

In-Season Management of Leaffooted Bug in Almonds

Project No.: 07-ENTO4-Haviland

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Objectives:

1. Evaluate interactions between leaffooted bug size, nut developmental stage (time of year), and variety on the type and severity of damage to the almond crop
2. Evaluate the effects of chemical insecticides on leaffooted bug adults

Interpretive Summary:

Introduction

During 2006 many almond growers in the lower San Joaquin Valley experienced significant damage from leaffooted bug. This sporadic pest uses needle-like mouthparts to penetrate the almond hull and feed on the kernel. Depending on when the feeding occurs, damaged kernels can either cause the nut to abort, result in a sticktight with no kernel, or result in a harvested nut with a black stain. Each of these types of damage reduces either the quality or quantity of nuts.

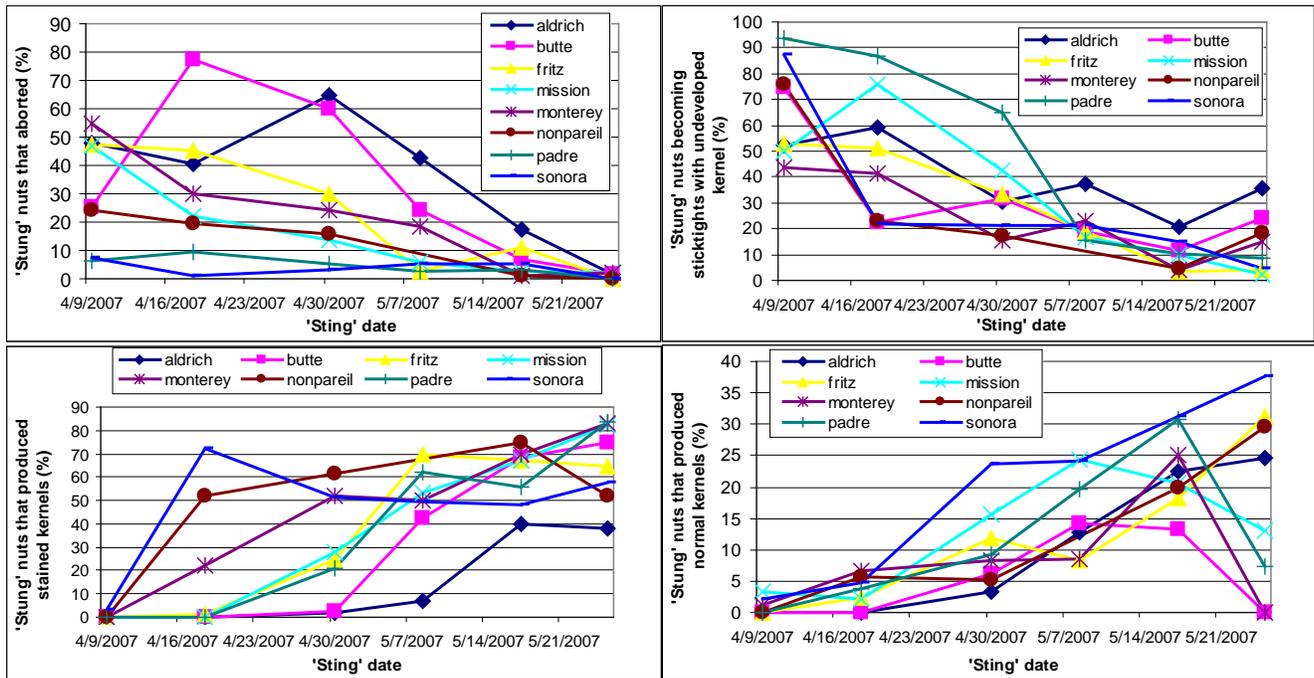
As reports of damage from this pest in 2006 became more and more widespread, certain patterns in damage became evident. The most prominent of these was that there are huge differences in varietal susceptibility to damage. It was not uncommon for growers to report hundreds of aborted Fritz nuts per tree while the adjacent row of Nonpareils appeared relatively unaffected. We also had numerous growers and pest control advisors asking similar questions related to what is leaffooted bug, when does it damage the crop, how long will it continue causing damage, did all the damaged kernels abort or will some show up at harvest, why are different varieties affected so differently, and how can we learn from 2006 so that this doesn't happen again? This project is an attempt to answer as many of these questions as possible.

What we have learned

1. Leaffooted bug damage in almonds is caused almost exclusively by adult bugs in the spring that migrate into the orchard. The immature offspring of these bugs either do not survive well, or have mouthparts too small to damage the kernels.
2. Leaffooted bug feeding on the almond hull can cause gummosis, but does not result in damage to the kernel, which can continue to develop normally.
3. Damage from leaffooted bug feeding, from the perspective of a grower, was best categorized into three groups; nuts that aborted, nuts that became sticktights, and nuts with fully developed but damaged kernels (=offgraded at the huller).
4. Damage type depends on when the feeding occurs (Figures 1-4). This was evaluated by simulating leaffooted bug damage by pricking a small pin through the hull and kernel of 100 nuts per each of 8 almond varieties every ~10 days in April and May. In general, nearly 100% of the nuts stung in early April either aborted or became sticktights. In mid-April, approximately 50 to 70% of the stung Nonpareil and Sonora (both early harvested varieties) nuts had developed kernels with stains on them, followed by 20% for Monterey. Damage to other varieties on this date still produced aborted or sticktight nuts, suggesting that kernel maturity is a key factor in determining the type of damage.

For most varieties, early May is when the greatest shift in damage type occurred, with most nuts in April either being aborted or sticktights, and most damaged kernels in May turning into developed, stained kernels. By late May no simulated feeding resulted in nut abortion, 0 to 36% of the nuts became sticktights, and 38 to 84% of the nuts would have been offgraded at harvest. The remaining nuts could have been

Figures 1-4. Effects of simulated leaffooted bug feeding on the percentages of nuts that aborted, became sticktights, had stained kernels, or developed normally.

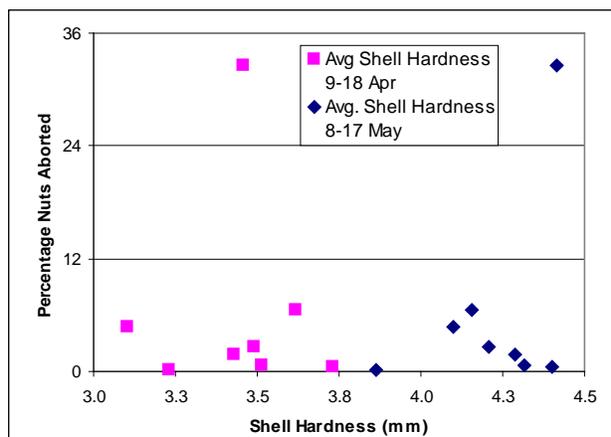


sold.

5. Simulated leaffooted bug damage resulted in more sticktights and less aborted nuts compared to real leaffooted bug damage. Aborted nuts from simulated damage also took weeks to fall off of the tree compared to the 7-10 day period observed by many growers. This suggests that the primary cause of rapid nut abortion of nuts fed on by leaffooted bug is the result of some other factor, such as injection of a toxin or other substance into the kernel, than due to the physical effects of probing and penetrating the kernel.
6. There are large differences in varietal susceptibility to leaffooted bug damage. Of the 15 varieties evaluated during 2006 in the Kern County Regional Almond Variety Trial, Fritz was by far the most susceptible variety, with 33% of the nuts aborted and another 30% of the nuts that were harvested having shriveled or black-stained kernels (total 63%). Sonora was the second most affected variety with an overall 12% of the nuts damaged, followed by Aldrich (8%), Livingston (6%), Monterey (4%), Carmel (3%), and 2 or less percent for 2-19E, Butte, Mission, Nonpareil, Padre, Price, Ruby, Winters, or Wood Colony. More details on these data are reported by Haviland in the 2006-7 Reports CD from the Almond Board of California that is being distributed at the 2007 Almond Industry Conference.
7. Varietal harvest dates do not help explain differences in susceptibility to damage. For example, the two most heavily damaged varieties were Fritz and Sonora, which happen to be the earliest and latest harvested varieties evaluated.

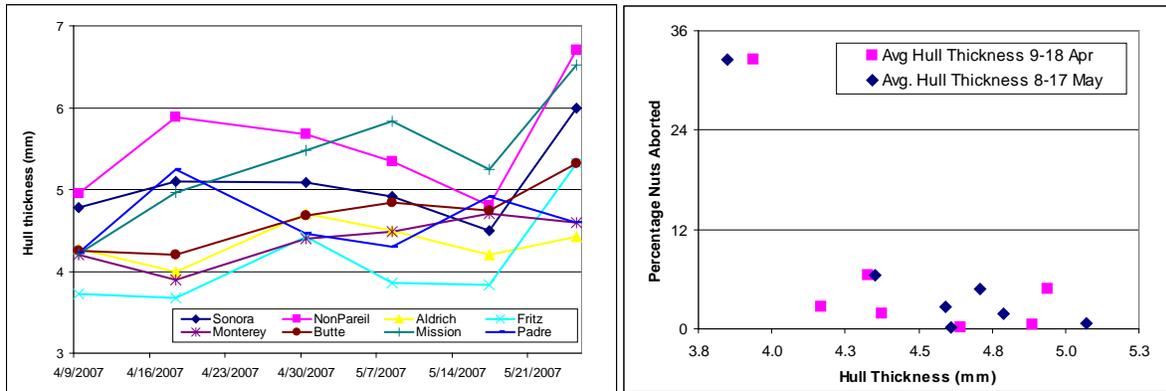
8. Designations of varieties as hard and soft-shelled (at harvest) do not explain differences in susceptibility to damage. While it is true that the only two hard-shelled varieties (Mission and Padre) had limited damage, soft varieties had some of the greatest (Sonora) and least (Nonpareil and Winters) amounts of damage. Likewise, shell hardness in April and May, as measured with a penetrometer in 2007, could not explain differences in varietal susceptibility to damage (Figure 5).

Fig. 5. Correlation between shell hardness (Apr. and May 2007) and percentages of nuts damaged by leaffooted bugs (same orchard in 2006)



9. Differences in hull thickness appear to be the primary factor that influences differences in varietal susceptibility (Figures 6-7). Fritz, which is by far the most susceptible variety to leaffooted bug damage, also has the thinnest hull during April and May. This means that the bug has to penetrate a shorter distance to reach the kernel, and that the elevated levels of susceptibility to damage could simply be that the bugs are more likely to penetrate to the kernel.

Fig. 6-7. Hull thickness in April and May 2007 of 8 almond varieties, and correlations of that hull thickness to the percentages of nuts damaged in leaffooted bugs (same orchard 2006)



Conclusions:

We are making significant progress in trying to understand the damage from leaffooted bugs that occurred in the lower San Joaquin Valley in 2006, and why it occurred. To date we have documented the differences in susceptibility of 15 varieties to damage by leaffooted bug and determined that hull thickness in April and May is the most plausible mechanism to explain varietal differences in susceptibility to damage. We have also documented changes in the types of damage that occur from early April to late May, and determined that classic categorizations of varieties (i.e., hard shell vs. soft shell, or early vs. middle vs. late-season) fail to explain trends in varietal susceptibility.

Now that we are gaining a better understanding of what happened in 2006, it is time to develop improved methods of control. This will be the key objective during the second half of this 2007-2008 research year.