

DORMANCY, CHILL ACCUMULATION, REST-BREAKING AND FREEZE DAMAGE – what are the risks?

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Once the chill requirement has been met, continued cold temperatures maintain the buds in a resting state, but the buds are 'ready' to begin growing because internal metabolic inhibitors are no longer present to withhold growth. Those inhibitors have decreased over time as the chill requirement has been satisfied. Bud growth will resume once temperatures become favorable and as the buds become less dormant, more metabolically active, cold-hardiness diminishes. Hardiness is lost very rapidly once buds begin growth. At full bloom, no cold-hardiness exists and killing temperatures do not have to be as low as when some or all cold-hardiness was present.

Often there can be a warming period in January or early February that tends to increase flower bud respiration, reduce the depth of the dormant state, reducing winter hardiness. Thus, even without swollen buds or open flowers, temperatures can be low enough to reach the 'critical temperature' that will kill buds, and temperatures don't have to be as cold or cold for as long as when buds are fully dormant for freeze damage to occur. Critical temperatures for the various tree fruits have been established in other areas, such as Michigan and Washington, however, California's growing conditions are different enough that we can't depend on the critical temperatures established elsewhere, and we do not have equivalents for California that are exact or published.

Damage to the Tree Canopy

The tree's canopy (not just buds, flowers and fruits) may also be damaged by freezes, particularly during the transition into dormancy or out of dormancy when tissues are more active and less cold-hardy. Freeze damage to the vegetative parts of the tree can result in dead twigs, shoots, spurs and predispose the living tissues to diseases such as bacterial canker and fungal diseases. When this occurs the current year's crop may not be the only loss, but productivity for the tree, or some trees in the orchard, may be reduced for some time. Different trees may be affected within the orchard, or only parts of the trees due to micro-climactic differences within the orchard or within the tree, or the kind of freeze that occurs. Sometimes a single variety may be more susceptible, or different rootstocks may predispose the scion (the cropping portion of the tree) to greater or lesser cold-hardiness, hence, susceptibility. There are no hard-and-fast rules as there are too many variables and each occurrence must be evaluated case-by-case.

How does application of rest-breaking agents (RBAs; CAN17, Dormex or dormant oil) affect the risk for frost damage? What about dormant oil at pest control rates?

Even in a 'good' chill year, application of rest-breaking materials can advance bud development, so that buds become less dormant, metabolically active and may break early once warm temperatures allow budbreak. If RBAs are applied and there is a warm period either before or after the application, followed by freeze events, the buds are much more susceptible to freeze damage. This is a risk even with application of label rates of dormant oil for those species that respond to it as an RBA (like pear and prune).

So what choices are there for growers?

- Determine if you really need to apply RBAs. If the amount of chilling received appears to be 'normal' to 'good' by early January, compared to historic data, then it might be a good idea to leave well enough alone and don't apply RBAs.
- If you do apply RBAs, consider a lower concentration than you would use in a 'low' chill year. If chilling is good, you may not need as much product or any RBA at all, and reducing the risk of either phytotoxicity or freeze damage is more important than that extra 'boost'.
- In 2006, 'Bartlett' pear trial in the Sacramento Delta (see Figure 1); freeze damage in the form of crop loss was assessed. 4% Dormant Oil Plus (emulsifiable, UAP) applied from December 23 (30 chill portions) to January 25 (54 chill portions) did not increase inflorescence bud death, but Dormant oil tended to reduce crop load with the greatest reduction in the earliest (23 Dec, 30 CP) treatment, which also reduced the proportion of #1 fruit significantly, as well as estimated total yield. All treatments occurred before the big warming trend that preceded the freeze.
- In 2006, cherry treated just before the freeze with CAN17, Dormex or Dormant oil (during the warm period) was not adversely affected by the freeze. Buds probably did not have enough time to advance development before the freeze, so they didn't experience damage.
- In 2008-2009 application to 'Bing' cherry with CAN17 (16.7%) + RNA Activator 85 (0.5%), 150 gallons per acre, applied at 50-53 chill portions (Jan 20) pushed bloom by 2 weeks and those trees that were advanced in bloom lost 25-40% of the crop due to the freeze that followed a warm period.
- How about this year? Many sites are ahead of accumulation for the previous year – by 3 to 5 chill portions most places, a little less or more depending on where you are. This looks to be a high chill year with current cold conditions persisting for awhile. Warming periods are not unusual in January and February, and the current El Niño (warm Pacific currents) is expected to persist at least through March. Typical lows in the Stockton area for January are ~37°F. Frosts can occur at any time in January and early-mid February. With good chill accumulation, RBAs provide less necessary benefit than in low chill years and may increase risk for subsequent frost damage.
- Risk for phytotoxicity for any RBA is increased when tissues are more metabolically active. If warming has occurred, phytotoxicity risk is increased. This means that any treatment you would not want to apply with green tissue showing may also be more phytotoxic.

Figure 1. Sacramento Delta: Temperature pattern during 2005-2006 dormant period (daily minimum and maximum air temperatures). Arrows indicate dates of application for 4% Dormant Oil Plus (emulsifiable) to 'Bartlett' pear, timed to 30, 34, 50 and 54 chill portion accumulations.

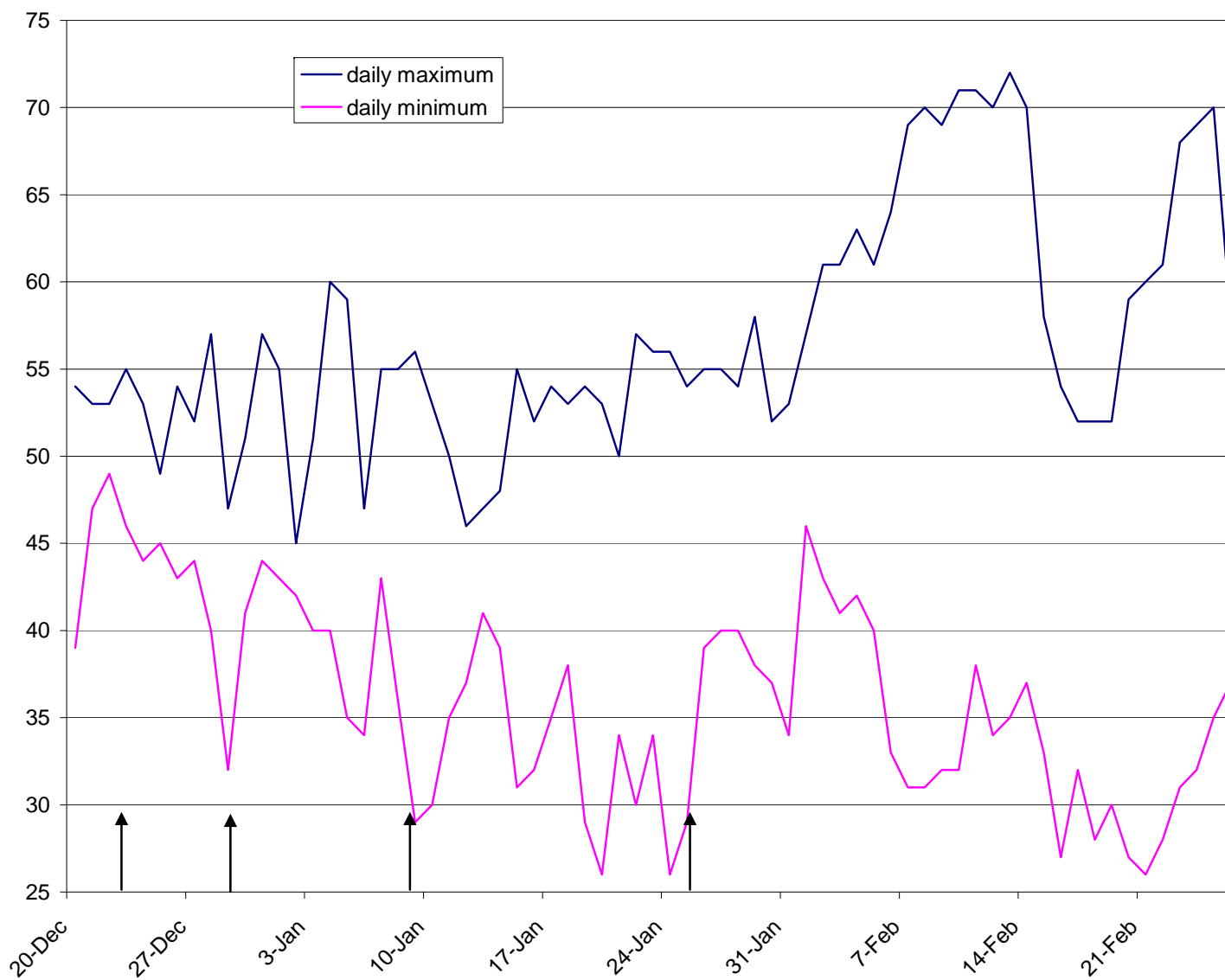


Figure 2. Santa Clara County -- Temperature pattern during 2005-2006 dormant period (daily minimum and maximum air temperatures). Arrows indicate dates of application for 4% Dormex, 25% CAN17 + 1.5% RNA or 3% Dormant Oil Plus (emulsifiable) to 'Bing' cherry, timed to 46 or 50 chill portion accumulation.

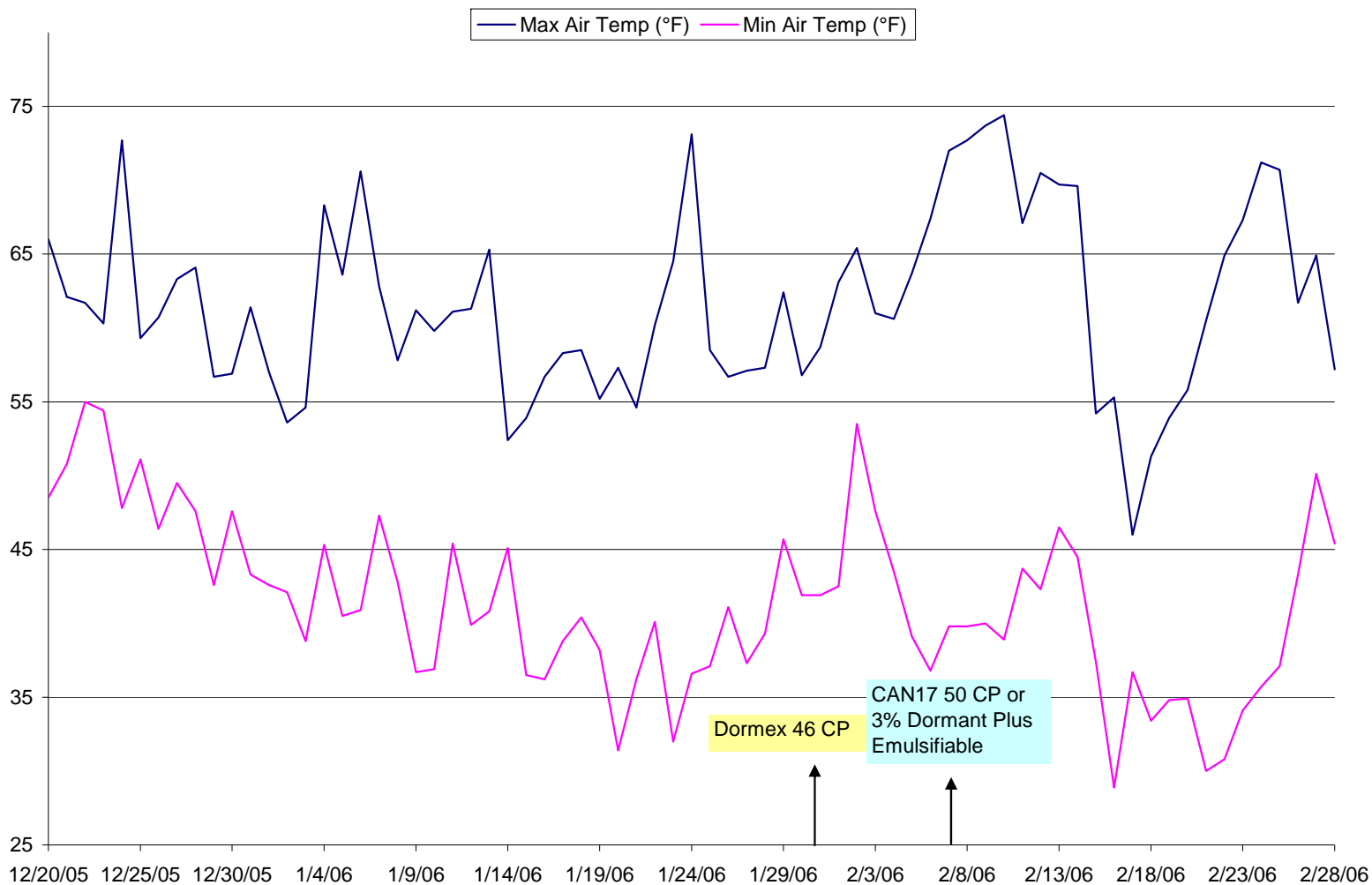


Figure 3. San Joaquin County -- Temperature pattern during 2005-2006 dormant period (daily minimum and maximum air temperatures). Arrow indicates date of application for 16.7% CAN17 + 0.5% RNA to 'Bing' cherry, timed to 50 chill portion accumulation.

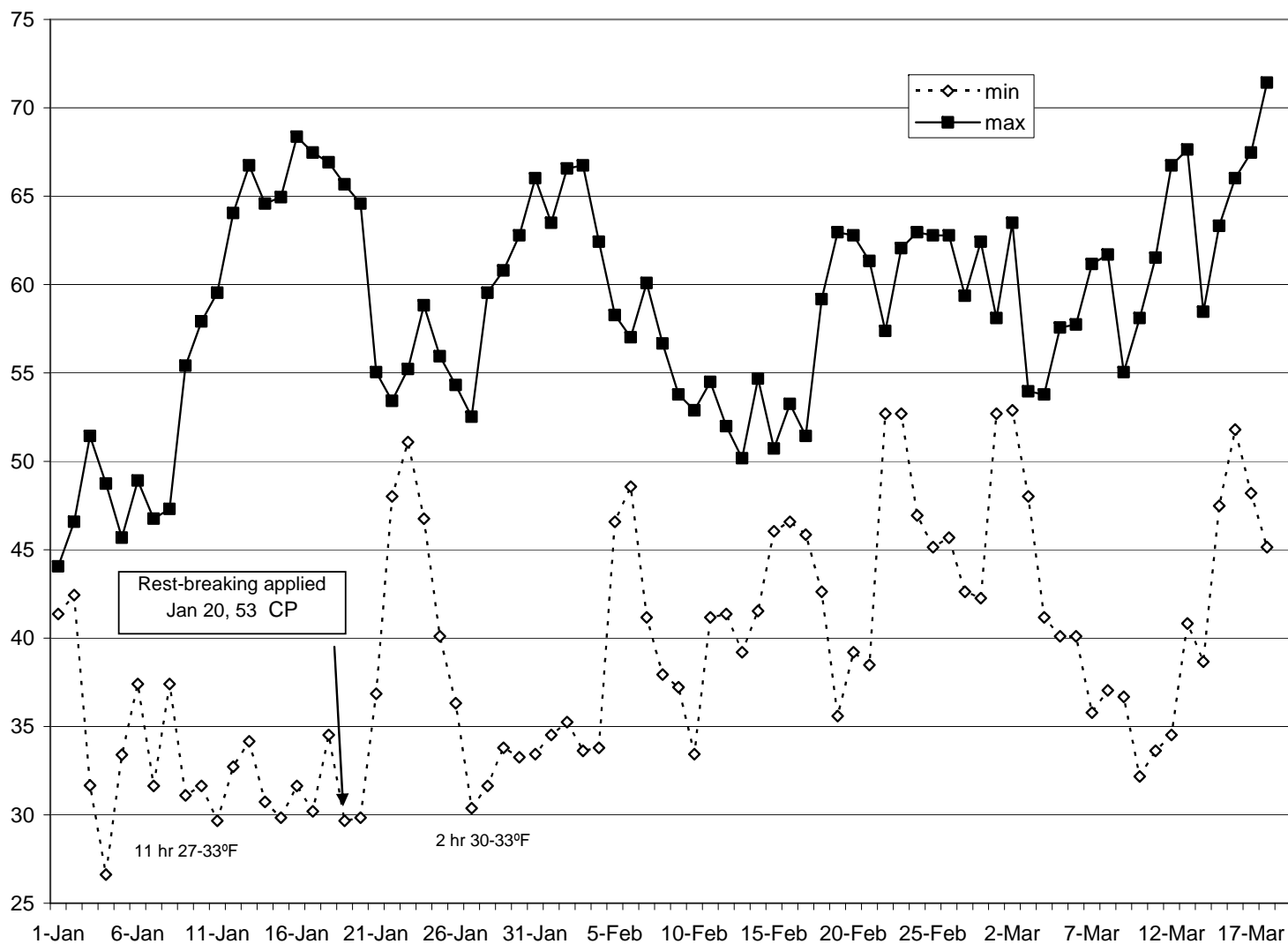


Figure 4. Current Minimum, Maximum temperatures for Stockton. Chill accumulation right now is ahead of 2009

