Blueberries bloom in late winter or early spring in Florida, making the flowers and young fruit highly susceptible to freeze and frost injury.

Killing freezes can occur as late as mid to late March throughout much of Florida, long after the initiation of bloom, especially for early-ripening southern highbush blueberry cultivars.

This publication describes practices that growers can use to minimize freeze damage.

**Freezes and freeze protection**

Freezes during February, March, and April are a much greater problem for Florida blueberry growers than was anticipated 20 years ago.

The shift away from rabbiteye blueberries toward early-ripening southern highbush cultivars has significantly increased the potential for crop losses from late winter and early spring freezes.

Currently, if some method of freeze protection is not employed, freezes during flowering and early fruit development remain the greatest threat to southern highbush blueberry production in Florida.

Several factors affect the severity of damage to blueberry plants, flowers, and fruit in particular freezes. Some of these factors are fairly well understood; others have received little study.

**Freeze protection methods**

Overhead irrigation systems—designed for freeze protection with diesel, rather than electric, pumps—are the most widely used and practical method of reducing blueberry fruit losses to freezes in Florida (Figures 1 and 2).

Large volumes of water must be pumped to get good protection.

The number of gallons per minute needed to protect one acre depends on the temperature,
wind speed, relative humidity, and design of the system.

In Alachua County, blueberry crops have occasionally been lost between February 20 and March 20, even in fields protected with overhead irrigation at a rate of 0.2 inches per hour. Temperatures of 26°F combined with 15 mph winds and low humidity exceed the protection capabilities of such a system, even though the same amount of water would protect flowers down to 18°F with no wind.

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Figure 1. A blueberry field protected by overhead irrigation during a freeze. While blueberry canes are relatively pliable, the ice load can break canes and uproot plants.
Figures 2a and b. Blueberry flower buds protected by overhead irrigation during a severe freeze. Clear ice, as seen here, is usually an indication of adequate freeze protection.

Some growers have designed systems that can be quickly altered to deliver 0.4 inch of
water per hour by changing riser heads.

A practical system might be able to deliver 0.25 inch per hour over 10 acres or 0.4 inch per hour over 6 acres.

In most years, the entire 10 acres could be protected. In years with severe late freezes, 4 acres could be allowed to freeze so that the other 6 acres could be given maximum protection.

Before installing an irrigation system, seek advice from an irrigation specialist.

The best use of an irrigation system for freeze protection requires experience and close attention to the weather.

Blueberry flowers and fruit will not freeze if temperatures in a weather bureau shelter located alongside the plants at the same height as the flowers stay at 32°F or above.

Frost on the grass between the rows does not necessarily mean that flowers are damaged since, on humid nights, frost can form when temperatures in the weather shelter are as high as 36°F.

With a clear sky and no wind, a thermometer placed open to the sky will read about 2°F colder than the same thermometer at the same height in a weather shelter.

By placing several thermometers throughout a blueberry field, one can learn a lot about the temperature distribution patterns in that field during radiation freezes.

If or when to turn on the irrigation system during a cold night can sometimes be a difficult decision to make.

The answer depends on such factors as the capabilities of the irrigation system, state of development of the crop, relative humidity, temperature, and wind speed.

Some of these factors cannot be predicted with certainty. The following guidelines should be helpful in most but not necessarily all situations.

First, the system should not be used on nights where the temperature-wind combination produces conditions more extreme than the system was designed to handle. Refer to a reliable forecast and Table 1 to determine whether or not the system should be used.
**Calm nights**

If there is no wind predicted and a decision is made to run the system, it is usually turned on when a thermometer hung under the open sky from a bare branch in the coldest part of the field reaches 32°F.

However, if the dew point temperature is below 25°F, the system should be turned on at 34°F, which will probably be only about half an hour before the temperature reaches 32°F.

The temperature has a great tendency to fall to within 1°F of the dew point on clear, calm nights.

If the dew point is 26°F or lower and frost forms on flowers or berries, they will be killed.

If the dew point temperature is 30°F or higher and frost forms on flowers or berries, they may not be damaged.

During the morning following the freeze, if there is no wind and the sun is shining brightly, the irrigation can be turned off when icicles are falling rapidly from the plants and have been falling for more than half an hour.

Never turn off the irrigation before icicles are falling no matter what the temperature.

If the dew point temperature is below 20°F, continue running irrigation until the shaded air temperature rises to 40°F. If it is windy and the dew point is 26°F or lower, do not turn off the irrigation until most of the icicles have fallen.

**Windy nights**

For windy freezes, the decisions about whether or not to run irrigation become complicated. Table 1 provides guidelines for determining the amount of water required to protect fruit at various temperature/wind speed combinations.

However, the values in Table 1 assume normal relative humidity. If relative humidity is very low, as sometimes happens when a cold dry air mass moves into Florida, the values in Table 1 may underestimate the amount of water needed for adequate freeze protection.

Paying attention to the dew point temperatures during various nights of freeze protection will help take the mystery out of why crops are sometimes saved when it seemed too cold and windy and why crops may be lost when it seemed they should have been saved.
**Overhead irrigation the afternoon or evening before the freeze**

Experienced fruit growers have long known that irrigating their fields the afternoon before an expected freeze can sometimes reduce the damage caused by the freeze.

There are four situations in which this practice is potentially useful to blueberry growers.

**First situation**

It is a calm afternoon, and minimum temperatures are forecast to be on the borderline between damaging and safe. A wet ground may allow the grower to avoid or delay having to turn on the system during the night.

**Second situation**

The dew point is low and the wind speed is expected to be erratic during the night, or temperatures are expected to be at or below the damaging point with light winds and a rising wind expected later in the night.

Even though a rising wind in the night frequently brings in colder, drier air behind a secondary cold front, the effect may be to raise the temperature of the blueberry flowers, as cold surface air is mixed with warmer air above the inversion and the wind raises the flower temperature to the temperature of the surrounding air.

**Third situation**

The grower lacks sufficient pumping capacity to protect the entire acreage against a freeze of the expected severity.

A decision is made to change the sprinkler heads to a larger orifice diameter in half of the field and close off the valve to the other half.

It may be possible to reduce damage in the half that cannot be irrigated during the night by thoroughly wetting the soil during the afternoon before the freeze.

**Fourth situation**

This may be the most common situation in which growers could improve their crops by adopting a practice that is seldom used at present.
Frequently during January and early February, after blueberry flower buds have begun to swell, a freeze occurs in which the dew point is so low, the air so cold, and the probability of some wind during the night so high that no experienced grower would choose to run the irrigation at night for fear of causing massive damage from evaporative cooling, frozen emitters, broken branches, and uprooted plants.

Furthermore, many of the flower buds may still be quite dormant and will survive if nothing is done.

Frequently in late January, the flower buds may show a wide range of developmental stages.

**Alternative freeze protection methods**

Wind machines and helicopters have been used to some extent to protect blueberry crops from freezes in Florida.

Both are based on the fact that on clear, calm nights, a strong temperature inversion develops, in which temperatures within 6 feet of the ground may become much colder than temperatures 50–100 feet aboveground.

By mixing these air layers, wind can raise the temperature near the ground by about 4°F, the exact amount varying with the strength of the temperature inversion and the effectiveness of the air mixing.

On nights with wind, wind machines and helicopters cannot warm an orchard because no temperature inversion develops.

*Source: University of Florida IFAS Extension*