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Leaffooted Bugs in Almonds

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Introduction

Leaffooted bug has a history of being an infrequent pest in Almond orchards throughout the San Joaquin Valley. In Kern County it was first found causing damage to the Sonora variety in the Delano area in 1986. After that it went relatively unnoticed until 2000 when it caused yield reductions in several isolated locations in the San Joaquin Valley. This year there have been widespread reports of damage to almonds and pistachios from Fresno down through Kern County. Reports on damage range from insignificant to severe, with leaffooted bug densities ranging from non-existent to high, even sometimes among different orchards within the same general vicinity.

Identification

Adult leaffooted bugs are relatively large brown insects, up to 1 inch in length, that have a long proboscis extending nearly the length of the body. They also have a white stripe across the abdomen and flattened leaf-like structures on their hind legs for which they are named.

Immature leaffooted plant bugs have the same general shape as the adults, but can look quite different. Small immature leaffooted plant bugs have an orange body, brown legs, a brown head, and brown wing pads. They can easily be mistaken for assassin bugs, but differ in that they have a long, backwards-facing proboscis compared to a relatively short downward or forward-facing proboscis on an assassin bug. As leaffooted bugs mature the body gradually becomes browner and the wing pads enlarge. Generally speaking, the last larval stage and the adult look the same except for the presence or absence of fully developed wings.

Life Cycle

In general, leaffooted bugs are considered to have two generations per year. They overwinter as adult females both within and outside the orchard. Some preferred sites are under brush, inside wood piles, and in other concealed locations. During the spring in late April and May the adult females, which are good flyers, migrate into orchards such as almonds and pistachios. Once in the orchard they begin to feed and reproduce. Adult females lay eggs in chains of about 8 to 10 rectangular brown eggs. Adult females are thought to live anywhere from four to six months, and will continue to lay chains of eggs during that period. Immature leaffooted bugs that emerge from eggs by the overwintering females feed and become adults anywhere from July through fall. As temperatures cool and day length shortens the leaffooted bugs, which are now all in the adult stage, migrate to a site to overwinter. Details about overwintering sites and how they are selected are still relatively unknown.

Damage

Nymphs and adults feed by inserting their proboscis into plant tissues and sucking out fluids. During late April through May, feeding on the nut hull can be ‘superficial” or it can be deep into the endosperm (kernel). If the feeding takes place in the endosperm, the embryo dies, the nut turns yellow and drops to the ground.

The first evidence of nut damage by the leaffooted bugs is clear gumming on the nut surface. A cut underneath the gumming area will reveal a sting that may stop at the endocarp where a gum pocket may form. In some nuts the sting may continue all the way to the seed cavity where lesions can be found in the endocarp (shell) and seed coat (pellicle).

The damage is not uniform throughout the orchard or even within a tree. Some areas and some trees will be more affected than others. Oftentimes the damage occurs in clusters such that if one nut is affected, three or more nearby nuts will also be affected. This is likely caused by the same bug feeding on multiple nuts.

Leaffooted bugs can cause significant nut loss within an orchard. A cage study conducted by Daane et al (2002 report to Almond Board of California) showed that one adult female during a 7 day period on 10-12 caged nuts was able to cause 20% nut drop and 20% nut damage at harvest. That is a total of 40% loss of 10-12 nuts during one week of feeding.

Leaffootted bugs also have varietal feeding preferences. In Kern County on June 10, 2000, Mario Viveros collected data on the damage of leaffooted bugs in Nonpareil, Sonora and Fritz trees. Ten 30-nut samples were taken from each of these varieties. Data were collected on gumming of the hull (surface and inside) and endosperm or kernel lesions. The results (Table 1) show that Sonora was the most damaged and Nonpareil the least with Fritz in the middle. They also show that gumming on the outside of the kernel does not necessarily mean that the kernel has lesions.

Table 1: Evaluation of leaffooted bug damage on three almond varieties, Kern Co., 2000

Variety	Gumming of Hulls (%)		Kernel with Lesions (%)
	Outside	Inside	
Nonpareil	2.3	0.0	0.0
Sonora	22.5	20.0	13.3
Fritz	8.0	14.0	2.5

Daane et al (2002 Almond Board of California Report) showed similar results by using cage studies. Whereas the Viveros data showed that bugs prefer to feed on one variety over another (i.e., one possibly tastes better than the other), the Daane data (Table 2) shows that there are actual differences in the susceptibilities of the varieties to damage. Differences occurred even when the same numbers of bugs were caged on the same number of nuts of different varieties. As was previously noted, Non-Pareil appears to be less susceptible than other varieties such as Fritz, Carmel, and Butte.

Table 2: Evaluations of leaffooted bug damage to nuts in cage studies, April 2002

	Percentage of Damaged Nuts				
	Non-Pareil	Fritz	Carmel	Butte	Mission
Dropped Nuts	2.1	10.7	20.2	10.5	5.6
External Damage at Harvest	8.0	12.3	17.5	6.5	0.0
Internal Damage at Harvest	5.0	6.9	1.2	3.3	0.0

Leaffooted bugs can also damage almonds later in the season. They are capable of drilling all the way through the shell and into the meat. This causes black spots or wrinkled, misshapen nutmeats.

Control

In most years leaffooted bug is controlled by an egg parasitoid, *Gryon pennsylvanicum*. Later in the season it is not uncommon to find over 80% parasitism of leaffooted bug eggs. These parasitoids have been seen this spring, but cannot be relied on for control during this very sensitive period in the crop.

Control is currently based on the use of the Lorsban®, permethrin/pyrethroids or Sevin®. The biggest concern with these products is the potential to flare mites later in the season. Growers using these products should watch their mite populations closely and follow treatment guidelines available for mites.

Unfortunately there are no official monitoring programs or treatment thresholds available for leaffooted bug. Each individual grower and PCA will need to make their own decision on whether or not a spray is needed. This decision should be based on the number of bugs seen in the orchard, their known longevity in the field (adults are around for a long time), the amount of gumming seen on the nuts, and the tolerance for damage in the crop. PCAs basing treatments on gummosis and nut drop should also recognize that there is a lag time between when feeding takes place, gummosis occurs, and the nuts drop and that not all nuts with gummosis will end up being damaged.

Prune fruit cracking

Franz Niederholzer, UC Cooperative Extension, Sutter/Yuba Counties

2005 was a bad year for prune fruit cracking – at least in parts of the southern Sacramento Valley. Cracking can ruin fruit and provide an easy starting point for brown rot infection. There are two different types of fruit cracking in prunes: end cracking and side cracking. Each occurs under different situations, but both are related to fruit growth. This article gives a brief review of what is known about prune fruit cracking and how it can be managed to minimize crop damage.

End cracking occurs within days after dry trees are irrigated anytime before late July (when the fruit are essentially finished growing). The sudden increase in tree water status at least doubles fruit flesh pressure, especially in the tip, and cracking occurs soon afterwards.

Managing end cracking is simple. **Don't let trees get water stressed in spring and summer**—particularly May and June. In my experience, the worst end cracking years are those with wet, cool springs. Under those conditions, trees can use a lot more water than falls as rain, even though the soil surface might be moist, the skies often cloudy, and conditions not seem as though water might be limiting. There are several ways to keep track of orchard water status: pressure bomb, Watermark sensors, ET estimates, etc. All work if used regularly. Contact your local UCCE farm advisor for information on any of these practices.

Side cracking usually happens when water forms (dew or rain) on the surface of exposed fruit during the final growth stage (when the fruit "cheeks" fill out). Large fruit, which expand and contract to a greater degree in a 24 hour period than smaller fruit, are usually most sensitive to side cracking. Side cracking potential is high during a three week period beginning a week after the cheek diameter of the fruit is greater than the suture diameter. (This is when the fruit "plump up"). This cracking window falls around July 4 in most years, but will probably be a least a week later this year due to the delayed bloom and cool March and April. During this "window", cooler weather can lead to dew forming on the fruit, an increase of pressure in the fruit, and cracking on the sunny-side of exposed fruit. (That portion of the fruit skin is sun-toughened, less elastic, and more likely to break under increased fruit flesh pressure.) Summer rain can also lead to this kind of cracking.

Managing side cracking is difficult, because the weather can't be managed. Some growers don't flood irrigate during the side cracking "window" hoping to keep orchard humidity low and reduce chances of dew forming on the fruit. Orchards irrigated with micro-jets or drip irrigation often have lower humidity than flood irrigated orchards and less side cracking than growers with flood irrigation. Side cracking varies more from year to year than from orchard to orchard, because it is generally related to regional weather, not conditions specific to a particular orchard.

Finally, in research by Dr. Nick Mills, professor of entomology at UC Berkeley, prune trees infested with mealy plum aphid showed a higher percentage of end cracking than trees without aphids. The aphids don't appear to directly cause the cracking, but they make the damage worse if cracking conditions occur in an orchard.

Multiple pathogens implicated in lower branch death

Maxwell Norton, UC Cooperative Extension

Many almond farmers in the Central Valley have observed a significant number of spurs and branches on the lower parts of trees dying. On the ground, many leaves can be observed as they fall off the dying branches.

Some blocks have significant numbers of nuts falling also but this is probably unrelated. It is normal to have nuts drop in late spring and the drop is a little heavier than normal this year. The dropped nuts probably were pollinated but fertilization of the ovary was not complete or for some reason it aborted.

Examination by a UC pathologist shows that three organisms are associated with the dead spurs and branches. In many we find the fungal organism *Colletotrichum*. This is the cause of Anthracnose disease which is a common cause of spurs and branch dieback. It also causes blossom blight similar to brown rot disease. Leaves on infected spurs will have marginal burning and will stay attached after dying.

Two other organisms we are finding are *Phomopsis* and *Botryosphaeria*. We do not know much about the relationship between these two organisms and how much damage they do to almonds. They are not considered new nor exotic organisms as they are reported in the literature.

For a few years now the growers of the varieties Butte and Padre have noticed a persistent problem with lower branch death. This also is a mystery but UC Cooperative Extension researchers are studying the problem and suspect a couple organisms. There is no spray recommendation at this time. I suspect that the popularity of micro jet irrigation may play a role in this because they increase humidity in the orchard and must be run for long periods to deliver enough water to satisfy the needs of the tree.

Another disease I suspect has been active this year is green fruit rot (or jacket rot) which is caused by the pathogens: *Botrytis, Sclerotinia or Monilinia.* Green fruit rot begins during the latter part of the bloom period when the fungus infects senescing petals and anthers. As fruit sets and starts to grow, a brown spot develops. Frequently this leads to rot of the entire fruit.

My preliminary recommendation for branch dieback at this time is to prune out the infected branches and remove them from the orchard. Any thing you can do during the year to reduce humidity may help. Dormant pruning to assure some sunlight is reaching the lower limbs will help. Next spring – an aggressive fungicide program that targets anthracnose and jacket rot diseases is probably warranted. Contact your pest control advisor to discuss this.

More information can be found at our web site **ucipm.ucdavis.edu** and also by picking up a copy of Integrated Pest Management for Almonds #3308 at the Cooperative Extension office at 2145 Wardrobe, corner of Wardrobe and Grogan in west Merced.

WATERLOGGING and PHYTOPHTHORA

by Janine Hasey, UC Cooperative Extension, Sutter/Yuba Counties

Many orchards are showing the effects from the excessively wet spring and high water flows in our rivers and Sutter Bypass that caused saturated soils and water seepage as the tree crops were leafing and blooming. Flooded conditions are worse in the growing season especially as the weather warms up. In saturated situations, water replaces the oxygen in the soil and anaerobic processes take place. These include production of gases such as methane and decomposition of organic matter by anaerobic bacteria that can produce some very toxic materials such as hydrocarbons, phenolic acids, sulfur and cyanogenetic compounds. Flooding also increases growth regulator levels of ethylene and abscisic acid while others such as cytokinins decrease resulting in poor leaf expansion and chlorosis, premature senescence and leaf abscission, and stem growth disruption. There is a reduction in root initiation and growth and many other physiological changes occur. Trees decline and may collapse rapidly or decline slowly over a few years before dying. When possible, drain the water from flooded orchards as quickly as possible and where soils are saturated, allow the vegetation to grow for an extended time before mowing to help dry down the soil.

Saturated soils also favor Phytophthora root or crown rot diseases. If Phytophthora is the problem in your orchard, there are treatments available that may help alleviate the problem. USDA Plant Pathologist from UC Davis, Greg Browne, has researched the effects of phosphonate treatments on walnuts and almonds. Phosphonates (inorganic and organic salts of phosphoric acid, the active ingredient) can provide systemic activity against water mold fungi and have helped manage diseases caused by Phytophthora. They are translocated both upward and downward in the plant; the mode of action is complex and not completely understood, but evidence suggests that phosphoric acid disrupts the growth of Phytophthora and increases the plant's defenses.

There are several phosphonate products available on the market. Dr. Brown found that using Fosphite® applied in late summer/early fall as either a foliar spray or foliar + phosphonate chemigation on walnut reduced the area of cankers caused by P. citricola compared to the untreated control trees. In another study on almonds, he found that using Nutri-Phite®P+K applied as a preventative foliar spray in the fall or spring suppressed development of Phytophthora cankers for up to 5 months. Many growers have already applied a phosphonate product on their orchards this spring. These treatments should perform better as the canopy fills in. For walnuts, that would be around middle of to late May this year depending on the variety. You may want to consider the early fall timing also in severe situations. Make sure to check the label because tank mixing with copper may result in phytotoxicity. Not all these phosphonate materials are registered for controlling Phytophthora; some are only foliar nutrient sprays. Make sure to check label before using them for Phytophthora suppression.

THE PEACH CROP and PREDICTING HARVEST TIMING

by Janine Hasey, UC Cooperative Extension, Sutter/Yuba Counties

The crop this year is approximately 25 percent down. The bright side though is that thinning costs are down. Reference date for 2006 is May 26, 10 days later than the May 16 reference date in 2005. Full bloom was March 3, 2005 compared to March 14, 2006. The heat units accumulated driven by temperature the first 30 days after bloom are used to predict when a peach orchard will be ready to be harvested. Temperatures those first 30 days are critical and what happens after that has a much smaller effect on harvest date. In the very warm spring of 2004, we accumulated 7,826 growing degree hours (GDH) at the Nicolaus CIMIS weather station. That was one of our earlier harvests with a very short growing season and fruit sizing problems. 2005 was better normal harvest timing with 6,018 GDH 30 days after bloom. In 2006, we only accumulated 3,532 GDH 30 days after bloom. We have never experienced a year with temperatures as cold as these after bloom since the predictive model has been in existence. UC Davis Extension Pomologist Ted DeJong said it is possible that we may be picking Loadels in August. The main point is to be prepared for a later than usual peach harvest this year.

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