PROGRESS REPORT TO THE AGRICULTURAL RESEARCH FOUNDATION FOR 1999-2000

Title: Damage Potential and Population Assessment of Phytophagous Heteropterans

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Significant Findings:

Phytophagous heteropterans, such as Lygus bug, boxelder bug, and various stink bugs, were the primary source of insect-caused fruit injury over the five years of the Medford Codling Moth Areawide Program (CAMP). In pear, most of the fruit damage is caused by Lygus bug feeding in the early and mid part of the season, as opposed to apples, where the majority of the fruit damage is the result of mid to late season feeding by stink bugs.

Damage from Lygus bug and stink bug was considerably reduced in 1999 over the two previous years. This reduction can be attributed, in part, to increased effort in monitoring and the use of insecticide treatments in blocks where high levels of Lygus and stink bugs were found in the groundcover. The effect of directing an insecticide spray at the groundcover for control of Lygus and stink bugs was examined. A number of insecticides were tested using this application technique and were, generally, found to be effective in reducing Lygus and stink bug populations in the groundcover.

Sleeve cage studies demonstrated that fruit injury from Lygus and Calocoris was very similar but that damage expression differed significantly with pear cultivar. The effect of repeated mowing of the groundcover on Lygus and stink bug populations appeared to confirm earlier results which indicate that mowing may be an important tool in the management of these phytophagous heteropterans within the orchard.

Objectives:

1) Characterize the direct damage caused by phytophagous heteropterans.

2) Examine the population distribution, seasonal dynamics, and species composition of phytophagous heteropterans which inhabit orchards.

3) Compare methods of monitoring phytophagous heteropterans.

4) Analyze the impact of mowing and other groundcover vegetation management practices on movement of *Lygus* spp. and other phytophagous heteropterans.

5) Correlate specific orchard groundcover characteristics with fruit injury caused by phytophagous heteropterans.

Procedures

Seasonal Population Dynamics and Comparison of Sampling Methods—Within the Medford CAMP sixteen blocks, twelve pear and four apple, representing ten pear cultivars and four apple cultivars were selected for this study. The blocks were chosen on the basis of having a previous history of true bug damage and to represent a wide array of groundcover management styles. Three of the blocks were clean-cultivated to some degree, while the remainder had varying levels of managed sod. The weeds within the blocks varied in both abundance and species composition. Groundcover vegetation was surveyed twice during the year—early and late season. During each vegetation survey, ten locations in the block were randomly selected and the groundcover vegetation was assessed using a one meter square apparatus. The horizontal area occupied by each plant species was estimated. At each of the ten locations vegetation was surveyed both in the row middle and within the tree row.

Three primary methods of sampling for true bugs were employed: limb-tapping with an 18" by 18" beating tray, sweep-netting with an 15" diameter muslin sweep net, and inspection of fruit for signs and symptoms of bug feeding. In select blocks, where high populations of stink bugs had been observed late in the season, two types of pheromone trap designs were compared, the jar and tube trap. Samples were taken periodically through the season up to harvest. All heteropterans, both predaceous and phytophagous, were recorded in the beating tray, sweep net, and sticky trap samples. In addition to recording heteropteran predators, the abundance of coccinellids, lacewings, earwigs and other generalist predators was recorded. Fruit damage was generally classified in one of three categories: eruptions on the fruit surface which occur early in the season (early season Lygus), depressed areas on the fruit underlain by hard stone cell formation (mid-season Lygus), and depressed areas underlain by soft tissue exhibiting brown or white discoloration (stink bug).

Groundcover Management: Effect of Alternate Row Mowing—In a block at the experiment station a comparison of complete mowing and the mowing of alternate rows was made. Plots were approximately one acre in size to minimize interactions between adjacent plots and a plot which was left unmowed was also included. Three sweep net samples, consisting of fifteen sweeps per sample, were taken from each of the 24 rows in the block prior to and following each mowing. Sticky traps were deployed in every other row to monitor movement of Lygus and other bugs and pheromone traps for stink bugs were used late in the season. Plots were mowed monthly, but in the alternate mowing plot only every other row was mowed. In the next mowing of the alternate row plot, the row that had been previously mowed was skipped, and the row which had been skipped was mowed. Beating tray samples were also taken, five trays from each row, after each mowing.

Damage Characterization: Sleeve Cage Study—The sleeve cage study was conducted at two times during the season, mid-season (mid-June to July) and late season (mid-July to August). In the mid-season test, boxelder bugs were caged on four pear cultivars and two apple cultivars; Lygus and Calocoris were caged on Bartlett, Comice, and Bosc; while various species of stink bugs were caged on Bartlett. In the late season test, Lygus were caged on five pear cultivars and Braeburn apples; Calocoris, due to a lack of availability, were only caged on Bartlett; stink bugs were caged on Braeburn apples and, depending on species, Gala apples and/or Bartlett pear. Boxelder bugs were not present in high enough numbers to be tested late in the season. Fruit was evaluated after two to four weeks and also at harvest. The presence of live adult bugs and their eggs or nymphs within the cage was noted when the fruit were evaluated. Fruit remaining for harvest evaluation were removed and peeled in the laboratory to look for any signs of bug feeding.

Chemical Treatment: Comparison of Registered Compounds—At the end of July, sweep net samples in a commercial apple orchard with a history of true bug damage, indicated the presence of high numbers of Lygus adults and nymphs along with stink bugs, primarily nymphs, which included Euschistus, Chlorochroa, and Thyanta among other species. As the true bugs were found exclusively in the groundcover, mainly on clover, treatments were applied with a speedsprayer using only the bottom nozzles directed toward the skirt of the tree and effectively treating the groundcover in the process. Six materials registered for true bug control were used at label rates in unreplicated plots measuring approximately 15 acres in size. Two pear blocks within the orchard were not treated and were sampled to serve as a comparison. Sweep net samples were taken from the center of each plot prior to treatment and then one week and three weeks following treatment.

Results and Discussion

Damage from true bugs in the Medford CAMP site for 1999 is shown in Table 1. Pear and apple differ quite markedly in the type of true bug damage that is found. Lygus damage predominates in pear while damage in apples is caused almost exclusively by stink bugs. Cultivar differences are apparent in both pear and apple, as seen in Table 2, although differences in groundcover and spray programs must also be taken into account. For example, the Braeburn and Granny Smith blocks, which have had high levels of stink bug damage in the past, were both treated with insecticides when stink bugs were observed in the groundcover, without those treatments damage might have been much higher.

The seasonal population trends in pear for true bugs pests and a number of generalist predators are shown in Table 3. While the numbers in the beating tray samples are fairly low they do show an influx of stink bug and Lygus into the tree canopy late in the season. Results from the sleeve cage study indicate that late season Lygus may not be as prone to causing injury to pear fruit as populations earlier in the season. Conversely, when stink bugs were caged on apples late in the season the damage was initially slight, but by harvest Braeburn apples exhibited severe damage. A late season stink bug population was observed in a block of Rosired pears during the late season fruit sample, no fruit damage was evident but fruit marked with stink bug droppings were seen. When fruit were peeled, stink bug injury was common on the fruit with stink bug droppings, and much less common, although not entirely absent, on the fruit not marked with droppings, see Table 4. When the block was sampled two weeks later, fruit injury had continued to increase.

Mowing resulted in lower levels of pest true bugs (Table 5). Reductions in the numbers of Lygus and stink bug nymphs were evident in the mowed plot, however, the reduction in adult levels of those pests was even more pronounced. Two generalist predators observed at fairly high levels in the groundcover were true bugs—Nabis (damsel bug) and Geocoris (big-eyed bug)—both are known to feed readily on Lygus nymphs, which were also present at high levels. Mowing of alternate rows generally resulted in populations of insects in the groundcover higher than observed in the totally mowed treatment and lower than in the unmowed treatment. Alternate row mowing did appear to conserve adult Lygus and stink bugs, as they were only slightly reduced when compared to the not mowed treatment. Attempts to monitor the activity of adult Lygus and stink bugs in the tree canopy within the mowing plot were largely unsuccessful. In the multiple beating tray samples conducted in the mowing plot, two Lygus were found in the not mowed treatment and two in the alternate mowing treatment, while none were seen in the always mowed treatment. In the twelve sticky cards placed throughout the block, two Lygus and two Calocoris were caught throughout the entire sampling period. Jar and tube traps baited with stink bug pheromone were placed in each treatment late in the season and failed to catch a single stink bug even though they were present in the groundcover.

The results of the chemical trial are shown in Table 6. The majority of pest true bugs sampled were Lygus although stink bugs, mainly Euschistus, were observed in all treatments. The true bugs were primarily in the nymphal stage when the treatments were applied. In the two pear blocks which were not treated but were sampled, the true bug population increased three fold over the course of the trial, indicating that the reductions seen in the treated areas relative to the pre-treatment count do not represent a natural decline in the population. While all the treatments appeared to provide a substantial degree of population reduction, these results are strictly preliminary and more rigorous and controlled testing needs to be done.

Improved sampling methods are still needed to adequately monitor populations of true bugs in the orchard. The beating tray is inefficient but remains the best way to monitor true bugs in the tree canopy. Sticky traps for Lygus and pheromone traps for stink bugs gave very poor results in 1999. A sex pheromone for Calocoris was also tested in 1999 with poor results. Sweep-netting is an efficient way to sample the groundcover for Lygus, Calocoris, and even stink bugs. However, the connection between the population of true bugs in the groundcover and true bug activity in the orchard canopy is still not welldefined. One aim of this research is to further understand true bug movement between the groundcover and the tree canopy.

Groundcover management, either by mechanical means (i.e. mowing) or chemical treatment can reduce populations of true bugs in the groundcover. In 1999, blocks with a history of high true bug damage were treated for true bugs when populations appeared to build in the groundcover. These treatments did appear to result in much lower levels of damage than had been observed in recent years. With the knowledge that the groundcover vegetation within an orchard can harbor a number of pest true bugs as well as beneficial species, it is important that groundcover plantings used to encourage natural enemies be evaluated for their potential to provide habitat for pest species.

Table 1. Percent fruit damage due to true bugs in the Medford CAMP site in 1999.

	Mid-season Fruit Sample		Harvest Fruit Sample	
	Lygus	Stink bug	Lygus	Stink bug
Pears	0.24	0.04	0.29	0.07
Apples	0.02	0.84	0	1.49

Table 2. Percent fruit injury at harvest due to true bugs by cultivar in 1999.

	Lygus	Stink bug
Pears		
Red cultivars	0.57	0.16
Comice	0.26	0.06
Bosc	0.13	0.03
Apples		
Braeburn	0	2.13
Granny Smith	0	1.52
Gala	0	1.0
Fuji	0	0.42

Table 3. Beating tray samples in pear blocks: early, mid, and late season averages, number per 50 trays.

	Early season 4/19-5/13	Mid-season 6/3-7/8	Late season 7/22-9/24
Pest true bugs			
Lygus	0.04	0	0.42
Calocoris	0	0.03	0
Stink bug nymphs	0	0	0.17
Stink bug adults	0	0	0.28
Generalist predators			
Deraeocoris brevis	0.15	0.04	0.19
Heterotoma	0	0.02	0
Nabis	0	0.02	0.61
Orius	0	0.02	0.83
Soldier beetle	0.33	0.04	0
Coccinellids	0.15	0.08	0.08
Green lacewing adults	0.18	0.10	0.14
Brown lacewing adults	0	0.02	0.66
Lacewing larvae	0	0.06	0.42
Earwigs	0	2.43	1.78

Table 4. Percent stink bug injury evident when fruit is peeled, Rosired pears, with and without stink bug droppings present on the fruit.

		Rating of stink bug injury*		
	None	**Slight**	**Moderate**	**Severe**
Sampled on 8/24				
With droppings	10	15	61	14
No droppings	95	4	1	0
Sampled on 9/8				
With droppings	4	16	58	22
No droppings	89	3	8	0

* slight = single feeding injury, located near stem
moderate = more than one injury, located near stem
severe = numerous injuries, not limited to the stem area

Table 5. Results from 1999 mowing plot—seasonal means, number per 50 sweeps

	Always mowed	Alternate row mowed	Not mowed
Pest true bugs			
Lygus nymphs	35.8	56.2	84.8
Lygus adults	3.5	10.9	12.5
Calocoris	.03	.27	.36
Stink bug nymphs	.74	.73	1.22
Stink bug adults	.03	.51	.52
Generalist predators			
Nabis	16.1	15.9	19.4
Orius	15.6	29.4	49.0
Geocoris	8.5	8.9	14.6
Coccinellids	0.61	0.78	0.68
Lacewings	0.11	0.10	0.36

Table 6. Percent reduction in Lygus and stink bugs relative to the pre-treatment count, sampled by sweep-net, following chemical treatment

Material applied	One week post-treatment	Three weeks post-treatment
Carzol	100	97
Dimethoate	98	100
Thiodan	98	95
Vydate	97	88
Asana	85	76
Provado	88	61