

California Pepper Commission
Research Report 2022-2023

I. IDENTIFICATION

A. California Pepper Commission

B. Insect Pest Management on Peppers

C. Proposal for period beginning March 2022, ending February 2023.

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 26 April 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 numbers three, four, and five.

Table 1: Pepper Chemical Trial List of Treatments 2022

Treatment #	Compound	Rate-Product	Application Dates	Company Sponsor
1	Non-treated	-	-	-
2	Intrepid 2F+ Sequoia 2 SC Radiant SC Dyne-amic	10.0 oz 4.5 oz 7.0 oz 0.125%	6/16, 6/28, 7/14, 7/21	-
3	Organic IPM Pyganic 5.0EC Trilogy EC Entrust SC	15.0 oz 64.0 oz 8.0 oz	6/16, 6/28, 7/14, 7/21	-
4	Sivanto Prime - Drench	28.0 Fl oz	6/16	Bayer
5	Sivanto Prime - Foliar	14.0 Fl oz	7/7	Bayer
6	Intrepid 2F+ Sequoia 2SC VST-Exp. + Leprotec Dyne-amic	10.0 oz 4.5 oz 8 wt oz 1 pt 0.125%(v/v)	6/16, 6/28, 7/14, 7/21	Vestaron
7	VST-Exp. + Leprotec Radiant SC Dyne-amic	8 wt oz 1 pt 7.0 oz 0.125%(v/v)	6/16, 6/28, 7/14, 7/21	Vestaron
8	Chem Standard: Sequoia 2 SC Asana XL Dyne-amic	4.5 oz 9 oz 0.25 %	6/16, 6/28, 7/7, 7/14, 7/21	-



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, two field assessments of insects on 24 June and 2 August were made by counting all insects on five plants per replicated plot. On 26 July, 50 mature-green to ripe fruit were harvested from the center row of each plot (200 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).



Photos by Greg Kund



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 no significant differences in the first count (Figure 3). All of the insect counts were below 3 percent. The second field count, which was done late in the season, had an increase in total psyllid numbers showing that the psyllid population was developing (Figure 4). Psyllid egg numbers were high but nymphal and adult counts remained low for all treatments except treatment 8 (Asana XL and Sequoia 2SC). Treatment 8 had a significantly higher number of adult psyllids compared to the other treatments including the untreated control (Figure 4). Typically, adult psyllid numbers increase when a pyrethroid is applied numerous times throughout a growing season. Field counts of Lepidoptera, leafhoppers, thrips, aphids, whiteflies, and mites were low and not statistically different between treatments.

Harvest Evaluation

Our harvest assessment revealed low to moderate numbers of insects and damage in the various treatments, yet there was no statistical separation except for bagrada bug at $p=0.067$ (Table 2). Spider mites infestation and damage on the fruit was low and treatment 4 had no mite damage (Figure 5).

Damage to the calyx caused by beet armyworm and tomato fruitworm was fairly low and not significantly different between treatments (Figure 6). Overall lepidopteran pressure was low in this study and there were no differences between treatments for total lepidopteran damage (Figure 7). Over the past several pepper growing seasons we have seen an increase in bagrada bug damage. The harvest assessment had significant differences between the treatments for bagrada bug damage (Figure 8). Treatments 2, 6, and 8 were the better performing combinations of products that limited bagrada bug damage from 2-4%. All three of these treatment combinations included Sequoia 2SC. Bagrada bug damage is associated with star shaped lesions under the skin of the fruit as shown in 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.

Table 2.

Mean Number of Fruit Damaged/Replicate a

Treatment/ Formulation	Rate Amt/acre	Internal	External	All Leps	Bagrada Bug	Calyx Damage	Mites
1 Non-treated	-	0.50	3.50	4.00	6.50	1.25	0.75
2 Intrepid + Sequoia 2 SC Radiant SC Dyne-amic	10.0 oz 4.5 oz 7.0 oz 0.125%	0.00	2.25	2.25	1.00	1.25	1.25
3 Organic IPM Pyganic 5.0EC Trilogy EC Entrust SC	15.0 oz 64.0 oz 8.0 oz	0.00	3.25	3.25	9.75	1.75	0.50
4 Sivanto Prime - Drench	28.0 Fl oz	0.00	1.75	1.75	5.50	2.50	0.00
5 Sivanto Prime - Foliar	14.0 Fl oz	0.00	2.00	2.00	4.00	1.50	0.25
6 Intrepid + Sequoia 2SC VST-Exp. WSG + Leptotec Dyne-amic	10.0 oz 4.5 oz 8 wt oz 1 pt 0.125%(v/v)	0.25	0.75	1.00	2.00	1.00	1.00
7 VST-Exp. WSG + Leptotec Radiant SC Dyne-amic	8 wt oz 1 pt 7.0 oz 0.125%(v/v)	0.25	1.50	1.75	5.50	1.50	0.25
8 Chem Standard: Sequoia 2 SC Asana XL Dyne-amic	4.5 oz 9 oz 0.25 %	0.00	3.25	3.25	1.00	2.00	1.00
ANOVA F value (by column)		1.371	1.277	1.202	2.235	0.400	0.589
ANOVA P value (by column)		0.262	0.303	0.339	0.067	0.927	0.758

^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 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 6-24-2022. Need to put "Treatment" on the X axis label.

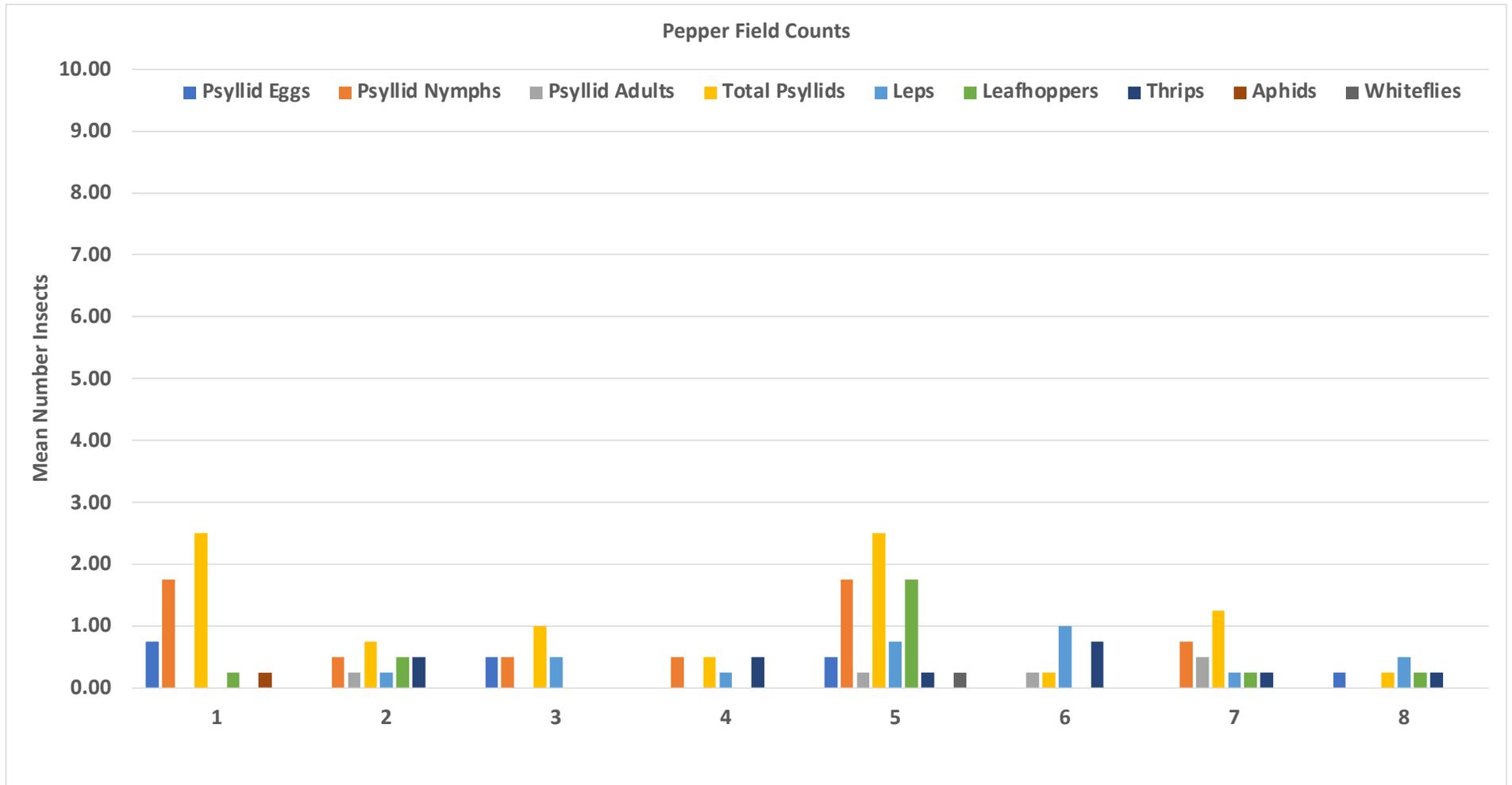


Figure 4. Pepper field insect counts 8-2-2022.. Need to put “Treatment” on the X axis label.

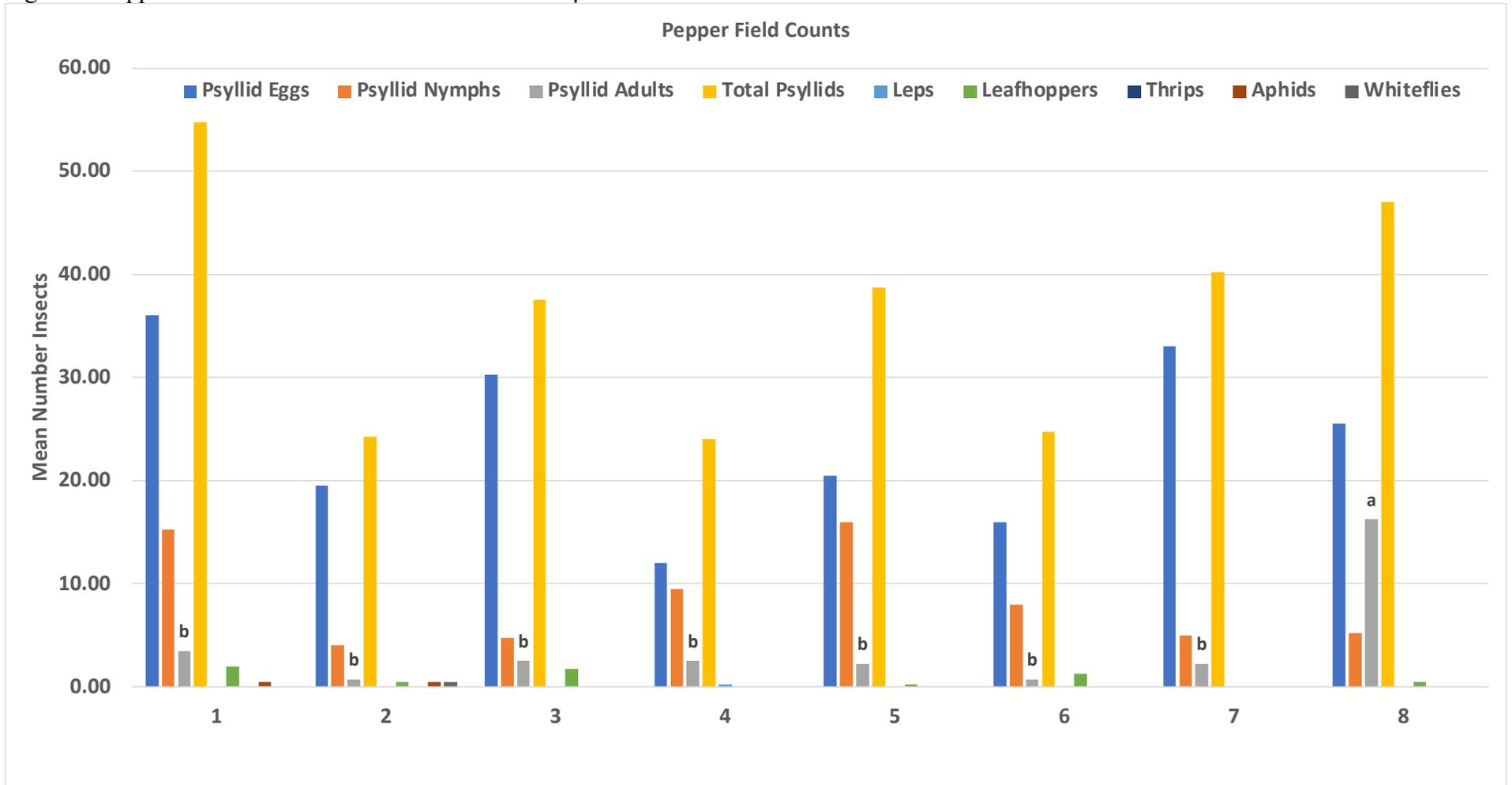


Figure 5. Spider mite infestation and damage on pepper fruit at harvest.

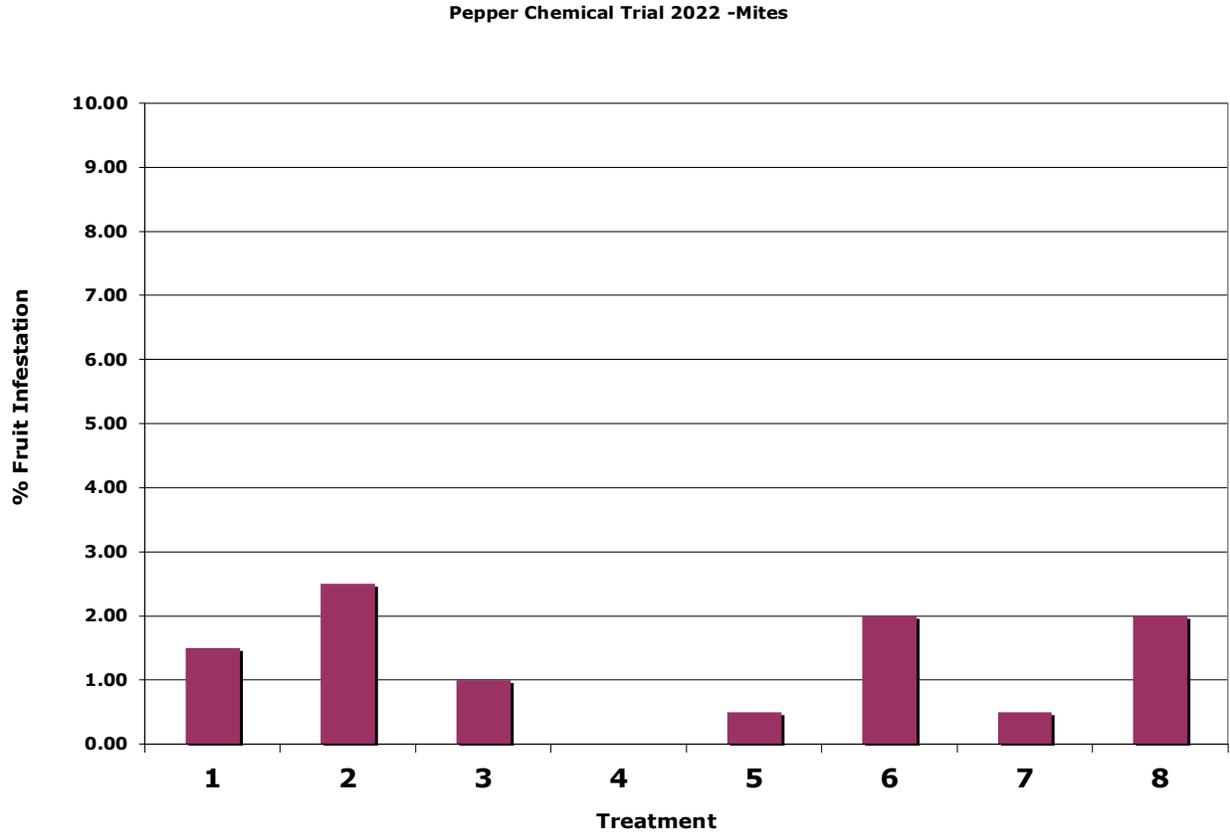


Figure 6. Calyx feeding damage

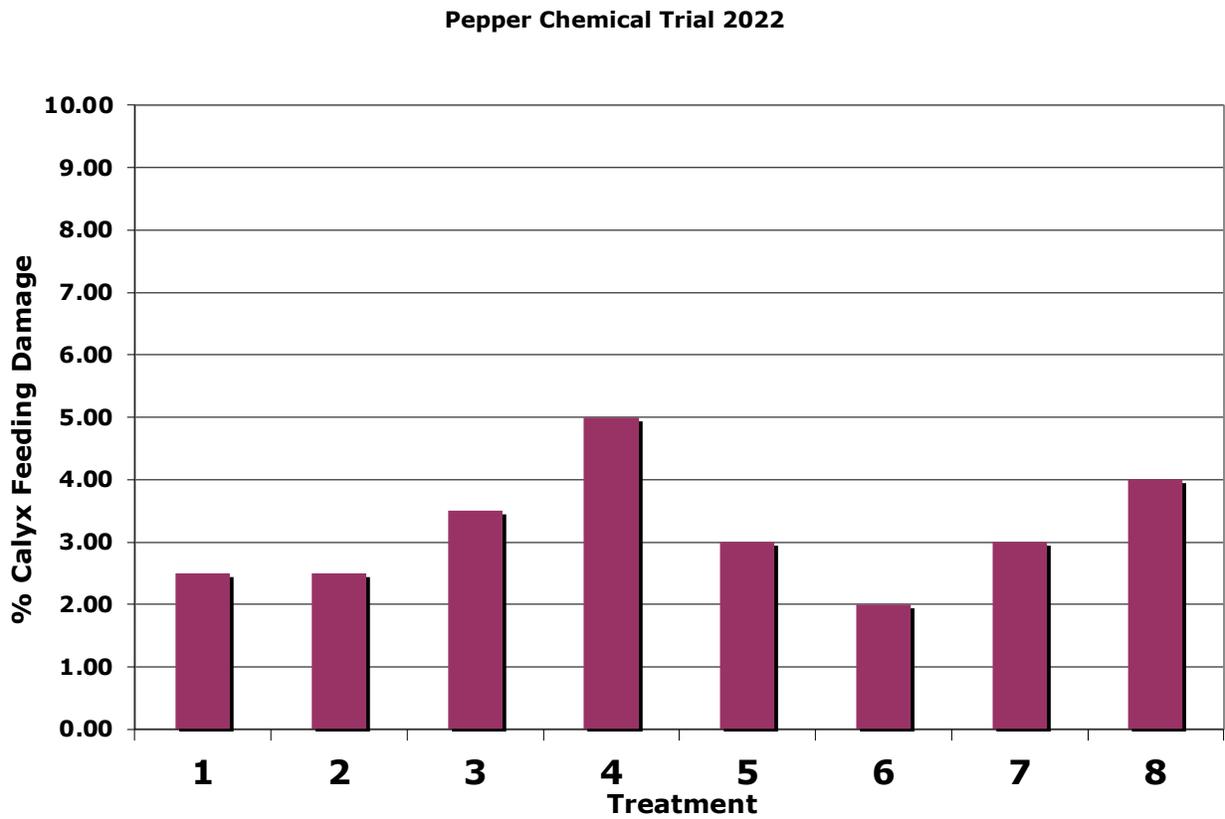


Figure 7. All Lepidopteran damage combined

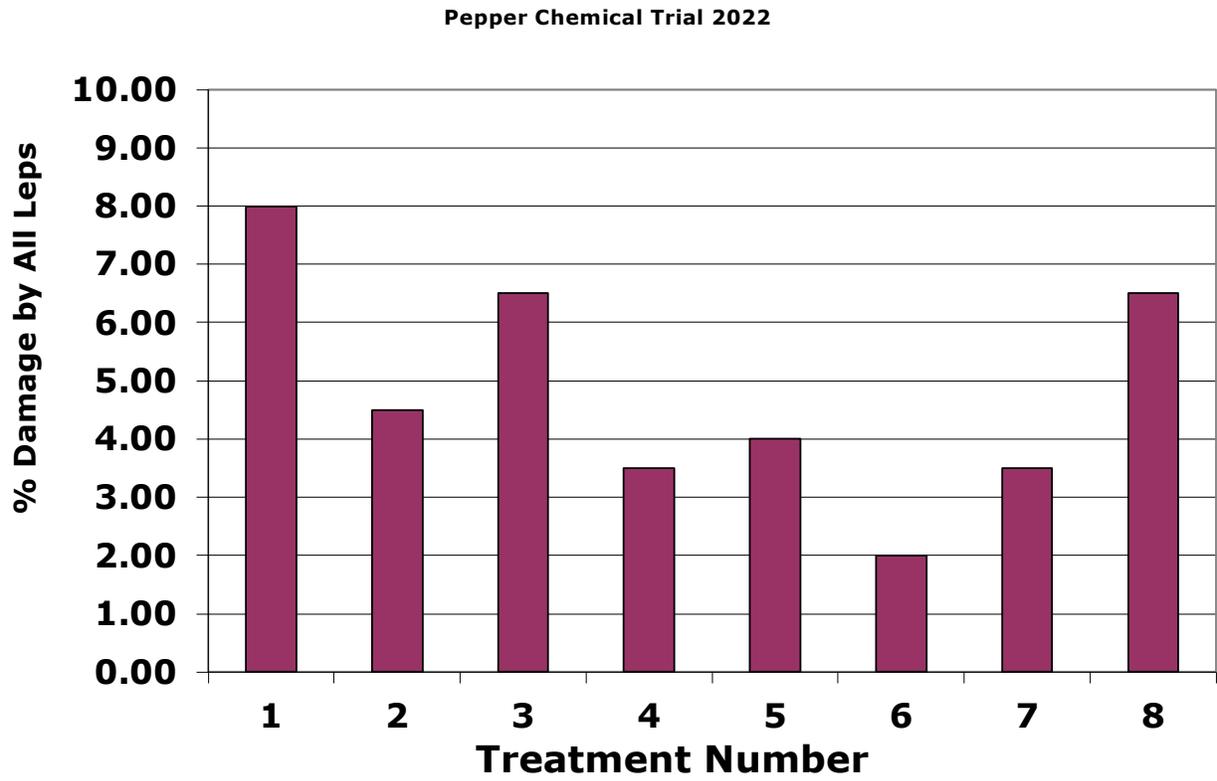


Figure 8. Damage by bagrada bug

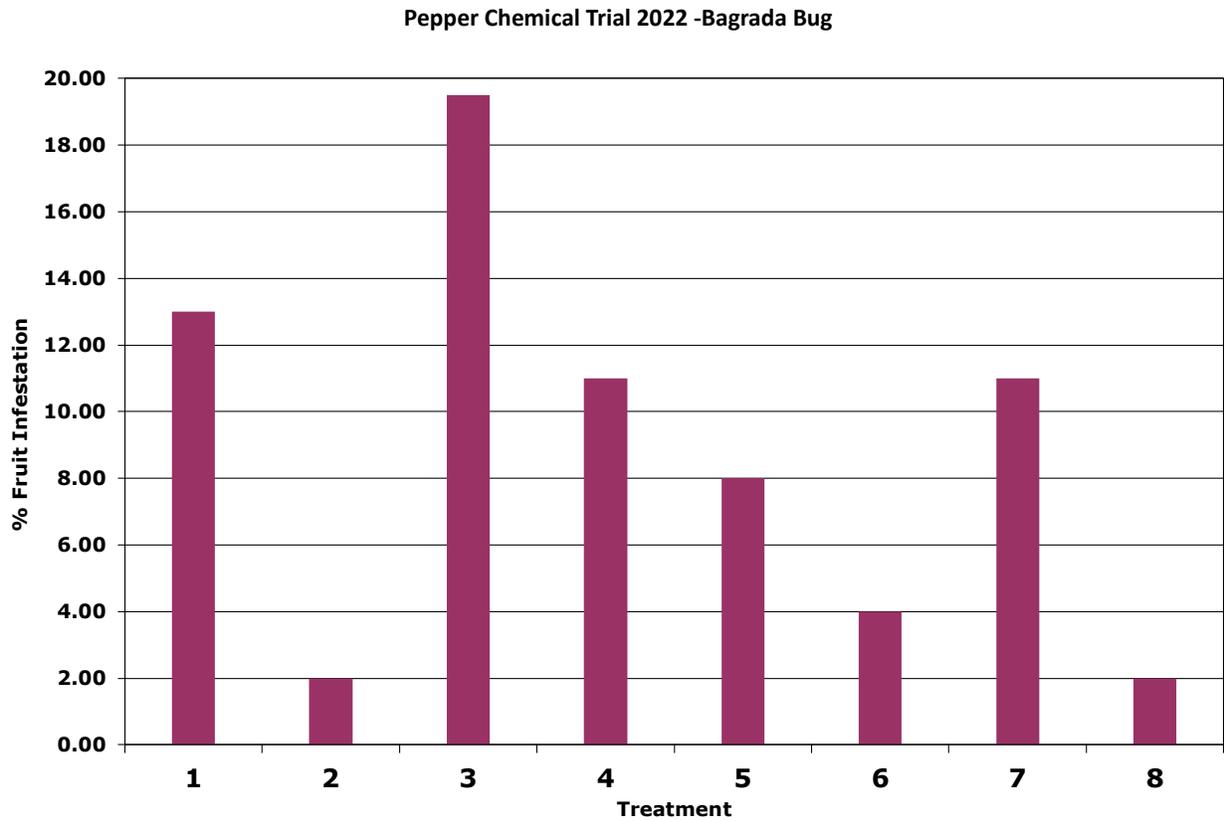


Figure 9. Bagrada bugs cause damage by feeding with their needle-like mouthparts. Multiple insertions of their mouthparts at each feeding site causes cell wall damage to the pepper fruit resulting in the visible star shaped patterns.



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.