Monitoring secondary pest outbreak by unknown chewing feeders

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Abstract

We monitored eight orchards in Lake and Mendocino counties for the presence of katydids and earwigs. Forktailed bush katydid nymphs, *Scudderria furcata* were first noticed feeding on weeds in late May and early June. In June through early July nymphs were observed on pear trees feeding on 4th or 5th leaf from the tip of the growing shoot. Katydid feeding damage on the fruit was first observed in late July. Fruit damage appears as bite holes the size of a pencil eraser. Caging insects on branches with fruit showed that the first three katydid instar nymphs did not feed on the fruit. Feeding damage on the fruit was caused by fourth and fifth instar nymphs and by the adults. Damage increased as the fruit softened. We monitored katydid populations in plots treated with Assail, Danitol, Success, Intrepid or untreated controls. We did not observe a significant difference between treatments. Earwigs were observed in large numbers in one orchard. Earwigs fed at night upon the margins of the newest leaves at the tip of the growing shoot. When earwigs hide between two pears they occasionally cause superficial feeding damage to the pear skin.

Problem and Its Significance:

With the adoption of codling moth mating disruption, the use of wide-spectrum insecticides such as organophosphates has decreased. Unknown to us in the past, use of organophosphates suppressed secondary pests. In recent years, it has been observed that in some orchards, feeding damage caused by an unknown pest appears just as the fruit softens. This damage does not occur every year and is also sporadic in its distribution within the orchard. Many times the damage is first noticed in the harvest bins when the fruit arrives in the packing shed, thus making it hard to discover which insect caused it and when. The damage appears as an irregular chewing mark the size of a pencil eraser. Sometimes this damage is observed in trees at the margin of the orchard but sometimes it is in low levels throughout. Among chewing insects, grasshoppers, katydids, nocturnal Lepidoptera, earwigs may be the culprits. We monitored eight orchards, four in Mendocino and four in Lake County from June until harvest.

Objectives:

1) Through observation and trapping elucidate which insect is causing the fruit feeding damage.
2) Evaluate three insecticide treatments for control of katydids.

Plans and Procedures:

We monitored four orchards each in Lake and Mendocino counties. After trying several monitoring techniques such as beating tray samples and sweeping nets we determined that the best sampling technique was direct observation. In June and early July, while weeds were present before mowing, we observed weekly 200 weeds per plot. We recorded the number of katydid nymphs observed per plot. We also monitored weekly 5 shoots per tree in each of 100

trees and recorded insects observed and leaf feeding damage. Starting in mid-July until harvest we monitored weekly 200 fruit clusters per plot for damage. At harvest we examined 500 fruit per plot and calculated percent damage.

Four orchards in Lake County and three orchards in Mendocino County that received insecticide treatments in early June for katydid control were monitored weekly for katydid nymphs and adults until harvest. The treatments applied were a) Assail or Danitol, b) Success and c) Intrepid or untreated. Treatments were applied the second and third week of June. Plot evaluation was also conducted at harvest.

To determine if katydid were causing the fruit damage observed we caged one forktailed bush katydid per branch, each branch containing one pear. Katydids were divided into three age groups: 1) 1st to 3rd instar nymphs, 2) 4th and 5th instar nymphs and 3) adults. We conducted 15 replications per age group. For the first two dates, only nymphs were present, thus for those dates we only conducted the experiment with two age groups. Insects were left inside the cages for one weak. At the end of the week we recorded leaf and fruit damage and the insect stage. We moved the insects to a new branch and repeated the experiment for a four consecutive weeks.

Results

In Table 1 we report the number of forktailed bush katydids observed feeding on weeds, pear shoots and the fruit damage they caused. Forktailed bush katydid nymphs were first observed feeding on weeds, primarily malva and lambsquarter, starting in late May through June. In June and early July katydids were observed on pear trees feeding on the 3rd to 5th leaf from the top on tender growing shoots. Very low numbers of insects were observed at any given date. In July it was very hard to detect nymphs or adults in either the weeds or the tree foliage or fruit. Feeding damage on the fruit started appearing in mid-July. There was no correlation with the numbers of nymphs or adults detected through the season and the amount of damage detected on the fruit. For example in orchards B and C in Mendocino County we observed the highest number of katydid early in the season, yet fruit damage was very low. Conversely in Mendocino orchard D, we observed only two katydids during the season, yet the damage reached 46% at harvest. In this orchard damage was first noticed on July 19 and increased until harvest (Figure 1).

Orchard D in Mendocino County also had a high earwig population. Feeding damage was observed on the youngest leaf at the tip of the growing shoots. The leaf damage caused by earwigs can be readily distinguished from that of katydids. Earwigs feed on the margins of the youngest leaves, while katydids make holes on slightly older leaves. Monitoring after sunset revealed on average one earwig per five shoots. At night earwigs moved from under the bark to the tip of the shoot and fed at the edge of the youngest leaves. During the day, the earwigs hid under the bark and occasionally between two pears. Even though the population was very high, only two pears were observed damaged by earwigs feeding on the skin while hiding between them.

There was no significant difference in katydid population or fruit damage between the insecticide treatments in the seven orchards surveyed (Table 1).

Caged 1st to 3rd instar nymphs fed on the leaves and did not feed on the fruit, even during

the fourth week of the experiment, two weeks before harvest, when the fruit was getting softer (Table 2). Between 25 to 63% of the larger nymphs and adults fed on the fruit when caged on a pear branch for one-week intervals (Table 2). An average katydids feeding hole is approximately ¼ inch deep and ½ inch in diameter.

Discussion

The damage observed in previous years appears to be caused by older katydids nymphs and adults feeding on the fruit. Forktailed bush katydids first appear in the orchard in late May, early June. Fruit damage is noticed in mid-July and increases through harvest. It is not clear if the eggs of katydids overwinter in the orchard or if they overwinter in the riparian corridor and in vineyards adjacent to pear orchards thus is the young nymphs that migrates into the orchard in the spring. We collected overwintering eggs inserted into the bark of grapevines and reared from them forktailed bush katydids. The literature states that these katydids lay their eggs in the leaves of evergreen plants. The orchard with the highest damage at harvest (Mendocino D) was next to a vineyard with a high population of katydids and extensive feeding damage on the leaves. The blocks closest to the riparian corridor appear to have the highest initial population of young katydid nymphs early in the spring. Further studies to determine egg overwintering sites are needed to develop better monitoring techniques. Presently there is no efficient and reliable method to monitor for this insect. If katydids do not overwinter in the orchard it is important to determine where they are migrating from and the distance they can travel in the spring. The population of katydid was too low in the seven orchards surveyed to be able to evaluate treatment effect.

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Table 1: Number of katydid observed on weeds and on pear shoots, number of damaged fruit and percent damage at harvest in four pear orchards each in Lake and Mendocino Counties.

Date:	**6/7**	**6/21**	**6/28**	**7/6**	**7/11**	**7/19**	**7/26**	**8/2**	**8/11**	**8/16**	**8/23**	**8/30**	**9/12**	**9/19**	**Harvest***
						Total # of katydid/plot/sampling date									% damage
Lake A															
Assail	3[w]	0	0	0	0	0	0	0	0	0	0	0	0	0	1.2
Intrepid	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.5
Success	4[w]	0	0	0	0	0	0	0	0	0	0	0	0	0	1.3
Lake B															
Assail	2[s]	0	0	0	0	0	0	0	0	0	0	0	0	0	0.4
Success	1[s]	0	0	0	0	0	0	0	0	0	0	1[f]	0	0	0.1
Lake C															
Assail		0	1[w]	0	0	0	0	0	0	0	0	0	0	0	ns[i]
Success		0	0	0	0	0	0	0	0	0	0	0	0	0	ns
Control		0	0	0	0	0	0	0	0	0	0	0	0	0	ns
Lake D															
Assail		0	3[w]	0	0	0	0	0	0	0	0	0	0	0	ns
Danitol		2[s]	0	0	0	0	0	0	0	0	0	0	0	0	ns
Intrepid		1[s]	0	0	0	0	0	0	0	0	0	0	0	0	ns
Success		2[s]	0	0	0	0	0	0	0	0	0	0	0	0	ns

Date:	**6/3**	**6/14**	**6/21**	**6/28**	**7/5**	**7/12**	**7/19**	**7/26**	**8/2**	**8/9**	**8/16**	**8/23**	**Harvest**
						Total # of katydid/plot/sampling date							% damage
Mendo A													
Danitol	0	0	0	0	0	0	0	0	1[f]	0			0.0
Success	0	0	0	1[s]	0	0	0	0	0	0			0.0
Control	0	0	0	1[s]	1[s]	0	0	3[f]	4[f]	2[f]			0.2
Mendo B													
Assail	3[w]	1[w]	5[w]	3[w]	2[w] 1[s]	0	0	0	0	0			0.1
Success	4[w]	0	2[w]	0	0	0	0	0	0	0			0.0
Intrepid	2[w]	1[w]	0	0	0	1[w]	0	0	0	0			0.0
Mendo C													
Danitol	0	1[w]	0	0	0	0	0	0	0	ns			0.0
Success	0	0	5[w] 11[s]	1[s]	2[s]	0	0	0	0	ns			0.1
Control	0	0	3[s]	4[s]	2[s]	2[s]	0	2[f]	8[f]	ns			0.2
Mendo D													
Control	0	0	0	2[s]	0	0	3[f]	14[f]	43[f]	75[f]	83[f]	92[f]	46.0

[f] = # of damaged fruit in 200 sampled fruit per plot
[s] = # of katydid sampled in 500 shoots per plot
[w] = # of katydid sampled in 200 weeds per plot
* = % fruit damage at harvest
[i] = not sampled

Table 2 – Percent fruit damage caused by the three katydid stages during a cage experiment

	% fruit damage			
	07/19/05	07/26/05	08/02/05	08/09/05
1st to 3rd instar nymph	0	0	0	0
4th and 5th instar nymph	29	33	60	25
Adult	Not available*	Not available	63	56

* Adults were not available on the first two dates of the experiment

Figure 1 – Percent katydid fruit damage in an untreated orchard (D) in Mendocino County