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Effects of Cultural Practices on Cold Protection[1]

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The relation of cultural practices to freeze damage will refer to radiation freezes unless otherwise stated. Advective freezes, such as those that occurred in the 1980's, behave differently. Most of the principles in the following apply for all freezes but are less effective during windy freezes because of the rapid air movement and transport of cold air during these events.

SOIL MANAGEMENT

The texture and color of soils affect their ability to absorb, store and radiate heat; however, such characteristics cannot be manipulated in an established grove so they are not considered here. On the other hand, modifying the grove floor and adding soil moisture offers a major means of passive cold protection. Much more heat can be stored and conducted better in moist than in dry soil. Also, compact soil with a firm surface is a better conductor of heat than loose soil which has been recently cultivated. Weeds, sod and litter are effective heat insulators. They reduce both the heat absorbed during the day and that emitted at night. Weeds, particularly high weeds in middles, impede the flow of cold air down slopes and are deleterious. Therefore, soil should be managed so it is as free from weeds and litter as possible, moist and compact. Data as to the degree of effectiveness of the above is sparse but observations confirm the importance of these conditions. Temperature differences between sod and other weed control systems were smallest when it was closely mowed and greater when height of weeds was increased. Recently cultivated soils resulted in lower temperatures than that tilled early enough to let the soil compact. Most Florida growers herbicide the tree row but not the spaces between trees, which is either mowed or cultivated. Also, many growers have low volume irrigation that wets only part of the soil surface. Herbiciding the entire grove floor and using a system that wets as much of the soil area as possible should enhance protection from a radiation freeze and may even provide assistance in the case of advective freezes. Weeds in the grove during the winter may also be a serious fire hazard, especially after they are desiccated from drought or frost.

IMPEDING AIR DRAINAGE

Good air drainage is recognized as one of the major factors determining the warmth of a site during radiation freezes. This is particularly true for Florida's Ridge area which has many hills, often with lakes at the bottom. Weeds also have harmful effects (see "Soil Management"). Also, dams of brush or trees at the foot of a slope can greatly change the temperature of at least a portion of a slope by blocking the flow of cold air to lower-lying land. Brush and tree dams are most likely to occur at edges of swampy areas and lakes. Growers at times drag pruning refuse to the bottom of the slope and thereby create a temporary dam. Removing the brush and

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trees or the pruning refuse entirely or even cutting a number of swaths through them will help alleviate the problem.

TREE SPACING AND ROW ORIENTATION

Plantings with wide spaces between trees are colder than those spaced more closely because there is more tree mass per acre, more canopy to intercept radiant heat from the soil, and because there is more transfer of radiant heat between closely spaced trees. Trees planted in a rectangle on a slope should have rows run up and down the slope. The rows should be kept pruned by hedging for maximum air drainage. This may conflict with the benefits of running rows north and south to provide maximum light on tree sides. The cold hazard usually outweighs any benefits of added light. Hedgerowing across the slope serves as a dam that impedes air drainage just as brush, trees, and high weeds do. If trees are planted so close in a row that hedging is mandated, then occasional lines of trees running down the slope should be removed to provide for air drainage. Some growers feel "lifting the tree skirts" (removing the lower branches) will permit the cold air to flow under the trees, and it will. This reduces the beneficial microclimate effect of the canopy. However, "lifting the skirts" benefits spray application and other cultural practices. Therefore, the grower will have to choose which cultural practice has priority.

Interestingly, plantings at very high densities are more effective at blocking the wind in the event of an advective freeze. With windy freezes, minimization of wind movement may be beneficial.

PRUNING

Although a hedged and topped grove is probably slightly colder than a completely canopied one, growers have no choice but to hedge tree sides and top in order to facilitate harvesting and pest control and to maintain maximum yield. Severely topping trees just prior to or during the freeze season is a major mistake because it destroys the canopy and its attendant advantages. Hedging during this period is likely to reduce the effectiveness of the canopy but not nearly as much as topping. On the other hand, hedging and topping well before the freeze season can stimulate the growth of a thicker canopy and be advantageous. There are no research data to confirm the above views, only observations and logic based on the principles of physics.

PEST AND DISEASE CONTROL

The objective of pest and disease control in protecting against freeze damage is to maintain a dense canopy and avoid debilitation of the tree. Virus-damaged trees are reportedly more susceptible to freeze damage. The primary pests and diseases that cause leaf drop and thereby tend to reduce the warmth of the microclimate under the canopy are greasy spot and mites. Severe leaf drop could also debilitate the tree. The level to which varying degrees of leaf loss reduce the canopy effect and debilitates the tree has not been documented. It is quite possible that slight or moderate leaf loss has little or no effect; however, growers with chronically cold areas would be well advised to maintain a dense canopy.

MINERAL NUTRITION

The bulk of evidence indicates freeze damage is not influenced by any mineral element as such. Maximum cold hardiness comes from maintaining a dense canopy of leaves that are not deficient in any mineral element. Deficiencies of magnesium (Mg) caused severe leaf loss several decades ago and gave rise to the suggestion that magnesium was directly related to cold hardiness; however, its influence on hardiness appears to be through its effect on leaf drop and not to a given level of Mg in leaves. Likewise, it is well documented that high levels of potassium also do not increase hardiness. Late applications of nitrogen that cause excessive growth and delay the development of winter dormancy reduces cold hardiness and should be avoided.

IRRIGATION

Reducing irrigation in the fall and early winter was shown to induce dormancy and increase cold hardiness. However, water deficiency severe enough to weaken the tree and cause leaf drop reduces cold hardiness. It appears logical to withhold enough water in fall and early winter to induce early dormancy, or at least not delay it, but water stress should not be developed to a point where a rain would force new growth and destroy dormancy. Later in the winter when dormancy and hardiness are controlled by the temperature, irrigation should be used to provide a maximum reservoir of heat and optimum conduction of heat into the soil during the day and out at night.

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MANAGING FREEZE-DAMAGED PLANTINGS

Where the extent of damage is sufficiently limited that an effective canopy develops by the following winter, emphasis should be placed on repairing the canopy through optimum water, fertilizer and pest and disease control during the summer, enhancing development of dormancy through withholding late applications of fertilizer and by restricting water use as much as is feasible in the fall. Weed-control, maintenance of adequate soil moisture and avoidance of dams of brush or pruning refuse at the foot of slopes should be emphasized during the winter. Killing back to framework branches creates different demands and options. Lack of canopy reduces tree mass and the canopy's role as a cover or shield is destroyed. Some growers leave long framework branches when pruning freeze-damaged trees. It would have been better to cut back more severely to force out a protective canopy sooner; however, no pruning practices will develop an adequate canopy by the winter following the freeze. Large limbs with sparse foliage absorb much heat during the day and the bark is probably more active and susceptible to cold damage than shaded ones. Little attention has been given to this situation for citrus. Spraying whitewash or white paint on citrus trees has been used to prevent sun damage to bare citrus branches in the spring and summer but not induce or maintain dormancy and cold hardiness in the fall and winter following a freeze. In Florida, where sun damage is not likely, whitewashing delays new growth and canopy development as much as two weeks when applied in the spring. Applying whitewash sprays to bare limbs in fall and winter should enhance dormancy. White latex paint applied to the trunks of peach trees during the winter have both lowered trunk temperatures greatly and reduced severe freeze damage to them. Modification of cultural practices to maximize tree warmth and cold hardiness may run contrary to other management objectives at times. For example, small or even modest-sized trees might be subject to blowing sand if soil is completely bare from tree to tree, making it necessary to leave strips of mowed cover periodically. Such factors must be taken into account and a compromise reached.