Prune Board Research Report 1992

MANAGING PEACH TWIG BORER WITH Bacillus thuringiensis

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ABSTRACT

This project was jointly funded by the Cling Peach Advisory Board, California Tree Fruit Agreement and California Prune Marketing Board.

Previous studies indicate Bacillus thuringiensis applied during bloom is as effective as organophosphates plus oil dormant treatment for control of peach twig borer (PTB). In 1991, 17 grower applied demonstration plots were conducted throughout the central valley of California. This work was continued in 1992 with a total of 19 blocks involved.

Procedures were the same during both years. Bt was applied two times during bloom at the rate of one lb. per acre, generally in combination with fungicides. The remainder of the cling peach and prune orchards were treated with dormant oil plus phosphate treatments. The standard in fresh shipping orchards, all of which were organic, received dormant oil only.

Results indicate that ground applications of Bt are equal to or better than standard dormant treatments for PTB control in prunes, almonds and early harvested fresh peaches and nectarines. During the two years of this study, acceptable PTB control has been achieved without in-season treatments in these crops. Control of early season worm pests such as the green fruitworm is enhanced by bloom Bt applications. However, in the absence of in-season treatments neither dormant organophosphates nor Bt alone is adequate, in cling peaches, to prevent unacceptable PTB damage in varieties harvested after the beginning of the third summer generation.

After two years in the same orchards the only pest which showed any inclination to increase in the Bt plots was San Jose scale. However, parasite activity appears to be increasing which could eventually provide biological control, especially if orchards receive dormant oil treatments.

OBJECTIVES

1. Refine and validate, in large grower applied plots, results of 1990 and 1991 research indicating Bt applied during bloom can provide control of PTB in stone fruits.

2. Document the impact of eliminating dormant organophosphates on other pest and beneficial organisms over a three-year period in large plots.

3. Determine impact of beneficial organisms on San Jose scale.

INTRODUCTION

Peach twig borer (PTB) is a serious pest of stone fruits in California. Historically, control of PTB has been accomplished by treating overwintered larvae with an oil plus organophosphate insecticide during the dormant period. In addition to being effective on several pests, it has been assumed that dormant treatments have minimal impact on beneficial organisms. Recently, dormant organophosphates have not been as effective for control of PTB as in the past. Dormant treatments are also suspected of drifting to nearby crops, and killing raptors, including hawks, present in orchards at the time of application.

Early instar PTB larvae spend the winter in overwintering sites, called hibernacula. Larvae feed within the hibernacula on warm days during the winter and emerge as 1st or 2nd instar larvae as trees begin to leaf out in the early spring. Newly emerged overwintered larvae feed on emerging shoots and fruit buds, often attacking several, before completing development. After maturing, PTB larvae seek sheltered areas to pupate and emerge as adults in late March or early April. First summer and subsequent generation larvae emerge from eggs and bore into tender shoots or fruit. There are three to four generations per year.

Attempts to control PTB after petal fall with stomach poisons or insect pathogens have not been successful since larval development is completed within a single shoot or fruit. However, since overwintered larvae feed on several shoots before maturing, we decided to try to control them with Bacillus thuringiensis an insect pathogen that attacks only lepidopterous larvae. In addition to being non toxic to beneficial organisms, Bt is not toxic to humans and wildlife and is regarded as being safe to the environment.
Preliminary experiments were conducted to determine if Bt applied at bloom would provide adequate control of PTB. Bloom time treatments were chosen because we were attempting to cover emerging shoots with the material before shoot elongation, and treatments could be combined with fungicides, thus saving spray application costs. These experiments were conducted in a stone fruit orchard near Kingsburg, Tulare county, and an almond orchard near Arbuckle in Colusa county during the spring of 1990. Shoot strike data indicate that two treatments during bloom with Bt were as effective as a dormant Diazinon plus oil treatment for PTB control. In 1991 we conducted 17 demonstration plots in stone fruits throughout the state with good success. This program was repeated in 1992 in 19 blocks.

PROCEDURES

In 1991 demonstration plots were conducted in 11 peach and nectarine orchards and six prune orchards located throughout San Joaquin and Sacramento Valleys. In 1992, 14 peach and nectarine blocks and five prune blocks were involved. Seven peach and all five prune plots in 1992 were also part to the 1991 experiments. Where possible, plots consisted of a minimum of a 25 tree check plot which received dormant oil only, a Bt plot of three to five acres which received dormant oil plus Bt applied two times during bloom at the rate of one lb. per acre, and the grower's normal standard OP plus oil. Bt was generally applied in combination with fungicides. Three different formulations of Bt were evaluated, with different products being assigned to particular orchards randomly. Organic

orchards did not receive dormant phosphates and only two treatments were present All peach orchards were treated with OFM mating disruption so in-season treatments for OFM could be avoided. If treatments for other pests were applied to the standard, the Bt and check plots received the same treatment in most cases.

Each orchard was visited weekly and observations on fruit phenology, diseases, and insects were recorded as they occurred. Peach twig borer adults were monitored by placing one or two pheromone traps, depending on plot size, in each plot. Traps were monitored weekly. Shoot strikes were counted at least once during the season; after emergence of the overwintered generation and/or after emergence of first summer generation larvae. Ten trees were selected at random for counting and all shoot strikes recorded. PTB and OFM strikes were entered separately.

Fruit samples were collected at harvest by selecting 50 fruit from 20 trees (1000 fruit) at random. Samples from individual trees were kept separate. Each fruit was closely inspected for damage by insects including PTB, OFM, leafrollers, scale, cutworms, and katydids. Percent damage for each type of damage was calculated.

Mites were monitored when/if weekly visual observations indicated mites were present in the orchard. Five leaves were picked at random from 20 trees (100 leaves per sample), brushed with a mite brushing machine and counted under a binocular microscope. Plant feeding and beneficial mite species were expressed as average number of mites per leaf. A binomial mite sampling method was also tested in two prune orchards.

Scale insects were monitored by harvest fruit samples and shoot samples (five shoots from 20 trees in each plot) during the dormant period. Parasitism will be determined by placing infested gourds in the most heavily infested orchards and on a heavily infested block at the Kearney Agricultural Center.

RESULTS AND DISCUSSION

Shipping peaches and Nectarines: Many orchards in the San Joaquin Valley suffered significant PTB fruit damage in spite of dormant organophosphate sprays plus one to three in-season treatments. In spite of this heavy population pressure in some areas, Bt performed as well or better than standard treatments. This was the second year on the Bt program for all blocks of fresh shipping fruit. Bt was effective in reducing the number of shoot strikes from overwintered PTB larvae to a low level of .5 shoot strikes per tree or less in all eight blocks treated, Table 1. Harvest data indicate good control of PTB in all Bt treated blocks with a reduction of from 60 to 90 percent depending on the variety, Table 1. PTB fruit damage in the Tulare County Elegant Lady variety was probably higher because heavy infestation from brown rot masked some of the PTB damage. One-half the Tulare Elegant Lady block received two additional Bt treatments at the beginning of color change to see if PTB control could be improved with additional treatments at this time. Table 1 shows that these additional treatments are not beneficial with the same amount of damage occurring with or without the fruit ripening treatment.

During weekly observations in the Fresno County Elegant Ladies, it was noticed that an unusually high number of OFM shoot strikes were present after the beginning of the second OFM flight. This block had been treated with OFM mating disruption dispensers. It was obvious that mating disruption was not effective in this block and it was treated with an organophosphate for the third OFM flight. Even with a treatment, OFM damage averaged 4.6 percent at harvest, well above what most growers would expect or tolerate, Table 1. There were also apparent OFM mating disruption failures in two of seven cling orchards, Table 2.

Pheromone trap numbers were low in all fresh shipping fruit and as in 1991 do not appear to be a good indicator of potential PTB damage.

Fruit infested with San Jose scale was essentially the same as in 1991, indicating that in the absence of disruptive summer treatments, San Jose scale can be controlled in shipping fruit with dormant oil alone, Table 1.

Omnivorous leafroller damage was too low in all varieties to collect meaningful data on this pest. However, it should be pointed out that all varieties were harvested before the beginning of the third OLR generation.

Katydid caused considerable damage in the Maygrands and Sweet Home nectarines in 1992, Table 1. As in 1991 this is probably more related to the absence of in season insecticides. It does not appear that Bt had any impact either positive or negative on this pest.

Cling Peaches: In contrast to 1991 PTB populations were extremely high in three of the seven cling orchards monitored. There was little indication of this when plots were evaluated by counting overwintered shoot strikes. However shoot strike counts in June were much higher than counts taken at the same time in 1991. One Merced county orchard had over 80 strikes per tree in the check, 41.8 in the standard and 25.8 in the Bt, Table 2. Even with a 68 percent reduction in the Bt treated area and 3 in-season treatments, severe green fruit damage occurred in all 3 Merced county plots and fruit sorting was necessary at harvest, Table 2.

Although not as striking, we had the same experience in a Starn block in Butte county, Table 2. In addition to higher than acceptable PTB strike counts, OFM counts were high enough to indicate a failure with OFM mating disruption. The entire block was treated with an organophosphate in late June and July. In spite of in-season treatments worm damage at harvest was unacceptable for both PTB and OFM and extensive sorting was required to pass grade.

We also experienced unacceptable fruit damage at harvest in a Starn block in Sutter county and an organic Loadel variety block in Merced County. In Sutter county shoot damage by overwintered larvae was too low to detect, even in the check. We did find a few shoot strikes in June but there was no indication that a severe problem existed, Table 2. Because of past experience, and because only one application of MD dispensers had been applied it was initially decided that we should treat the entire block with an organophosphate. However, after consulting with the grower it was decided to treat only the portion of the orchard which had received a dormant treatment and see if we could get through the remainder of the season in the Bt treated area and the check. Fruit damage

by third generation PTB larvae increased so rapidly that by the time we detected a problem in the check 26% of the check had been damaged by newly hatched PTB larvae. Although there was a 75% reduction in fruit damage in the Bt and standard treatments, damage was still well above what could be tolerated. The standard block was only marginally better than the Bt block, even though a June treatment of Guthion had been applied to the standard. Much of the damage in the standard was caused by the second PTB generation, indicating there was probably a more severe problem in the standard than in the Bt treated block.

The Loadel block in Merced county also suffered unacceptable damage. This can be explained because the grower decided to apply the Bt at bloom to every other row, resulting in poor coverage. It was apparent that control was poor after initial shoot strike counts. In order to try to save the crop we treated first summer generation larvae three times with Bt. We were able to keep the damage at 5%. even though strike counts at that time indicated over 19 strikes per tree. This is our third successful experience with attempting to reduce PTB damage with well timed Bt sprays in May. This indicates treatments at this time may hold promise if properly timed and good coverage is achieved. We plan on following up on this lead next year.

The Dr. Davis in Yuba County received a June Asana treatment and none of the treatments had any appreciable damage at harvest.

There were two cling blocks that did not receive summer treatments and had acceptable PTB damage at harvest. The Butte Ross block was conducted in conjunction with Dr. Rice. In this block some treatments were treated with PTB mating disruption in addition to Bt. Unfortunately check damage was so low that no valid comparisons can be made.

Another block of Starns were treated in Fresno county. Again PTB populations were too low in this block to draw any conclusions. However OFM damage in this block was excessive in spite of two applications of mating disruption material.

Cling peach harvest samples indicate none of the blocks experienced any increase in San Jose scale populations with only dormant oil treatments for the past two years, Table 2. At this time, if growers start with a low scale population, there is reason to believe that scale can be kept at a low level with dormant oil + biological control. This is verified by the fresh shipping orchards that have received oil only dormant treatments for nine years without any appreciable buildup of scale.

Leafroller damage at harvest was low in all blocks. It does not appear that dormant treatments have any impact on omnivorous leafroller, the primary leafroller in peaches and nectarines. There is some indication that Bt may actually provide some reduction in the numbers of this pest.

Mites did not develop to economic levels in any of the cling peach blocks in 1992.

The value of top fruit and shoot sampling to monitor OFM and PTB populations was again demonstrated this year. OFM pheromone traps were maintained in all orchards. Few adult were trapped because of mating disruption. However, shoot

and fruit counts were able to detect a problem in those orchards where control with mating disruption was less than satisfactory.

Prunes: Four of the five prune blocks utilized in 1992 were the same blocks with the same treatments as in 1991. Peach twig borer populations were low to moderate in all blocks, Table 3. However, there was an increase in harvest damage in all blocks over 1991. Overwintered and first summer generation shoot strike counts were not taken in any of the blocks because experience from last year indicated they were of little value. Harvest samples show that in all plots, Bt treated blocks had comparable or lower harvest damage than the standard in 1992.

The check in the Tulare V block had 4% PTB damage at harvest with the Bt and standard treatments having just over 1%. PTB damage was low in all the Tulare F plots ranging from 1.3% in the check to .6% in the Bt plot. PTB damage was relatively low in all the Sacramento Valley orchards with the highest damage being 2.3% in the standard treatment in the Butte J orchard. It is interesting to note that although the check in the Butte B orchard suffered .1 % damage, damage in the standard was higher at 1.1 %. At least in the Sacramento valley the value of dormant treatments for PTB control was questionable, this year. In fact, damage in the standard was higher in both the Butte J and B orchards than in the check. PTB control was good in all Bt treatments and no differences in formulations was evident.

The total number of peach twig borer adults trapped in pheromone traps for the season were erratic in all prune orchards with the numbers having no consistent relationship to the amount of shoot or fruit strikes.

Extensive San Jose scale monitoring took place in prunes because this was the only species in our plots with appreciable populations. Fruit samples indicate San Jose scale infestations were consistently higher in Bt and check plots than in standard treated blocks. However in all blocks, with the exception of the Tulare F block, scale counts in 1992 were the same or lower than 1991 counts in both the check and Bt treated areas, Table 4. At least part of this decline is due to the impact of parasites. July twig samples from the Tulare V, check and Bt plots, which did not receive any dormant oil, indicate a scale/parasite ratio of 1.9. Fall samples, completed in prunes, also indicate a low scale/parasite ratio in the Tulare orchards, Table 5. This demonstrates that parasites are active and are playing a role in reducing scale numbers. However, fall samples also show higher scale populations in 1992 in all treatments in all the prunes in the Sacramento Valley. Scale/parasite ratios are also high in all plots signifying dormant oil treatments will be necessary in 1993 in all blocks. Another year of data should confirm whether biological control will be effective. It is interesting that the amount of scale in the standard also increased over 1991 levels.

Three species of scale parasites were reared from scales collected in prunes. Studies to determine the behavior and effectiveness of these parasites with the ultimate aim of using augmentative releases of scale parasites are currently underway.

Bt was again effective in controlling early season worm pests such as green

fruitworm and spring cankerworm, Table 3. Cankerworm was the most common early season worm pest in the Butte B orchard and Bt at bloom resulted in a 60 to 70 percent reduction in damage from this pest when compared to the check and standard. Little difference in the fruitworm damage was noted in the Sutter K block, but the majority of the damage was due to fruit-tree leafrollers which was heavy in all treatments just after bloom. Early season worms were lower in both the Bt and standard blocks in the all other prune orchards when compared to the check.

As mentioned above fruit-tree leafroller was common early in the season in the Sutter K orchard. However, little fruit feeding resulted and no differences between treatments could be detected. Fruit-tree leafroller was also present in low to moderate numbers in the Tulare V orchard in all treatments this year. However, populations were lower than in 1991.

Moderate to high oblique banded leafrollers were encountered in the Tulare F block in 1991. Although we were able to trap moths of this species in both the Tulare F and Tulare V orchards, we were unable to detect nests or damaged fruit this year. Fruit-tree leafroller larvae were collected from the Sutter K and Tulare V orchards and reared for parasites. The only parasite recovered was a tachinid fly. In 1991 up to seventy five percent of the leafroller larvae were parasitized by Macrocentrus iridescens, a polyembryonic wasp in the Tulare V block. This parasite was not reared this year even in the check or Bt treated areas. The reason for this is not known. It is not possible with these limited data to determine if in the absence of disruptive insecticides parasites may be able to provide economical control of leafrollers.

Brown almond and European red mite populations were lower in all orchards when compared to 1991 and did not reach a treatable level in any of the prune orchards.

Another aspect of our work this year was to test the binomial sampling scheme developed for almonds in prunes. The mite complex is similar and it is expected that treatment thresholds will also be quite similar. Data collected in 1992 indicate that in the presence of predator mites, prunes can tolerate at least 32 % of the leaves being infested without any apparent damage. This was the highest percent infested encountered, Table 6. We expect prunes to be able to tolerate up to 45% infested as had been determined for almonds.

In cooperation with Dr. Beth Grafton-Cardwell's laboratory, we surveyed 1 peach and 4 prune orchards for predaceous mites. It is surprising that the only predaceous mite found in the four prune orchards sampled was Typhlodromus caudiglans rather than M occidentalis, the western orchard predator mite Table 7. At present we are unable to predict the impact this different species will have on the probability of biological control of mites in prunes.

SUMMARY

There is no relationship between adult PTB trap catches and damage or potential damage in any of the orchards monitored. In fact there is some question whether traps are of any value other than using them to biofix phenology models to determine correct spray timing. It appears that shoot strike counts and top

fruit counts are the best indicator of population density that we have at this time.

In contrast to 1991, weather conditions were deal for the use of Bt and other stomach poisons in the spring of 1992. Under the populations levels in study orchards, two applications of Bt applied from pink bud to petal fall provided control of PTB equal to or better than dormant organophosphate plus oil applications. No pattern of increased or decreased pest problems were apparent in orchards eliminating the dormant phosphate for two years in these studies except for a slight increase in San Jose scale in the Tulare F block. However, blocks should be followed for several years before one could make a decision one way or another. Used in conjunction with mating disruption for OFM, there is a good possibility that early season peaches, prunes, and almonds could be economically grown without "hard" insecticides. This is desirable for consumers, environmentalists and growers.

It appears this program can be easily adapted by growers with no additional application costs. BT can be combined with brown rot treatments which are generally applied at pink bud and full bloom. Two tests in almonds in 1992 indicate that low volume Bt treatments (32 to 42 Oz. per acre) by air, look promising.

Bt-pests.tbl

Table 1

Impact of Bt on Fresh Shipping Peaches and Nectarines Pests, 1992
Tulare County, California

Variety		OW strikes avg/tree	Harvest date	% infested PTB	OFM	LR	SJS	KD
Maycrest	Check	.3	5/17	3.8	3	.4	.7	.3
	Javelin	.2		.9	.2	.8	.6	.2
Springcrest	Check	.6	5/17	3.7	.3	.8	.4	.5
	Biobit	.1		1.6	.4	0	0	.4
Spring Lady	Check	2.6	5/21	8.5	0	.1	-	-
	Javelin			1.1	0	.3	.5	.7
Sweet Home	Check	1.5	6/6	.4	.1	.6	1.5	2.3
	Biobit	.3		.3	0	0	.1	1.8
Maygrand	Check	.9	6/8	1.6	.1	1.0	0	7.2
	DiPel	0		.4	.1	1.0	0	4.7
Elegant Lady	Check	1.5	7/3	4.0	.2	.4	.1	.8
	DiPel[1]	.4		.5	.5	.1	0	.2
	DiPel[2]			.5	.8	.2	.1	.8
2 yr. old	Check	2.9						
	Bt	.5						
Elegant Lady (Fresno Co.)	Check	.2	7/4					
	Javelin	.2		0	4.6	-	.1	-

[1] Bloom Bt only.

[2] Bloom + color break Bt.

Table 2

Impact of Bt on Cling Peach Pests, 1992

Variety	County	Treatment	Shoot strikes avg/tree April	Shoot strikes avg/tree Jun PTB	Shoot strikes avg/tree Jun OFM	Harvest Date	Harvest PTB	Harvest OFM	Harvest LR
Loadels	Merced	Biobit	3.6	19.2		7/4	5.3	.9	0
Ross	Butte	Check	.3	2.2	2.9	7/22	.4	.6	.4
		DiPel-bloom	.6	.6	.6		.1	.1	.4
		DiPel-Bl + PH					0	.3	0
		DiPel + PTB MD		.5	1.4		0	0.1	.10
		DiPel-Bl + PH + PTB MD				.1	.4	.2	
		Std.+ ISO (OFM)		1.7	1.9		.7	.3	0
		Std.+ Con (OFM)	0	2.1	1.5		.7	.7	.1
Dr. Davis	Yuba	Check		1.1	0	7/26	.6		
		Std.		2.9	0		.1	.1	
		DiPel		1.2	.1		.1	.1	
Halford	Merced	Check	3.8	80.4		8/1	11.2	0	0
		Std.	.9	41.8			11.5	.2	0
		DiPel	.6	25.8			12.4	0	0
Starn	Fresno	Javelin				8/21	0	8.8	
		Std. + Javelin					0	5.6	0
Starn	Butte	Check	0	6.1	5.8	8/19	2.2	2.8	.3
		Std.	0	5.2	5.1		2.1	2.2	.1
		Javelin	0	10.1	7.6		4.2	4.7	.3
Starn	Sutter	Check	0	.9	.3	8/19	23.0	.6	.3
		Std.	0	.7	0		5.0	0	0
		Javelin	0	.7	.1		7.0	0	.6

Table 3

Impact of Bt on Prune Pests, 1992

Grower	County	Material	1000 Fruit/sample % Infested PTB	GFW	SJS	LR
Vossler	Tulare	Check	4.0	.1	1.9	1.0
		Std.	1.2	.8	.1	.3
		Biobit	1.1	.4	2.7	1.0
Fallert	Tulare	Check	1.3	.4	8.7	.2
		Std.	1.1	.1	1.4	.5
		Javelin	.6	.1	9.4	.6
Kells	Sutter	Check	1.7	2.1	0	0
		Std.	1.0	1.3	0	0
		DiPel	.8	1.5	.2	0
Johnson	Butte	Check	2.0	.6	0	.5
		Std.	2.3	.6	0	.4
		Javelin	1.1	0	.3	.1
		DiPel	1.3	0	0	0
Bozzo	Butte	Check	.1	5.6	0	1.0
		Std.	1.1	6.2	0	.6
		Javelin	0	1.2	0	0
		DiPel	0	2.7	0	0

Table 4

Percent of Fruit Infested With San Jose Scale at Harvest

Block/Variety		1991	1992
Butte B Prunes	Check	.8	0
	Std	.3	0
	Bt	.1	0
Butte J Prunes	Check	0	0
	Std	0	0
	Bt	0	.3
Sutter K* Prunes	Check	.2	0
	Std	.3	0
	Bt	.1	.2
Tulare V Prunes	Check	4.6	1.9
	Std	.1	.1
	Bt	3.5	2.7
Tulare F Prunes	Check	4.5	8.7
	Std	.8	1.4
	Bt	3.0	9.4
Maycrest Peach	Check	0	.7
	Bt	0	.6
Springcrest Peach	Check	0	.4
	Bt	0	0
Spring Lady Peach	Check	0	0
	Bt	.2	.5
Sweet Home Nectarine	Check	1.1	1.5
	Bt	.4	.1
Maygrand Nectarine	Check		0
	Bt		0
Elegant Lady Peach	Check	.1	.1
	Bt	0	.1

* Different block.

Table 5

Comparison of 1991 & 1992 Fall San Jose Scale Samples

		Treatment Total							
		Alive		Parasitized		% twigs infested		Scale/parasite ratio	
County	Year	91	92	91	92	91	92	91	92
Butte B	Std	13	67	6	2	11	41	2.17	34
	Bt 1	35	160	0	9	26	67	0	18
	Bt 2		135		16		53		0.4
	Check	27	97	6	3	19	52	5	32
Butte J	Std	1	34	0	2	1	11	0	17
	Bt. blue	3	26	0	2	3	15	0	13
	Bt. orange		32		1		10		32
	Check	0	17	0	9	0	10	0	1.9
Sutter	Std	6	10	0	0	4	6	0	0
	Bt	11	22	1	2	7	13	6	11
	Check	5	34	0	5	4	19	0	6.8
Tulare F	Std	19	27	6	8	14	18	3	3.4
	Bt	14	19	5	26	12	17	3	0.7
	Check	18	7	9	10	13	7	2	0.7
Tulare V	Std	3	2	0	0	3	2	0	0
	Bt	17	13	3	6	17	10	3	2.2
	Bt + G	90		1				90	
	Check	26	32	2	12	16	14	13	2.7

Table 6

% of Leaves Infested

		Bt			Std			Check		
	Date	Web-spinning	ERM	Pred.	Web-spinning	ERM	Pred.	Web-spinning	ERM	Pred.
Tulare F	16 Jun	13	6	2	33	18	28	16	42	1
	23 Jun	1	0	6	3	3	1	4	5	1
	30 Jun	4	3	8	7	8	6	4	3	2
	7 Jul	13	4	29	24	7	1	29	17	21
	14 Jul	7	5	13	1	1	13	36	3	13
	22 Jul	2	2	33	34	0	17	33	0	25
Tulare	16 Jun	6	2	13	5	4	4	16	5	8
	23 Jun	4	4	0	9	1	6	4	0	2
	30 Jun	4	1	1	3	0	1	5	0	0
	7 Jul	5	5	6	6	1	7	3	1	4
	14 Jul	2	0	0	1	1	0	5	7	0
	22 Jul	4	1	27	0	1	22	9	1	9

Table 7

Survey of Predaceous Mites in 1992 Bt Plots *

Crop & Number of Acres	Collection Date	Surrounding Crops	Field Location	Species Found
Peaches 30 acres	June 12, 1992	peaches	Sweet Home 4399 Ave. 200	*Eusieus tularensis*
Prunes 80 acres	June 12, 1992	prunes, beans, grapes	Tulare County Ave 160 & Rd 180	*Typhlodromus caudiglans*
Prunes 40 acres	June 17, 1992	walnuts	Butte County Johnson Clan Rd.	*Typhlodromus caudiglans*
Prunes 40 acres	July 6, 1992	cotton	Tulare County Ave 160 & Rd 160	*Typhlodromus caudiglans*
Prunes 80 acres	June 17, 1992	prunes, walnuts	Sutter County Hwy 99 & Bogue	*Typhlodromus caudiglans*

* In cooperation with Katryn Schiro and Dr. Beth Grafton-Cardwell.