University of California
Agriculture and Natural Resources
Cooperative Extension
Fall 2023, Vol. 28 Issue 2

THE SCOOP

on fruits and nuts in Stanislaus County

A Retrospective Look at 2023: Navel Orangeworm Damage at Harvest in Almonds

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The rates of insect and plant development are closely related to weather, particularly temperature. Unique weather patterns from wet winter/spring, cooler early summer, and hot late summer of this year influenced almond pests and crop phenology differently compared to previous years. Navel orangeworm (NOW) development was relatively normal until the population exploded during and after hull split. Major hemipteran insect pests, such as leaffooted bug and stink bugs, were "normal" in 2023, with sporadic damage in some orchards (Table 1, Page 1). Ant damage has been minimal.

Table 1. Average % damage of almonds by three major pests in 2023. A total of 12 samples (50 nuts in each sample) were collected from the orchard edges and interior

	Nonpareil var.						*Independence var.*	
Pests/sites	**Hughson_G**	**Delhi**	**Snelling**	**Tracy**	**Cressey**	**Hughson_T**	**Ceres**	**Turlock**
Hemiptera	0.33	1.17	1.17	5.42	6.83	4.17	5.08	0.08
NOW	4.08	1.25	5.75	9.67	12.25	3.58	0.83	1.50
Ants	0.00	0.00	0.08	0.00	0.00	2.67	0.25	0.00

What might have happened this year with NOW?

- **NOW population and hull split timing.** The dynamics between the NOW population and crop phenology determine the overall NOW damage in almonds. One of the cornerstones of NOW management is an early Nonpareil harvest to remove the crop before egg-laying by the third flight of NOW occurs. Figure 1 shows the NOW flight activity for the North San Joaquin Valley in 2023. Nonpareil hull split began around the third week of July in the Modesto area – much later than in most years. Because Nonpareil hull split occurred well after the start of the second flight, the first half of the NOW moths in the second flight laid their eggs on last year's mummy nuts instead of the current season's nuts. However, the second half of the second NOW flight was able to lay their eggs on current-season Nonpareil nuts. Because it takes longer (1050 degree days) for NOW to complete a generation in mummy nuts compared to only ~700 degree days in current-season nuts, adults emerged from the mummies and current-season nuts at different times. This resulted in heavy egg-laying during an extended period from August 22nd - September 27th. The delayed onset of hull split, coupled with an extended hull split period this year meant that Nonpareil was most vulnerable during this heavy egg-laying period by the third and fourth flights. NOW adults were actively laying eggs throughout September and even the first week of October, which impacted the pollinizer varieties as well.

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 Roger Duncan, Jhalendra Rijal, and Abdelmoneim Z. Mohamed and covers topics on all tree crops, irrigation and soils, and associated pest management.

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- **Poor orchard sanitation.** The exceptionally wet winter/spring of 2023 made mummy sanitation difficult for many growers. These extra mummy nuts provided a large food source for overwintering and first-generation NOW. This ultimately led to increased NOW pressure later in the season.
- **Minimalist approach to orchard management.** Due to poor almond and walnut prices, some growers may have elected not to mummy shake, apply fewer sprays, or use cheaper materials. Shorter residual materials may not have been sufficient for the protracted hull split this season.
- **Nontraditional insecticide spray timing.** Since hull split was at least two to three weeks later than usual in 2023, growers who applied sprays at "normal" timing were too early, and residues were insufficient when hull split finally started.

New issue – occurrence of Carpophilus beetle infesting almonds.

In the last two years, some growers and PCAs have reported feeding injury in almonds by a Carpophilus beetle (Family: Nitidulidae, generally known as sap-feeding beetles). We collected adult beetles and larvae from infested almonds and sent them to CDFA for identification. CDFA has identified this beetle as *Carpophilus truncatus*, a species that has been infesting almond orchards in Australia since 2013 but was not known to be present in California. In brief, these beetles seem to attack mostly Nonpareil nuts during hull split. Adults chew through the shell, leaving a small, 2-3 mm, circular hole, and lay eggs on the kernel. Adults and larvae feed on the nutmeat, completely converting the kernels into fine white powder mixed with their white frass (Figure 2). Based on initial reports, beetle infestations may have been widespread in many San Joaquin Valley counties, including Stanislaus, Merced, and Madera. We collected samples from three infested almond orchards in Merced and Stanislaus Counties and evaluated the damage (Table 2, Page 3). Carpophilus feeding injury is difficult to differentiate from NOW damage and often occurs in the same nut.

Although NOW and Carpophilus often infest the same nuts, a significant percentage (21-57%) of the infested nuts were from Carpophilus feeding only. So, it is clear that Carpophilus can damage nuts regardless of previous NOW infestation. CDFA is now working to assess the potential impacts of this species and determining what to do next.

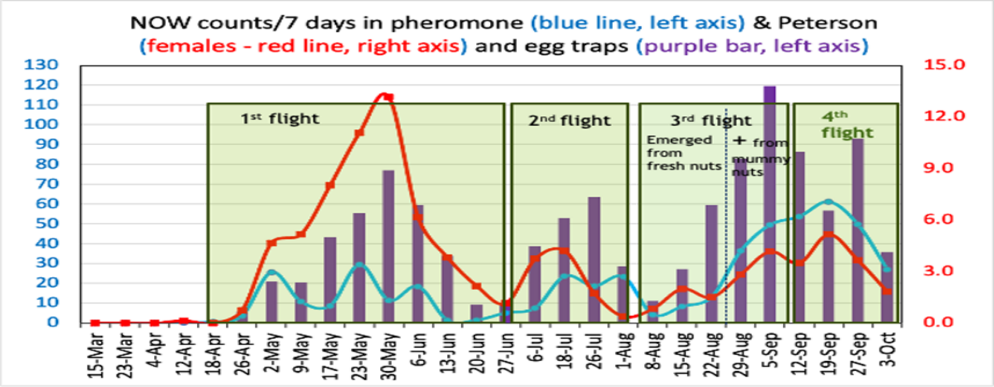

Figure 1. Seasonal navel orangeworm phenology in almond orchards in the Modesto area, 2023.

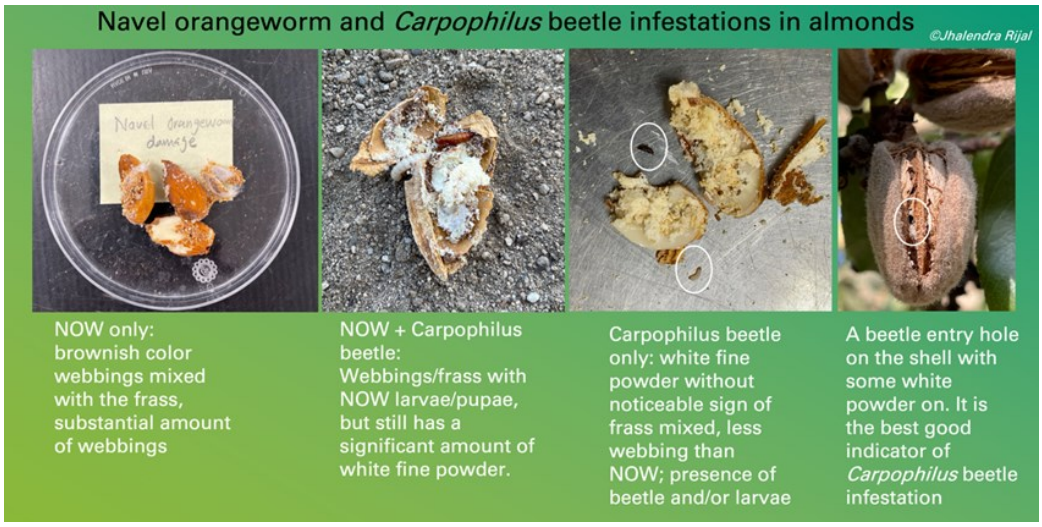

Figure 2. Navel orangeworm and Carpophilus beetle infestation damage symptoms in almonds.

Table 2. Damage caused by *Carpophilus* beetle and navel orangeworm in selected almond orchards				
	% damage (out of total infested nuts)			% infestation overall
Site	*Carpophilus* only	NOW only	*Carpophilus* + NOW	
Merced 1 (n = 53 nuts)	21.15	30.77	48.08	98.00*
Merced 2 (n =300 nuts)	26.67	58.33	15.00	12.00
Stanislaus (n =300 nuts)	56.69	16.96	26.35	38.00
*Merced 1: nuts were collected from single infested Nonpareil tree, so had a very high infestation.				

Tight Budget? Consider Not Pruning Bearing Almond Orchards

Roger Duncan, Pomology Farm Advisor, UCCE Stanislaus County

Multiple, long-term field trials conducted by University of California farm advisors have determined that pruning almond orchards does not improve yields in the short term or preserve yields in the long term. Across multiple studies, some lasting 20 years or more, yields were frequently a little better in unpruned trees, but differences were often not significantly different statistically. These included studies with hand pruning and mechanical hedging and topping.

One of the first California trials was headed by John Edstrom at the Nickels Estate Soils Lab in Arbuckle from 1979 – 1999. Trees that were trained and pruned only for the first two years and then left essentially unpruned for the next 19 years produced an additional 906 pounds over the 21-year study compared to trees that were pruned every year. Statistically insignificant. In the last year of the study, Nonpareil trees that were pruned every year yielded 2,136 pounds per acre in the 21st leaf while "unpruned" trees yielded 2,307 lbs. per acre. This trial demonstrated that unpruned trees stayed just as productive as trees that were pruned every year for 21 years.

In a follow-up field trial at Nickels from 1997-2022, currently monitored by Franz Niederholzer, total yields in "unpruned" trees were statistically similar to the annually pruned trees. They were also similar to trees that were mechanically topped in the second and fourth dormant seasons and then left unpruned. In that trial, "unpruned" trees out-yielded standard pruned trees in the early years, and then production between all pruning treatments was similar after the 6th leaf. The researchers also noted no increase in disease or mummies in unpruned trees, and tree height appeared shorter than annually pruned trees.

Simultaneously, a pruning trial was initiated in Kern County in 1996, planted in a deep, Wasco sandy loam soil. That trial, initiated by former UC farm advisor Mario Viveros, tested several different pruning strategies. They included dormant pruning by hand every year, dormant pruning by hand every other year, and various strategies using mechanical topping and hedging every year or every other year, with and without follow-up hand pruning. All of these strategies were compared against trees with no scaffold selection and no annual pruning. The trial was followed for 11 years. At the end of the trial, cumulative yields were statistically similar for all pruning strategies for all three varieties, although unpruned trees trended towards higher yields. Mario also noted that unpruned trees did not have more stick tights and were shorter than annually hand-pruned trees.

Finally, I conducted a pruning trial here in Stanislaus County from 1999-2019. In this 37-acre trial, we compared trees initially trained to three scaffolds and moderately pruned every year (standard pruning) against trees that were trained only for the first two years and then left unpruned for the next 18 years. We also compared trees that were left completely untrained and unpruned for the life of the experiment. We compared these different pruning strategies in high-density and low-density plantings and on a high-vigor rootstock (Hansen) and a moderate-vigor rootstock (Nemaguard). In the final year of the study, yields were almost identical among pruning strategies. Cumulatively, trees trained for two years and then left unpruned for 18 years yielded 911 pounds per acre more than annually pruned Nonpareil trees, not statistically different. In the Carmel variety, trees that were never trained or pruned accumulated 4,423 pounds more than standard pruned trees over the life of the trial. At the end of this trial, unpruned trees were the same height as annually pruned trees.

At the average almond prices and labor costs during this Stanislaus trial, conventional training and annual pruning

would have reduced cumulative net income by up to $14,000 per acre, including pruning, stacking and shredding costs, plus slightly lower cumulative yield. Although untrained and unpruned trees tended to have slightly higher yields, they were more prone to scaffold failure, especially in widely spaced trees. This also led to more eventual tree loss from fungal canker diseases. Counter to expectations, the no-training and no-pruning strategy worked better in the most tightly spaced trees (10' x 22') than trees planted 18 or 22 feet apart. That is because trees planted far apart got larger, and branches were more likely to break or get in the way of equipment.

Based on these and other studies, plus observations of many almond orchards in California, almond growers should consider training their young trees for the first 1 - 3 years, depending on variety, vigor, and tree spacing to develop a structurally sound tree. Closely spaced trees (10-12 feet apart) may not need much scaffold selection or initial pruning at all. After the initial training phase, almond trees still need occasional pruning to remove broken or diseased limbs and to remove branches that are in the way of equipment or are a safety hazard for equipment operators. There are reasons to prune almond trees. Yield is not one of them.

The Effect of Training and Pruning on Cumulative Yield of Almonds Through the 19th Leaf.* Stanislaus County.				
	Nonpareil		Carmel	
Training & Pruning Strategy	19th Leaf (lb / acre)	Cumulative Yield (lb / acre)	19th Leaf (lb / acre)	Cumulative Yield (lb / acre)
Trained to 3 scaffolds; Annual moderate pruning	2998 a	41,326	2461 b	38,851
Trained to 3 scaffolds; Unpruned after 2nd year	3080 a	42,237	2784 ab	41,732
No scaffold selection; No annual pruning	3004 a	42,278	2801 a	43,274

*Yields are an average across all tree spacings and two rootstocks.

Salt Leaching in Orchards and Vineyards

Abdelmoneim Z. Mohamed, Ph.D., Irrigation and Soils Advisor, UCCE Stanislaus County

Leaching refers to the process of flushing excess salts from the root zone of plants through the soil, which promotes a more productive growing environment. However, the combination of limited rainfall and extensive irrigation and fertilizer applications in California orchards and vineyards can lead to insufficient leaching, resulting in an accumulation of salts in the root zone. During the transpiration process, crop roots take up water and leave most of the salts behind. Salt accumulation in the root zone creates osmotic stress conditions and plants must extend energy to get water from the soil. The increase in energy use and reduction in transpiration decreases shoot growth and yield. Salt buildup can also result in toxic conditions for plants and decrease water infiltration in the soil. In drip-irrigated orchards, salts tend to accumulate on the edges of the wetted areas along tree rows while in microsprinkler irrigated orchards, they accumulate in the middle of the tree rows that are on the edges of the wetted patterns. Soil texture plays an important role in salt buildup; more salts accumulate in heavier soils compared to sandy soils. Also, irrigation from surface water has a lower salinity level than well water.

An effective leaching strategy requires soil and water salinity analysis. Regular soil testing and monitoring can help farmers detect salt accumulation earlier so they can take corrective actions. For example, leaching is required for almonds if the electrical conductivity (EC) of soil is higher than 1.5 dS/m (Table 1, Page 5), as yield will decline after this salinity threshold point. When salt levels are above 1.5 dS/m, a reduction in growth rate and yield can range from 18-21% for almond trees on peach rootstocks such as Nemaguard or Lovell.

Leaching can be done in-season or at the end of the season (dormant leaching). In-season leaching is important when soil salinity in the root zone at the beginning of the season is near the threshold. In-season leaching can be implemented by increasing the irrigation duration of each event by 15-20%. This practice has some risks if soils conditions are kept too wet and can

result in reduced root development, root diseases, nutrient leaching, and delayed fruit development. Leaching salts is more effective in winter (dormant leaching) because of reduced evaporation and plant water demand. Leaching occurs when soil water content is higher than field capacity. By filling the soil profile with irrigation water prior to the rainy season, this ensures that subsequent rainfall will maximize the amount of leaching during the winter.

Table 1. Soil and water salinity threshold for some crops

Crop	ECe (dS/m)	ECw (dS/m)
Almond	1.5	1
Grape	1.5	1
Plum (Prune)	1.5	1
Peach	1.7	1
Apricot	1.6	1

Source: Ayers and Westcott (1985)

After salinity analysis, the leaching requirement can be calculated using the following equation:

$$LR = \frac{EC_W}{5\,EC_e - EC_W}$$

where LR is the minimum leaching requirement fraction %, ECe is the average soil salinity tolerated by the crop as measured on a soil saturation extract (dS/m), and ECw is the salinity of the applied irrigation water (dS/m).

Example: Almond has a soil salinity threshold of 1.5 dS/m (Table 1, Page 5). What is the leaching requirement if the salinity of irrigation water is 1.5 dS/m?

Answer: LR = (1.5 × 100) ÷ {(5 × 1.5) – 1.5} = 25%

The total irrigation water amount needed to meet crop water demand and leaching can be determined as follows.

$$WR = \frac{ET_C}{1 - \left(\frac{LR}{100}\right)}$$

where ETc is the crop water requirement (mm) and WR is the water requirement depth (in).

Example: Crop ET is calculated to be 0.8 inches, and the desired leaching requirements (fraction %) is 20%. How much water must be applied?

Answer: WR = 0.8 ÷ {1 – (20 ÷ 100)} = 1 in

The amount of water required for leaching to reduce soil EC to 1.5 dS/m can be estimated from (Table 2, Page 2) adapted from the reclamation curves for saline soils using sprinkler methods or intermittent ponding sprinkling methods (Pritchard et al. 1985).

Table 2. Depth of water required for leaching to reduce soil EC to 1.5dS/m

Soil Average Rootzone dS/m	2	3	4	5	6
Amount of water (inches) per foot of rootzone	2.4	3.6	5	6	7.2