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# California Pepper Commission
# Research Report 2018-2019

## I. IDENTIFICATION

**A. California Pepper Commission.**
**B. Insect Pest Management on Peppers**
**C. Proposal for period beginning March 2018, ending February 2019.**
**D. Principal Investigator:**
Dr. John T. Trumble
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University of California, Riverside
**E. Cooperating Personnel:**
Greg Kund
Department of Entomology
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Michael Jones
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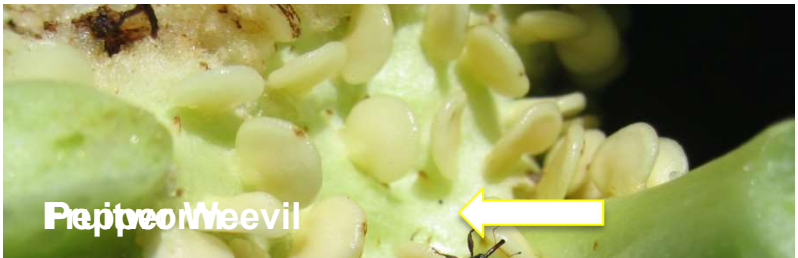
**F. Locations of Work:**
U.C. Riverside Agricultural Operations
Riverside, CA
Riverside County, CA
**G. Insects**
Tomato/Potato Psyllid: *Bactericera cockerell*i (Sulc)
Beet armyworm (BAW): *Spodoptera exigua* (Hübner)
Tomato Fruitworm(TFW): *Helicoverpa zea* (Boddie)
Leafminer: *Liriomyza sativae* (Blanchard)
Leafminer: *Liriomyza trifoilii* (Burgess)
Lygus bugs: *Miridoa* spp.
Stink bugs (SB): *Pentatomidae* spp.
Pepper weevil (PW): *Anthonomus eugenii* Cano
Green peach aphid (GPA): *Myzus persicae* (Sulzer)

## II. Field Screening Trials for Effective Pesticides

Seedlings were transplanted in a sandy loam type soil on 10 May at the University of California Riverside's Agricultural Operations field #10G. Experimental plots were 3 rows wide (5-ft centers) by 40 ft long and separated by a 3-ft buffer. The pepper transplants were drip irrigated (water pH 7.2 - 7.5). Treatments were replicated 4 times in a RCB block design. Application dates and a treatment list are shown in Table 1. All applications were made during working hours when wind conditions were mild. A tractor-mounted boom sprayer with 6 nozzles per row incorporated D-3 orifice disks, #25 cores, and 50 mesh screens. Operating pressure was 100 psi delivering 100 gpa. All treatments included an adjuvant as specified except treatment number seven, which consisted of Pyganic, Trilogy, Mycotrol O, and Entrust.

**Table 1: Pepper Chemical Trial List of Treatments 2018**

| Treatment # | Compound | Rate-Product | Application Dates | Company Sponsor |
|---|---|---|---|---|
| 1 | Control | - | - | - |
| 2 | Radiant SC +<br>Sequoia 2 SC<br>Dyne-amic | 7.0 Fl oz<br>4.5 Fl oz<br>0.25% | 6/14, 6/28, 7/3, 7/12,<br>7/19, 7/27 | Dow |
| 3 | VST-00634 LC<br>Bioprotec<br>Latron B-1956 | 16.0 fl oz<br>16.0 fl oz<br>0.125 %v/v | 6/14, 6/28, 7/3, 7/12,<br>7/19, 7/27 | Vestaron |
| 4 | VST-00634 LC<br>Bioprotec<br>Latron B-1956 | 32.0 fl oz<br>16.0 fl oz<br>0.125 %v/v | 6/14, 6/28, 7/3, 7/12,<br>7/19, 7/27 | Vestaron |
| 5 | Venerate XC<br>Bond Max | 3 qt<br>18 Fl oz | 6/14, 6/28, 7/3, 7/12,<br>7/19, 7/27 | Marrone Bio |
| 6 | IPM<br>a-Intrepid +<br>Sequoia 2 SC<br>b-Radiant SC<br>c-Vydate L<br>Dyne-amic | <br>10.0 oz<br>4.5 oz<br>7.0 oz<br>32 oz<br>0.25% | <br>6/14, 7/12<br><br>6/28, 7/19<br>7/3, 7/27 | Dow |
| 7 | Organic IPM<br>a-Pyganic 1.4EC<br>b-Trilogy EC<br>c-Mycotrol O<br>d-Entrust SC | <br>32.0 oz<br>64.0 oz<br>32.0 oz<br>8.0 oz | <br>6/14, 6/28, 7/19<br>6/28, 7/19<br>7/3, 7/12, 7/27<br>7/3, 7/12, 7/27 | |
| 8 | Chem Standard:<br>Asana XL<br>Dyne-amic | <br>9 oz<br>0.25 % | 6/14, 6/28, 7/3, 7/12,<br>7/19, 7/27 | |



Early and late season field counts of insect populations were taken by counting a single branch from four plants per plot (plots were replicated four times per treatment) to determine what impact the treatments had on insect populations. On 9 Aug, 50 mature-green to ripe fruit were harvested from the center row of each replicate (200 per treatment) and examined for internal damage (TFW), external damage (BAW), and hemipterous pests (SB). Fifty fruit were also inspected for damage from pepper weevils (PW), potato psyllid (PP), and aphids (GPA). Results are shown in Table 2.

Lepidopteran pressure was low to moderate in the category of 'external damage by BAW' (Figure 2). Internal damage by the pepper weevil was very low this year and could be a result of hot weather conditions. Some pepper weevils were seen in the field, but no internal damage by larvae was found. Potato psyllids were present in the field but we did not see significant numbers in our harvest assessment. Damage to the calyx by TFW, BAW, and PW feeding showed no differences between treatments (Figure 1). Harvest assessment of aphid infestation did show a difference for treatment 8, which was the Asana product (Figure 3). Field counts of psyllids revealed significant differences between the treatments for the number of adults. Treatment eight had the highest number of total psyllids (Figure 4).

**Table 2.**

| Treatment/ Formulation | | Rate Amt/acre | Mean Number of Fruit Damaged/Replicate [a] Internal | External | All Leps | Pepper Weevil Internal | Calyx Damage | Aphids |
|---|---|---|---|---|---|---|---|---|
| 1 | Control | - | 0.00 | 2.25 | 2.25 | 0.00 | 3.50 | 1.25 b |
| 2 | Radiant SC + | 7.0 Fl oz | 0.00 | 3.00 | 3.00 | 0.00 | 1.00 | 0.00 c |
| | Sequoia 2 SC | 4.5 Fl oz | | | | | | |
| | Dyne-amic | 0.25% | | | | | | |
| 3 | VST-00634 LC | 16.0 fl oz | 0.00 | 2.00 | 2.00 | 0.00 | 4.50 | 0.25 bc |
| | Bioprotec | 16.0 fl oz | | | | | | |
| | Latron B-1956 | 0.125 %v/v | | | | | | |
| 4 | VST-00634 LC | 32.0 fl oz | 0.00 | 2.00 | 2.00 | 0.00 | 1.50 | 0.00 c |
| | Bioprotec | 16.0 fl oz | | | | | | |
| | Latron B-1956 | 0.125 %v/v | | | | | | |
| 5 | Venerate XC | 3 qt | 0.25 | 2.50 | 2.75 | 0.00 | 2.00 | 0.00 c |
| | Bond Max | 18 Fl oz | | | | | | |
| 6 | IPM | | 0.00 | 3.25 | 3.25 | 0.00 | 1.25 | 0.00 c |
| | a-Intrepid + | 10.0 oz | | | | | | |
| | Sequoia 2 SC | 4.5 oz | | | | | | |
| | b-Radiant SC | 7.0 oz | | | | | | |
| | c-Vydate L | 32 oz | | | | | | |
| | Dyne-amic | 0.25% | | | | | | |
| 7 | Organic IPM | | 0.00 | 2.75 | 2.75 | 0.00 | 1.75 | 0.00 c |
| | a-Pyganic 1.4EC | 32.0 oz | | | | | | |
| | b-Trilogy EC | 64.0 oz | | | | | | |
| | c-Mycotrol O | 32.0 oz | | | | | | |
| | d-Entrust SC | 8.0 oz | | | | | | |
| 8 | Chem Standard: | | 0.00 | 1.25 | 1.25 | 0.00 | 3.25 | 50.00 a |
| | Asana XL | 9 oz | | | | | | |
| | Dyne-amic | 0.25 % | | | | | | |
| ANOVA F value (by column) | | | 1.000 | 0.563 | 0.556 | -- | 2.242 | 2587.9 |
| ANOVA P value (by column) | | | 0.455 | 0.778 | 0.783 | -- | 0.066 | 0.001 |

[a] Means in columns followed by the same letter are not significantly different ($P<0.05$ level, Fisher's LSD Test). Internal damage due primarily to (TFW); external damage due primarily to (BAW). Calyx damage can be attributed to (TFW), (BAW), and (PW) feeding.

Figure 1. Calyx feeding damage

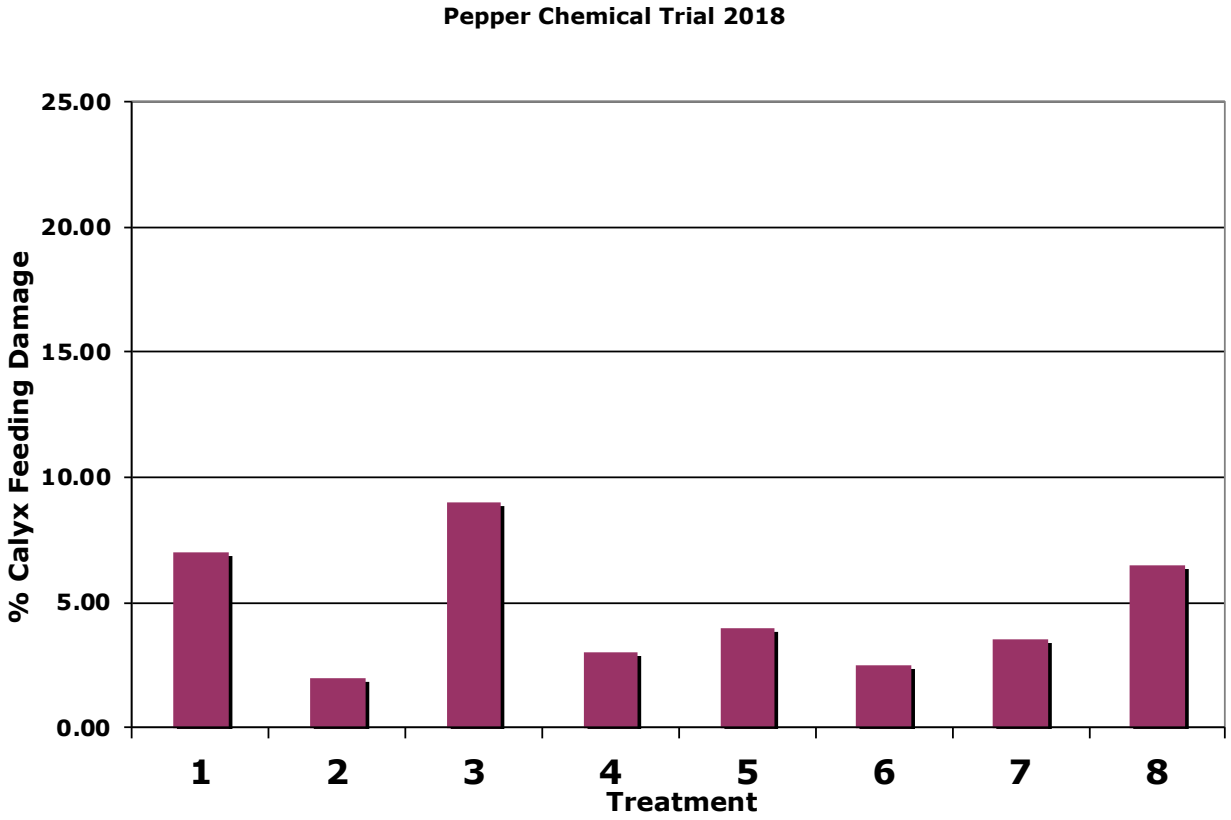



Figure 2. Lepidopteran damage

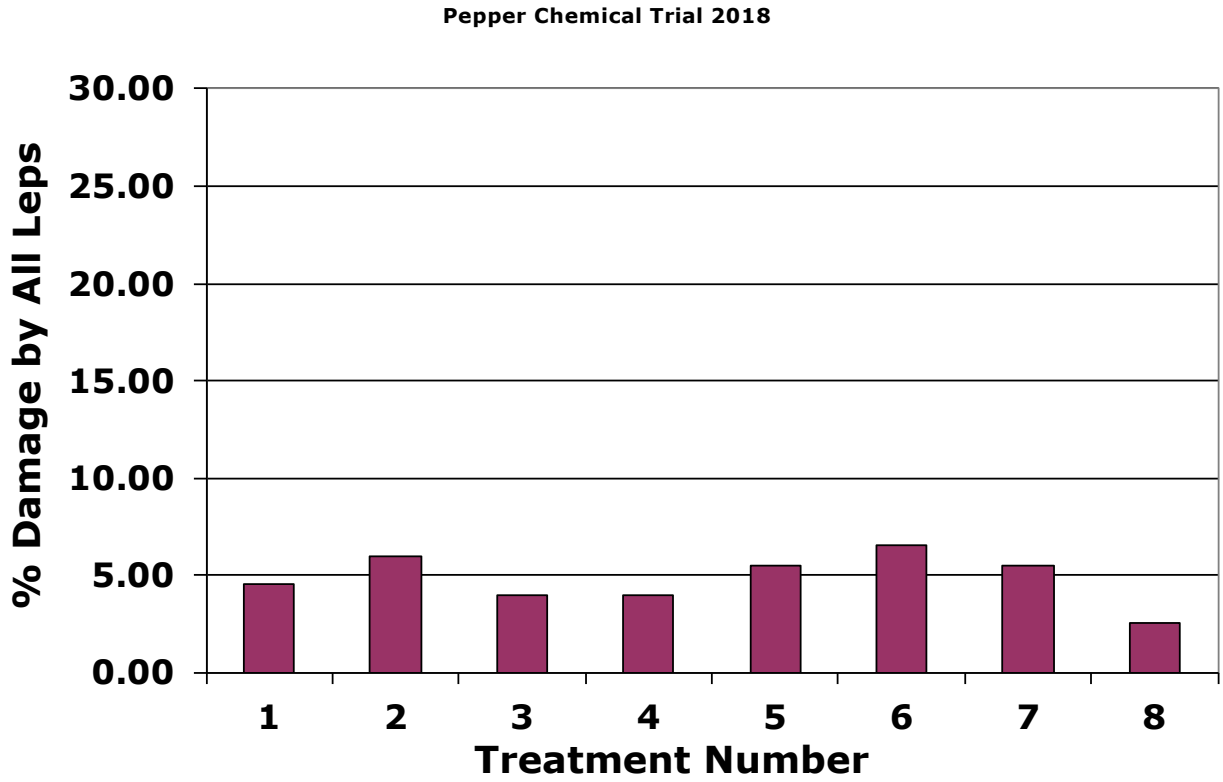


Figure 3. Pepper field Aphid counts.

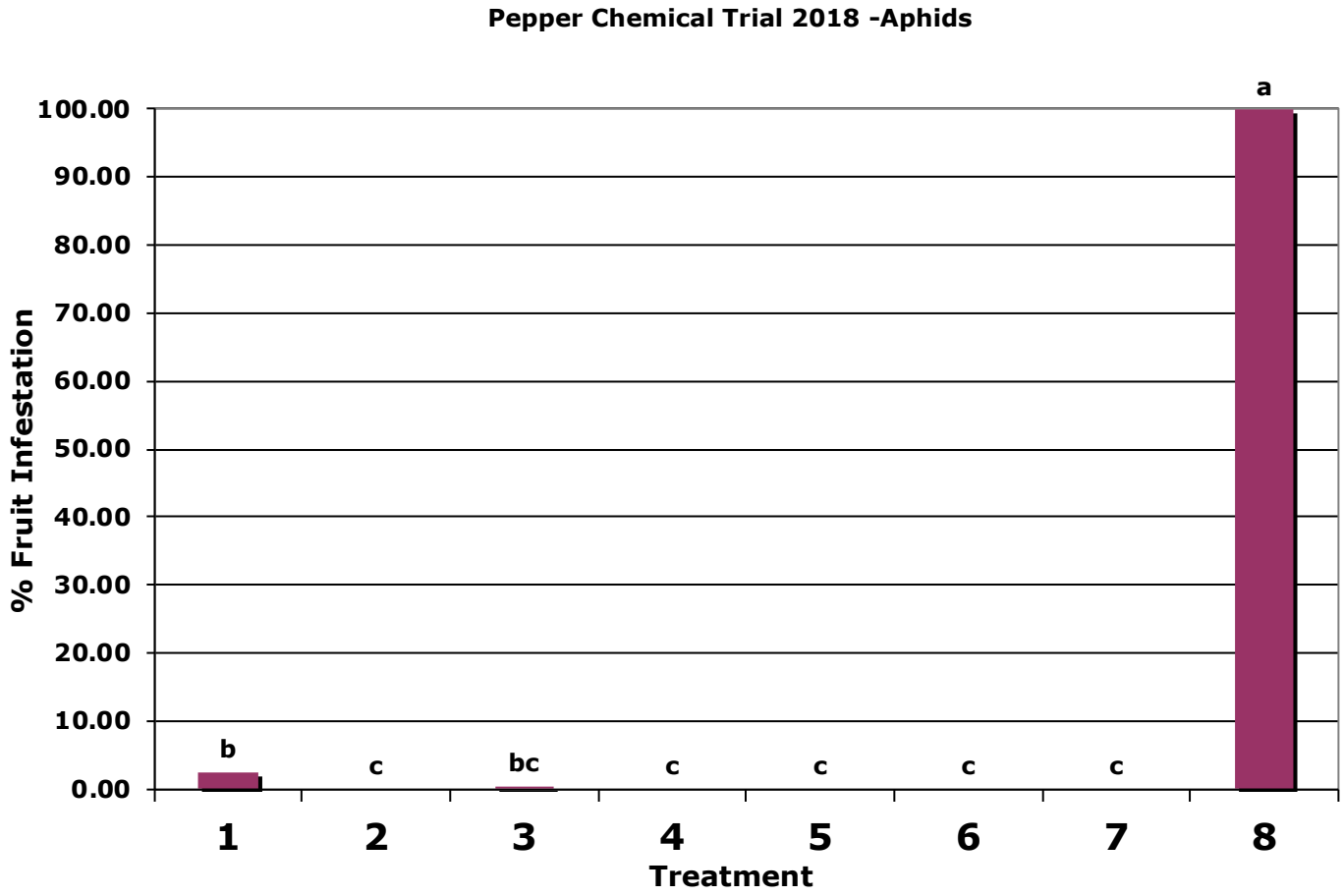
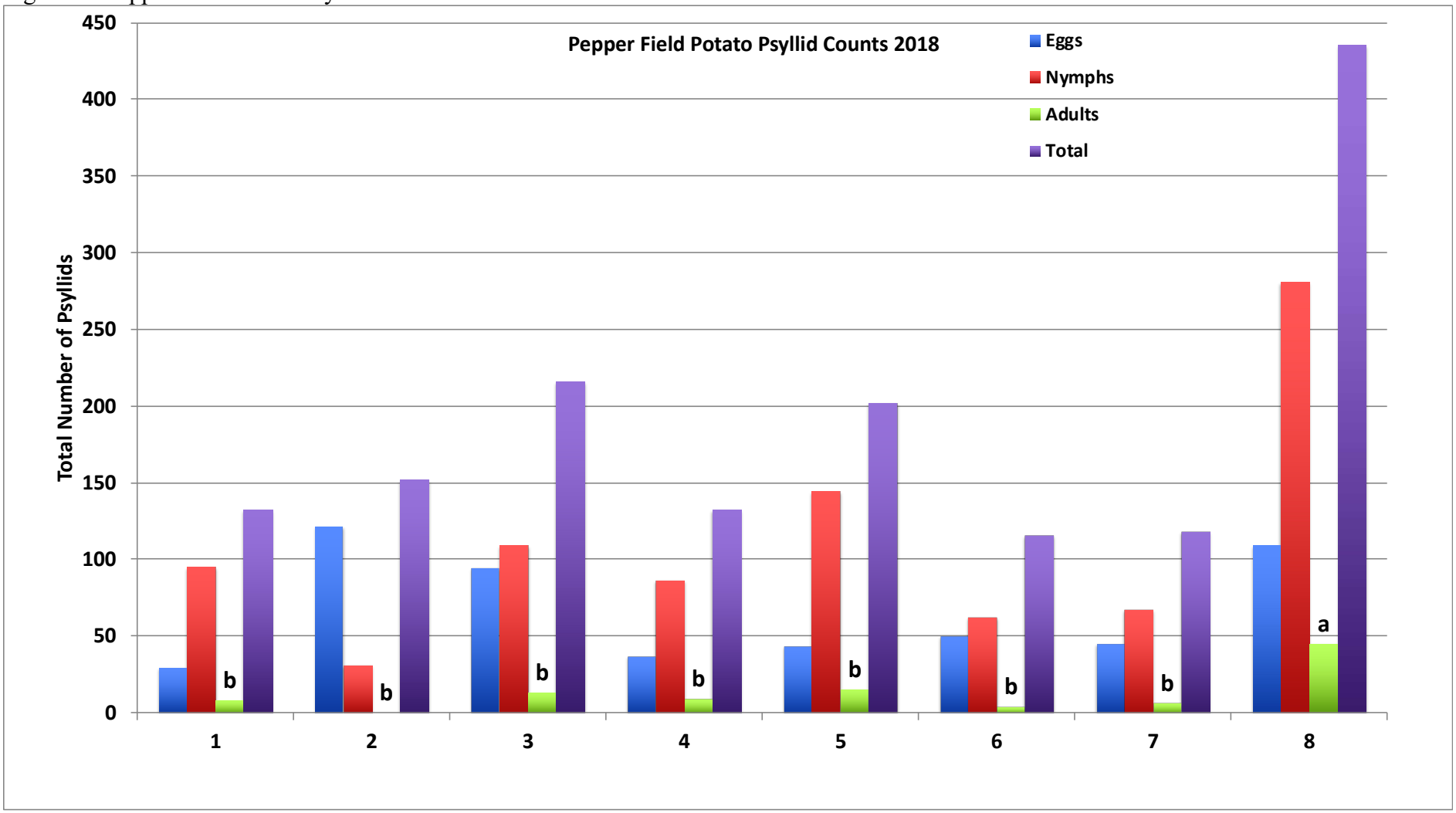


Figure 4. Pepper field Potato Psyllid counts.



## III. Laboratory Research

### Objectives:

Test the susceptibility of *Bactericera cockerelli* pepper psyllids to Exirel™ using a field collected population of pepper psyllids found on *Capsicum annuum* CV. "California Wonder" peppers, which were located at the Agricultural Operations field station of UC Riverside and a commercial pepper field in Fillmore, CA.

### Key Conclusions:

- Exirel™ provided good control of all psyllid populations at rates that were well below recommended field application amounts. At the rates tested, the UCR Agricultural Operations population showed the most signs of potential resistance.

### Methods

Two different populations of *Bactericera cockerelli* pepper psyllid nymphs were exposed to Exirel™ to determine their level of susceptibility. The collection locations of the colonies are listed below:
1-UCR Agricultural Operations pepper field-collected colony, Riverside, CA
2-Fillmore, CA (Guiberson Road) pepper field-collected colony

The susceptibility of each population was tested by placing 10 $2^{nd}$-$3^{rd}$ instar psyllid nymphs on a leaf with a camel-hair brush. The host plants used for the "UCR Agricultural Operations" and "Fillmore, CA" populations were *Capsicum annuum* CV. "California Wonder" peppers. The nymphs were allowed to acclimate to the new leaf for an hour prior to being sprayed with a hand-held sprayer. The entire plant was sprayed until runoff and both sides of the leaves were sprayed for maximum coverage. Each treatment was replicated 5 times. All treatments included "Dyne-amic" as an adjuvant at 0.25%. The range of rates to be tested were determined from several preliminary assays. We started with the highest field rate and did multiple dilutions until we were able to find rates in the $LC_{95}$, $LC_{90}$, $LC_{50}$, and $LC_{25}$ range. The following rates of Exirel™ were tested:
1) Untreated
2) 0.2 oz/Ac
3) 0.1 oz/Ac
4) 0.075 oz/Ac
5) 0.05 oz/Ac
6) 0.025 oz/Ac

The nymphs were counted for mortality every 24 hours for a total of 6 days. These data were analyzed at 24 and 48 hour periods. The JMP Pro 12.2 statistical program was used to run probit analyses.

### Results

The results indicate that the "Fillmore, CA" field collected colony (Figure 1) was very susceptible to Exirel™. The psyllid populations from "UCR Agricultural Operations, CA" (Figure 2) showed more signs of resistance than the "Fillmore, CA" field collected population. Based on these data, potential resistance levels are variable between locations. However, the high rate of Exirel™ provided 100% control within 48 hours for both colonies tested.

**Figure 1. UCR Agricultural Operations Pepper Field**

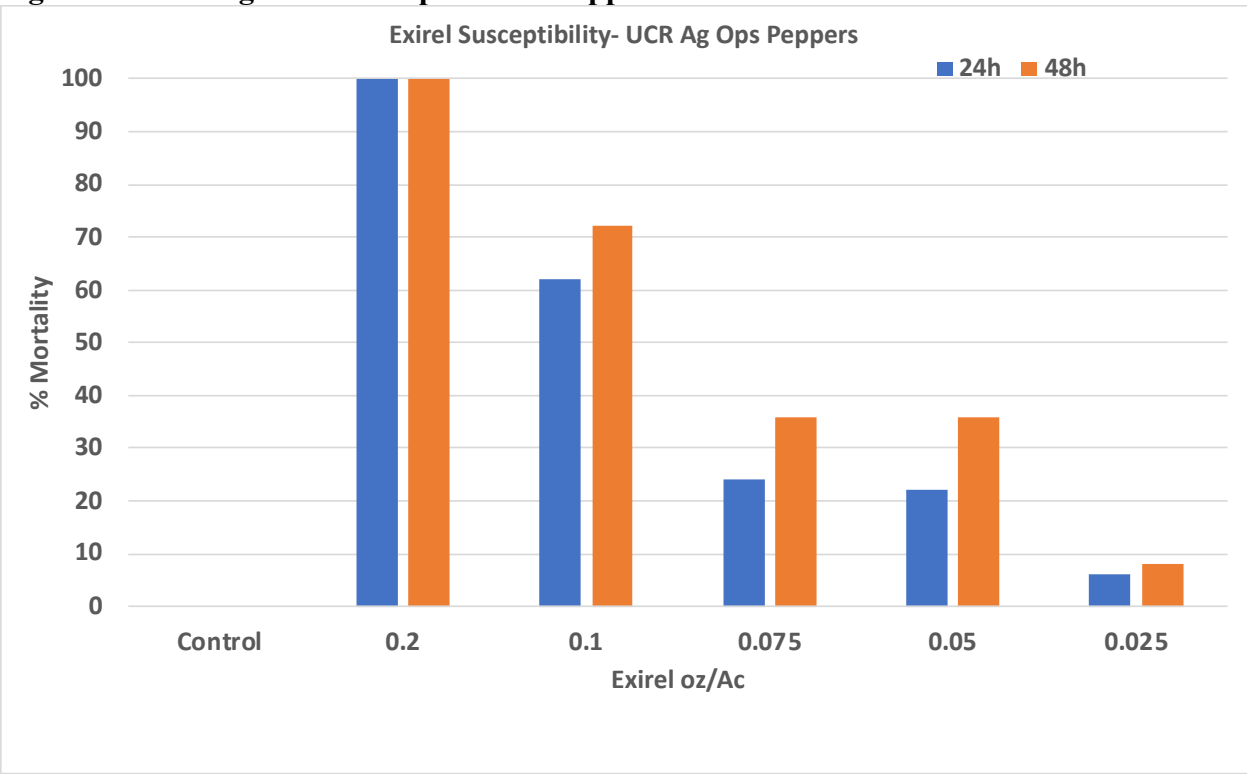
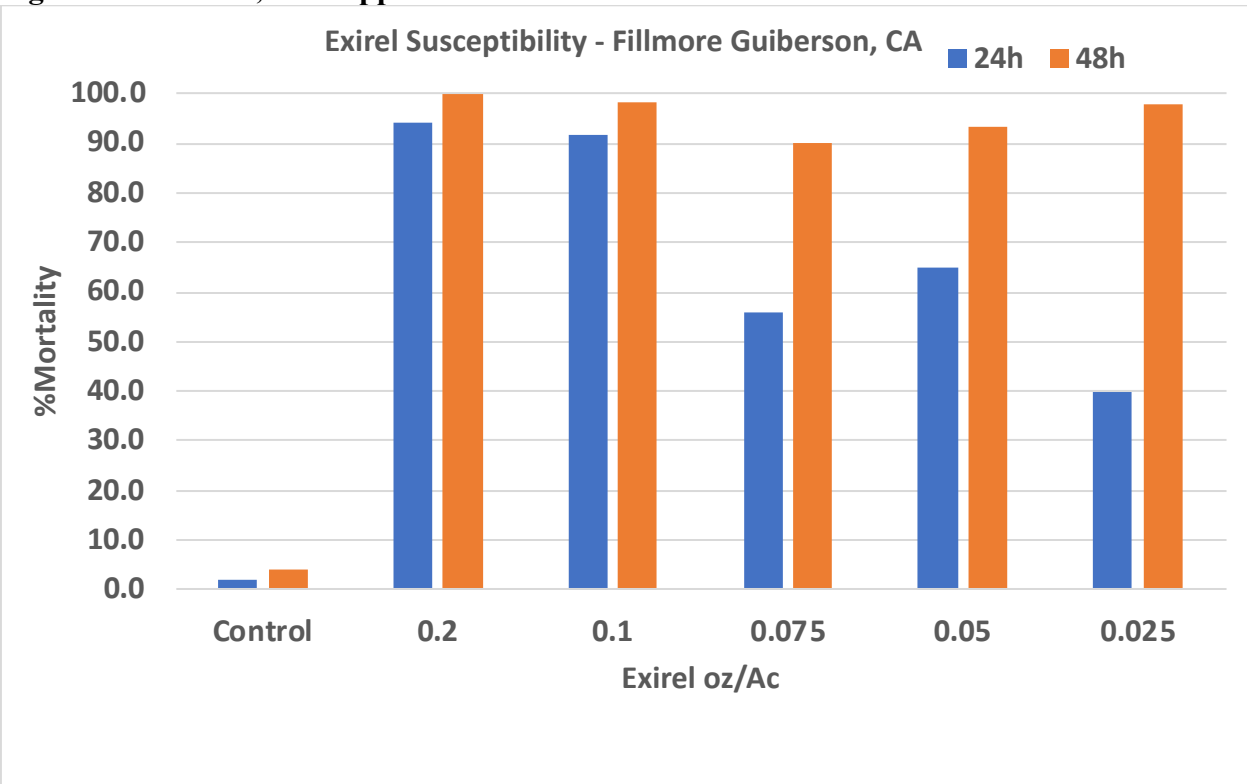



**Figure 2. Fillmore, CA Pepper Field**



## IV. Additional Research

We are continuing to test strategies and chemicals for psyllid control such as repellents to disrupt insect behaviors. Successful repellents and insecticides will be incorporated into an IPM program. We are continuing to study pepper weevil control and are testing some alternative products that would comply with the Food Quality Protection Act.

## V. Additional Funding Support

Funding from the Pepper Commission has been leveraged by acquiring additional financial support for our pepper research. We have received monetary awards to study and develop pepper IPM program strategies, as well as chemical industry support.