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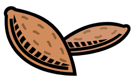

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Submitted by:

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Pollination and honey bee safety

Joseph Connell, UCCE Farm Advisor, Butte County

Always be aware of honey bees whenever they're in your orchard to pollinate your crop. After all, you're paying good money for the bees to do a critical job! Honey bees feed pollen to the larva so they need to have an active brood nest and be increasing in population to have a demand for pollen. When almond flowers shed their pollen in the morning, the bees are likely to collect nearly all of it by early in the afternoon. If you're spraying a fungicide, try to make the application in the late afternoon or at night to minimize the potential for pollen contamination.

There has been some concern about the combination of fungicides with adjuvants that could potentially be more of a problem for bees than simply using the fungicide alone. It's worth pointing out that University disease control trials (which result in the fungicide efficacy tables printed in this newsletter) are generally conducted without adjuvants and with only the fungicide material used in the tank. Excellent disease control is obtained with several fungicides in these trials.

If the weather remains dry and clear throughout bloom there may be minimal need to apply bloom fungicides. One application just ahead of full bloom should be adequate for good disease control under these conditions.

Whenever your trees are blooming or bees are in the field there is no reason to apply any insecticide that could potentially be toxic to honey bees. In fact, making such a choice is rather foolish in my personal opinion. When we did research years ago that showed petal fall sprays could control peach twig borer (PTB) as well as dormant sprays, we were using and recommending the addition of *Bacillus thuringiensis* (BT) to the tank mix. BT sprays provided good control of PTB and this material is non-toxic to honey bees and their larvae. In-season sprays in May or at early hullsplit after the bees are gone is another effective alternative.

You can go a long way toward protecting the health of honey bee colonies by avoiding contamination of pollen and pollen foragers and by staying away from using any products with potential toxicity to honey bees or their larvae while bees are in your orchard. This is good husbandry and it's in the interest of both the grower and the beekeeper.

Orchard sanitation: a key winter practice in almond production

Franz Niederholzer, UC Farm Advisor, Colusa/Sutter/Yuba Counties

It's time to complete the time consuming, relatively expensive, and essential practice of mummy counting and, when necessary, sanitation in California almond orchards. We have had a very dry winter and the natural decomposition of mummy nuts may be reduced if the winter remains dry. While an article on almond orchard sanitation is a review for most growers, the topic is so important that the UC Farm Advisors in the Sacramento Valley feel this is worth emphasizing.

What's the problem? Navel orangeworm (NOW) is the key pest in almond production. Kernel damage from NOW feeding directly reduces grower income. Nuts damaged by NOW feeding are at high risk of *aflatoxin* infection. Aflatoxin contamination is a major issue in food safety and European Union (EU) markets.

What's the solution? A NOW management program in almond orchards in the Sacramento Valley should include 1) winter orchard sanitation, 2) early harvest, and 3) a hull split spray if necessary. Not all three steps are needed in every year.

Why sanitize? NOW population overwinters in almond orchards as larvae in mummy nuts. The adults emerge, mate, lay eggs on mummies, and larvae must feed on mummy nuts until hull split of the new crop in the summer. Removal and destruction of mummy nuts in the winter provides two important steps in NOW management:

1. Directly destroys overwintering NOW in mummy nuts.
2. Reduces or eliminates food and oviposition sites (mummy nuts) for the first generation of NOW during the spring/early summer.

A carefully sanitized almond orchard starts the season with a low NOW population and low food supply for any remaining NOW moths or those entering from nearby.

Why an integrated approach? Combining all three parts of an integrated NOW control program delivers the best pest control results. Sanitation reduces overwintering populations and NOW food source in the spring, but can't protect splitting nuts in the summer from the few remaining NOW or those flying in from outside the orchard. NOW populations that move in at hull split can build rapidly on high quality food (new crop nuts). Hull split spraying provides only partial NOW control (50% in many experiments) due to the difficulty of 1) controlling a pest with sprays when egg laying occurs over a period of time and 2) getting good spray coverage -- especially in the tree tops. Early harvest requires longer drying time on the orchard floor, something some growers – especially those with micro-irrigation -- have moved away from to get water back into the orchard as quickly as possible, but, it is a key component of a good NOW control program and it is much better than harvesting later and getting caught by rain.

How to sanitize? Here is a check list of practices that make up a complete sanitation program.

- Count mummies in the dormant tree canopies before January 15, looking at 20 or more trees per block. If the average count is more than two mummies per tree, plan on poling or shaking the orchard to remove mummies from the trees before the end of January.
- Get mummies out of the trees by February 1. Since buds are already swelling in many orchards this January, the sooner the better for shaking or poling – if you haven't already done this.
- Blow or rake all mummies on the orchard floor into the middles and destroy them (mow or disc) by March 15. This step is especially important in this dry winter, where nuts on many orchard floors aren't exposed to the usual moist conditions that rot nuts and reduce NOW survival.

What does the dry winter so far mean to NOW sanitation? As of mid-January, 2014, this winter looks a bit like the winter of 2012, where there were cold temperatures but not a lot of rain. 2012 was a high NOW damage year in many orchards around the state. This winter, it might be important to check mummy numbers in the trees, even if you have not had much of a history of mummy survival and NOW pressure.

Won't the cold weather in early December reduce NOW numbers? In early, 2012, Dr. Frank Zalom, professor of entomology at UC Davis, told me that growers should not count on cold weather to reduce NOW numbers to a level that eliminated the need for sanitation, especially in a dry winter. He was right about NOW in 2012. This history makes me think that NOW is likely to have survived the early December, 2013 cold just fine.

Bottom line: Winter sanitation should be especially important for NOW management this year. Don't miss the opportunity!

Observations on Butte County Rootstock Trials

Joseph Connell, UCCE Farm Advisor, Butte County

Several rootstocks have been observed in various orchard situations with local growers in Butte County over the past ten years or so. The complete results of these trials can be found in past Annual Rootstock Project Reports to the Almond Board of California. The following article summarizes the most useful results and conclusions.

Replants were planted in non-fumigated oak root fungus spots to gauge their compatibility with almond and survival when exposed to the fungus. 'Nonpareil' on 'Empyrean 101' rootstock has been observed in two orchards since 2004. Nine trees of 'Nonpareil' on 'Krymsk 86' were replanted in oak root fungus spots in commercial orchards in spring 2010 and ten trees on another rootstock were similarly planted in 2012.

Nonpareil' on 'Empyrean 101' rootstock is similar in size and vigor to nearby trees on 'Marianna 2624'. Although growing in an oak root fungus spot since 2004, none of these trees succumbed to *Armillaria mellea*. However, four out of seven 'Empyrean 101' rooted trees are leaning compared to trees on 'Marianna 2624' so poor anchorage precludes the use of this rootstock for almonds.

Nine 'Nonpareil' trees on 'Krymsk 86' planted in spring 2010 in three different oak root fungus spots have established and grown well. In spring 2013 (4^{th} leaf), all nine trees continue to be healthy while a 'Lovell' rooted replant of similar age in one of the fungus spots died. Ten 'Nonpareil' trees on another rootstock being screened for potential *Armillaria* resistance were planted in an oak root fungus affected orchard in 2012. All trees established well and have so far remained healthy.

In a replant disease fumigation trial planted in 2004, 20 single tree replicates of 'Krymsk 86', 'Lovell', 'Marianna 2624', and 'Ishtara' rootstocks were planted in both fumigated and non-fumigated tree sites. By 2011, 'Krymsk 86' trunk circumference was largest while 'Lovell' benefited most from fumigation. After eight years, 47 percent of the 'Ishtara' trees and 8 percent of the 'Lovell' rooted trees were leaning. There were no leaning trees on the 'Krymsk 86'rootstock. Both 'Ishtara' and the 'Krymsk 86' rootstocks had 5 percent of the trees missing while 'Lovell' rootstock had 10 percent missing. 'Ishtara' has been killed by oak root fungus in other fields and poor anchorage made this rootstock unacceptable for almonds.

Another replicated rootstock trial was planted in March 2010 following the removal of a previous 'Lovell' peach rooted orchard containing some plum rooted replants. 'Nonpareil' trees on 'Rootpac-R', 'Atlas', 'Krymsk 86', and 'Empyrean 1' rootstocks are compared to trees on the standard rootstocks 'Nickels' and 'Lovell'. Four of the six rootstocks established well in the first growing season with no tree losses. 'Atlas' suffered 10% mortality at planting and 'Nickels' lost 16% of the new trees. After the third growing season, trees on the 'Empyrean 1' rootstock were largest in trunk circumference and those growing on 'Krymsk 86' were the smallest. 4th leaf 'Nonpareil' yields were heaviest in trees on 'Empyrean 1' rootstock and lightest on 'Rootpac-R' and 'Krymsk 86' rootstocks. Other rootstocks produced intermediate yields. Mortality and anchorage will be noted as opportunities arise.

ALMOND: FUNGICIDE EFFICACY

Fungicide	Resistance risk (FRAC)[1]	Brown rot	Jacket rot	Anthrac -nose	Shot hole	Scab[3]	Rust[3]	Leaf blight	Alternaria leaf spot [3]	PM-like[5]	Hull rot[16]
Bumper/Tilt[4]	high (3)	++++	+/-	++++	++	++	+++	ND	++	+++	++
Indar	high (3)	++++	+/-	+++	++	++	NL	ND	+	ND	----
Inspire Super[4]	high (3/9)	++++	++++	ND	+++	+++	+++	ND	+++	ND	+++
Luna Sensation	medium (7/11)[3,7]	++++	++++	++++	++++	++++	++++	ND	++++	+++	+++
Pristine	medium (7/11)[3,7]	++++	++++	++++	++++	++++	+++	ND	+++	+++	+++
Merivon*	medium (7/11)[3,7]	++++	++++	++++	++++	++++	+++	ND	++++	++++	+++
Quash[4]	high (3)	++++	++	++++	+++	+++	++++	ND	++++	+++	+++
Luna Experience	medium (3/7)[3]	++++	+++	++++	+++	++++	++++	ND	++++	+++	+++
Quadris Top	medium (3/11)[3]	++++	+++	++++	+++	++++	++++	ND	+++	+++	+++
Quilt Xcel	medium (3/11)[3]	++++	+++	++++	+++	++++	++++	ND	+++	+++	+++
Rovral + oil[8]	low (2)	++++	++++	----	+++	+/-	++	ND	+++[9]	ND	----
Scala[3]	high (9)[3, 7]	++++	++++	ND	++	----	ND	ND	+	----	----
Tebuzol (Elite**)	high (3)	++++	+/-	+++	++	++	+++	ND	+	ND	++
Topsin-M/T-Methyl/ Incognito[2]	high (1)[2, 7]	++++	++++	----	----	+++[8]	+	+++[6]	----	++	----
Vangard	high (9)[3, 7]	++++	++++	ND	++	----	ND	ND	+[9]	----	----
Fontelis	high (7)[4]	++++	++++	++	++++	+++	+++	ND	+++	ND	----
Abound[4]	high (11)[3, 7]	+++	----	++++	+++	++++	++++	+++	+++[10]	+++	+++
Elevate	high (17)[7]	+++	++++	----	+	ND	ND	ND	ND	ND	----
Protexio*	high (17)[7]	+++	++++	----	+	ND	ND	ND	ND	ND	----
Gem[4]	high (11)[3, 7]	+++	----	++++	+++	++++	++++	+++	+++[10]	+++	+++
Laredo	high (3)	+++	----	++	++	----	+	+++	----	+++	----
Rovral/Iprodione /Nevado	low (2)	+++	+++	----	+++	----	----	ND	++[9]	----	----
Bravo/Chloro-thalonil/Echo /Equus[11,12]	low (M5)	++	NL	+++	+++	+++[15]	++++	NL	NL	----	----
Captan[4,12]	low (M4)	++	++	+++	+++	++	----	+++[6]	+	----	----
CaptEvate**	low (M4/17)	+++	+++	+++	+++	+++	----	+++	+	----	----
Ph-D	medium (19)	++	+++	----	++	+++	+++	ND	++++	ND	++
Syllit*	Medium (M7)	+	----	ND	+++	++++	ND	ND	+	ND	----
Rally[13]	high (3)	+++	----	++	+/-	----	+	+++	----	+++	----
Ziram	low (M3)	++	+	+++	+++	+++	----	++	+	----	----
Copper[14]	low (M1)	+/-	+/-	----	+	+[15]	----	----	ND	----	----
Copper + oil[14]	low (M1)	ND	ND	----	+	+++[15]	----	----	ND	----	----
Lime sulfur[12]	low (M2)	+/-	NL	----	+/-	++[15]	++	NL	NL	----	----
Sulfur[4,12]	low (M2)	+/-	+/-	----	----	++	++	----	----	+++	----
PlantShield***[17]	low	----	----	----	----	----	----	----	----	----	----

Rating: ++++ = excellent and consistent, +++ = good and reliable, ++ = moderate and variable, + = limited and/or erratic, +/- = minimal and often ineffective, ---- = ineffective, NL = not on label, and ND = no data

*** Registration pending in California**

****Not registered, label withdrawn or inactive**

*** Section 24C (special local needs) registration approved in California for silver leaf disease of almond.

[1] Group numbers are assigned by the Fungicide Resistance Action Committee (FRAC) according to different modes of actions (for more information, see http://www.frac.info/). Fungicides with a different group number are suitable to alternate in a resistance management program. In California, make no more than one application of fungicides with mode of action Group numbers 1, 4, 9, 11, or 17 before rotating to a fungicide with a different mode of action Group number; for fungicides with other Group numbers, make no more than two consecutive applications before rotating to fungicide with a different mode of action Group number.

Almond: Fungicide Efficacy, continued

[2] Strains of the brown rot fungi *Monilinia laxa* and *M. fructicola* resistant to Topsin-M and T-Methyl have been found in some California almond orchards. MBC-resistant strains of the jacket rot fungus, *Botrytis cinerea* and powdery mildew fungi, have been reported in California on crops,
other than almond and stone fruits and may have the potential to develop in almonds with overuse of fungicides with similar chemistry. MBC-resistant strains of the scab fungus, *Cladosporium carpophilum*, have been found in California.

[3] Field resistance of *Alternaria* sp. and *Cladosporium carpophilum* to QoI and SDHI fungicides has been detected in almond orchards. AP-resistant populations of *Monilinia* spp. have been found on other stone fruit crops in California.

[4] Of the materials listed, only sulfur, Abound, Gem, and some of the DMI fungicides (FRAC Group No. 3) are registered for use in late spring and early summer when treatment is recommended.

[5] PM-like refers to a powdery mildew-like disease on almond fruit that is managed with fungicides. Recent information suggests an *Acremonium* species is involved.

[6] Excellent control obtained when combinations of Topsin-M or T-Methyl and Captan are used.

[7] To reduce the risk of resistance development start treatments with a fungicide with a multi-site mode of action; rotate or mix fungicides with different mode of action FRAC numbers for subsequent applications, use labeled rates (preferably the upper range), and limit the total number of applications/season.

[8] Oils recommended include "light" summer oil, 1-2% volume/volume.

[9] Not registered for use later than 5 weeks after petal fall.

[10] Efficacy reduced at high temperatures and relative humidity; experimental for Alternaria.

[11] Bravo Ultrex, Bravo WeatherStik, Echo Ultimate, and Chlorothalonil are currently registered.

[12] Do not use in combination with or shortly before or after oil treatment.

[13] Efficacy is better in concentrate (80-100 gal/acre) than in dilute sprays.

[14] The low rates necessary to avoid phytotoxicity in spring reduce the efficacy of copper.

[15] "Burns out" scab twig lesions when applied at delayed dormant. (Chlorothalonil can be applied with dormant oil during tree dormancy).

[16] Hull rot ratings are for the disease caused by *Rhizopus stolonifer*. Ratings for the disease caused by *Monilinia* spp. will be provided in the future.

[17] Active ingredient, *Trichoderma harzianum* Rifai strain KRL-AG2, provides control of Silver leaf disease.

ALMOND: TREATMENT TIMING

Note: Not all indicated timings may be necessary for disease control.

Disease	Dormant	Bloom			Spring[1]		Summer	
		Pink bud	Full bloom	Petal fall	2 weeks	5 weeks	May	June
Alternaria	----	----	----	----	----	++	+++	+++
Anthracnose[2]	----	++	+++	+++	+++	+++	+++	++
Brown rot	----	++	+++	+	----	----	----	----
Green fruit rot	----	----	+++	----	----	----	----	----
Hull rot[7]	—	—	—	—	—	—	—	+++
Leaf blight	----	----	+++	++	+	----	----	----
Scab[3]	++	---	---	++	+++	+++	+	---
Shot hole[4]	+[5]	+	++	+++	+++	++	----	----
Rust	----	----	----	----	----	+++	+++	+[6]

Rating: +++ = most effective, ++ = moderately effective, + = least effective, and ---- = ineffective

[1] Two and five weeks after petal fall are general timings to represent early postbloom and the latest time that most fungicides can be applied. The exact timing is not critical but depends on the occurrence of rainfall.

[2] If anthracnose was damaging in previous years and temperatures are moderate (63°F or higher) during bloom, make the first application at pink bud. Otherwise treatment can begin at or shortly after petal fall. In all cases, application should be repeated at 7- to 10-day intervals when rains occur during periods of moderate temperatures. Treatment should, if possible, precede any late spring and early summer rains. Rotate fungicides, using different fungicide classes, as a resistance management strategy.

[3] Early treatments (during bloom) have minimal effect on scab; the 5-week treatment usually is most effective. Treatments after 5 weeks are useful in northern areas where late spring and early summer rains occur. Dormant treatment with liquid lime sulfur improves efficacy of spring control programs.

[4] If pathogen spores were found during fall leaf monitoring, apply a shot hole fungicide during bloom, preferably at petal fall or when young leaves first appear. Re-apply when spores are found on new leaves or if heavy, persistent spring rains occur. If pathogen spores were not present the previous fall, shot hole control may be delayed until spores are seen on new leaves in spring.

[5] Dormant copper treatment seldom reduces shot hole infection but may be useful in severely affected orchards and must be followed by a good spring program.

[6] Treatment in June is important only if late spring and early summer rains occur.

[7] Make application at 1-5% hull split to manage hull rot caused by *Rhizopus stolonifer*.

ALMOND: SUGGESTED DISEASE MANAGEMENT PROGRAMS BY FUNGICIDE FRAC[1] GROUPS

Note: Not all indicated timings may be necessary for disease control (*see* Treatment Timing Table). If treatments are needed based on host phenology, weather monitoring, inoculum models, or environmental-disease forecasting models, suggested fungicide groups are listed for each timing.

How to use this table:

1) Identify the disease(s) that need(s) to be managed. Know the disease history of the orchard especially from the previous season.
2) Select one of the suggested fungicide groups. *Numbers separated by slashes are pre-mixtures, whereas numbers grouped by pluses are tank mixtures.* If several diseases need to be managed, select a group that is effective against all diseases. Refer to the fungicide efficacy table for fungicides belonging to each FRAC group. Group numbers are listed in numerical order within the suggested disease management program.
3) Rotate groups for each application within a season and, if possible, use each group only once per season, except for multi-site mode of action materials (e.g., M2) or natural products/biological controls (NP/BC).

disease	dormant	bloom			spring		summer	
		pink bud	full bloom	petal fall	2 weeks	5 weeks	may	june
alternaria	----	----	----	----	----	2	3, 7, 3/9, 3/7, 3/11, 7/11 11 19	3, 7, 3/7, 3/9, 3/11, 7/11 11, 19
anthracnose	----	3, 7, 3/7, 3/9, 3/11	3, 7, 3/7, 3/9, 3/11 7/11 11	3, 3/9, 3/7, 3/11 11 m3 m4	3, 7, 3/9, 3/11, 3/7 7/11 11 m3 m4	3, 7, 3/7, 3/9, 3/11 7/11 11 m3 m4	3, 7, 3/7, 3/9, 3/11 7/11 11 m3 m4	3, 7, 3/7, 3/9, 3/11 7/11 11 m3 m4
brown rot	----	1[2] 2 (+oil) 3, 3/7, 3/9, 3/11 9	1[2] 2 (+oil) 3, 7, 3/9, 3/11, 9 3/7, 7/11 11	1[2] 2 (+oil) 7, 9, 3/11 7/11	----	----	----	----
green fruit rot	----	----	1[2] 2 (+oil) 3/7, 3/9, 7, 9 3/11, 7/11	----	----	----	----	----
leaf blight	----	----	1[2] 2 3, 3/7, 3/9, 3/11 11	1[2] 2 3, 3/7, 3/9, 3/11 11 m3 m4	3, 3/7, 3/9, 3/11 11 m3 m4	----	----	----
scab[4]	m1+oil, m2[3]	----	----	1[2], 3/7, 3/9, 7, 7/11[2] 3/11, 11[2] m3 m4, m5	1[2], 3/7, 3/9, 7, 7/11[2] 3/11, 11[2] m3 m4, m5	3, 3/7, 3/9, 3/11 7, 7/11[2], 3/11, 11[2] m2[3] m3, m4	m2[3] m4	----
shot hole	m1	2 3, 3/7, 3/9, 3/11, 7, 9, 11	2 3, 3/7, 3/9, 3/11 7, 7/11 9, 11	2 3, 3/7, 3/9, 3/11 7, 7/11 9 11	7, 7/11 11 m3 m4 m5	7, 7/11 11 m3 m4 m5	----	----

Continued on next page . . .

Almond: Suggested Disease Management Programs, continued

Disease	Dormant	Bloom			Spring		Summer	
		Pink bud	Full bloom	Petal fall	2 weeks	5 weeks	May	June
Rust	----	----	----	----	----	3, 7, 3/7, 3/11 7/11 11, 19 M3	3, 7, 3/7, 3/11 7/11 11, 19	3, 7, 3/7, 3/11 7/11 11, 19

[1] Group numbers are assigned by the Fungicide Resistance Action Committee (FRAC) according to different modes of actions (for more information, see http://www.frac.info/). Group numbers are listed in numerical order within the suggested disease management program. Fungicides with a different group number are suitable to alternate in a resistance management program. Refer to the fungicide efficacy table for fungicides belonging to each FRAC group.

[2] Strains of *Monilinia fructicola* and *M. laxa* resistant to Topsin-M, and T-Methyl are present in some California almond orchards. Resistant strains of the jacket rot fungus, *Botrytis cinerea*, and powdery mildew fungi have been reported in California on crops other than almond and stone fruits and may have the potential to develop in almond with overuse of fungicides with similar chemistry.

[3] Use liquid lime sulfur in dormant applications and wettable sulfur at and after pre-bloom.

[4] Apply petal fall treatments based on twig-infection sporulation model.