

**California Pepper Commission**  
**Research Report 2021-2022**

**I. IDENTIFICATION**

**A. California Pepper Commission**

**B. Insect Pest Management on Peppers**

**C. Proposal for period beginning March 2021, ending February 2022.**

**D. Principal Investigator:**

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**E. Cooperating Personnel:**

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**F. Locations of Work:**

U.C. Riverside Agricultural Operations  
Riverside, CA  
Riverside County, CA

**G. Plants:**

BELL PEPPER: *Capsicum annuum* L. 'Cal Wonder'

**H. Insects:**

Bagrada bug; *Bagrada hilaris* (Burmeister)

Beet armyworm; *Spodoptera exigua* (Hübner)

Beet Leafhopper; *Circulifer tenellus* (Baker)

Green peach aphid; *Myzus persicae* (Sulzer)

Lygus bugs; *Lygus hesperus* (Knight)

Pepper weevil; *Anthonomus eugeni* Cano

Serpentine Leafminer; *Liriomyza trifolii* (Burgess)

Silverleaf Whitefly; *Bemisia argentifolii* (Bellows and Perring)

Stink bugs; *Pentatomidae* spp.

Tomato/Potato Psyllid; *Bactericera cockerelli* (Sulc)

Tomato Fruitworm; *Helicoverpa zea* (Boddie)

Twospotted Spider Mite; *Tetranychus urticae* (Koch)

Vegetable Leafminer; *Liriomyza sativae* (Blanchard)

## II. Field Screening Trials for Identification of Effective Pesticides

Seedlings were transplanted in a sandy loam type soil on 20 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 (Figure 1). The pepper transplants were drip irrigated (water pH 7.2 - 7.5). Treatments were replicated 4 times in a randomized complete 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 three, which consisted of Pyganic, Trilogy, and Entrust.

**Table 1: Pepper Chemical Trial List of Treatments 2021**

Treatment #	Compound	Rate-Product	Application Dates	Company Sponsor
1	Non-treated	-	-	-
2	Intrepid <u>2F</u> + Sequoia 2 SC Radiant SC Dyne-amic	10.0 oz 4.5 oz 7.0 oz 0.25%	6/25,7/15,7/29 6/25,7/15,7/29 7/1,7/22,8/5	-
3	Organic IPM Pyganic 1.4EC Trilogy EC Entrust SC	32.0 oz 64.0 oz 8.0 oz	6/25,7/1,7/29 7/1,7/29 7/15,7/22,8/5	-
4	Sivanto Prime Soil application	28.0 Fl oz	6/18	Bayer
5	Sivanto Prime Foliar application	14.0 Fl oz	7/15	Bayer
6	Intrepid <u>2F</u> + Sequoia 2SC Spear-Lep + Leptotec Dyne-amic	10.0 oz 4.5 oz 2 pt 1 pt 0.125%(v/v)	6/25,7/15,7/29 6/25,7/15,7/29 7/1,7/22,8/5 7/1,7/22,8/5	Vestaron
7	Spear-Lep + Leptotec Radiant SC Dyne-amic	2 pt 1 pt 7.0 oz 0.125%(v/v)	6/25,7/15,7/29 6/25,7/15,7/29 7/1,7/22,8/5	Vestaron
8	Chem Standard: Asana XL Dyne-amic	9 oz 0.25 %	6/25,7/1,7/15,7/22, 7/29,8/5	-



Photo by Greg Kund

Figure 1. The field trial was composed of eight treatments with 4 replicates each for a total of 32 plots. The field was located at UCR Agricultural Operations.

To determine the impact of insecticides, a mid-season assessment of insects was made by counting all insects on four plants per replicated plot. On 17 August, 100 mature-green to ripe fruit were harvested from the center row of each plot (400 fruit per treatment) and examined for the presence of potato psyllids, aphids and spider mites and for damage caused by beet armyworm, bagrada bug, and other stinkbugs (external feeding) as well as tomato fruitworm (internal feeding). We also searched the calyx for damage caused by beet armyworm and tomato fruitworm. Furthermore, we opened 50 fruit per plot and inspected them for the presence of pepper weevil larvae (Figure 2).



Figure 2. Fifty harvested pepper fruit were picked for each tray and were subsequently evaluated for pepper weevil damage by cracking open each fruit. Damage was recorded when either larval feeding or adults were present inside the fruit.

## Results

### Field Sampling

For the field counts, there were significant differences in leafhopper numbers with the best control provided by treatment 2 (Intrepid, Sequoia, and Radiant) and 4 (Sivanto Prime- soil application) (Figure 3). The organic rotation (treatment 3) was not statistically different from the non-treated control, nor was it different from the other treatments except treatments 2 and 4. All other treatments (5-8) provided some level of control with means statistically different than the non-treated control. Considering the thrips numbers, the best treatment was 8 (Asana XL), with the other treatments providing intermediate control (Figure 3). The highest thrips numbers were counted in treatments 1 (non-treated control), 3 (Organic IPM), 5 (Sivanto Prime – foliar application), and 6 (Intrepid, Sequoia, Spear-Lep and Leprotec). Treatments 2, 4 and 7 had intermediate thrips numbers.

### Harvest Evaluation

Our harvest assessment revealed low to moderate numbers of insects and damage in the various treatments, yet there was some statistical separation (Table 2). Spider mite infestation and damage on the fruit was significantly higher in treatment 3, the rotation of organic products, than all other treatments which were statistically similar (Figure 4). This was unexpected, since the organic materials typically are light on spider mite predators. We suspect that the overall high mite numbers coming from adjacent plots overwhelmed natural enemies in the organic plots and the organic treatments did not provide the same level of control on the mites themselves.

Damage to the calyx caused by beet armyworm and tomato fruitworm was fairly low and not significantly different between treatments (Figure 5). Overall lepidopteran pressure was low in this study and there were no differences between treatments for total lepidopteran damage (Figure 6). However, there were some differences in the amount of external damage caused by beet armyworm as shown in Figure 7. As a point of interest, treatment 8 (Asana XL) performed

the worst in controlling beet armyworm suggesting that there may be some resistance developing in our beet armyworm field populations. The Sivanto treatments 4 and 5, provided modest control of beet armyworm with 6.5% and 4% damage. Treatments 2, 3, 6 and 7 were 3% or lower for damage caused by beet armyworm. Some bagrada bug damage (Figure 8) was seen in the untreated control at 5.5% but all of the other treatments were 2% or lower for damage and treatments 2 and 8 had no damage (Figure 9).

Internal damage by the pepper weevil was not present this year and could be a result of hot weather conditions. Some pepper weevils were seen in the field, but no damage was seen in any of the harvested fruit. Additionally, good control of weed host plants such as “nightshade” can eliminate a potential source for reproduction of pepper weevils. Nightshade berries can provide a food source for development of pepper weevil larvae. Therefore, it is recommended to control nightshade plants near commercial pepper field operations. Potato psyllids were present in the field, as seen in our field counts, but we saw very few in our harvest assessment.

Mean Number of Fruit Damaged/Replicate <sup>a</sup>

Table 2.

Treatment/ Formulation	Rate Amt/acre	Internal	External	All Leps	Bagrada Bug	Calyx Damage	Mites
1 Non-treated	-	0.00	1.75 abc	1.75	2.75	1.25	0.25 b
2 Intrepid + Sequoia 2 SC Radiant SC Dyne-amic	10.0 oz 4.5 oz 7.0 oz 0.25%	0.50	1.00 c	1.50	0.00	1.50	3.00 b
3 Organic IPM Pyganic 1.4EC Trilogy EC Entrust SC		0.25	1.50 bc	1.75	1.00	1.25	10.50 a
4 Sivanto Prime Soil application	28.0 oz	0.25	3.25 ab	3.50	0.25	1.00	0.25 b
5 Sivanto Prime Foliar application	14.0 oz	0.25	2.00 abc	2.25	0.00	2.25	0.50 b
6 Intrepid + Sequoia 2SC Spear-Lep + Leptotec Dyne-amic	10.0 oz 4.5 oz 2 pt 1 pt 0.125%	0.00	0.50 c	0.50	0.50	1.00	2.75 b
7 Spear-Lep + Leptotec Radiant SC Dyne-amic	2 pt 1 pt 7.0 oz 0.125%	0.25	0.25 c	0.50	0.25	1.50	3.75 b
8 Chem Standard: Asana XL Dyne-amic	9 oz 0.25 %	0.25	3.75 a	4.00	0.00	2.25	0.75 b
ANOVA F value (by column)		0.519	2.681	2.183	2.252	0.889	5.113
ANOVA P value (by column)		0.811	0.034	0.073	0.065	0.530	0.001

<sup>a</sup> 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 tomato fruitworm; external damage due primarily to beet armyworm. Calyx damage can be attributed to tomato fruitworm and beet armyworm.

Figure 3. Pepper field insect counts.

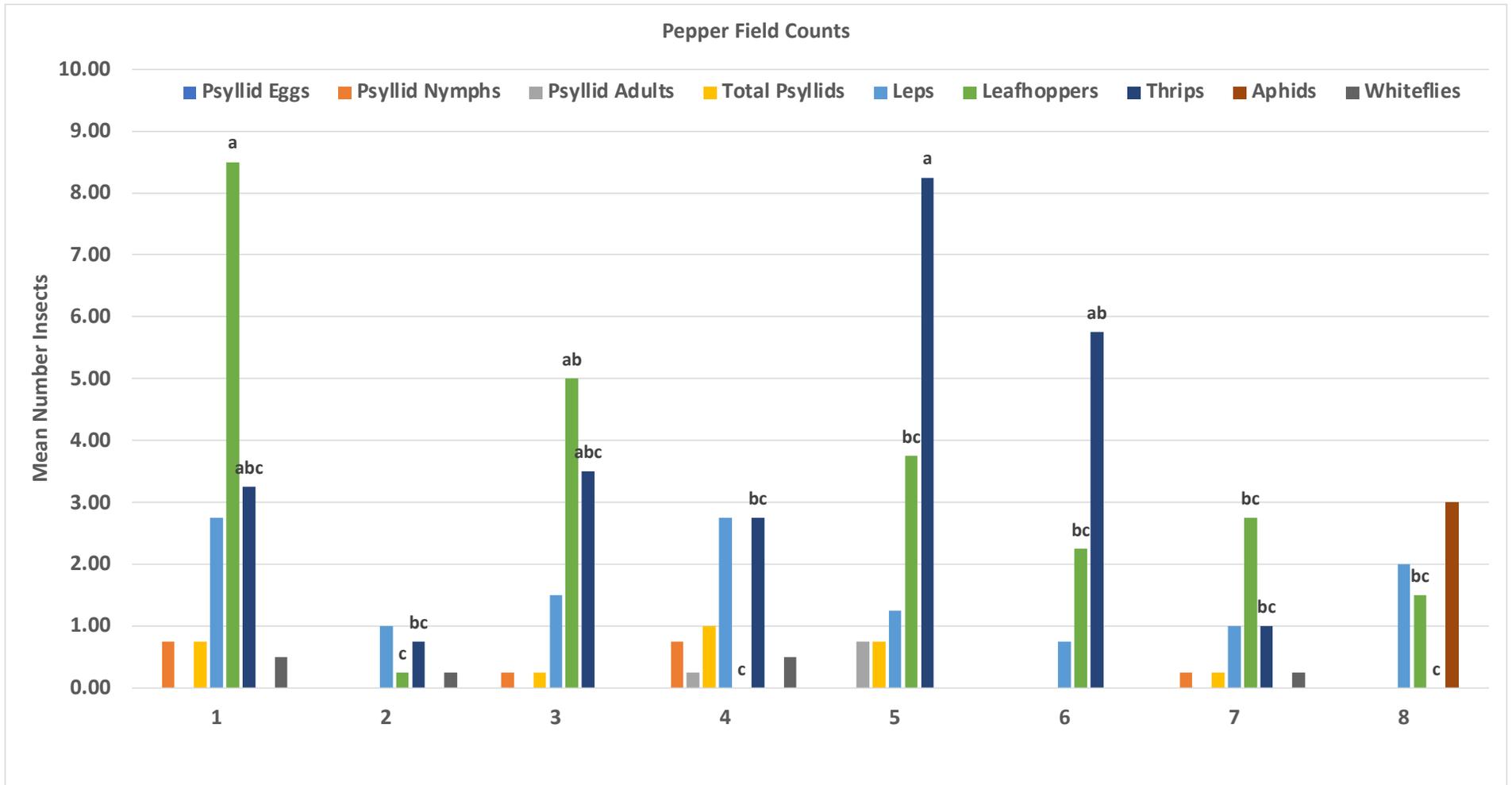


Figure 4. Spider mite infestation and damage on pepper fruit at harvest.

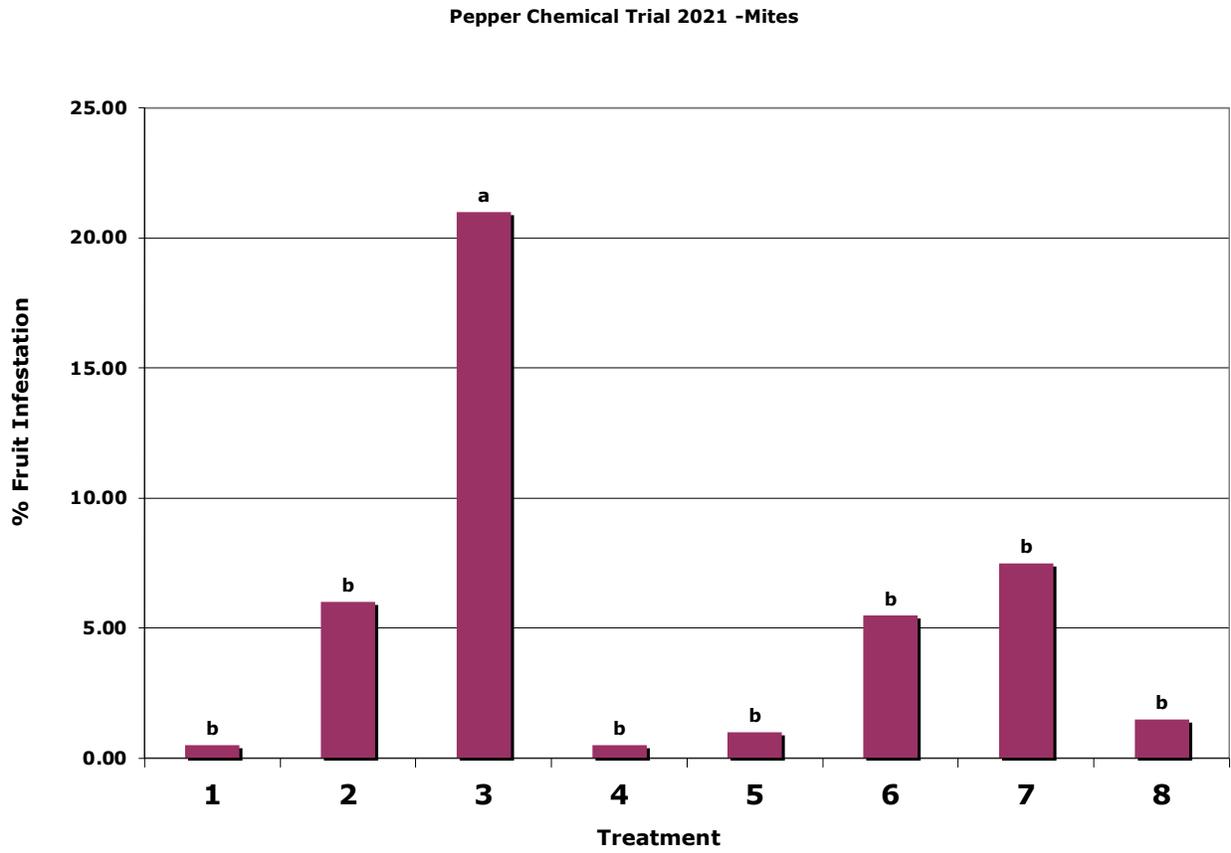


Figure 5. Calyx feeding damage

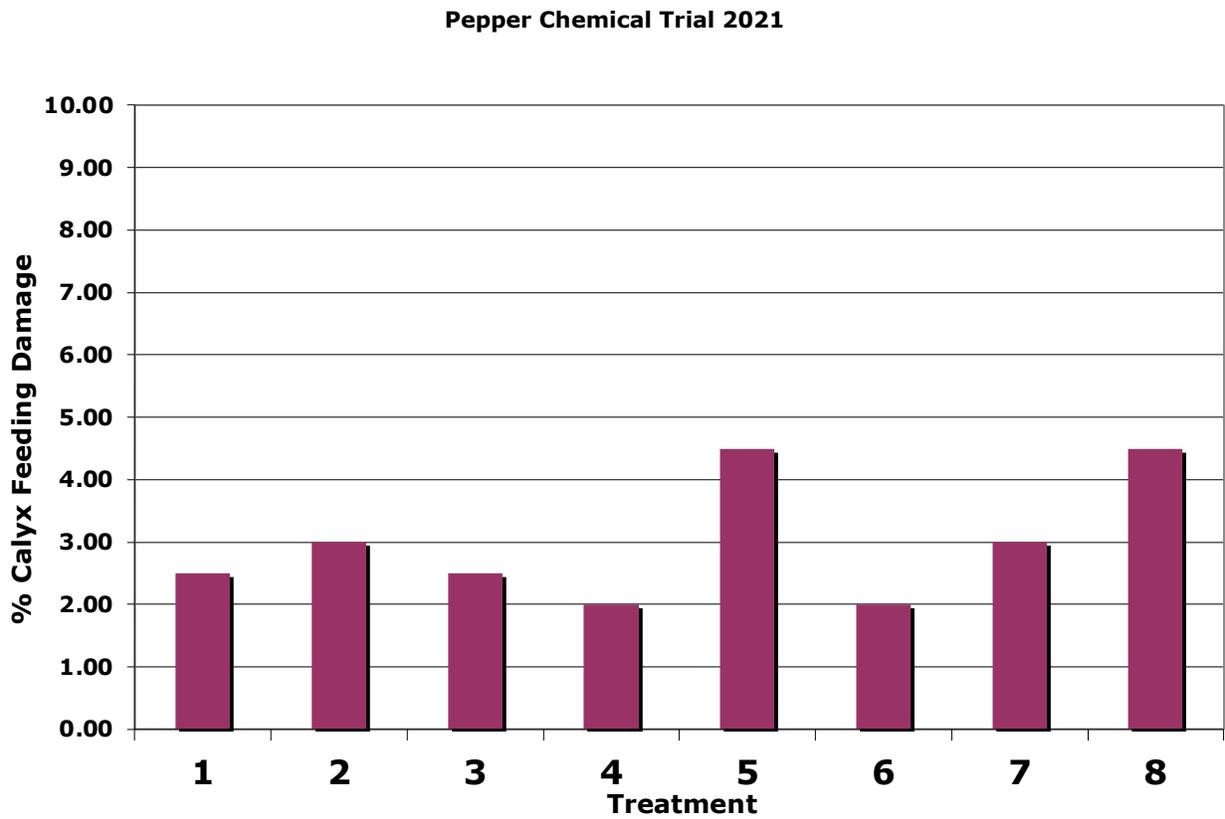


Figure 6. All Lepidopteran damage combined

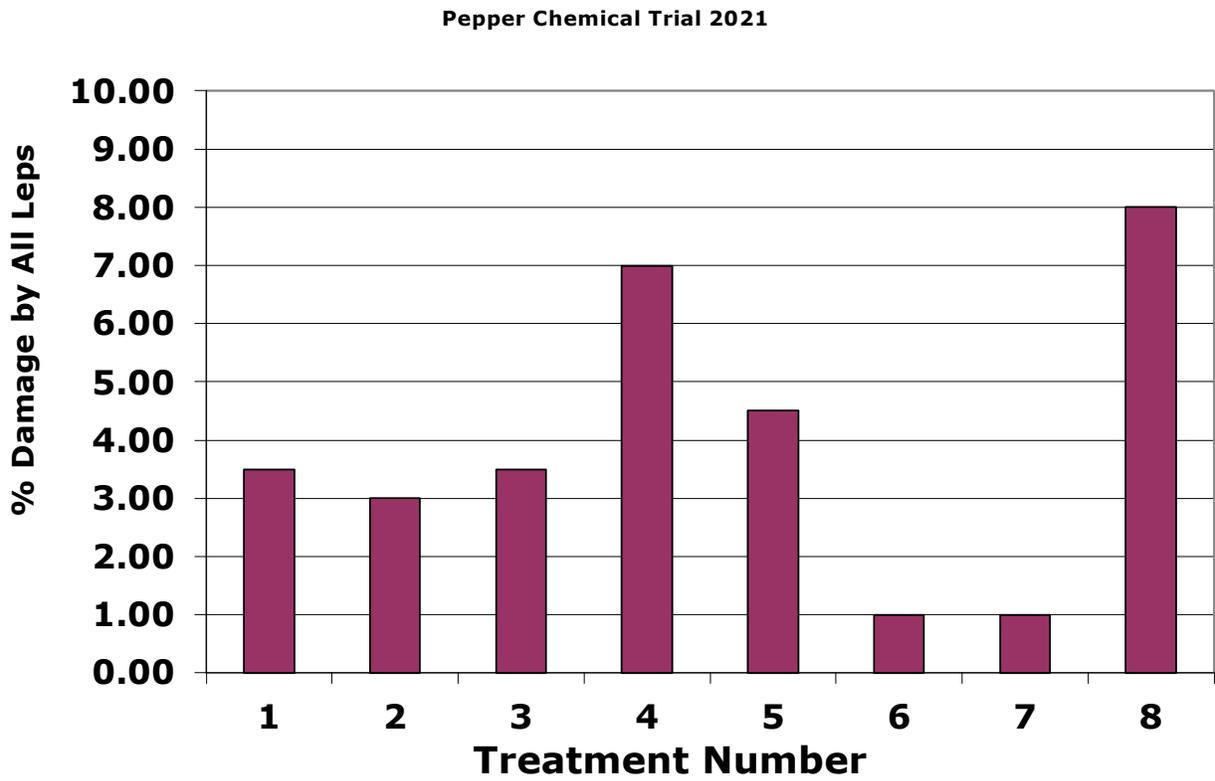


Figure 7. External fruit damage by beet armyworm

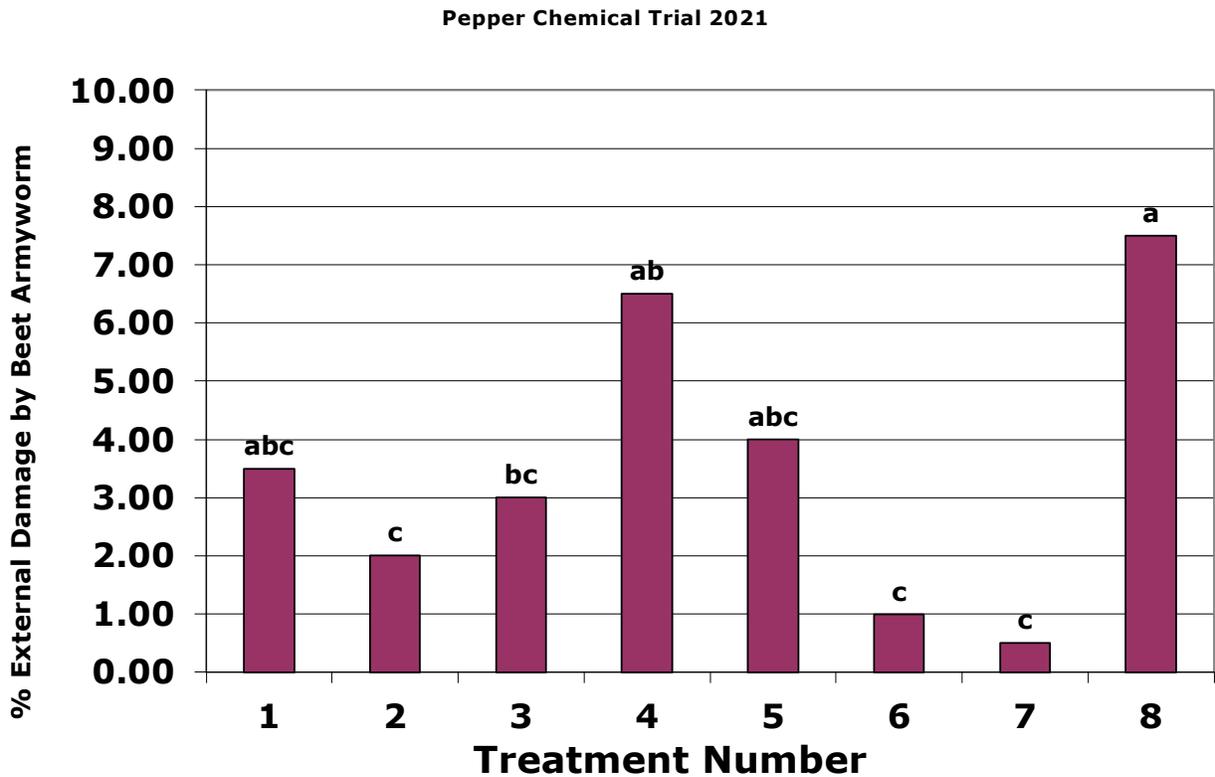
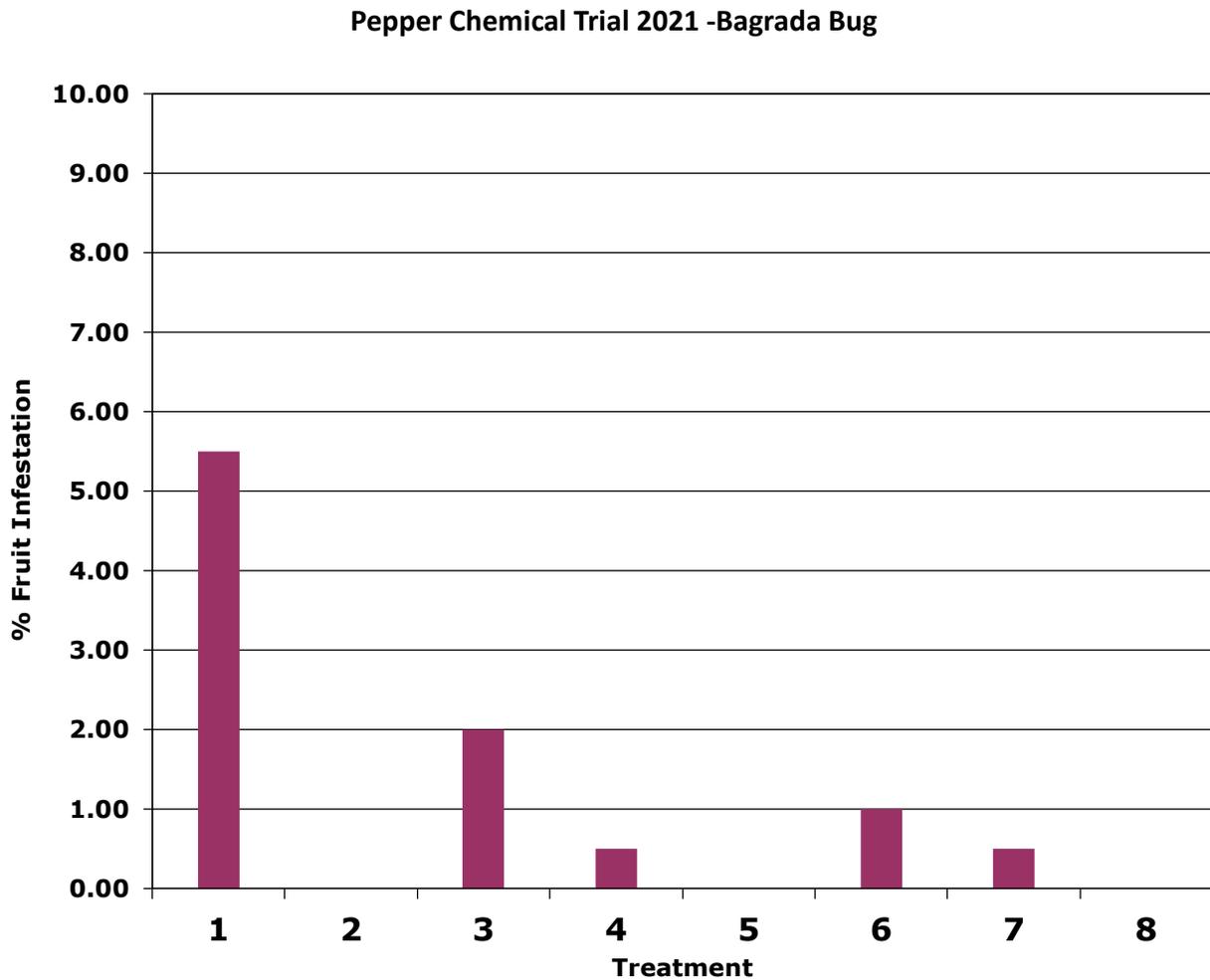


Figure 8. Bagrada bugs cause damage by feeding with their needle-like mouthparts. Multiple insertions of their mouthparts at each feeding site causes cell wall damage to the pepper fruit resulting in the visible star shaped patterns.



Figure 9. Bagrada bug damage



### **III. Additional Research**

We are continuing to test strategies and chemicals for psyllid and leafhopper control that disrupt insect behavior and cause mortality. Successful repellents and insecticides will be incorporated into an IPM program. We have been testing several novel compounds that have shown promising results for insect control and we are hopeful that some of these products will eventually be available to pepper growers. We are continuing to study pepper weevil control and are testing some alternative products that would comply with the Food Quality Protection Act.