UNIVERSITY OF CALIFORNIA • COOPERATIVE EXTENSION • GLENN COUNTY
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ORCHARD FACTS

February 16, 2010
Vol. XI, No. 1

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Bill Krueger
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Sacramento Valley Prune Newsletter

Bacterial Canker and Blast in Prunes

Bill Krueger UC Farm Advisor, Glenn County

Bacterial canker is a serious disease of all prunus species. The causal bacteria, *Psuedomonas syringae* is widespread in nature producing disease under predisposing conditions such as high ring nematode populations, poor drainage caused by clay or hardpan soils, sandy or gravelly soils, or inadequate nutrition, particularly, low nitrogen.

Young trees 2 to 8 years old are most often affected. Cankers on branches and twigs are usually elliptical producing substantial gumming. Cutting below the outer bark, cankers reveals reddish brown necrotic streaks or flecks in the phloem beyond the margin of the canker. Cankers may girdle and kill limbs or the entire tree. When this happens, a sour smelling liquid often exudes from the bark of the dying branch or tree. The root system is not affected and suckers usually grow from the roots.

Cankers begin with infection in the fall and winter and develop during dormancy and into early spring. Cankers are not perennial and usually die out in summer.Wet, freezing conditions during bloom and early leafing may result in the blast phase of the disease as flowers and newly opening leaf buds become infected, die, and turn brown. Dying buds and spurs become necrotic, turning dark brown and exuding gum.

Management considerations

Avoid planting prunes on sites which are prone to develop this disease such as sandy or gravelly coarse textured soils, clay or hard pan soils with poor drainage, and sites known to have ring nematodes or with a history of bacterial canker.

Marianna 2624 is the most susceptible rootstock and is slightly more susceptible than Myro 29C. Peach rootstock is more resistant to bacterial canker but is more susceptible to *Phytopthora* crown and root rot and should not be used if this disease is a concern. Peach rooted trees are prone to overcropping and may require management practices such as additional pruning and thinning.

When ring nematode is present, backhoeing and fumigating prior to planting can help get the trees off to a good start and reduce disease incidence. Be sure trees have adequate nitrogen but are not over fertilized. Trees low in nitrogen are more susceptible to bacterial canker.

Pruning in the late spring or early summer rather than in winter or early spring may help reduce the incidence of bacterial canker. Copper sprays during the fall and winter have not reduced bacterial canker under California conditions.

Heat at bloom: How hot is too much?

Franz Niederholzer, UC Farm Advisor, Sutter/Yuba Counties
Rich Buchner, UC Farm Advisor, Tehama Co.
Bill Krueger, UC Farm Advisor, Glenn Co.
Carolyn DeBuse, UC Farm Advisor, Solano/Yolo Co.

Hot weather at bloom ruined the prune crop in all of California in 2004 and in the south Sacramento Valley in 2005, and 2007. Average yield per acre in those years was about 0.5 dry ton per acre in Sutter/Yuba Counties. High temperatures (>80°F) at full bloom appear to be responsible for the damage. With funding from the California Dried Plum Board, we have been working to learn how much heat will severely damage a prune crop at full bloom and whether growers can manage to set a crop when heat strikes at bloom. Here is what we think we know so far about orchard temperatures at bloom and fruit set:

Hourly average orchard temperatures* during full bloom	Expected outcome
<70°F	**Good – Excellent fruit set.**
<80°F	Good fruit set.
<5 hours at or just above 80°F	Poor to decent set and crop.
10+ hours above 80°F	**Probable crop disaster**

*Based on temperature data taken every 3-5 minutes and then averaged every hour.

Other information:

- High temperatures (80°F or higher) before full bloom -- before flowers are fully open -- does not appear to harm the crop.
- Temperature, not relative humidity, appears to be the key factor in fruit set reduction. In 2007, hot weather without wind damaged the Sutter/Yuba crop. Run water to cool the orchard when temperatures climb. Don't run water based on wind alone.

Heat at bloom: What to do?

Franz Niederholzer, UC Farm Advisor, Sutter/Yuba Counties
Rich Buchner, UC Farm Advisor, Tehama Co.
Bill Krueger, UC Farm Advisor, Glenn Co.
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Summary:

1) High temperatures (above 75°F) at bloom slow down or kill prune flower activity.
2) In 2005 and 2007 in Yuba City, 2-3 days of high temperatures during full bloom with a total of 10+ hours over 80°F = crop disaster.
3) In 2009, a couple of hours of temperatures at or just above 80°F did not harm the crop.
4) To try to increase fruit set if temperatures are above 75°F this year, consider:
   a. Cooling the orchard with irrigation water. Soil should be kept moist (not saturated) when high temperatures occur. Run sprinklers during the day when it's hot. Turn them off when temperatures cool in the evening.
   b. Making sure bees are in the orchard to optimize pollination.
   c. Leaving grass long in the block if hot weather is predicted.

What can growers do if temperatures are forecast for >75°F at full bloom?

Cool the orchard with irrigation water. Evaporative cooling may reduce temperatures enough to help set a crop. Impact sprinklers or micro-jet irrigation systems have an advantage over flood irrigation systems for orchard cooling. There are reports of good crops

1) in 2005 after running water, while other growers ran water with no benefit. In 2009, we could measure only very small reduction in orchard temperatures (1-2°F) and increase in relative humidity (10%) where water was run during hot weather. This could be the difference between disaster and a light to moderate crop, but don't expect miracles.

Here are some key points to consider when using irrigation water to try to reduce temperatures in an orchard:

a. The top one foot of soil should be moist (not saturated) when warm weather hits.
b. If you can only irrigate part of the orchard per set, run water long enough to wet the soil and then shift flow to another part of the orchard. "Flash" irrigation water across irrigation checks and move on to others when using flood irrigation. If the soil surface drys and isn't rewet, the potential for evaporative cooling decreases significantly.
c. Concentrate irrigation/cooling efforts on the upwind side of the orchard. Let the wind move the cooled air through the orchard.
d. If I was a grower, I'd start running water (impact sprinklers or microjet sprinklers) when the temperature gets over 70°F. If I only had flood irrigation to work with, I'd try to wet the soil surface in advance of predicted warm (over 70-75°F) weather. If the warm weather stayed and the soil surface dried, I'd irrigate again.
e. The key times to run sprinklers are when temperature in the orchard warms to 70°F and above. Running your sprinklers at night to protect against high temperatures is like running your sprinklers during the day to protect against freezing temperatures at night. The goal of sprinkling to reduce temperatures is to get water to evaporate as it moves from the sprinklers to the ground. More evaporation will occur during the heat of the day than when it's cool.

2) **Get bees in the orchard**. This means renting bees, as native bee populations have weakened due to bee mites and poor food availability. Experience suggests better fruit set in 2005 and 2007 on trees close to hives, and poor fruit set away from the hives. It may be beneficial to spread hives throughout the orchard. In larger almond orchards beehives are distributed at 1/10 to ¼ mile intervals through the orchard for optimum pollination. If the orchard is smaller than 40 acres, hives can be distributed around the perimeter.

3) **Leave grass long** in the orchard if heat at bloom is predicted. Tall, well irrigated vegetation should be 1-2°F cooler compared to short mowed vegetation on the orchard floor. If frost is a threat at bloom, keep the orchard ground cover as short as possible. Delay the orchard floor management decision as long possible so that a better forecast of bloom weather is available and can be included in the final decision.

Prune out *Cytospora* cankers to reduce disease pressure

Joe Connell, UC Farm Advisor, Butte County

As prune trees leaf out and begin to grow this spring it's an excellent time to identify limbs killed or weakened by *Cytospora* cankers. Look for dark, sunken cankers on the bark of limbs showing dieback or sudden wilting. When the bark is peeled back, *cytospora* cankers have distinct zonate margins that are different from the streaking and flecking in the tissue that is characteristic of bacterial cankers.

Pruning out diseased limbs and burning them will reduce disease pressure and the number of spores that can spread to new wood this coming season. Be sure to cut into healthy wood several inches to one foot below any canker symptoms. Check the cut surface of damaged limbs to ensure that all disease has been removed. Incomplete canker removal wastes time and money and won't control the disease.

Cytospora canker is a weak pathogen caused by the fungus *Cytospora leucostoma* that's spread by wind and rain to bark damaged by other stresses. Avoid stress factors this season that predispose prune trees to disease spread such as

potassium deficiency, water stress, sunburn, and subsequent borer attacks. The fungus shows maximum growth in hot temperatures around 90ºF and is particularly active in late summer to early fall.

There are no chemical controls for *Cytospora* cankers. For more detailed information on disease management and for excellent photos of disease symptoms and fungus signs that will help you know what to look for, visit the IPM web page (www.ipm.ucdavis.edu) and click on Agriculture and floriculture; Prune; and *Cytospora* canker (under diseases).

Prunes Need Honey Bees to Pollinate Flowers and Set Fruit

Joe Connell, UC Farm Advisor, Butte County.

French prune flowers have pistils that are elevated above the anthers that bear the pollen. Although self-fertile, they require honeybee pollinators to move the pollen around on the flowers for effective pollination and subsequent fertilization and fruit set. Prune flowers are not wind pollinated. Dr. Robin Thorpe, emeritus entomologist at UC Davis reported on prune pollination studies in the 1970's. In several experiments, exclusion of pollinators by caging French prune trees caused a lower percentage of fruit set, less than 1.3 percent, compared with 3.6 to 21.8 percent for open pollination (uncaged trees), and 15.5 to 19.4 percent fruit set for trees caged with honey bees. These experiments demonstrated how essential honey bee pollination was for setting a prune crop.

Honey Bee Populations. Supplemental pollination with honey bee colonies may be even more important today since the wild bee population has been reduced by *Varroa* mites. Eric Mussen, Extension Apiculturist, UC Davis, indicated that the varroa mite, *Varroa destructor*, was pretty well distributed throughout the country by 1992 and by 1995-96 there were very few feral colonies across the nation. *Varroa* mites continue to be challenges in commercial beekeeping operations and they have significantly increased costs of maintaining colonies. Wild honey bee populations have increased somewhat since the mid-1990s but they may not be able to provide the pollination that prunes require to set a good crop.

Are Honey Bees Present? In some areas there just aren't many bees left. If you relied only on "natural" pollination to set a crop in your prunes are you disappointed? In some neighborhoods, competing blooms (mustard) or lack of bees may reduce prune pollination and result in poor fruit set. Fewer available bees may not be able to visit enough flowers to set a good crop during a short bloom. On the other hand, prunes surrounded by almonds may have lots of bees in the neighborhood and will likely do better in both good and bad pollination years. If you don't have honey bees in the area you may want to plan on having colonies brought into your prunes to be more certain of having a crop.

Foraging behavior. Bees can forage at least 3 miles from their colony but most tend to stay within a few hundred yards of the colony if there are adequate food rewards nearby. Prune blossoms are rewarding and will receive adequate visitation from nearby colonies depending on competition from other plants. Flight activity and foraging are proportionate to colony strength. At low temperatures bees from strong colonies are more likely to fly than are bees from weak colonies. Honey bees fly when temperatures are 55ºF and higher. They do not fly in rain or in wind stronger than 15 mph. Cloudiness reduces flight activity, especially when temperatures are near the 55º threshold for flight. Honey bees often visit plants other than prunes if pollen and nectar rewards are sufficient. Thus, the density of bees and blooms within a mile or two of an orchard can greatly influence the number of bees available for prune pollination.

What's a good colony? For pollination purposes a good colony is one that has an active brood nest with uncapped worker brood at the start of prune bloom. Bees feed pollen to developing larvae so open brood cells indicate the hive has a demand for pollen. When pollen is in demand in the hive, more pollen foragers are sent into the field to collect pollen thus pollinating and setting your prune crop.

How much colony strength is needed? Use strong colonies with 8 or more frames of bees. This is not usually a problem for prune growers because colonies have just come from almonds where their populations have expanded rapidly. Always protect colony strength by being careful with spray applications around bees.

How many colonies per acre? The usual recommendation for prunes is one colony per acre depending somewhat on local conditions. A large number of variables affect local needs including colony strength, the number of colonies in the neighborhood, plant competition within a 3-miles radius, and weather conditions during bloom.

Bloom Brown Rot Management

Richard Buchner and Joe Connell UC Farm Advisors, Tehama / Butte Counties and
Jim Adaskaveg, Professor, UC Riverside

Brown rot blossom/twig blight caused by *Monilinia* species is the most important blossom disease of prune in California. Generally, *M. laxa* is the primary pathogen on blossoms, whereas *M. fructiola* is the main pathogen on fruit. Both species, however, can cause blossom blight and fruit rot under favorable environmental conditions.

Properly timed fungicide treatments effectively protect flowers and developing fruit. Orchards with a history of brown rot should be treated but all orchards are vulnerable in a severe brown rot year. The challenge is trying to anticipate or predict disease pressure. Fungicides are best used as preventative treatments and many provide little benefit when applied after infection occurs. If disease conditions are severe, a two-spray program with a first application at green bud/white bud followed by a full bloom (60-80% open flowers) application may be the best choice. The first spray targets brown rot while the second one targets brown rot, russet scab, and jacket rot. Prune flowers are most susceptible to brown rot infection at full bloom. A single full bloom application may be a good choice particularly under less severe disease pressure. A single-delayed bloom treatment (20-40% open flowers) will effectively manage brown rot and russet scab. If you select this strategy, a fungicide or a fungicide mixture with kick-back (post-infection) activity is preferred. Some orchards might get by with no fungicide applications but this is a risky strategy if you guess wrong on the disease pressure. Location of the orchard (soil-type, water drainage, micro-climate effects of rivers, foot hills, etc.), type of irrigation system (high or low canopy wetness), history of diseases at the orchard site (especially in the previous growing season), amount of expected precipitation (dews and rainfall) and expected temperatures all contribute to estimating the "disease pressure".

New fungicides are very effective for brown rot management. Stone fruit growers are fortunate to have excellent fungicide choices, but don't forget the potential for *Monilinia* to develop resistance to these fungicides. The game plan is to alternate between fungicide groups. For designing fungicide programs, the Tables below list the registered fungicides, indicated their performance against different prune diseases and show critical tree growth stages (phenology) for optimizing timing of fungicide treatments (www.ipm.ucdavis.edu). Be careful when planning and selecting fungicides for managing diseases on prune. Some labels indicate that they are only for "fresh prunes" or "fresh plums" meaning they should not be used for dried prunes or plums.

The following is a review of selected Fungicide Resistance Action Committee (FRAC) groups important for California prune and stone fruit production:

FRAC group 1 is the Benzimidazole class with a single-site mode of action and very high resistance potential (e.g., Topsin-M/T-Methyl). *Monilinia* spp. have developed resistance to this fungicide class soon after its introduction and exclusive use. Furthermore, resistant isolates have remained stable in the pathogen population and are still widespread in California stone fruit production areas.

FRAC group 2 is the Dicarboximide class with a multi-site mode of action and low resistance potential (e.g., Rovral/Iprodione). This class remains important for brown rot blossom blight management, although pre-harvest uses on fruit have been canceled since 2000.

FRAC group 3 is the DMI-Triazole class with a single-site mode of action and high resistance potential (e.g., Orbit/Tilt/Bumper, Indar, Rally). This fungicide class is the current standard material for managing brown rot of stone fruit. Resistance has been reported in *M. fructicola* populations in the southeastern United States.

FRAC group 7 is the succinate dehydrogenase inhibitor (SDHI) class with a single-site mode of action and high resistance potential (e.g., Boscalid - a component of Pristine).

FRAC group 9 is the Anilinopyrimidine class with a single-site mode of action and high resistance potential (e.g., Vangard, Scala). These fungicides are highly effective for brown rot blossom blight

control. They may be inconsistent in their performance in managing fruit brown rot especially in hot, humid environments. In 2007, isolates of *M. fructicola* resistant to FRAC group 9 fungicides were first detected in Butte/Tehama Co. In 2009, isolates of *M. laxa* were also were identified resistant to this group from another orchard in Butte Co. In each orchard, disease control failures were reported. Although these reports are of apparent limited occurrence, this situation could become widespread if resistance management guidelines are not followed (*see below*).

FRAC group 11 is the Strobilurin class with a single-site mode of action and high resistance potential (e.g., Abound, Gem, Pristine – a combination product of Groups 7 + 11). These materials are effective for managing brown rot blossom blight and fruit rot when used as protective treatments. Their late-season use after early-season rainfall conducive to brown rot infections is not an effective strategy.

FRAC group 17 is the Hydroxyanilide class with a single-site action and high resistance potential (e.g., Elevate). This fungicide class is highly effective for brown rot and jacket rot (mostly *Botrytis cinerea*) on blossoms and brown rot of fruit.

In 2010, several new fungicide pre-mixtures that will be registered include Adament, Quadris Top, and Quilt Xcel (combination products of Groups 3 + 11), Inspire Super (a combination product of Groups 3 + 9), and Luna Sensation (a combination of Groups 7 + 11 similar to Pristine). These products have proven to be very effective in the management of brown rot and other prune diseases such as rust (*Tranzschelia discolor*) and green fruit rot or jacket rot (*B. cinerea* and other fungi).

Methods to Manage Fungicide Resistance:

1. Alternate fungicides with different modes of action. For example, if a FRAC Group 2 is used for the first application, choose a different fungicide class for the second application such as FRAC Group 9 or FRAC Group 9 mixed with FRAC Group M4 or M5.

2. Design fungicide programs with the goal in mind to use only one fungicide class per growing season. For example, use FRAC group 9 fungicides once per growing season preferably during bloom and, when possible, in combination with other fungicides such as captan or chlorothalonil (these can be used for russet scab control).

3. Apply fungicides at full label rates. Sub-lethal treatments increase the chance for resistant *Monilinia* spp. to survive.

4. Good tree coverage is essential for good disease control. If poor spray coverage results in a sub-lethal dose, resistant *Monilinia* spp. are favored.

5. If you suspect brown rot resistance or spray material failure, contact your Farm Advisor. Samples can be collected and analyzed for brown rot resistance.

PRUNE (DRIED PLUM)—FUNGICIDE EFFICACY 2010

Fungicide	Resistance risk (FRAC#)[1]	Brown rot		Russet scab	Rust
		Blossom	Fruit[2]		
Adament[2,7]	medium (3/11)	++++	++++	----	+++
Distinguish*	medium (9/11)	++++	++	----	++
Elite/Tebuzol[2,7]	high (3)	++++	++++	----	+++
Indar[2]	high (3)	++++	++++	----	+++
Orbit/Tilt/Bumper[2]	high (3)	++++	++++	----	+++
Luna Sensation*[2]	medium (7/11)[4]	++++	++++	ND	ND
Pristine[2]	medium (7/11)[4]	++++	++++	ND	ND
Quash[2,7]	high (3)	++++	++++	----	+++
Quadris Top*[2]	medium (3/11)[4]	++++	++++	ND	++++
Quilt Xcel*[2]	medium (3/11)[4]	++++	++++	ND	++++
Rovral + oil[2,5]	low (2)	++++	NR	----	NR
Scala[6]	high (9)[3,4]	++++	+++[6]	----	ND
Topsin-M/T-Methyl/Thiophanate-Methyl + oil[2,4]	high (1)[4]	++++	++++	----	----
Vangard[6]	high (9)[3,4]	++++	+++[6]	----	ND
Elevate[2]	high (17)[4]	+++	+++	ND	----
Rovral/Iprodione /Nevado[2]	low (2)	+++	NR	----	NR
Topsin-M/T-Methyl/Thiophanate-Methyl [2,3]	high (1)[4]	+++	+/-	----	----
Abound	high (11)[4]	++	+	----	+++
Botran	medium (14)	++	++	ND	ND
Bravo/Chlorothalonil/Echo/Equus[8,9,10]	low (M5)	++	++	++	----[9]
Captan[8,10]	low (M4)	++	++	+++	----
Gem[7]	high (11)[4]	++	+	----	+++
Rally[2]	high (3)	++	++	----	----
Sulfur[10]	low (M2)	+/-	+/-	----	++

Rating: ++++= excellent and consistent, +++= good and reliable, ++= moderate and variable, += limited and erratic, +/- = minimal and often ineffective, ---- = ineffective, ? = insufficient data or unknown, NR=not registered after bloom, and ND=no data

*** Registration pending.**

[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..

[2] Fruit brown rot treatments for fungicides in FRAC Groups 1,2, 3, 17, 7/11 are improved with the addition of 2% light summer oil. The oil is "light" summer oil (1-2% vol/vol). If applied in summer, fruit will loose their waxy bloom and look red. They will dry to normal color.

[3] Strains of *Monilinia fructicola* and *M. laxa* resistant to Benlate (label withdrawn), Topsin-M, and T-Methyl have been reported in some California prune orchards. No more than two applications of Topsin-M or T-Methyl should be made each year. 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 prune with overuse of fungicides with similar chemistry. Sub-populations of both *Monilinia* spp. have been shown to be resistant to AP (FRAC 9) fungicides on prune in CA.

[4] 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.

[5] Blossom blight only; not registered for use after petal fall.

[6] High summer temperatures and relative humidity reduce efficacy.

[7] Registered for use on fresh prunes only.

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

[9] Do not use after jacket (shuck) split.

[10] Do not use sulfur, captan, or chlorothalonil in combination with or shortly before or after oil treatment.

Agenda

UCCE Sutter/Yuba Prune Day

March 4, 2010

Veterans Memorial Community Building, 1425 Veterans Circle Dr., Yuba City

CE units have been requested.

Co-sponsored by Sutter County Ag Commissioner's Office

8:00 ***Sign-in and refreshments*** *courtesy of Prune Bargaining Association*

8:15 ***Using dormant oil spray for pest control and prune bloom advance***
Franz Niederholzer, UC Farm Advisor, Sutter/Yuba Counties

9:00 ***Topping Prune Trees***
Bill Krueger, UC Farm Advisor, Glenn County

9:30 ***Prune Irrigation Management Review***
Franz Niederholzer, UC Farm Advisor, Sutter/Yuba Counties

10:00 Break

10:15 ***What Ever Happened to the Pear Growers?***
Dave Westerholm, Universal Solvent Inc.

10:30 ***Ag Commissioners Update***
Sutter and Yuba Counties Ag Commissioner Representatives

11:00 ***Disease Management in Prunes: Brown rot and rust***
Dr. Jim Adaskaveg, UC Riverside

11:30 ***International Prune Marketing Situation***
Rich Peterson, California Dried Plum Board

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