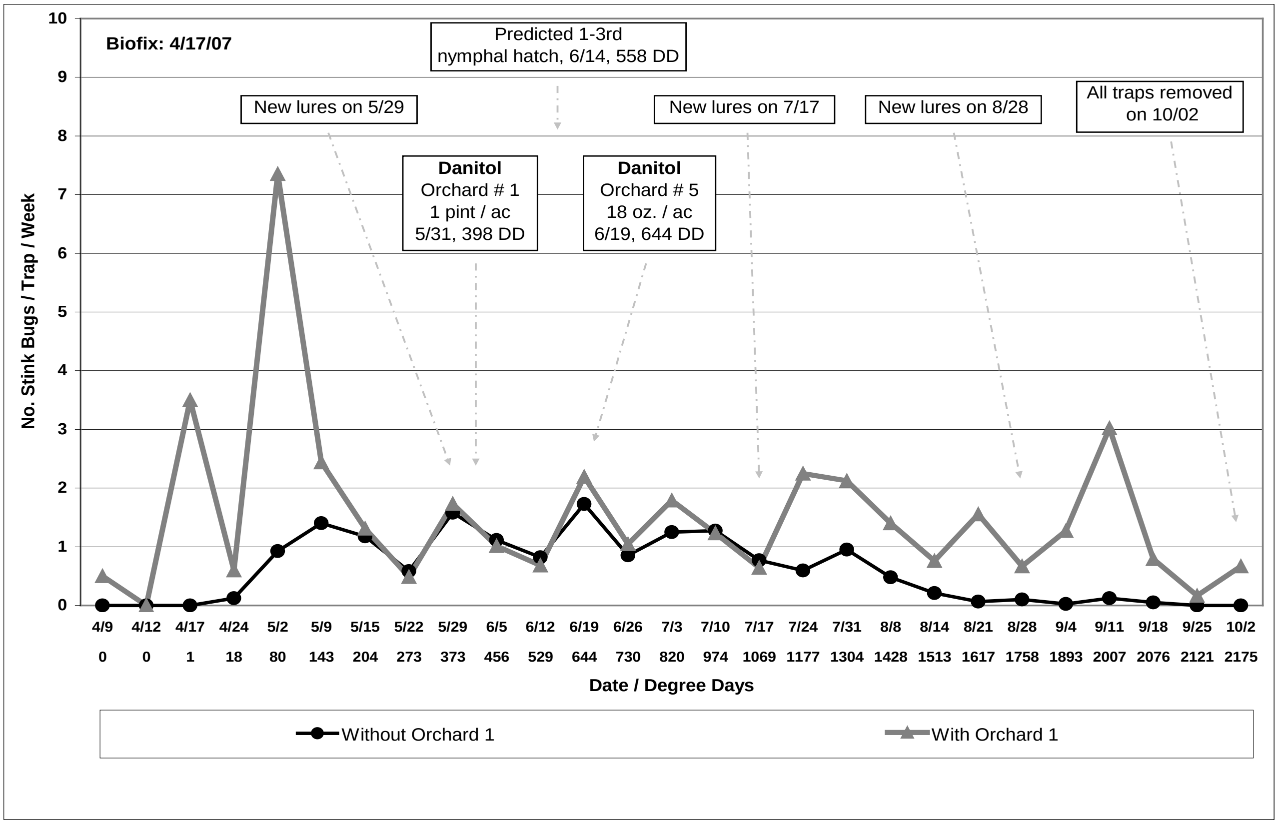

Figure 1a. Consperse stink bug average trap catch in traps with lures, and degree-days using an April 17 biofix, with and without Orchard #1, Kelseyville & Scotts Valley, Lake County, 2007.

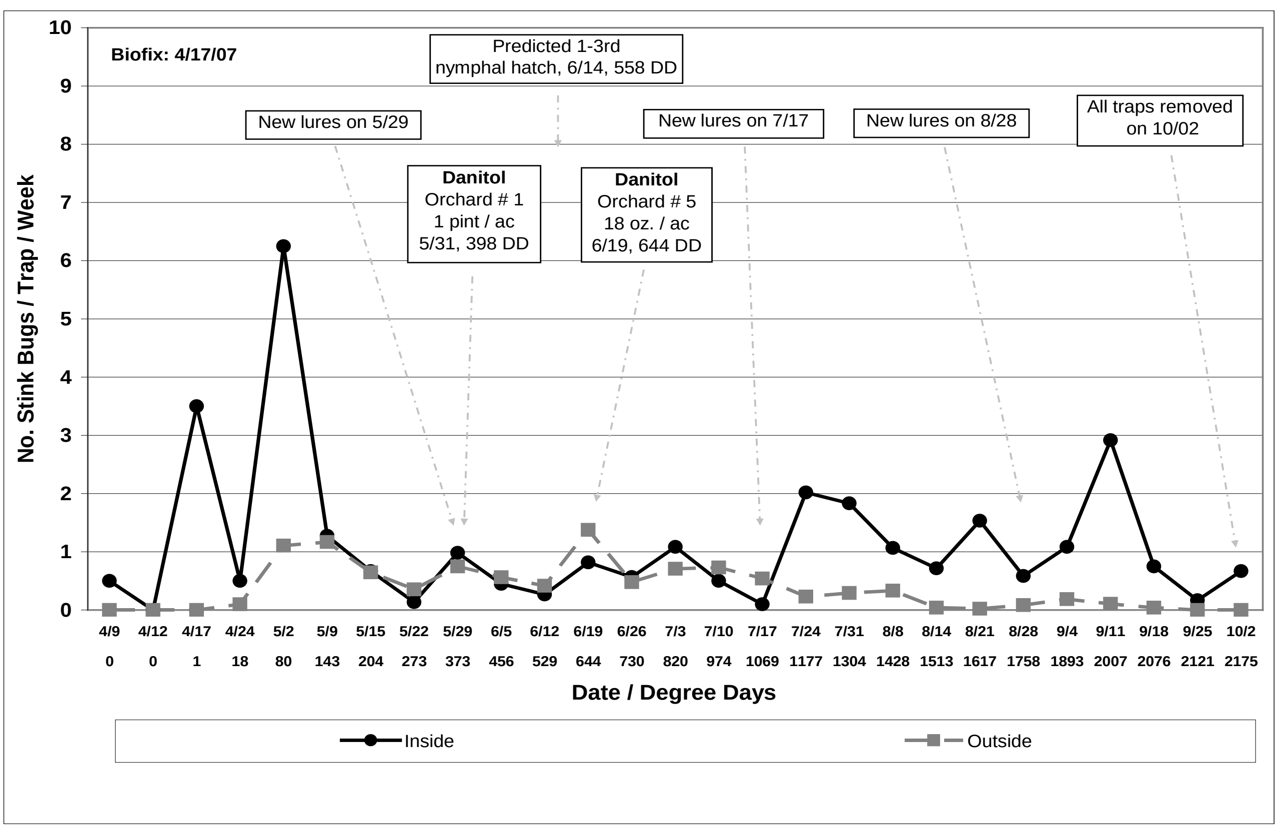

Figure 1b. Consperse stink bug average trap catch in traps with lures, and degree-days using an April 17 biofix, inside versus outside traps, average of 6 orchard locations, Kelseyville & Scotts Valley, Lake County, 2007.

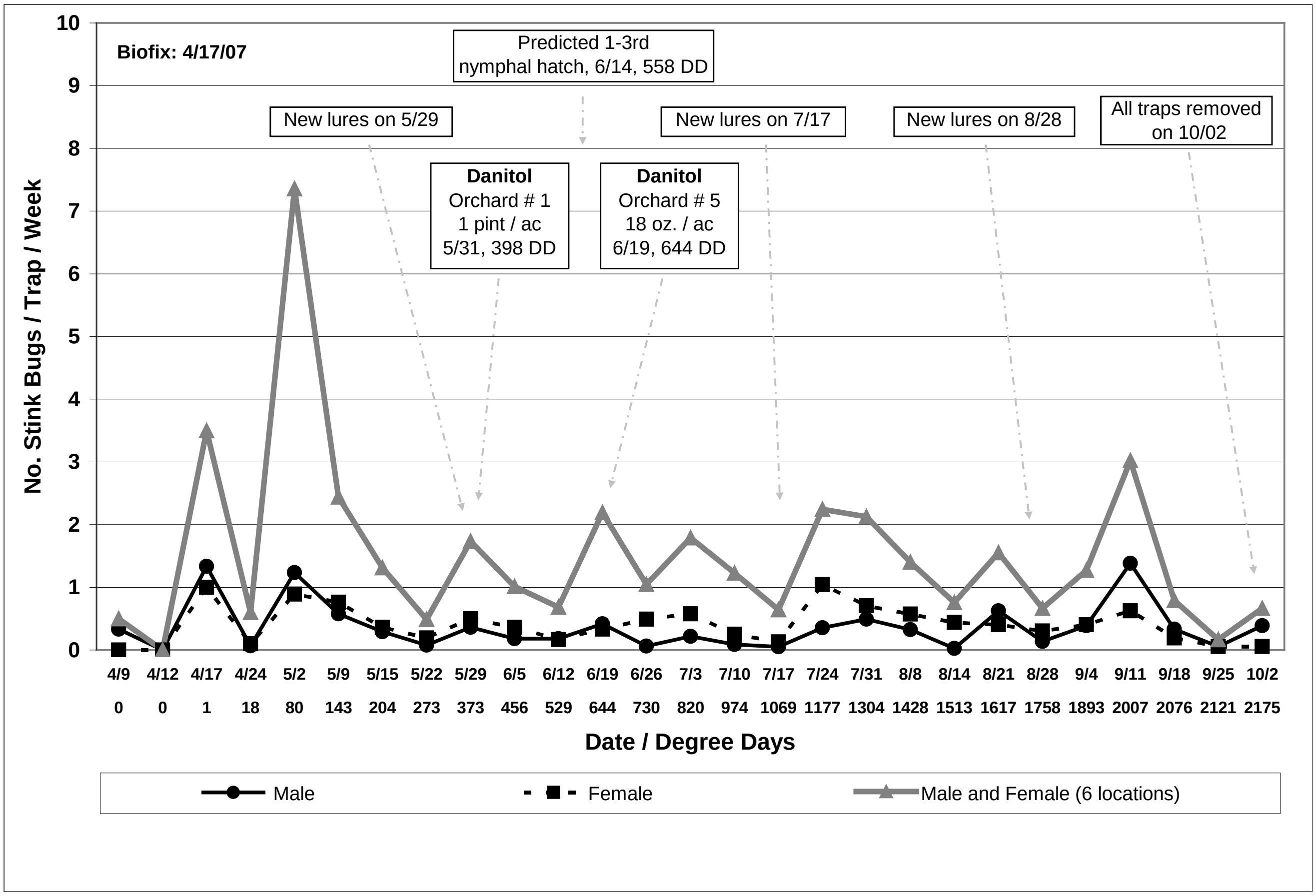

Figure 1c. Consperse stink bug average trap catch in traps with lures, and degree-days using an April 17 biofix, male, female and 6 orchard locations combined averages, Kelseyville & Scotts Valley, Lake County, 2007.

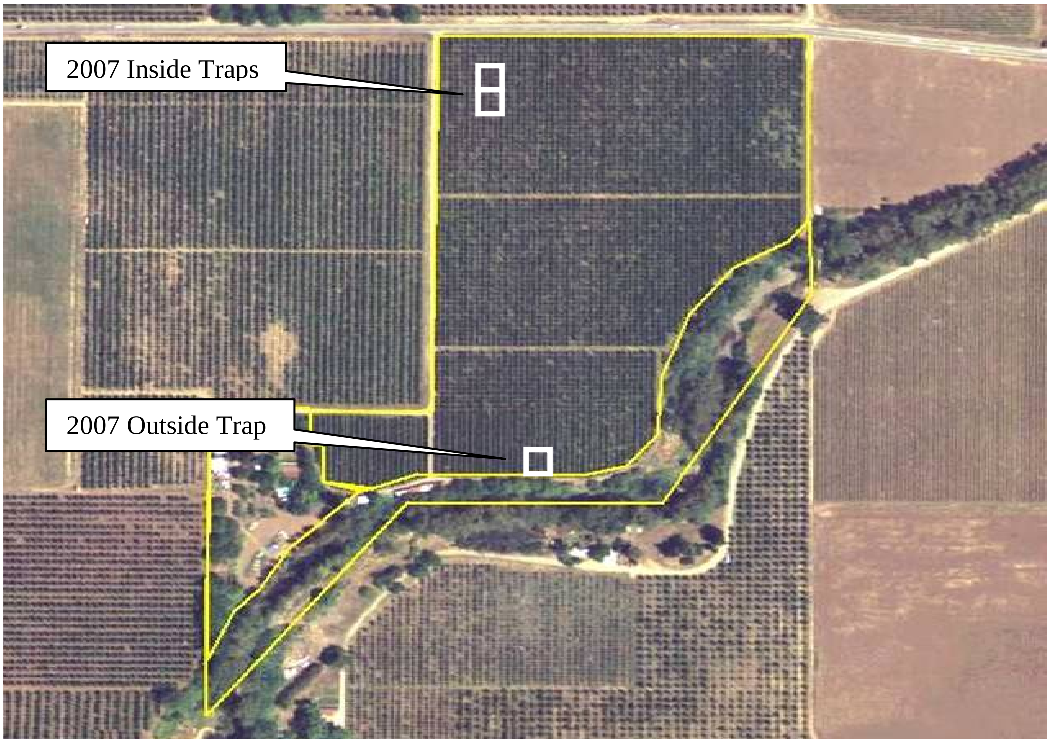

Figure 2a. Location of Consperse stink bug traps, Orchard #1, Kelseyville, Lake County, 2007

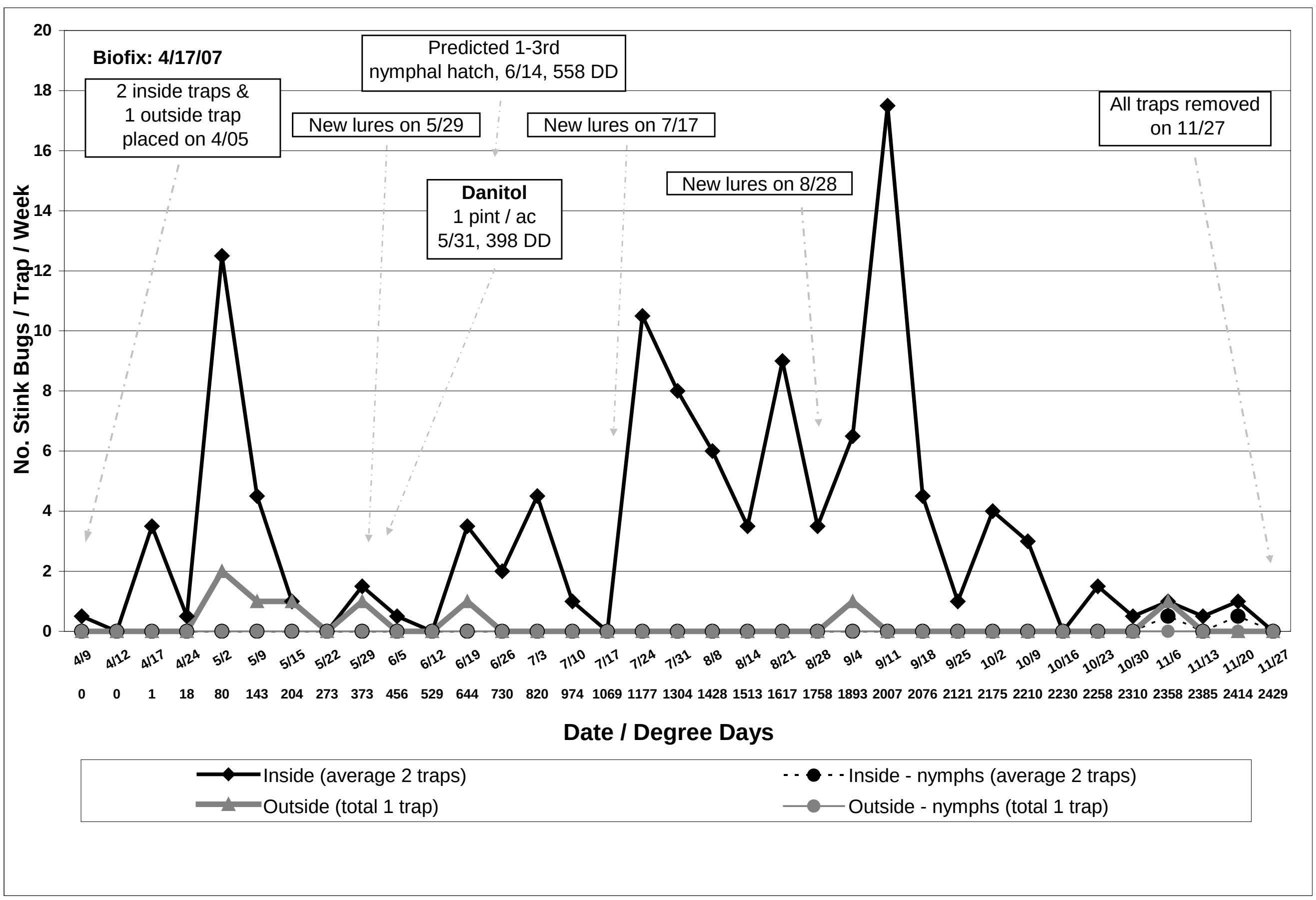

Figure 2b. Consperse stink bug average trap catch, in traps with lures, and degree-days using an April 17 biofix, weekly average of 3 traps, 2 inside and 1 outside, Orchard #1, Kelseyville, Lake County, 2007.

Figure 3a. Location of Consperse stink bug traps, Orchard #2, Kelseyville, Lake County, 2007

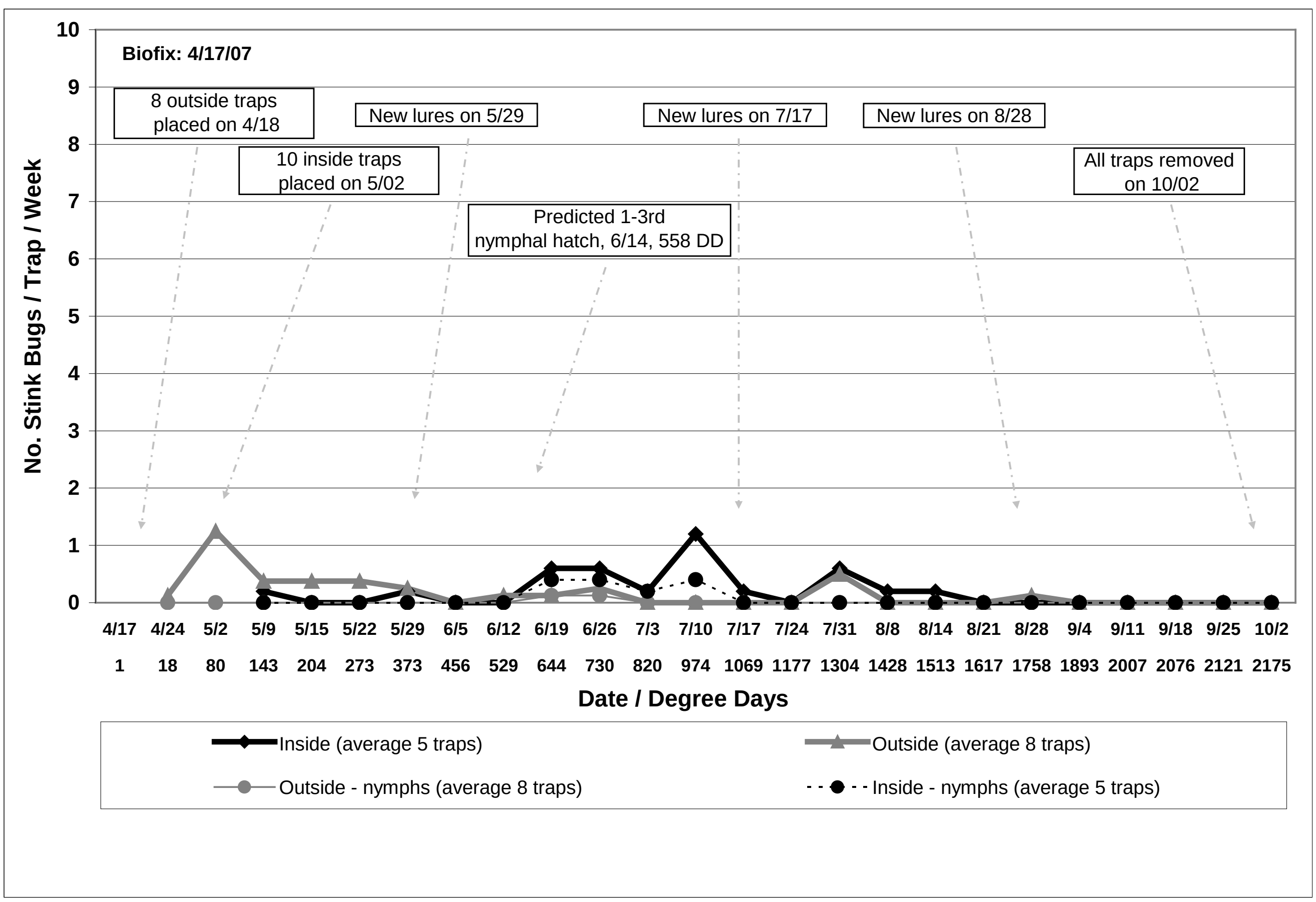

Figure 3b. Consperse stink bug average trap catch in traps with lures, and degree-days using an April 17 biofix, weekly average of 13 traps with lures, 5 inside and 8 outside, Orchard #2 (abandoned), Kelseyville, Lake County, 2007.

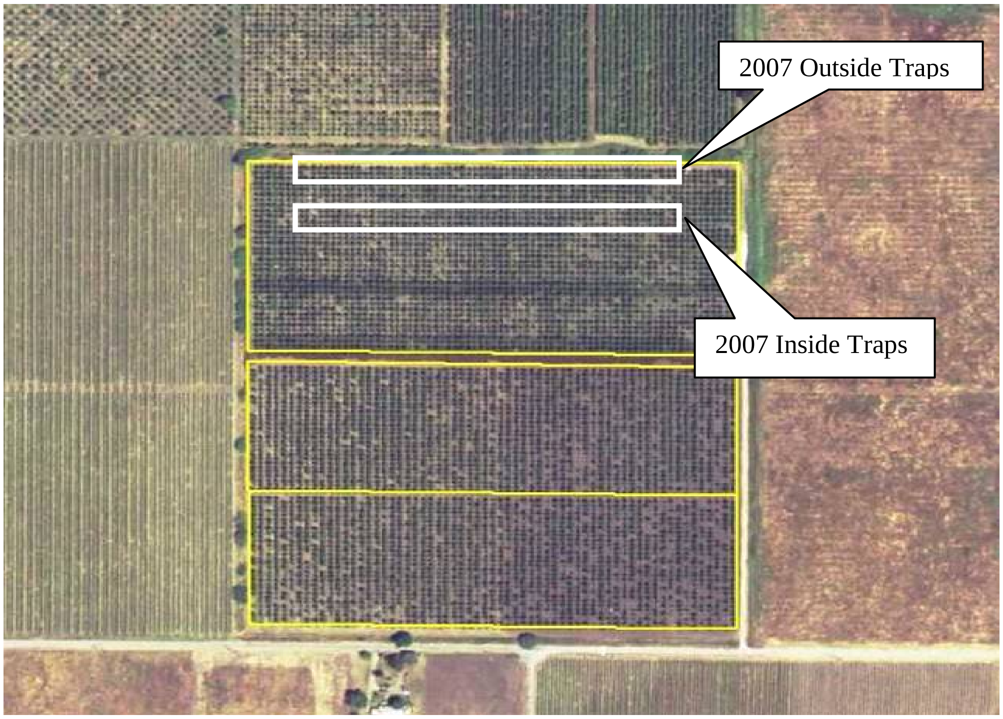

Figure 4a. Location of Consperse stink bug traps, Orchard #3, Kelseyville, Lake County, 2007

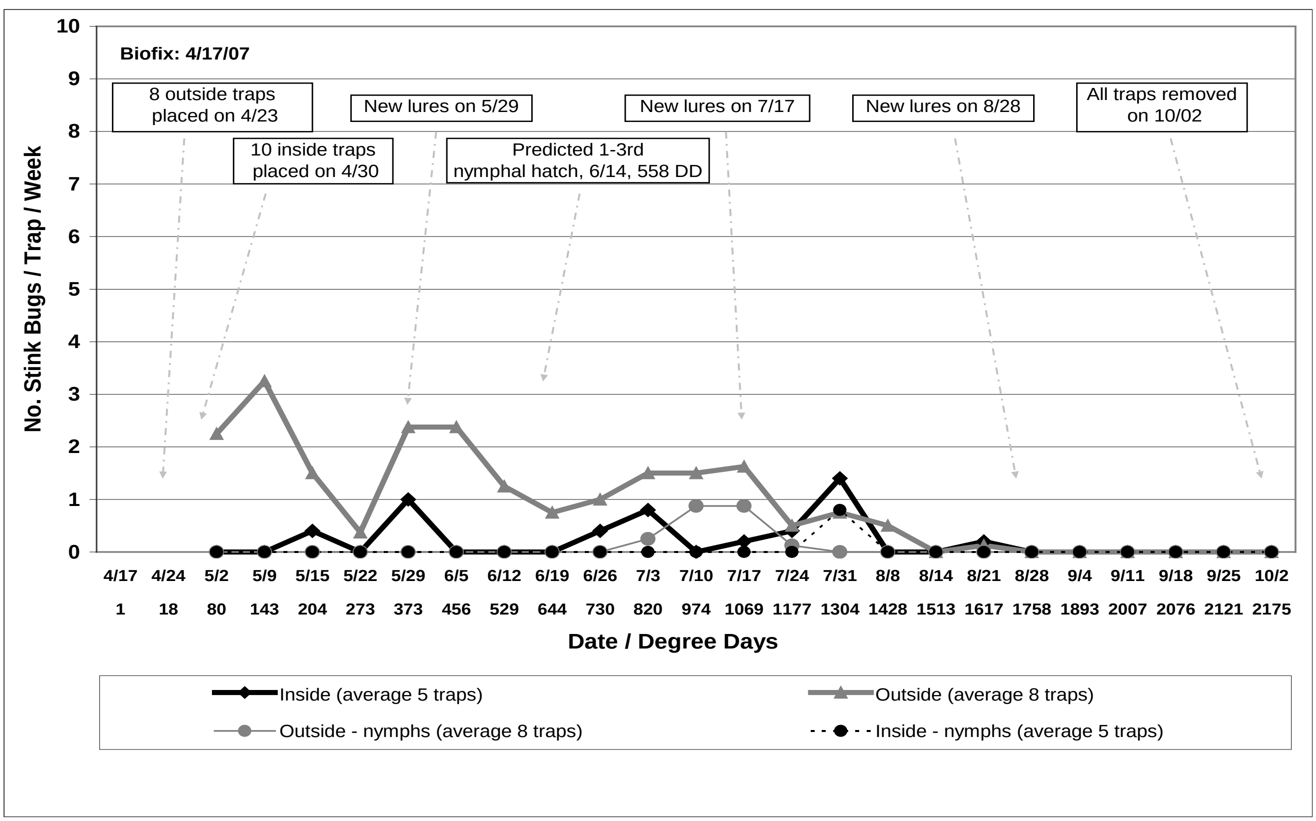

Figure 4b. Consperse stink bug average trap catch in traps with lures, and degree-days using an April 17 biofix, weekly average of 13 traps with lures, 5 inside and 8 outside, Orchard #3, Kelseyville, Lake County, 2007.

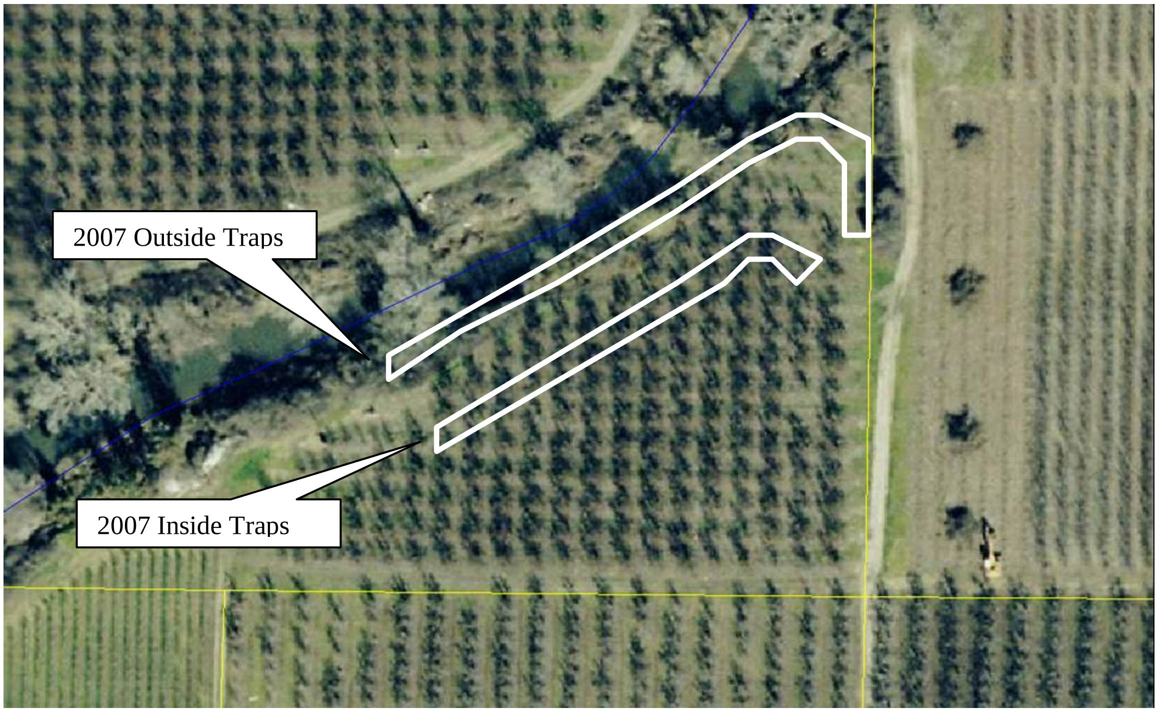

Figure 5a. Location of Consperse stink bug traps, Orchard #4, Scotts Valley (Lakeport), Lake County, 2007

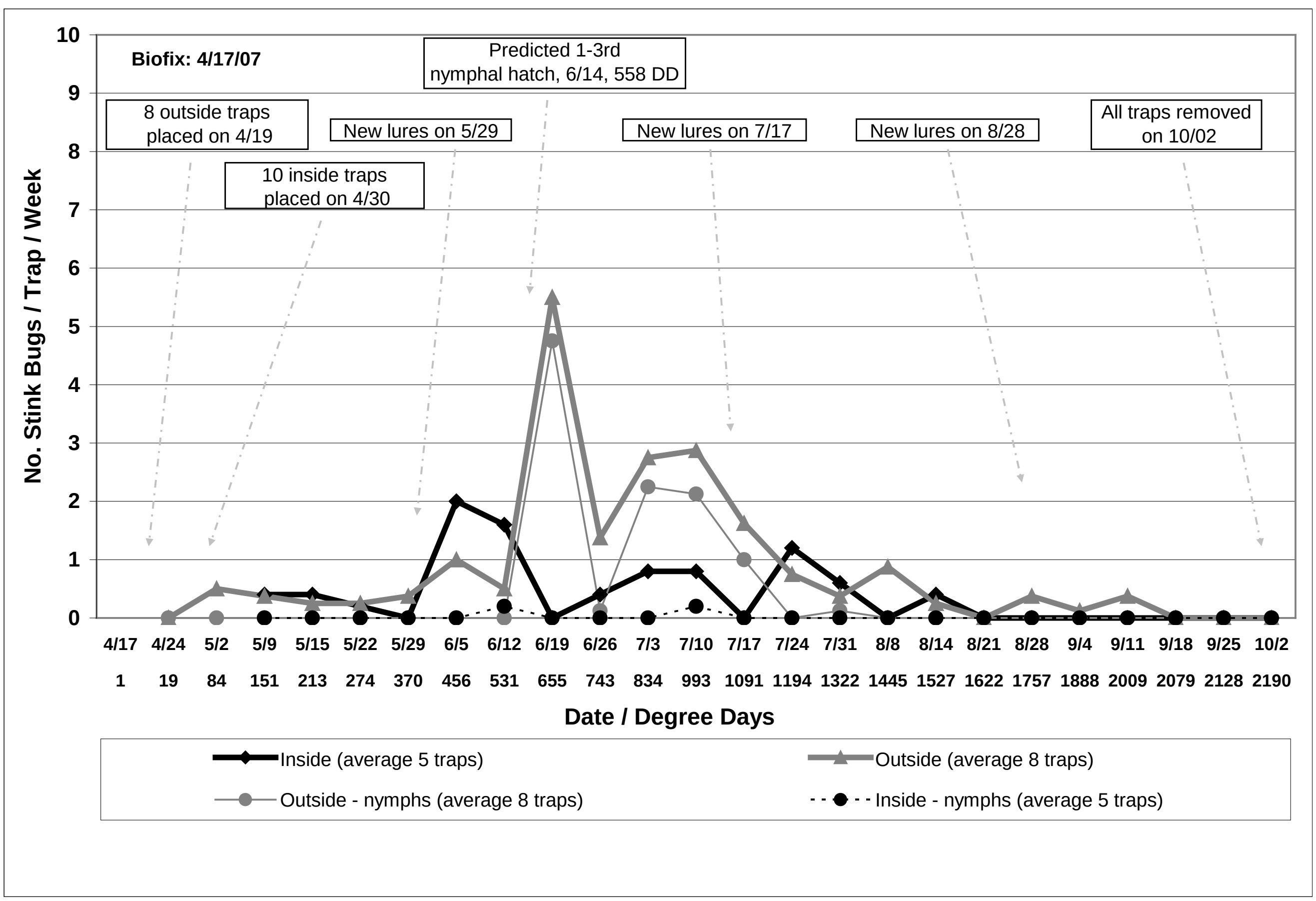

Figure 5b. Consperse stink bug average trap catch in traps with lures, and degree-days using an April 17 biofix, weekly average of 13 traps with lures, 5 inside and 8 outside, Orchard #4, Scotts Valley, Lake County, 2007.

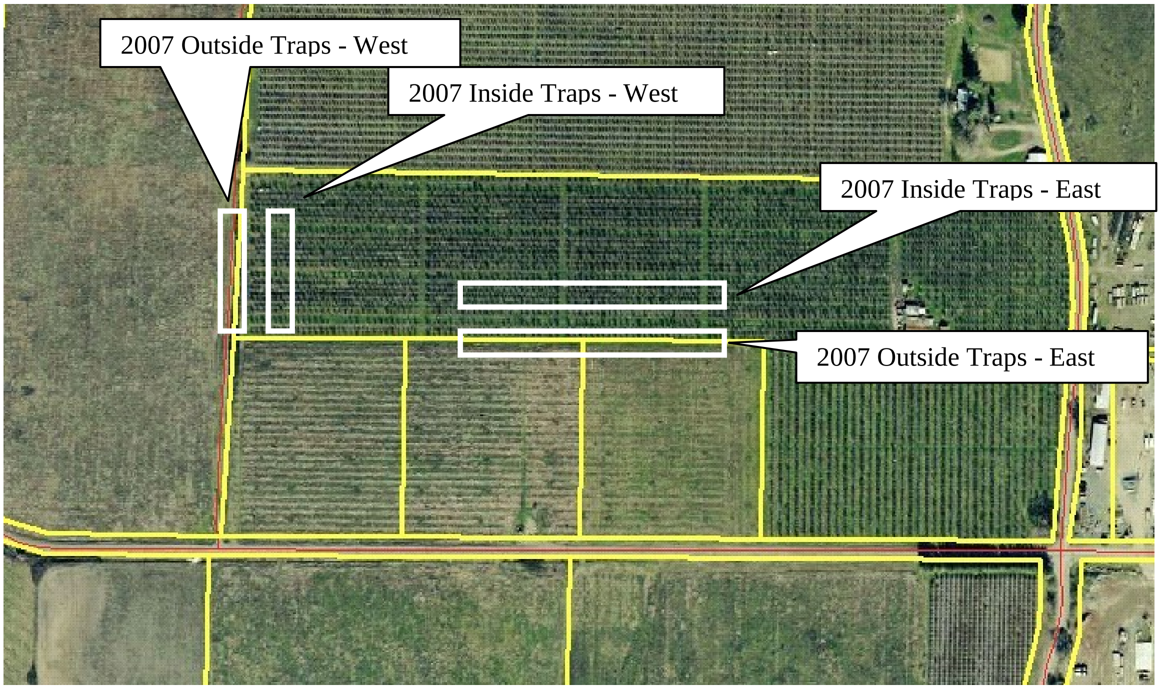

Figure 6a. Location of Consperse stink bug traps, Orchard #5, Kelseyville, Lake County, 2007

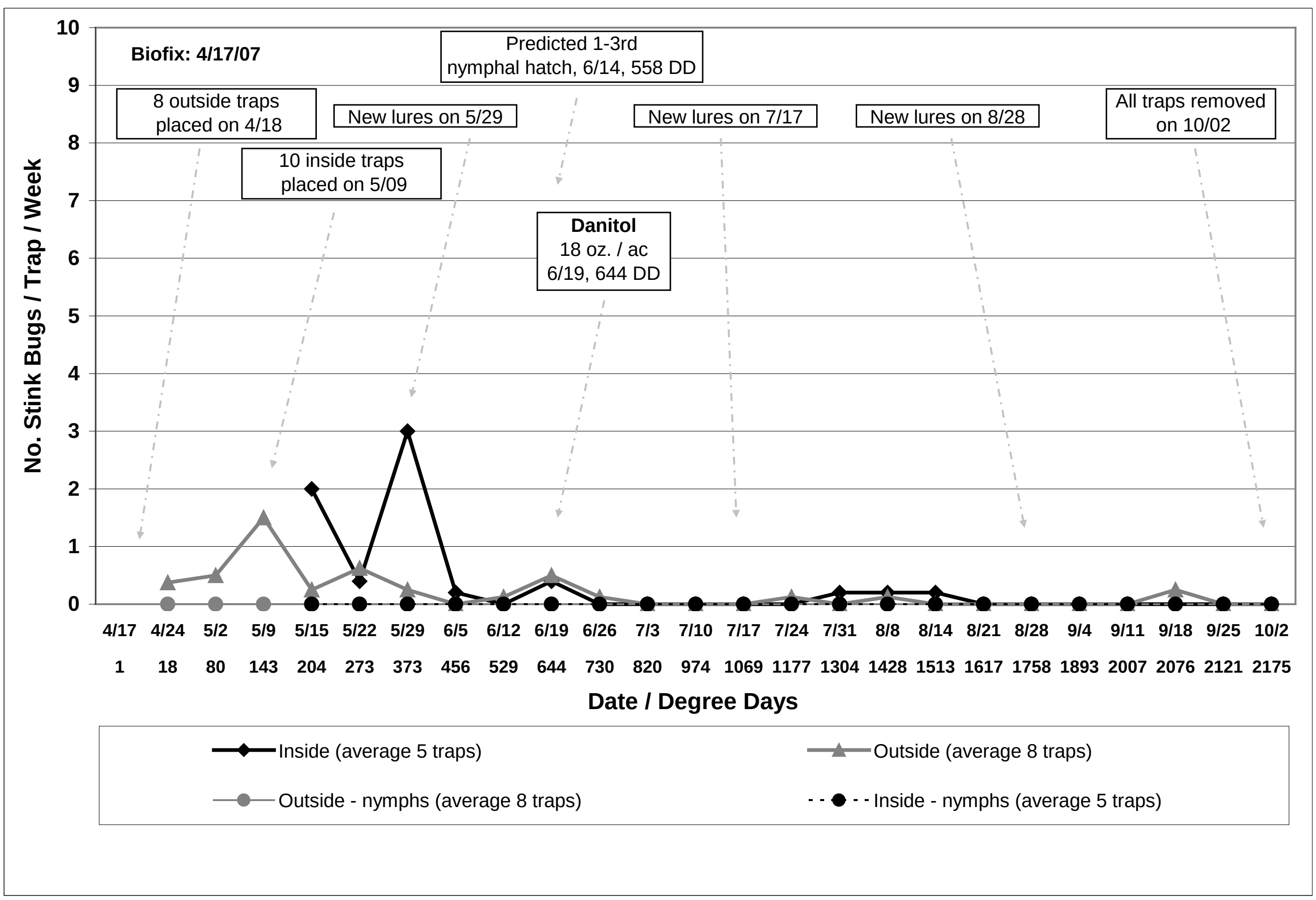

Figure 6b. Consperse stink bug average trap catch in traps with lures, and degree-days using an April 17 biofix, weekly average of 13 traps with lures, 5 inside and 8 outside, Orchard #5, East Section, Kelseyville, Lake County, 2007.

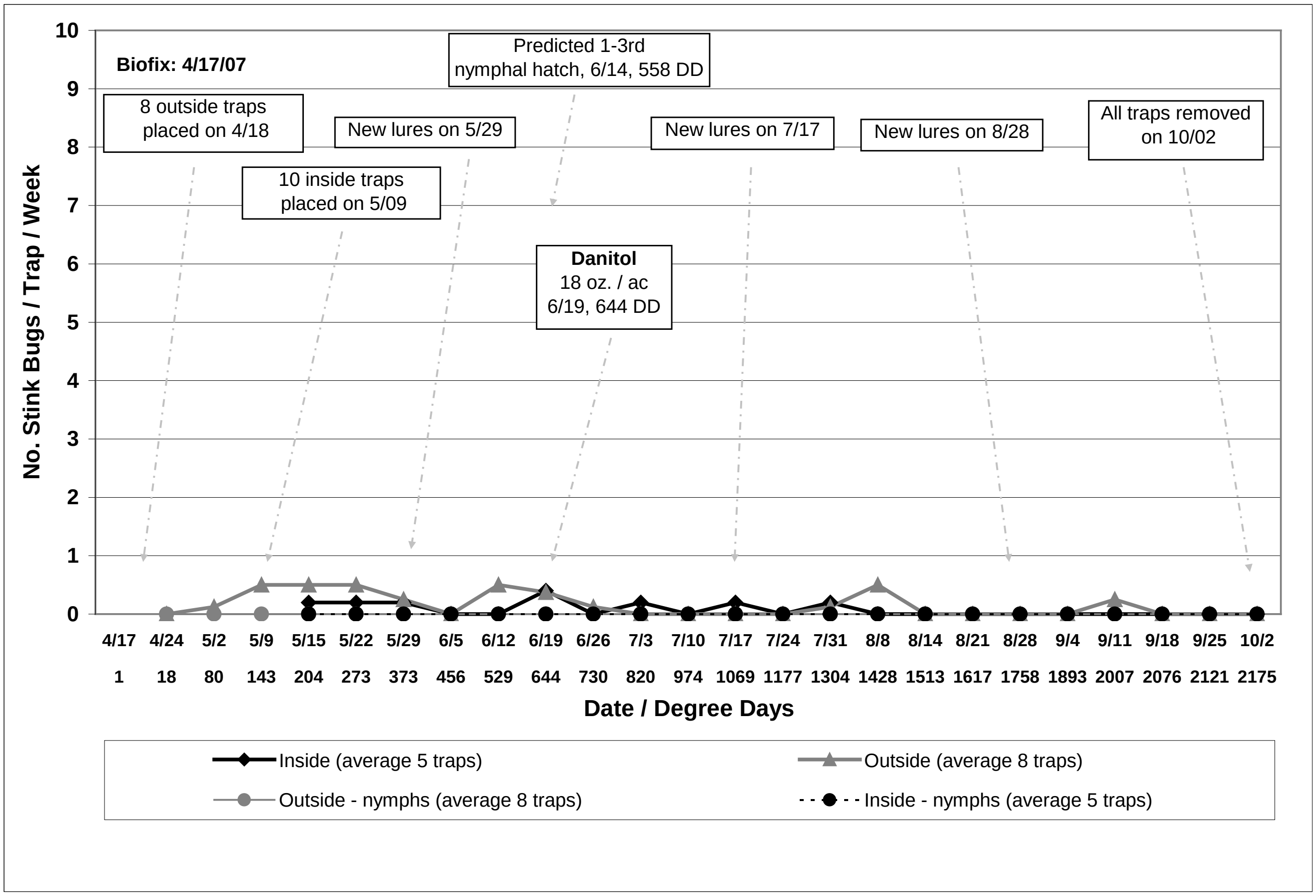

Figure 6c. Consperse stink bug average trap catch in traps with lures, and degree-days using an April 17 biofix, weekly average of 13 traps with lures, 5 inside and 8 outside, Orchard #5, West Section, Kelseyville, Lake County, 2007.

Table 1: Average total seasonal Consperse stink bug trap catch for orchards (#2-5) combined, Lake County, 2007, with lure only

	Average Total CSB/Season [1]		
Trap Location	Adults	Nymphs	Total
Outside (n=40)	8	3	11
Inside (n=25)	5	0	5
P-Value (t-test)	0.13	0.11	0.06

[1] Data analyzed using square root transformation

Table 2: Average per trap total seasonal adult Consperse stink bug trap catches, with lure only, Lake County, 2007 (male, female number in parentheses)

Location	Outside (m, f)	Inside (m, f)	Total (m, f)
1 *	7 (3, 4)	109 (55,54)	116 (58,58)
2	4 (2,2)	3 (1,2)	7 (3,4)
3	19 (7,12)	4 (1,3)	23 (8,15)
4	10 (3,7)	8 (4,4)	18 (6,12)
5 west	5 (2,3)	7 (4,3)	11 (5,6)
5 east	4 (2,2)	2 (1,1)	6 (2,4)
Average with Orchard #1	8	22	30
Average w/out Orchard #1	8	5	13

* Outside traps placed far from area with historical severe damage; data not included.

Table 3: Consperse stink bug damage in relation to distance from traps, Lake County, 2007

Distance From Tree	% Damage for 3 Orchard Locations			
	Orchard #1	Orchard #3	Orchard #5 (east, west combined)	Average
Trap tree	0.5	6.1	0.2	2.3
Tree adjacent to trap tree	n/a	2.3	0.2	1.3
Trees within trap row	0.5	n/a	n/a	0.5
2-4 rows away	0.3	0.1	0.0	0.1
5-9 rows away	0.2	0.1	0.0	0.1
10-15 rows away	0.1	0.0	n/a	0.1
Average total damage	.03	1.7	.01	.7