Partial citrus tree defoliation due to freezing temperatures.

Cold acclimation and freeze protection for Florida citrus

By Chris Oswalt and Davie Kadyampakeni

In preparation for winter in Florida, citrus growers must first understand some essential concepts related to protecting citrus from freezing temperatures. Specifically, growers need to know when and how to protect citrus trees from freeze damage.

WHEN TO PROTECT

When (i.e., at what critical temperature) will damage begin to occur? This temperature is dependent on the specific structural part of the tree requiring protection, the critical temperature and the duration at this critical temperature.

Structural components of a citrus tree include mature foliage or leaves, fruit, twigs, limbs, tree trunks, flowers and newly formed vegetative flush. The susceptibility or tolerance to freezing temperatures is related to the mass and maturity of the individual components. Flowers and newly formed vegetative flush are considered most susceptible to freezing temperatures, followed by fruit. Damage will begin to occur in round oranges after four hours at 28° F. The next most susceptible plant parts are mature foliage (leaves), twigs, stems and limbs. Eventually, if it is cold enough for a significant duration, trunk and/or tree death can occur.

Usually growers are most concerned with defoliation and twig and stem damage. Although fruit damage is the most immediate concern, with today's cold-protection methods, only a minimal number of these methods would be adequate for citrus fruit protection.

The critical temperature at which freeze damage occurs in Florida citrus varies throughout the season and is highly dependent on the air temperatures before a freeze and the tree's ability to acclimate to freezing temperatures. This acclimation process involves air temperatures before the freeze. It is also affected by tree vigor at the time of the freeze, rootstock/scion combination, current crop load, tree water status, tree nutritional status and other cultural practices that stimulate tree growth.

During the acclimation process, changes within the citrus plant itself tend to reduce what we call the amount of free water at the cellular level within the tree. This reduction in free water with a subsequent increase in cellular solutes (sugars) results in a depression of the temperature at which freeze damage will occur. The easiest current way to measure these changes in citrus acclimation during the winter is by determining the temperature at which the leaves in a citrus tree will freeze.

University of Florida Institute of Food and Agricultural Sciences (UF/IFAS) Extension makes weekly determinations during the winter in the laboratory from leaf samples collected in the field. Each winter this data is posted on the Florida Automated Weather Network (fawn.ifas.ufl.edu/tools/coldp/crit_temp_select_guide_citrus.php) website. This information can help determine if and when cold protection methods will be needed to protect citrus trees from freezing temperatures.

Another piece of the cold-protection puzzle is duration. Simply put, trees can survive with little or no damage at or below a given freezing temperature provided that the amount of time at that temperature is of short duration. An example is the susceptibility of new citrus flush 2 to 4 inches in length at one temperature with three different durations. At a minimum temperature of 28° F for 30 minutes, less than 5 percent of the new flush is killed. At 28° F for two hours, 50 percent of this flush is killed. If the duration is three hours at 28° F, 90 percent dies.

When looking at a similar scenario with round oranges, a one-hour duration at 26° F results in no fruit damage, while a four-hour duration at 26° F results in 30 percent fruit damage. These are factors to consider when making a citrus cold-protection plan.

HOW TO PROTECT

Citrus cold protection should be viewed based on the two typical types of Florida freezes, advective or radiational.

In an advective freeze, a cold air mass moves by advection into the state of Florida. This cold air with high winds results in dropping dewpoint temperatures.

A radiational freeze is typically the second night of a freeze event after the advective portion of the cold air has moved over the Florida peninsula. High pressure settles over the state. Calm winds and clear skies characterize a radiational freeze where heat in the plants and from the soil radiates up and is lost to the atmosphere.

Each of these types of freezes presents a unique set of circumstances to consider. The best source for forecast information about the type of freeze is from your local National Weather Service office.

Advective freezes are the hardest to protect against. The windy conditions do not allow for much in the way of microclimate modification due to the wind removing any of this environmental modification out of the grove. One potential silver lining in this type of freeze event is the drop of temperatures overnight is nearly linear, and durations at the predicted minimum temperature are generally brief.

In an advective freeze, the use of cultural practices and horticultural selections to optimize citrus acclimation and increase cold hardiness are the predominant methods of protecting mature citrus trees. The use of micro-sprinkler irrigation in these types of events is of little practical significance for mature trees, but can be very beneficial for young citrus trees. The use of micro-sprinkler irrigation can, under these freeze conditions, result in more damage due to evaporative cooling of plant surfaces.

In a radiational freeze event, clear skies, settling high pressure and calm winds are the main characteristics. Typically, the air mass is the same as the one brought in by advection the previous night. If little climatic modification of this air mass has occurred, it will have similar dewpoint and minimum temperatures as the advective air mass. The big difference under this type of condition is that although the minimum temperatures may be similar, the initial drop in temperature at sunset allows for significantly longer durations at a critical temperature.

In a radiational freeze, the use of micro-sprinkler irrigation for cold protection has been historically beneficial in protecting citrus trees from freeze damage. Micro-sprinkler irrigation produces heat from the warmth of the irrigation water and by the changes in the state of water as it goes from a liquid to a solid. This process releases heat that can modify the tree microclimate, resulting in increases in the tree canopy temperatures of up to 4° F under ideal cold-protection conditions.

SUMMARY

In conclusion, for an effective citrus cold-protection plan, a grower must understand the type of freeze predicted, the duration and predicted minimum temperature, the relative degree of citrus tree acclimation (critical temperature), and what part of the citrus tree requires protection. With this information, you can then decide on what methods of cold protection are best in your situation.

Consult edis.ifas.ufl.edu/cg095 and edis.ifas.ufl.edu/ch182 for additional information on citrus cold protection.

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