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Spring Control of Almond Diseases

Almond trees are susceptible to bloom and foliar diseases when it rains at bloom, and the decision of when to spray and what fungicides to use can be quite difficult. In the San Joaquin Valley we are usually in a low precipitation region and we cannot predict when and how much it is going to rain. We often receive rain during bloom which can result in favorable conditions for several plant pathogenic fungi to cause spring time diseases of almonds. The main diseases in almonds are Brown Rot Blossom Blight, Green Fruit Rot or Jacket Rot, and Shothole. Other less familiar diseases include Scab, Rust, Leaf Blight and Anthracnose. The fungi that cause these diseases are usually always present in almond orchards, sometimes in higher or lower amounts depending on the previous years disease levels and current environmental conditions.

Fungicide Control Programs

Generally, a good disease control program is based upon a wise choice of fungicides and good timing and coverage. Growers should assess the diseases present in their orchards and select materials carefully. Not all fungicides are equally effective on all diseases (fig. 1). It is a good idea to use more than one kind of fungicide for a broader spectrum of activity.

Usually two sprays are made for brown rot control. The first is usually done at 5-20 % bloom using a systemic fungicide such. Some of these fungicides may require a contact fungicide to reduce resistance. Resistance to these fungicides can develop over time and repeated use, thus try to rotate the fungicides you use. The second spray should be done at about 80% to full bloom or two weeks after the first spray. This is the most effective brown rot spray. Depending on the weather, a third

spray may be necessary if rains persist and two weeks of protection have gone by. Since we cannot predict the weather at bloom time, we must at least take some initial action to protect our crop. Application techniques are also important. Usually ground application is better than air; but care must be taken that both are applied correctly. In general, use properly calibrated and directed nozzles and maintain a slow speed.

Almond Frost Protection
Joseph H. Connell, UCCE Farm Advisor, Butte County

Whenever we discuss frost protection we're usually talking about mild, **radiation frosts** that occur on still, clear nights, often with the development of a strong inversion. Under these conditions we can often provide adequate protection by running water, or, with helicopters or wind machines in narrow valleys.

More damage is likely when **advection frosts** move cold air into orchards from accumulation areas outside the orchard. Cold air can drain out of canyons and will fill in low spots where air drainage is blocked. The cold air mass may overwhelm the upwind edge of the orchard for 10 to 15 rows even with solid-set sprinklers running. Advection frosts occur with wind present but if water is adequate and the wind is not too strong the majority of the orchard may still be protected.

Radiation and Advection frosts on the same night. Note the temperature response to the wind speed and direction that shows the effect of mixing vs. cold air drainage.

Soil and Groundcover Condition

Groundcover condition can affect orchard minimums with taller groundcover being a generally colder condition. Soil heat storage is reduced because sunlight is reflected and water is evaporated. Our work confirmed that the taller the cover, the colder the orchard floor, but, once the cover was 4 inches or more n height there was little difference in temperature. We also found that bare, moist soil is the warmest, but this is true only when the surface is moist. If pre-frost conditions are dry and windy and a dry crust forms on the surface, then, bare soil can be colder than a surface with a short (less than 2 inch) groundcover that tends to keep the surface moist with dew from the grasses and weeds.

The ground surface must be moist for bare ground to be warmest. Bare, firm, dry surfaces are likely to be colder. Follow dry windy conditions with a light irrigation to moisten the soil before a frost to obtain the greatest heat storage. Overall, bare ground is best if you can keep the soil surface moist. Be sure to keep groundcovers cut short to 2 inches or less during frost season.

Dry soil has many air spaces, lower heat storage capacity, and low heat conductivity resulting in colder minimums. Moist soil has more heat storage in its water, has higher conductivity, and it will have higher minimum temperatures. Irrigation should ideally wet the top foot over the entire orchard surface, soil moisture should be near field capacity, and these conditions should be achieved in advance to gain the most advantage.

Sprinklers and Micro-sprinklers

Under tree sprinklers work to provide protection because the heat contained in the water is added to the orchard system. As water cools, and then freezes, it releases a great deal of latent heat. This sensible heat is **radiated or convected** into the trees, thus providing protection. Sprinklers can be safely turned off when the wet bulb temperature upwind of the protected orchard is above the critical crop damage temperature or when all the ice melts.

In some orchards, frost protection is limited by the amount of water or pipe available. For those using **movable aluminum pipe**, we compared protection with sprinkler lines in every middle, every other middle or every fourth middle. Air temperature in all sprinkler areas was 1 to 2°F warmer than the unsprinkled control and there were no differences between these spacings. Soil surface temperatures were colder the further from the sprinklers with the dry centers between the lines in every fourth middle as cold as the unsprinkled control. Line spacing directly affects soil surface temperature but air movement evens out the benefits. Without air movement, protection may fail between the widely spaced lines. If these limitations apply in your orchard, concentrate your available resources (pipes and water) adjacent to the most frost susceptible variety rows.

We have also studied frost protection with **micro-sprinklers** applying 15, 25, and 40 gallons per minute per acre. The low application rate gave less protection than the higher rate. There was little difference in observed air temperatures in our experiments. However, the exposed temperatures

were 1 to 2°F warmer at the higher water rates. Exposed temperature is what the buds themselves experience. The fact that our low water application gave a lower exposed temperature indicates that protection with under tree micro-sprinklers is coming mostly from radiation rather than convection. We found a greater separation in exposed temperatures between the low and medium/high rates on the colder nights. Thus, micro-sprinkler application rate had little effect on air temperature but did affect temperature of exposed buds and flowers. Higher soil surface temperatures from higher application rates led to more radiation heating. This may be even more important if there is wind since convection is less effective then, but radiation would be unaffected under windy conditions.

Variety Frost Sensitivity

Critical temperatures for damage help us know when to turn-on and turn-off protection systems and can help us evaluate varieties when planting new orchards. Harry Hansen, US Weather Bureau, Chico, circa 1950's produced a chart showing that pink buds are more resistant to cold than is the full bloom stage, which is more resistant than small nuts (see Frost Protection, Chapter 23, page 157 in the 1996 Almond Production Manual, publications #3364).

Our work with artificial freezing in 1990 indicated that the early varieties Peerless, NePlus, and Sonora is hardier. This was especially so at pink bud when Peerless is still very sensitive while NePlus is intermediate. Of the mid-blooming varieties Nonpareil, Carmel, and Price, Carmel is the most sensitive, with Price intermediate and Nonpareil the most tolerant. Among the late blooming varieties Mission, Padre, and Butte, the Mission is most sensitive while Padre and Butte are similar with Butte possibly being slightly more sensitive than Padre. This summarizes our current knowledge of variety hardiness.

This brief review of variety hardiness, groundcover effects on orchard floor temperatures, and what we can and cannot accomplish with under tree sprinklers is covered more completely in the production manual reference above.

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SAVE THE BEES

UC Davis Extension Apiculturist Eric Mussen warns almond growers that certain fungicides should be used carefully when honey bees are pollinating their trees. At a recent meeting of the California Farm Bureau Federation Bee Advisory Committee, Eric explained that fungicides are not toxic to adult honey bees pollinating almond trees. But that two fungicides, Captan (captan) and Rovral (iprodione), can poison brood or immature bees when fungicide contaminated pollen is mixed into their diet. Adult bees flying through a spray can carry contaminated pollen back to their hive where the fungicide residues are combed off their bodies during the "pollen packing" procedure by bees. Eric suggests that growers should try to plan fungicide sprays in the afternoon when fewer bees are flying and there is less pollen left in the trees for the bees to collect. Both almond growers and bee keepers want those bee hives to be as strong as possible, so please consider bee activity when planning your fungicide application timing.

UPCOMING EVENTS

Advances in Codling Moth Management for Apples, Pears, and Walnuts (see flyer enclosed)

Understanding Agricultural Leases, March 29, 2003, 1-800-752-0881 or agrinfo@unexmail.ucdavis.edu

Cherry Production Short Course, March 25-27, 2003, 1-800-752-0881 or agrinfo@unexmail.ucdavis.edu

Practical Pruning: A Workshop for Arborists, March 25, 2003, 1-800-752-0881 or agrinfo@unexmail.ucdavis.edu

Central California Apple Symposium, March 6, 2003, Stockton Inn, Highway 99 and Waterloo Rd, Stockton, RSVP Mid Valley Apple Association, 6001 Maze Blvd, Modesto, CA 905358, price $10

 For special assistance regarding our programs, please contact us.