UNIVERSITY OF CALIFORNIA • COOPERATIVE EXTENSION • GLENN COUNTY
P.O. Box 697 (821 E. South St.), Orland, CA 95963 • (530)865-1107 • FAX (530)865-1109

ORCHARD FACTS

July 21, 2010
Vol. XI, No. 6

In This Issue

Almond Tree Blow-Over Problems

"Biofix" for Almond Worm Pests

Delivering a Clean Crop

Verticillium Wilt in Almonds

Understanding and Applying Information from a Soil Test - Part 2

Bill

Bill Krueger
Farm Advisor

Sacramento Valley Almond Newsletter

Almond Tree Blow-Over Problems

Bill Krueger, UC Farm Advisor, Glenn County

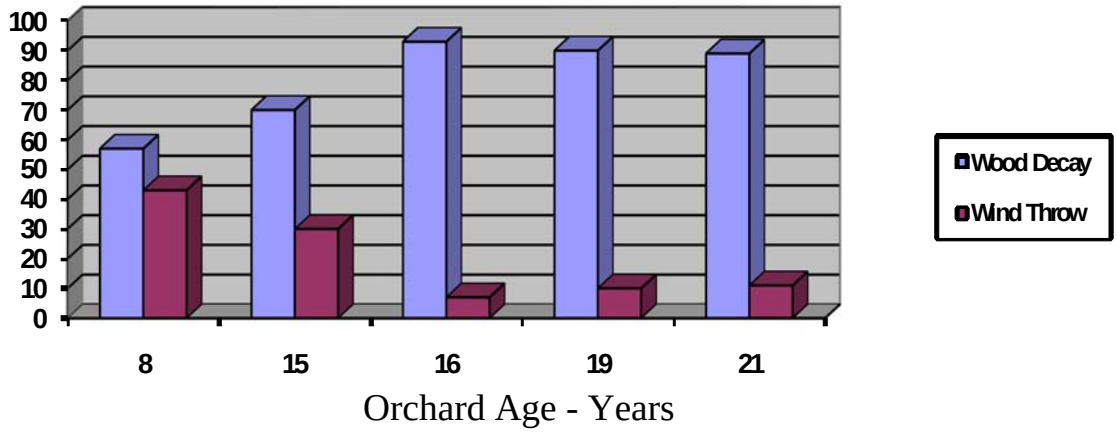
Periodically almond trees fall over. Heavy tree losses are usually associated with fall, winter, or spring storms with associated high winds and saturated soil conditions. To a lesser degree, tree failure can occur throughout the year. In March of 1995, a storm brought 6 inches of rain and wind gusts up to 100 mph to the Sacramento Valley and resulted in an estimated loss of 15,000 acres of almonds worth $210 million. More recently, storms with wind gusts in up to 70 mph in December 2002 and January 2008 resulted in tree losses greater than 30% in some orchards.

When trees fall, their failure can usually be classified as windthrows or wood decay related. Windthrow is when trees with sound healthy roots are uprooted as a result of strong winds and wet soil conditions. Wood decay related failures are the result of infection from wood decay fungi, which consume the lignin in the cell walls of the heartwood. Eventually these trees fall, often in wind storms or when the trees are heavily loaded with crop. Wood decay fungi are secondary pathogens and are not capable of penetrating intact plant membranes and must rely on some type of injury to gain access.

Survey work conducted by Joe Connell, Butte County Farm Advisor, and Dr. Jim Adaskaveg, UC Riverside Plant Pathologist following the March 1995 storm revealed the following. Generally, as trees age, tree losses increase. Windthrow was an important factor in young orchards (Fig.1) and as orchards matured wood decay became more dominant. Wood decay accounted for approximately 90 % of the tree loss in mature orchards. On Lovell peach, of 394 downed trees evaluated, 81% had crown gall and 77% had wood decay. Crown galls function as sites of entry for wood decay fungi.

Almond on Lovell Peach

% Tree Losses to Wood Decay and Windthrow



Generally almonds on Marianna 2624 rootstock suffered lower losses than Lovell peach rooted trees. The exceptions included orchards in flooded areas with softened soil and unpruned orchards with dense canopies. Generally plum rooted orchards had less crown gall and wood decay.

Suggestions for reducing tree losses from blow-over:

At Planting

- Use rootstock less prone to windthrow. There is currently much interest in the Krymsk 86 rootstock in the Sacramento Valley partly because it is believed to be better anchored. Anchorage only affects windthrow which is primarily a young tree problem. This is a new rootstock and there are still many unknowns. Unless Krymsk 86 is more resistant to crown gall and wood rots, blow-overs as the orchard ages may still be an ongoing problem. More information on rootstocks will follow in future editions of this newsletter.
- Orient strong roots in the direction of prevailing winds.
- Avoid planting on high berms perpendicular to prevailing winds.
- Pay attention to the orientation of irrigation wetting patterns particularly with regard to prevailing winds to ensure root distribution which favors anchorage.
- Planting depth. On well-drained soil, it may be possible to plant plum rooted trees deeper than they were in the nursery. In addition to reducing the number of root suckers, this may also provide for better anchorage.
- Avoid heading trees too high. Canopies on high-headed trees will have greater leverage and trees are at greater risk.

Post plant

- Prune by thinning out the tallest limbs to even up variety related tree height differences and allow wind to blow through the tree more readily. Taller trees will catch more wind and are at greater risk.
- Pruning by topping does not appear to provide the needed relief.
- Avoid irrigation prior to predicted strong winds.
- Zinc sulfate foliar fertilization in the fall which can promote early leaf fall and/or pruning prior to leaf fall to reduce wind resistance before fall and winter storms.

Wood Decay

- Prevent crown gall. Buy trees from a nursery with a good crown gall prevention program. Treat new trees prior to planting to prevent/reduce infection. Avoid injuring crowns and roots while doing orchard maintenance to decrease the chance of crown gall infection. Avoid any practices which may injure trunks or roots and create an opening for wood decay fungi.

"Biofix" for Almond Worm Pests

Melanie Covert and Joe Connell, Farm Advisor Intern and Farm Advisor, Butte County

A 'biofix' for each species marks the point in time when you catch the first moth or trap the first eggs. This date is used as the starting point for running degree day models for each of our almond pests. These insect phenology models and degree day calculations can improve spray timing when pressure is great enough to suggest that sprays are needed or predict when pest pressure may increase as harvest approaches. Biofix dates vary with location and the environment so it's best to monitor traps in your orchard and calculate spray timing from your own biofix if you wish to use this information most effectively.

Degree Day (DD) calculations. Upper and lower temperature thresholds vary for each insect species. Inexpensive temperature sensors can be purchased that directly output DD accumulations and local weather information. Or, DD calculations can be made easily from the biofix in your orchard using the Degree Day calculator on the UCIPM web site at http://www.ipm.ucdavis.edu under Agriculture and floriculture (Pest Management Guidelines).

Navel orangeworm (NOW). So far this year we have seen very few NOW eggs on traps in the orchards we're trapping. Strong storms and good sanitation helped to destroy mummy nuts and reduce overwintering larvae. The NOW biofix was April 23 in the Orland orchard we're watching. Using this date and projecting ahead, the second generation NOW egg laying should begin around July 15 and third generation eggs should arrive around August 19. Worm pressure increases as additional generations arrive. NOW produce large amounts of frass and webbing as they feed on the kernel and worm damage increases the potential for aflatoxin contamination. An early Nonpareil harvest before August 19th will avoid third generation egg laying and minimize NOW crop damage. Late harvesting soft shell varieties such as Livingston, Monterey, and Winters are more vulnerable if harvest is delayed.

Peach twig borer (PTB). We caught our first PTB moths in our pheromone traps in Durham on April 22 this year. The DD model indicates second generation larvae should hatch and begin feeding around July 16-20. If hullsplit occurs earlier or simultaneously, nuts could be vulnerable. If this generation emerges prior to hullsplit, larvae will feed mainly on shoots. PTB can be identified in shoot strikes as brown banded larvae and their nut damage is surface feeding on the kernel without any webbing present. The third generation of PTB larvae should hatch around August 22-26 and could put pressure on later splitting soft shelled pollenizers.

Oriental fruit moth (OFM). OFM is rarely a pest of almond kernels but can often be found feeding in the soft tissue of newly splitting hulls. The third generation is projected to emerge and start feeding around July 17th to 26th. Watch for them in hulls that are splitting at that time. OFM larvae are cream or pinkish colored while PTB larvae are brown banded.

Summary. A timely harvest, especially near other NOW hosts such as pistachios and pomegranates, minimizes exposure to NOW feeding. PTB damage predisposes nuts to NOW infestation, so good PTB management is an essential part of effective NOW management. Second generation PTB, NOW, and third generation OFM will be at a stage to potentially feed on split nuts toward mid to late July. If hullsplit is late due to the cool spring and you feel you have worm pressure, a spray timed at 1% hullsplit on sound nuts should line up pretty well with worm pests toward late July. Remember, a timely and rapid harvest is the best way to avoid significant worm damage. Get the crop off the tree and into the huller while the sun shines!

Worm pest	Generation length, DD	May spray timing DD after Biofix	Later generation insect activity, DD after Biofix	Biofix, start of 1st generation	1st Gen insect activity	Biofix, Start of 2nd Gen	2nd Gen insect activity	Projected Biofix for 3rd Gen	Projected 3rd Gen insect activity
PTB	1030	400-500	300-400	4/22 (1st moths, Butte Co.)	5/31-6/5 shoot strikes	6/30 2nd moth flight	Projected 7/16 - 7/20 Shoot strikes, or, nut feeding if after hullsplit	8/10 3rd moth flight	8/22-8/26 nut feeding or shoot strikes
NOW	Varies: 1056 on mummy nuts, 723 on new crop nuts	100	100	4/23 (1st eggs, Glenn Co.)	5/7 egg hatch on mummies	7/15 egg laying on mummies, OR, on new crop after hullsplit	Projected 7/20 egg hatch	8/19 egg laying if moth developed on new crop	8/24 egg hatch, nut feeding
OFM	920-1010	500-600	400-500	3/15 (1st moths, Tehama Co.)	5/1-5/7 shoot strikes	5/30-6/3 2nd moth flight	Shoot strikes 6/15-6/22	7/4-7/10 3rd moth flight	7/17-7/26 shoot strikes, or, hull/nut feeding

Delivering a Clean Crop

Franz Niederholzer, UC Farm Advisor, Sutter/Yuba Counties

Producing a clean almond crop provides short and long-term benefits. Low reject levels -- usually due to low levels of worm and/or ant damage -- mean better grower returns. Damaged nuts have no value in the market and some processors pay premiums for nuts below a certain percent damage. Low navel orange worm (NOW) damage also reduces the chance of aflatoxin contamination of nuts. Concerns about a high rate of aflatoxin detection in pistachio nuts from Iran caused the European Union to briefly ban imports of Iranian pistachios. Europe consumes roughly 30% of California almonds so attention to NOW control will help reduce the risk of aflatoxin and will help maintain the excellent reputation of California almonds in the world market.

In Sutter and Yuba Counties, and perhaps other regions of the Sacramento Valley, the Nonpareil (NP) crop is generally down in 2010, mostly due to poor pollination weather this spring. In light crop years, % NOW damage can be higher since fewer nuts are available to dilute NOW egg laying activity. A light NP crop often results in large nuts with poorer shell seal, which can mean easier nut access for NOW larvae. Wes Asai, former UC farm advisor and now a private consultant wrote a great article on this topic at: http://www.growingproduce.com/americanfruitgrower/?storyid=3862.

What does all this mean to growers and PCAs in 2010?

The following is a quick review of practices to consider to help deliver a clean crop.

Track NOW populations in your orchard. Use weekly egg trap counts to track moth flight development and determine when Nonpareil harvest should begin to avoid damage from the 3rd NOW generation. The graph in Figure 1 is an example of early harvest timed to minimize NOW damage.

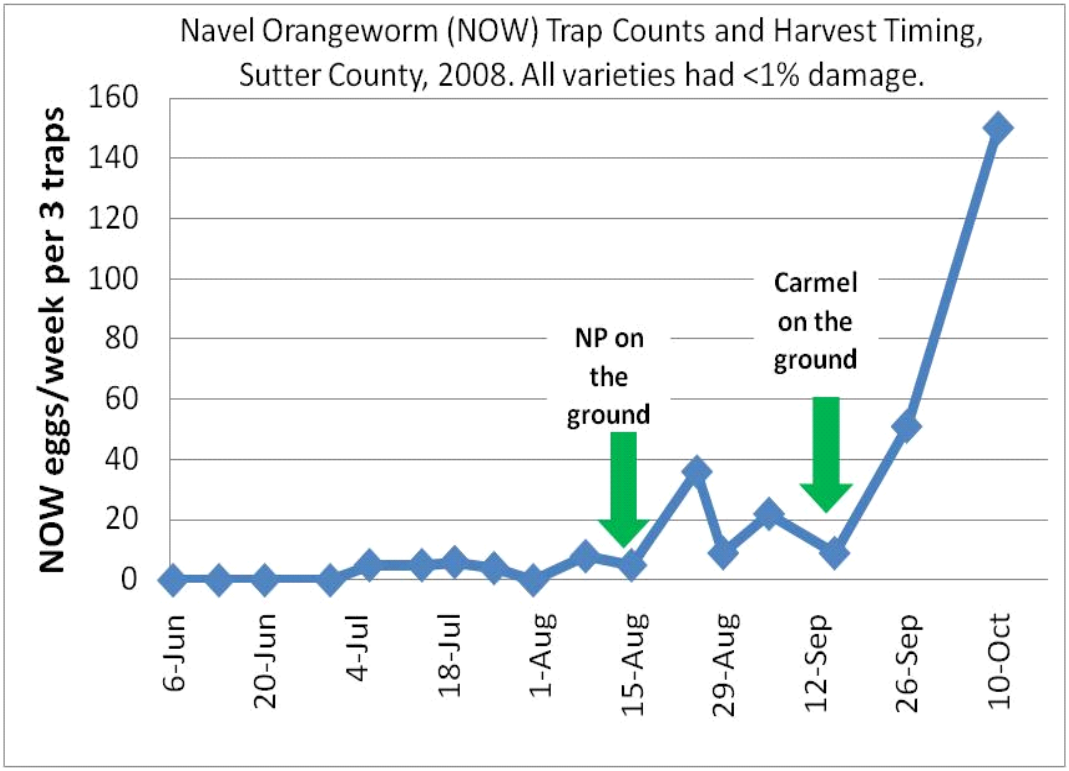
Harvest soft shell varieties ASAP. Nonpareil should be ready for harvest when 95-100% of the nuts at eye level are split (see photo). Test shake a few trees to make sure the orchard is ready to go. If at least 95% of the nuts come off, the orchard is ready to harvest. Be careful with harvest timing. Premature harvest can reduce nut meat quality due to embedded shells. Early harvest is key to a clean crop. Hull split sprays only control 40-60% of NOW larvae, so early harvest is vital to obtain the lowest reject levels - especially in a light crop year.

If needed, apply a hull split spray for NOW control once hull split has begun on sound nuts and eggs are being laid on split nuts or egg traps. If sound nuts are splitting, but eggs aren't being laid, wait to spray until you see eggs. If egg laying starts before hull split, wait until hull split starts before spraying. Hull split begins in tree tops on the southwest side. Check nuts in that part of the canopy on 5-6 trees per block

A nut ready for early harvest.

With an early harvest, nuts will dry more rapidly on the ground than in the trees. However, don't trade NOW damage for ant damage. Make sure ants are controlled when protein – eating ants are present. Ant bait should go down at least 4 weeks before predicted harvest. Prompt pick up of dry nuts will help reduce ant damage. Nuts are ready for pickup when hulls on 8 out of 10 harvested nuts snap instead of bend when bent back between thumb and index finger.

Combining an early harvest with a well timed hullsplit spray, if needed, should result in a cleaner crop with better returns to the grower.



Verticillium Wilt in Almonds

Carolyn DeBuse, Farm Advisor, Solano and Yolo Counties

Verticillium wilt can be seen in many young almond orchards this year. The cool wet spring has increased the disease's incidence. The symptoms show up in orchards in the late spring when the weather changes from cool to hot. The most visual symptom is dry yellow/brown leaves still hanging from one or two scaffolds of a young tree. At first look this disease gives the appearance of killing the trees but few trees are actually killed. The collapsed scaffolds often leaf out later in the year with the only loss being the tender tips of scaffolds that are too desiccated to regrow. It has been shown that affected trees can have reduced yields in subsequent years mainly due to smaller tree size.

Disease development

Verticillium wilt (also known as blackheart) is caused by the fungus *Verticillium dahliae.* This soil borne fungus can be found in bare soil as microsclerotia or in plant debris that remains in the field. Microsclerotia are hard coated compacted fragments of fungus that can withstand harsh environmental conditions staying quiescent in the soil for years until roots of a host plant are in the vicinity. When a host plant is near, the fungus infects the roots and grows in the xylem (water conducting tissue) of the plant. The xylem becomes plugged with the fungus making it nonfunctional for water transport causing the plant to wilt. Cool wet springs are favorable for the growth of the fungus promoting the development of the disease. The fungus's growth is slowed or terminated by the hot dry summer conditions allowing the affected scaffolds to recover. In following years, re-infection can occur from new root infections or surviving fungus within the tree's roots and wood.

Many plants are hosts for verticillium including all of the *Prunus* tree species, many row crops commonly grown in California (tomatoes, melons, potatoes, safflower, strawberry, eggplant, cotton) and many weed species (nightshade, groundsel, lambsquarters, dandelion, pigweed). Verticillium microsclerotia numbers can increase up to 60 per gram of soil where host plants have been grown. Yet, the disease can be a problem in new orchards planted where only 2-3 microsclerotia per gram of soil are found. The majority of the microsclerotia are found in the top layer of soil.

Diagnosing the disease

Almonds are most susceptible to the disease from 1-5 years of age with most of the disease showing in the 2nd to 4th years. The following symptoms will help diagnose the disease.

- Flagging or wilting of one or two whole scaffolds often starting at the top of the scaffold and progressing downward. The rest of the tree may remain healthy. (photo 1)
- Leaves turn yellow/brown and adhere to the affected branches. Some leaf drop occurs lower on the scaffold.
- Scaffold shoot tips desiccate creating a 'shepherd's hook' appearance.
- Cutting into the wood or making a cut across the wood will show a darkening and streaking of the xylem tissue. (photo 2 & 3)

What to do after Verticillium strikes

When you find verticillium affected trees the current recommendation is to be patient and not prune prematurely. The summer heat will slow the growth of the fungus and allow the tree to push new growth from the surviving tissue. I have already seen early infections this year begin to re-leaf. Do not prune out dead wood until you can tell how much of the tree will have made a full recovery. Often you'll find that only the tips of affected scaffolds have died. In 1st and 2nd leaf orchards, in extreme cases some trees may die and will need to be replaced.

How to avoid or minimize the disease

- Avoid planting new orchards following cultivation of susceptible host crops or weed infestations.
- Don't intercrop with verticillium susceptible hosts in new orchards.
- Take soil samples from the top 12 inches to determine amount of microsclerotia present before planting.
- If verticillium is a risk, in the year(s) prior to planting reduce the microsclerotia survival by flooding during the heat of summer, solarization using clear plastic tarps, fumigation with chloropicrin or a combination that contains chloropicrin, or grow a non-host cover crop like sudan grass.
- Use the verticillium tolerant Marianna 2624 rootstock if you are planting compatible almond varieties. Nonpareil is not compatible. M2624 comes with other negative issues such as suckering and possibly Union Mild Etch problems so all risks need to be considered in choosing this rootstock.
- If the orchard is already planted, black plastic mulch the first year can reduce infection or the use of a non-host cover crop (grasses) has been reported to help.

Photo 1. Verticillium wilt in a young almond tree (C. DeBuse)

Photo 2 & 3. Xylem darkening in verticillium-affected almond trees (C. DeBuse)

Understanding and Applying Information From a Soil Test - Part 2

Allan Fulton, Farm Advisor, Tehama, Glenn, Colusa, and Shasta Counties

Part 1 of this series (April 2010) emphasized that soil testing is complementary to plant tissue testing and not a substitute in orchard management. Considerations to ensure soil testing provides representative and useful information and interpretation of two common soil test parameters: 1) Saturation Percentage (SP); and 2) pH were also discussed. This article will focus on the nutrients nitrogen (N), phosphorus (P), and potassium (K).

Nitrogen

Nitrogen occurs in soils as organic and inorganic forms and soil testing may be performed to measure levels of either. Nitrate nitrogen (NO_3-N) is most commonly measured in standard soil tests because it is the primary form of nitrogen available to trees and, therefore, an indicator of nitrogen soil fertility. However, soil concentrations of NO_3-N depend upon the biological activity and may fluctuate with changes in soil temperature, soil moisture, and other conditions. Nitrate is also easily leached with rainfall or irrigation so current soil tests may not reflect future levels of nitrogen soil fertility. Table 1 provides guidelines for evaluating NO_3-N soil fertility levels.

Table 1. Guidelines for interpreting nitrate nitrogen (NO_3-N) levels in soil test results.

Fertility Level	ppm	lbs/acre[1]
Low	<10	<36
Medium	10-20	36-72
High	20-30	72-108
Excessive	>30	>108

[1] Some laboratories report NO_3-N as lbs/ac rather than as a concentration (ppm). A soil bulk density is assumed in this calculation so the NO_3-N fertility levels should be considered an estimate rather than an absolute level.

Ammonium nitrogen (NH_4-N) is also a plant available form of nitrogen in orchard soils and it can be determined with soil testing upon request. In general, NH_4-N is not determined and reported with a standard soil test. Ammonium nitrogen does not usually accumulate in soil because soil temperature and moisture conditions that are suitable for tree growth are also ideal for conversion of NH_4-N to NO_3-N. Ammonium nitrogen concentrations of 2-10 ppm are common. Levels above 10 ppm NH_4-N may occur in cold, wet soils or in soils irrigated with a water supply that is high in ammonium nitrogen.

Total nitrogen which is a measure of all organic and inorganic forms of nitrogen in soil can be determined with soil testing. However, it is not included in standard soil testing.

Phosphorus

Soil tests are performed to determine the concentrations of plant available phosphorus in soil. The Bray P1 Test is used for neutral and acid soils (pH 7.0 and lower) and the Olsen sodium bicarbonate test is used primarily for alkaline soils (pH>7.0) but can be used on soils with pH >6.5. These phosphorus soil tests measure ortho-phosphate (PO_4-P) and provide an index of the phosphorus availability. Table 2 provides guidelines for evaluating phosphorus soil fertility.

Table 2. Guidelines for interpreting phosphorus (PO_4) levels in soil test results.

Fertility Level	**Bray PI method PO_4 Concentration ppm**	**Olsen method PO_4 Concentration ppm**
Low	<20	<10
Medium	20-40	10-20
High	40-100	20-40
Excessive	>100	>40

Depending on soil pH, the availability of phosphorus to trees is influenced by two processes in the soil: 1) specific adsorption to iron and aluminum minerals; and 2) the precipitation or dissolution of calcium phosphate compounds. Both the Bray and Olsen methods of analyzing phosphorus fertility recognize these processes by providing an index of the phosphorus availability. However, neither method simulates the exact soil reactions that occur so the soil test values cannot be used to calculate available phosphorus in absolute terms as lbs P_2O_5 /acre. If soil test levels are reported in units expressed as lbs/acre rather than concentration, they should also be viewed as estimates or relative indicators. Lastly, phosphorus deficiency has not been common in California orchards, so if soil tests suggest low phosphorus fertility the possibility of a deficiency should be confirmed with plant tissue testing.

Potassium

Potassium undergoes exchange reactions with other cations in the soil such as calcium, magnesium, sodium, and hydrogen and this affects the plant available potassium. Therefore, an ammonium acetate extraction method is the most common method to model these soil reactions and analyze for potassium fertility. Less commonly, a sodium bicarbonate extraction method may be used to analyze potassium fertility. When the sodium bicarbonate method is used the soil test results might indicate slightly lower values. Table 3 provides guidelines to interpret potassium soil test results.

Table 3. Guidelines for interpreting potassium (K) soil test results using the ammonium acetate method.

Fertility Level	**Extractable K (ppm)**
Very Low	<75
Low	75-150
Medium	150-250
High	250-800
Very High	>800

Orchards growing on soils with extractable potassium concentrations less than 150 ppm in the root zone are most likely to respond to potassium fertilization. Soils with extractable potassium levels between 150 and 250 ppm are not as likely to respond as lower levels but they could be signaling a decline in fertility and a trend toward future deficiencies. Combining soil and plant tissue testing is preferred to monitor trends in potassium nutrition and guide management.

Glenn County
Cooperative Extension
P. O. Box 697
Orland, CA 95963

Nonprofit Organization
U. S. Postage Paid
Orland, CA 95963
Permit No. 63