Cold Hardiness Considerations in Vermont Orchards

Growing Tree Fruit in Cold Temperate Regions

In cold temperate regions such as Vermont, considerations for tree response to low temperature events are important. Apple trees begin to enter dormancy after harvest in the fall, with early cool temperatures and reduced day length prompting trees to begin leaf drop. At this time woody tissues begin to export cellular fluids into intracellular spaces. This allows cells to undergo freezing conditions with both more physical 'space' available for expansion and also increases soluble solids in the cell liquids, thereby decreasing their freezing point. This state of para-dormancy due to physiological changes in the tree can only be broken after a certain number of chilling hours below 40° have been reached. Because Vermont accumulates plenty of this cold conditioning weather, low-chill varieties are not required here, as they may be in more temperate growing areas. Accumulation of cold temperature units may be of more relevance during late winter freezes after the tree is conditioned to break dormancy.

Apricots, for example, are quite cold-hardy in terms of absolute minimum temperature they can withstand during dormancy, but require only 250-900 chilling hours as opposed to 200-2000 for apple. After reaching those hours much earlier than apples, apricots tend to bud out very early in the spring, and are often damaged by cold events. After reaching the required chilling hours the tree is relying on eco-dormancy, or generally cool weather, to prevent it from budding out. Late spring freezes which follow extended warm weather can therefore damage apple trees that have initiated growth, just as with apricots. For each bud stage development from green tip to bloom the tree becomes less tolerant of cold temperatures. Critical temperature values for damaging apple and other fruit trees are available from Michigan State University's Extension website.

Plant Hardiness

The best protection against cold and frost damage in fruit plantings includes planting hardy species and varieties on frost-protected sites with well-drained soils, and keeping the trees in an optimal nutritional state. Peaches, for example, are not considered hardy in most of Vermont, but select sites with good air drainage and proximity to water or other warming factors may allow for their cultivation. Generally peach fruit buds are considered hardy to -15° F. Some sites may have crops in some years, but often fruit buds are killed in cold winters, and entire trees are killed in some years. Recently the winters of 1993-1994 and 2003-2004 were cold enough to kill many of the trees planted in the state. Orchards placed on elevated sites or very close to large bodies of water such as Lake Champlain will have higher absolute minimum temperatures than sites that are located on lower ground. It is important to note that absolute elevation is not as important here as relative elevation, where the site is raised up above the local topography to allow for cold air to drain away from it. Likewise, orchards with poor soil drainage tend to produce many tree problems, including greater susceptibility to winter injury. Trees weakened by low oxygen conditions in the root zone or poor nutritional status are less able to withstand cold events during winter and spring.

Apple Orchard at UVM HREC Farm (UVM)

Pruning

Trees that have undergone recent pruning may be more susceptible to midwinter deep freeze damage (Pruning in Response to Deep Midwinter Cold). Pruning before complete tree acclimation, generally before January 1 in Vermont, should be avoided. Prioritizing blocks according to cold tenderness and pruning in order of increasing levels is a good strategy. Under this strategy, standard or semidwarf apples would be pruned first, followed by dwarf or other intensive apple plantings. This can be followed by any pear or stone fruit pruning that needs to be done in early spring.

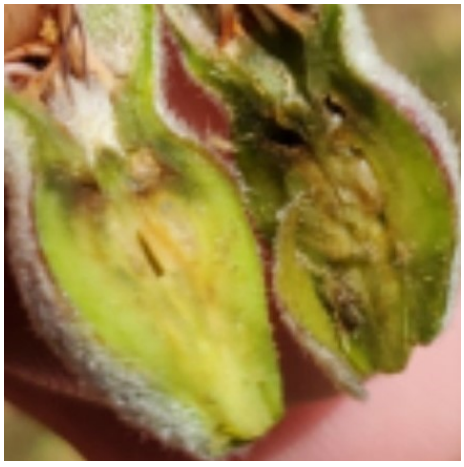
Late Spring Frosts

After the trees have begun to bud out and continuing into the bloom period, late spring frosts can be very damaging to fruiting tissues. Fruit buds are generally hardy in light frost conditions (28-32° F), but temperatures below 28 begin to cause economic damage to the potential crop for the season. Growers may initiate several control measures to protect trees from frost damage, including mixing the air layers with wind machines or helicopters during inversion events where the temperature higher up is warmer than near the ground. Other means to increase bud temperatures include the use of heating devices and overhead irrigation, where warmer water increases the bud temperature somewhat but the heat released by that water changing to a frozen state keeps the buds just above critical temperatures. Any of these measures must be well-designed for the planting size and architecture and the weather event that is likely to be protected against.

Frost Damage Protocol

Orchards which have seen frost damage to fruit buds can be managed to best maintain the remaining crop to harvest. An assessment of bud damage as soon as possible after a frost event is important. Blocks that still have 50% of healthy fruit buds still may be thinned chemically that season, depending on pollination and fruit set conditions. A lower proportion of healthy buds may require no thinning for the season. Trees that have lost their entire crop will have excessive vegetative growth for the season that must be controlled by restricting fertilizer applications, summer pruning, and possibly application of growth-controlling hormone sprays. The tendency to 'walk away' from a lost crop must also be avoided, as the trees will still need a minimum of pest protection to ensure that apple scab, phytophagous mites, and other pests do not increase their populations so as to weaken the trees or contribute to pest problems in future years.

Healthy Apple Fruitlet (UVM Fruit Blog)



Damaged Apple Fruitlet (UVM Fruit Blog)

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