



Almond Notes

Agriculture & Natural Resources



In this Sacramento Valley Almond News:

- Almond Varieties
- Crown Rot and Pruning Wound Cankers
- New Video: Managing almond pests using the Year-round IPM Program
- Tying Young Trees
- Navel Orangeworm Pressure?

April 5, 2013

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Almond varieties

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Proper almond variety selection can mean the difference between the commercial success or failure of an orchard. Varieties vary significantly in rootstock compatibility, pollen compatibility, bloom timing, harvest timing, sensitivity to different pests or diseases, and market acceptance/value. New varieties appear and fade from the market, with only a few becoming successful commercially. The selection process should be carefully approached and researched.

At this time, all established and thoroughly field tested almond varieties are self-incompatible. That is, pollination of flowers of an almond variety with pollen from the same variety will not produce nuts. Pollen from a different, but compatible almond variety is needed for effective fertilization (nut set). Not all almond varieties are pollen compatible with each other (see Table 1). Weather in the north state often spreads out bloom, so having at least three different compatible varieties in an orchard may provide the best chance for setting a commercial crop.

For the past 30 years almonds have been planted with alternating rows containing a single variety. This ensured good proximity of pollen for cross pollination by honeybees with good yields resulting. This keeps a good mix of pollen sources across the orchard and avoids mixing nuts from distinctly different varieties at harvest which results in downgraded value. Experiments with alternating varieties down the row or increasing the Nonpareil percentage have not proven significantly better in yield or value than alternating solid rows and the arrangement is more costly to harvest.

Select varieties with good bloom overlap for cross pollination (Table 2), pollen compatibility with other varieties in the planting, and nut maturities with sufficient separation to avoid harvesting mixed nuts (Table 3). There are no perfect varieties so consider all pros and cons for each variety before selecting those that best fit your specific location and operation. Marianna 2624 plum rootstock is resistant to waterlogging, wood rots, and oak root fungus but is not compatible with Nonpareil. The new Krymsk-86 rootstock is compatible with Nonpareil but whether it has the desirable attributes of Marianna 2624 remains to be seen. We will discover more as it faces these challenges over time.

Nonpareil, the most valuable and widely planted proven variety, is a hallmark of the California industry developed in 1879 by A.T. Hatch in Suisun. It is the standard mid-blooming earliest harvesting variety around which other varieties are selected. Orchards are commonly planted with every other row a Nonpareil row alternating with early and late pollinizers. This arrangement allows for the best possible pollination potential for the Nonpareil. Popular early pollinizer choices for Nonpareil include Aldrich, Peerless, and Winters. Sonora, an early pollinizer for Nonpareil produces a valuable nut but in some years has had disappointing yield if it bloomed too early for the two to effectively cross pollinate one another.

Sonora produces a high quality nut and commands a price very close to Nonpareil. It blooms three to eight days before Nonpareil and can cross-pollinate Nonpareil quite well depending on bloom date. In some years, Sonora may bloom too early to be set well by Nonpareil and may have a light crop if there are no other varieties in the orchard with open flowers near the beginning of Sonora bloom. The presence of another early blooming variety can mitigate this problem. Sonora harvests right after the Nonpareil group.

Aldrich blooms just ahead of Nonpareil and is a common early pollinizer for Nonpareil in the Sacramento Valley. The tree is very upright and vigorous, can be difficult to train by pruning, and the tallest upright limbs may need to be thinned periodically to control tree height. The variety usually has a heavy bloom but often a moderate yield. Its nuts fit into the California marketing group and harvest timing is with the Butte group.

Winters blooms between Sonora and Aldrich, roughly 3 days ahead of Nonpareil and has an extended bloom that covers Nonpareil well. It is susceptible to a range of diseases similar to other early blooming varieties such as Ne Plus Ultra and Peerless. It produces a quality nut that receives a premium in certain markets and it harvests with the Carmel group.

There are far more choices to select from when choosing a later blooming variety for Nonpareil pollination. Popular varieties that are frequently

planted to cover the mid to later part of the Nonpareil bloom include Carmel, Fritz, Wood Colony, Butte, and Monterey.

Carmel produces a high quality nut with a good shell seal. It grows much like Nonpareil though the tree is slightly smaller in size. It has a good market and is often sold as Carmel. The tree is susceptible to blossom brown rot and is especially susceptible to scab. Carmel is also sensitive to a serious genetic disorder that the industry must guard against -- noninfectious bud failure or "crazy top". This genetic disorder results in dehydration and death of terminal and lateral shoot buds during summer heat. Repeatedly, year after year, one or two buds on one year old shoots will survive and grow vigorously the following spring resulting in the distinctive "crazy top" or "witches brooming" seen in trees with substantial bud failure. As the severity of bud failure increases, fewer spurs are formed due to the failure of lateral buds. Trees that show bud failure early in the life of the orchard (2nd through 5th leaf) have the greatest reduction in productivity. When identified early they should be aggressively replaced. Certain nursery lines of Carmel trees have a very low incidence of bud failure. Before selecting a nursery to supply your orchard with Carmel trees, have the nursery field representative show you trees in established orchards over a range of planting years in your growing region. Carmel trees harvest near the end of the harvest season just ahead of Mission and Monterey.

Monterey is an effective pollinizer for late Nonpareil bloom and is an excellent producer. It's a variety that's been around for 40 years but until expansion of the in-shell market it was not planted much due to its high percentage of double kernels which reduced the quality and value of this nut depending on the processor. It's susceptible to diseases much like Carmel and has experienced anthracnose outbreaks in wet years. Monterey is harvested late in the harvest season, sometimes as much as 5-6 weeks after Nonpareil, roughly with Mission. The late harvest date can be a significant problem in the Sacramento Valley when rains occur in September and early October and the large fleshy hulls of Monterey are difficult to dry.

Fritz is an excellent pollinizer for Nonpareil, blooming with or slightly after Nonpareil. It is susceptible to anthracnose in wet springs. This variety has very good yield potential, but harvests dead last among currently planted varieties in the state – about 45 days after Nonpareil. The late harvest date (after Mission) makes Fritz a very risky option for planting in the Sacramento Valley.

Butte has been used to pollinate the late Nonpareil bloom. It's susceptible to brown rot but is a semi-hard shell variety that is resistant to navel orangeworm. It yields well, but usually commands a lower price than varieties in the Carmel or California marketing groups. Thus, use of this variety as a Nonpareil pollinizer is decreasing. Butte is mature and ready for harvest about the same time as Aldrich, just prior to Carmel but after Price.

A major issue in Sacramento Valley almond orchards is the compatibility of certain varieties with plum

rootstocks (Table 4) – those rootstocks can survive in wet, heavy soils in winter better than peach seedling or peach/almond hybrid. Nonpareil is not compatible with Marianna 2624 or M40, but appears compatible with Krymsk 86. Butte and Monterey are less compatible and are more susceptible to symptoms of union mild etch on plum rootstocks than are some varieties. When soils are too wet during the growing season, union mild etch can also be a problem on other varieties such as Peerless and Carmel on plum rootstock.

There are six primary marketing categories for California almonds (Table 5). Selling the crop at a competitive price and with a good return to the grower is paramount. Before selecting varieties for a new orchard, be sure to consult with the handler that will be marketing the crop to get their opinion on the desirability and potential returns per pound of any varieties you are considering.

Table 1. Pollen incompatibility groups (bold headings). Varieties listed under each bold heading are not compatible with other varieties in the same group.

<u>Nonpareil</u>	<u>Solano</u>	<u>Ne Plus Ultra</u>	<u>Thompson</u>	<u>Carmel</u>
IXL	Eureka	Merced	Granada	Livingston
Jeffries*	Jeffries*	Jenette	Harvey	Carrion
Long IXL	Kapareil	Norman	Mono	Jeffries*
Grace	Vesta	Price	Robson	Sauret #1
Profuse	Sonora	Ripon	Sauret #2	Monarch
Tardy Non		Rosetta	Le Grand	
		Aldrich	Wood Colony	<u>Mission</u>
		Pearl	Durango	Ballico
				Languedoc
<u>Monterey</u>	<u>Peerless</u>		<u>Jordanolo</u>	<u>Tokyo</u>
Monterey	Fritz			
Butte	Ruby	<u>Padre</u>		
Avalon				
Plateau	<u>Kochi</u>	<u>Winters</u>	<u>Tuono</u>	
Dottie Won				

*Jeffries possesses a special case of unilateral incompatibility.

Table 2. Full bloom timing for common varieties– Almond Regional Variety Trial, Chico. All trees are on ‘Lovell’ peach seedling rootstock. Orchard planted in 1993.

-----Number of days before or after Nonpareil full bloom (80% of flowers open)-----

Variety	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Average
Sonora	-8	-6	-9	-5	-7	-8	-1	-7	-5	-3	-8	-5	-6.0
Winters	-4	-6	-6	-2	-4	-3	0	-2	-3	-2	-6	-2	-3.3
Avalon									-3	-2	-8	-5	-4.5
Durango									-3	-1	0	3	-0.3
Aldrich	-3	0	0	1	-5	-2	-1	-1	-4	-1	-6	-3	-2.1
Price	2	0	3	1	-1	-1	-1	0	2	-1	-5	0	-0.1
Nonpareil	0	0	0	0	0	0	0	0	0	0	0	0	0
Wood Colony	0	-1	7	2	2	0	0	1	2	0	0	3	1.3
Carmel	2	1	6	2	0	-1	0	1	2	1	1	3	1.5
Monterey	2	0	6	4	0	2	0	1	2	1	0	3	1.8
Butte	3	6	8	6	4	0	3	4	2	2	2	4	3.7
Padre	4	8	9	6	4	0	3	7	3	2	3	5	4.5
Mission	4	8	10	6	6	5	4	6	3	2	3	5	5.2
Ruby	6	11	17	10	10	6	5	13	8	7	10	13	9.7

Source: Data from Joseph Connell, UCCE Farm Advisor, Butte County, Regional Variety Trial, CSU Chico.

Table 3. Nut maturity expressed as when the variety reaches 100 percent hull split and categorized by the number of days before or after 100% hull split on Nonpareil.

Kapareil Group	Sonora Group	Price Group	Butte Group	Carmel Group	Mission Group
10 days before Nonpareil	7 to 13 days after Nonpareil	15 to 21 days after Nonpareil	23 to 28 days after Nonpareil	29 to 34 days after Nonpareil	39 to 40 days after Nonpareil
Kapareil	Kochi* Sonora UC 2-19E Rosetta Jiml UC 1-102W* UC 2-43W* Johlyn UC 25-75	Donna UC 1-87 Price Jenette Morley Plateau	Yokut Wood Colony Livingston Sano Durango* Aldrich Padre Butte Chips	Savana Winters Carmel Avalon* Kahl Ruby	Monterey Mission

Rankings are based on a 10 year average of maturity data with the exception below.

* Rankings of these cultivars are based only on 4 years of harvest maturity observations.

Source: Data from Joseph Connell, UCCE Farm Advisor, Butte County, Regional Variety Trial, CSU Chico.

Table 4. Compatibility of important almond varieties with Mariana 2624 plum rootstock.

Compatible	Intermediate	Incompatible
Aldrich	Butte	Nonpareil
Carmel	Monterey	
Fritz		
Mission		
Padre		
Peerless		
Price		
Sonora		
Wood Colony		

Table 5. Marketing categories by variety kernel characteristics

<u>Nonpareil</u>	<u>Carmel</u>	<u>California</u>	<u>Ne Plus Ultra</u>
Jefferies	Carmel	Aldrich	Norman
Kapareil	Monterey	Ballico	Price
Long IXL	Sauret 2	Carrion	Ruby
Milow		Fritz	Solano
Nonpareil	<u>Mission</u>	Harvey	Sonora
Profuse	Butte	LeGrand	Thompson
	Mission	Livingston	
<u>Inshell</u>	Padre	Merced	
<u>Bleaching</u>	Ripon	Mono	
Peerless	Drake		

Crown rot or pruning wound cankers

Joseph Connell, UCCE Farm Advisor, Butte County

Heavy rains triggered crown rot infections or pruning wound cankers this past winter in almonds. November/December storms concentrated heavy rain in two very wet periods. In Chico, I measured 6.3 inches of rain falling in nine days between November 28th and December 6th followed by 5.9 inches between December 15th -25th. Wet saturated conditions created a nearly perfect environment for the establishment of *Phytophthora* crown rots or pruning wound cankers when pruning cuts were followed closely by these wet periods.

Crown rot. I've already observed crown rot on young trees in calls this spring. With fall *Phytophthora* infections, trees will begin to push

buds in the spring but will quickly wilt and die before new growth occurs. Excavating around the crown and cutting into the tissue will show brown discoloration under the bark. The cankers may extend up the trunk from the soil, sometimes nearly to the scaffolds on young trees. Slight depressions in the soil around tree trunks where water might puddle during rainy periods can be just enough to make one tree sick and die while others nearby without that liability will be unaffected. The best solution is to replant on a mound to make sure drainage around the crown is good.

Pruning wound cankers. *Phytophthora syringae* was isolated from pruning wound cankers during cool wet conditions in the early 1980s. This fungus is well adapted for growth and development in

almond tissue under the common winter conditions of the Sacramento valley, mild temperatures and high rainfall. In subsequent research, *P. syringae* was found to be virulent in branch cankers over a broad range of temperatures from 36° to 68° F with lower temperatures resulting in larger cankers. Phytophthora cankers can quickly expand from an infection site at pruning wounds extending to more than 6 inches within three weeks of infection. As spring progresses, amber colored gum balls extruding through the bark are frequently seen at the cankers margin.

These cankers die out as temperatures warm during late spring and by June the fungus cannot normally be isolated. The inability to isolate the fungus later in the season is not surprising since *P. syringae* will not grow at 80° F or above. This temperature is frequently exceeded during April and May in the central valley.

In subsequent seasons, after the cankers have died out and gumming has disappeared, the dead area will appear as a sunken canker with wound healing occurring from around the canker margins. If these cankers are on larger wood they may have little impact on the vigor of the branch. If they occur on young trees where competing scaffolds were removed to train the trees or if multiple cankers girdle a larger branch then death of the tree or branch above the cankers can occur.

Dried gum observed around inactive cankers in June through September can lead to confusion between this disease and other warm weather canker diseases such as those caused by *Ceratocystis fimbriata* and *Botryosphaeria dothidea* fungi. Both of these fungi have also been documented to occasionally invade pruning wounds under the right conditions. Cankers caused by these fungi are sometimes slower growing but they can be perennial cankers that eventually girdle and kill branches. If cankers are on a branch that can be removed by pruning that is the best way to eliminate the problem. *C. fimbriata* cankers are usually small diamond shaped cankers around the pruning wound. *B. dothidea* cankers have been observed to grow very fast surrounding pruning wounds made near the crotches of young trees. In recent research, a wide range of fungicide treatments were applied to *B. dothidea* trunk cankers and to

healthy tree trunks to try and protect them from infection. The fungicide treatments were not successful in restricting size of existing cankers nor did they protect healthy trees from new infections during the season when treatments were applied.

New video: managing almond pests using the year-round IPM program

Spring has sprung and your almonds are blooming. Not sure what you should be doing to manage pests for the upcoming season? Check out the year-round IPM program for almonds on the UC IPM web site. Need help using it? UC IPM has just published an online video to help you manage almond pests using the year-round program.

[How to Manage Almond Pests Using the Year-Round IPM Program](#) is a narrated how-to guide written for growers, PCAs, and others who work in almonds, showing what needs to be done throughout the season to stay on top of pest problems.

Going back and forth between the year-round IPM program and Pest Management Guidelines, the video gives an excellent look at how these two resources are used together to manage key almond pests such as navel orangeworm, peach twig borer, and shot hole. The video takes you deeper into the Guidelines with tips on taking dormant spur samples, monitoring for shoot strikes, and looking for predators and parasites of key pests. Also included are instructions on using treatment tables to choose pesticides that are effective while examining effects on honey bees, natural enemies, and the environment.

The video is broken into six chapters so you can easily view the section of the year-round program that you need help navigating.

You can find the online video on the Year-Round IPM Program for Almonds page at <http://www.ipm.ucdavis.edu/PMG/selectnewpest.almonds.html>. For more information about other year-round programs available or for a more general video tour, see http://www.ipm.ucdavis.edu/IPMPROJECT/about_yr_p.html.

Tying young trees

Joseph Connell, UCCE Farm Advisor, Butte County

Good pollination weather has set a nice crop in many orchards. Vigorous growing young trees that load up for the first time could be in danger of suffering substantial limb breakage with the first heavy crop. This problem, if anticipated, can be most easily avoided by tying in advance of the need. Nut fresh weight will reach the maximum in about mid-June and remain high until hull split when hull drying begins.

To save bending secondary and tertiary scaffolds, it may be necessary to temporarily prop them up and secure them in the desired position with a loop of tree rope. If tertiary scaffolds come down and remain bent over, vigorous watersprouts will push near the bend in the tertiaries which can result in the loss of those selected tertiary limbs as permanent scaffolds.

Now is the time to save the crop and the framework you've spent the first few years developing. Ties must be placed high enough around the perimeter of the canopy to support and maintain the desired framework if the effort spent is to be worthwhile. Ties placed too low will save the primary scaffolds but may still permit the loss of secondary or tertiary limbs.

Navel orangeworm pressure?

Joseph Connell, UCCE Farm Advisor, Butte County

Navel orangeworm may have potential this year to become a problem for a couple of reasons. If your orchard was well cleaned of mummy nuts by the winter storms in November and December followed up by a sanitation program in January then you may be in good shape. If not, and you still have mummy nuts in the trees harboring NOW, then, be aware.

The dry weather in January through March would have reduced mortality of the overwintering NOW still in mummies. Second, the warmer weather should have advanced the NOW life cycle which could result in an earlier third generation that is more likely to damage the crop.

Keep an eye on the situation by placing NOW egg traps in your orchard right away. Monitor egg laying to determine NOW pressure and use the Day Degree model to predict when egg laying will occur on the new crop.

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