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THE SCOOP

on fruits and nuts in Stanislaus County

‘Brown spots’ in almonds: What are they and how can they be addressed?

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Brown spot is an emerging quality concern for California almond growers. This issue has been rising in recent years, impacting growers’ bottom lines.

What are brown spots?

A brown spot is an external lesion or discolored mark that appears on the almond kernel at harvest. These blemishes are associated with feeding by adult hemipteran bugs, which pierce through the almond hull and shell to feed on the developing kernel. The most common hemipteran pests contributing to brown spots in almonds are the leaffooted bug (*Leptoglossus* spp.), and multiple species of stink bugs, particularly the green stink bug (*Chinavia hilaris*) and the invasive brown marmorated stink bug (*Halyomorpha halys*). These insects feed by inserting their piercing-and-sucking mouthparts into the nut, releasing digestive enzymes, and drawing the liquefied content. As a result, the nut produces clear gumming on the hull externally and pinholes or puncture feeding signs internally. Generally, there is a 7-10 day lag between feeding and the manifestation of clear gumming.

How does feeding time matter?

The leaffooted bug (LFB), the green stink bug (GSB), and the brown marmorated stink bug (BMSB) occur in almond orchards at slightly different times and densities. Adult leaffooted bug and brown marmorated stink bug overwinter outside the orchard in protected structures such as barns, houses, woodpiles, etc., and migrate to nearby almond orchards in the spring. BMSB is an invasive species that has been established as a significant pest in many almond orchards in the Northern San Joaquin Valley. BMSB adults can be found in orchards as early as mid- March, while LFB begins to be active around late March or early April. Adults of both pests emerge from their overwintering habitats for an extended period. They can continuously invade almond orchards through May for LFB, and even further into early June for BMSB. Early-season feeding by LFB and BMSB on the nuts through early May, when the embryo (kernel) begins to form from the endosperm (i.e., “jelly” stage) of the nut, can result in a high percentage of nut abortion and drop. The infested nuts that remain in the tree during this period and even through mid-May produce defective, “gummy” kernels. Since other physiological reasons can also produce gummy kernels, these defective nuts, which are caused by either of those reasons, are categorized as gummy kernels, not the brown spot. The typical “brown spot” occurs when these large hemipterans feed on the nuts, particularly close to

In this issue…

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The Scoop on Fruits and Nuts in Stanislaus County is a combined effort of UC Cooperative Extension Farm Advisors Jhalendra Rijal, and Moneim Mohamed, and covers topics on all tree crops, irrigation and soils, and associated pest management.

You may reach us at 209-525-6800 or by email.

and/or after shell hardening, which generally occurs in late May, or even early June in some years and regions. The timing of these physiological stages in nut development can vary slightly depending on the variety, area, and weather conditions in a particular year.

Although leaffooted bug adults (first generation) may be present in almond orchards in June or later, they tend to be in much lower abundance by then. They are usually not considered a significant contributor to brown spot at that time. Stink bugs, however, can thrive better in hot weather conditions and become a more substantial issue later in the season, contributing to higher brown spot damage.

The green stink bug exhibits a distinct infestation cycle in almonds. Although they overwinter in the orchard, the overwintering adults emerge in the spring and move to other hosts, such as weeds and early-season field crops, for survival. The first-generation adults typically transition to almonds from these other hosts in July onwards. However, we have observed green stink bug activity in almond orchards during the spring and early summer in recent years. The reason behind this may be due to reduced use of broad-spectrum insecticides and increased survival of overwintering adults due to warmer winters.

Leaffooted bug *Leptoglossus spp.* | Green stink bug *Chinavia hilaris* | Brown marmorated stink bug (BMSB) *Halyomorpha halys*

How can we effectively monitor these pests for timely control?
Monitoring for hemipteran pests is critical during the growing season, particularly in the spring for the leaffooted bug, and throughout the season for the brown marmorated stink bug. Keeping an eye out for early presence, and regularly monitoring their population from June through harvest, is critical for the green stink bug. In general, hemipteran pests and their damage occur more on the edge than in the interior of the orchard. Therefore, sampling and monitoring should focus on the orchard edge and areas with a history of damage. Although not easy, the most effective detection method is conducting visual surveys of the trees in mid-morning hours, when these pests are most active. There are traps available for leaffooted bugs. Conducting visual scouting of the orchard in addition to the trapping is recommended, as the capture rates in these traps appear to be low, especially when pest pressure is low.
A clear sticky trap baited with a BMSB lure is an effective detection tool for BMSB. No effective traps are available for monitoring green stink bugs, so visual sampling is the only option.

Another critical point to consider is the influence of landscape factors. When other host crops, such as tomatoes, beans, alfalfa, peaches, cotton, or corn, are nearby, the green stink bug can migrate from those crops to almonds, especially in mid-to-late summer, when those crops are harvested. Orchards located within a few miles of potential overwintering shelters such as barns, structures, woodpiles, etc, and residential areas with numerous landscape trees and the presence of trees of heaven (*Ailanthus* sp.), which is the preferred non-crop host, are at a higher risk for BMSB.

Approximate timing (shaded boxes below) of sampling for three major hemipteran pests of almonds

Pest	March	April	May	June	July	August
Leaffooted bug	■	■	■			
Green stink bug				■	■	■
Brown marmorated stink bug	■	■	■	■	■	■

What are the control options?

No treatment threshold has been developed for these insects in almonds. Damage depends not only on the population within an orchard, but also on the migratory population outside of the orchard. Insecticide spray decisions are based on the orchard's damage history, current season bug activity, and other landscape factors surrounding the orchard. Broad-spectrum contact insecticides, such as pyrethroids (e.g., Bifenthrin, Warrior II, Assana), are efficacious and economical choices since adults are the primary target of the spray; however, these pesticides are also known to impact mite and scale predators later. Additionally, the frequent use of pyrethroids can increase the risk of contaminating water bodies, an issue that the state water board has scrutinized in recent years. It is recommended that the decision to spray be weighed carefully, considering the increased potential need for one or two miticide applications. There are a few additional active ingredients, such as indoxacarb (Avaunt eVo) and acetamiprid (Assail), which have shown a reduction in damage by hemipterans in recent studies and can be used as a rotational product. Pyrethrins, azadirachtin, Spinosad, or combination products with two or more of these active ingredients are included for organic growers. Some bioinsecticide products containing microbial toxins are also available. Remember to always follow the label instructions when applying pesticides.

What are the key takeaways?

- Brown spot damage in almonds is often the result of feeding by hemipteran bugs, particularly from mid-season through hullsplit.
- Proper identification and monitoring of leaffooted and stink bugs are essential for timely intervention.
- Integrated pest management strategies, such as applying insecticides based on sampling, can reduce brown spot incidence and protect kernel quality.
- Growers and pest control advisors are encouraged to regularly scout and respond to pests using integrated pest management (IPM) tools and practices.

Evapotranspiration Based Irrigation Scheduling for Nut & Fruit Trees

Moniem Mohamed, Irrigation and Soil Advisor for North San Joaquin Valley, UCCE Stanislaus

A quick-reference guide for growers

Why schedule irrigation with evapotranspiration (ET)? Efficient water use is now more important than ever for California's orchard crops. With increasing pressure on groundwater resources and the need to improve irrigation efficiency, growers are turning to science-based tools like ET to guide their irrigation decisions. ET based irrigation scheduling matches the water your trees have used since the last irrigation; transpiration (T) through leaves, plus soil evaporation (E) (Figure 1). Replacing only the amount used by the tree plus an appropriate leaching fraction can improve water use efficiency and reduce pumping costs.

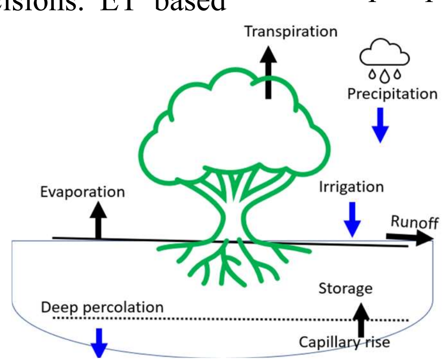


Figure 1: Evapotranspiration process and soil water balance

Determining the amount of water a crop uses though evapotranspiration, or ETc, is calculated by multiplying the known ET value of a reference crop, usually grass, (ET_o) by a percentage, or crop coefficient (K_c), which changes through the season based on canopy cover, weather, and day length (Table 1) [$ET_C = ET_o \times K_C$].Scientists continue to refine the KC values of each crop. Crops with full canopy coverage, like alfalfa, have the highest ET rates, slightly lower than if water was just sitting in a pan in the sun. The reference ET (ET_o), is reported daily on the California Irrigation Management Information System (CIMIS) website.

Table 1: Bi-Weekly crop coefficients (K_c) for almond and walnut (use the table as a quick reference; adjust for canopy cover on young trees)

Date	Almond Kc (SJV)	Walnut KC (SJV)
Feb 16-28	0.41	
Mar 1-15	0.62	
March 16-31	0.62	0.12
Apr 1-15	0.80	0.53
Apr 16-30	0.80	0.68
May 1-15	0.94	0.79
May 16-31	0.94	0.86
June 1-15	1.05	0.93
June 16-30	1.05	1.00
July 1-15	1.11	1.14
July 16-31	1.11	1.14
Aug 1-15	1.11	1.14
Aug 16-31	1.11	1.14
Sept 1-15	1.06	1.08
Sept 16-30	1.06	0.97
Oct 1-15	0.92	0.88
Oct 16-31	0.92	0.51
Nov 1-15	0.69	0.28

Subscribe to our weekly Crop Water Use email report if you don't want to run these numbers yourself. Each week you will receive the estimated ETc for almonds, peaches, walnuts, winegrape vineyards, alfalfa, pasture, and pistachios in Stanislaus County. To subscribe, click **HERE**, scan the QR code below, or call our office at 209-525-6800.

Need block-specific ET?

Obtain the free data from OpenET (https://etdata.org) or install commercially available sensors that measure actual ET right in your orchard.

Steps to schedule irrigation with ET

1. Obtain weekly reference $\mathbf{ET_o}$ (inches) from your nearest CIMIS station.
2. Look up the seasonal $\mathbf{K_c}$ for your crop (Table 1).
3. Calculate your ETc by multiplying the reference ET_o by the current fraction K_c ($\mathbf{ET_c = ET_o \times K_c}$.)
4. Divide by your **system's application efficiency** (**AE**) to get the net inches to apply.
5. Convert acre-inches to gallons (1 acre-inch= 27,154 gal).
6. Divide gallons by system flow per acre (gph per tree× number of trees per acre) to get total **hours** to run the system that week.
7. Split hours into at minimum of 2-3 sets per week; adjust after rain or sensor feedback.

Especially when using ground water or district water high in salinity, apply an appropriate leaching fraction (an extra 10-15 %) to keep salt from building in the rootzone. Keep your system efficiency high; clogged emitters quickly lead to under-irrigation and poor application uniformity.

Keep this cheat-sheet in the pump shed and update the Kc as the season progresses at bloom, mid-season, and post-harvest.

You can use the following equations to calculate application rate, irrigation set time, and applied water:

$$\textit{Microsprinkler system application rate } (in/hr) = \frac{\textit{Avg tree flow rate } (gph)}{\textit{Tree spacing } (ft^2)} \times 1.6$$

$$\textit{Irrigation set time } (hrs) = \frac{\textit{Crop water use } (in/day)}{\textit{Application rate } (in/hr)}$$

$$\textit{Applied water } (in) = \frac{\textit{Pump flow rate } (gpm) \times \textit{irrigation set time } (\text{min})}{\textit{Irrigated orchard area } (acre) \times 27{,}152}$$

Another formula to determine the set time required factors in the depth of water you want to apply, the field size, and the system's flow rate. Keep in mind that sandy soils don't hold as much water and need to be irrigated more often with shorter run times than heavy soils

$$\textit{Irrigation set time } (hrs) = \frac{\textit{Net water application } (in) \times \textit{Irrigated acres } (acres) \times 43560}{96.3 \times \textit{Flow rate } (gpm) \times \textit{Irrigation system efficiency } (\%)}$$

These calculations need to be adjusted to the covered area by your irrigation system (Table 2).

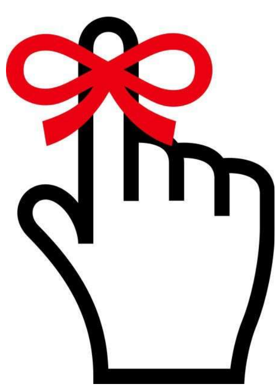
Table 2: Percent of wetted area for different irrigation systems

Irrigation system	% of wetted area
Single line drip	20 – 30%
Double line drip	20 – 50%
Micro-sprinkler	30 – 60%

A three-tool approach to smarter irrigation:

Plant-based tools tell you when the trees need water.
ET-based numbers tell you how much water to apply.
Soil-based readings reveal how much moisture is still in the root zone (what's still in the bank).

No single irrigation-scheduling tool is perfect. Relying on one method can work, using two is better, but combining all three together will help you make the most informed and effective water management decisions.



MEETING REMINDER

Tree & Vine IPM Breakfast Meetings

Location: Old Mill Café
600 9th Street
Modesto, CA 95354

Time: 7 AM

Upcoming Dates & Topics:

June 18, 2025 - *Ryan Hill,* UCCE Tehama County
Topic: Weed Control in Tree and Vine Crops