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Texas Agricultural Extension Service

Texas Citrus Cold Protection

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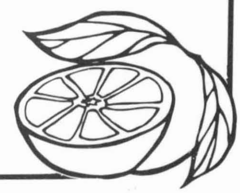

The major risk to the Texas citrus industry is the occurrence of freezes severe enough to damage fruit and trees. The Lower Rio Grande Valley experienced major freezes in 1949, 1951, 1962 and 1983, plus moderate freezes in 1973, 1979 and 1985.

The extent of freeze injury is influenced by several factors: minimum temperature; duration of minimum temperature; time of freeze occurrence; tree size (age); dormancy; variety of scion and rootstock; and general condition. For example, 3 to 4 hours at or just below a threshold temperature may be more damaging than a brief drop to a few degrees below threshold. Moreover, a freeze in December almost invariably causes more damage than the same freeze would cause in late January. This is because of acquired hardiness of citrus, i.e., citrus trees can acquire cold hardiness by exposure to cool temperatures, so trees in January usually are hardier than in December. In addition, crop losses in January are less because fewer fruit remain on the trees as the season progresses.

The larger the tree, the less likely it is to be killed and the more rapidly it can recover. For example, the 1983 freeze killed almost all wood less than 4 inches in diameter. Large trees with 4-inch sub-scaffolds recovered more rapidly than younger trees which had to be cut back to the trunk.

Although there are no documented differences in cold hardiness among varieties of a particular kind of citrus, there are differences between kinds. For example, navel oranges are considered to be slightly more cold hardy than other sweet oranges. Oranges are more cold hardy than grapefruit and grapefruit are more cold hardy than lemons and limes. Swingle citrumelo rootstock provides more cold hardiness than sour orange, which in turn is more cold hardy than Carrizo or Troyer citrange.

Differences in the extent of freeze damage normally occur as a consequence of variable topography drainage. However, general tree condition can make a major difference in the extent of damage and recovery. Orchards that are healthy as a result of having received good nutrition, irrigation, pest control and weed control throughout the season can better withstand cold damage than orchards receiving less than optimal care.

Orchard Freeze Protection

Once the orchard is planted, all factors of site, topography, rootstock and scion variety, tree spacing and density and other permanent considerations affecting cold resistance have been established. Moreover, as winter approaches, the ability of an orchard to withstand cold has been established by the cultural practices followed during the season. Consequently, there are few viable options left to provide adequate freeze protection.

Soil Banks—Tree Wraps

Trees younger than 3 to 4 years old can be partially protected by soil banks or tree wraps. Soil banks and wraps are used to protect young tree trunks. This provides a basis for growing a new top following removal of the existing freeze-killed top. Soil banks are most effective, but are difficult to install and remove after 2 to 3 years because of the tree canopy. Soil banks should be in place from the first of December through the end of February.

Permanent wraps should be installed after planting and normally are removed when the trees are about 4 years old. A wide variety of wrap materials is available, including polyurethane, fiberglass, polyethylene and other synthetics. Most

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offer only a few degrees of protection. Improved wraps which incorporate a reservoir of heat-retaining liquid provide freeze protection comparable to that achieved with soil banks.

Irrigation

Irrigation can provide one to five degrees of cold protection during a radiation freeze (clear skies, light wind), but this protection would be negated by evaporative cooling during an advective freeze (windy and cloudy). During freezes, water is warmer than air temperature and can release radiant heat to the trees. Additional heat is released when water freezes, thereby providing added cold protection. However, evaporation of water during an advective freeze requires heat; thus, resulting in colder temperature.

Flood irrigation must be applied quickly and must be sustained throughout the freeze to provide protection. Problems of inadequate water availability, extended application time, saturated root zone and potential loss of acquired hardiness limit the practicality of flood irrigation for cold protection in most orchards. Moreover, concrete pipelines may break during irrigation under freeze conditions and water may not be available from irrigation districts during freezes.

Microsprayer/microsprinkler application at a minimum rate of 20 gallons per acre per minute can provide a few degrees of cold protection. Slightly greater protection is provided at higher rates of 30 or 40 gallons per acre per minute. However, application must begin before air temperature reaches freezing and must be continued until air temperature rises above freezing. Such irrigation is particularly useful in combination with tree wraps on young trees.

Wind Machines and Heaters

Wind machines can be effective during radiation freezes that have a strong temperature inversion, but such inversions may not occur. Consequently, economics do not favor wind machines as an effective cold protection alternative in citrus orchards in Texas.

Heat provided by orchard heaters and fuel blocks can be quite effective in cold protection under most circumstances. However, increased costs of heaters, labor and fuel have made such supplemental heating uneconomical.

Preventing Ice Formation

Freeze damage occurs when ice crystals form inside plant tissues and break membranes and cell walls, thus, causing death of cells and plant tissues. Water can supercool, i.e., remain liquid at temperatures below freezing, in the absence of ice nucleating agents.

Ice nucleation active (INA) bacteria have been identified in citrus. It has been reported that the control or elimination of certain ice nucleating bacteria can result in some control of ice formation within citrus tissues, thereby reducing freeze damage. However, research into this approach to cold protection is relatively recent and has not provided adequate information on which to base recommendations.

Nursery Freeze Protection

Because cold damage in orchards cannot be prevented and most cold protection measures are not economically feasible, citrus nurseries must be protected by whatever means are available to quickly provide the trees required by the industry following a major freeze. Container nurseries generally are enclosed during winter and should have supplemental heat available. Field nurseries can be protected by banking, flooding, overhead sprinkler irrigation, polyethylene row covers, orchard heaters, helicopters to mix warmer air in inversion layers or a combination of these methods.

Nurserymen should not ignore their sources of budwood and rootstock seed. Specific trees for budwood and rootstock production should be maintained and protected by nurseries to avoid an interruption in nursery operations and the supply of new trees. It is inexpensive insurance to collect and store adequate quantities of seed and budwood prior to a potential freeze.

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