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Observations of the February 2012 Freeze and Its Effect on Commercial Blueberry Plantings

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Producers of commercial southern highbush blueberries often have to take precautions to protect their crop from freezing conditions encountered during the growing season. Cultivars that produce fruit during the optimum market window for Florida producers, ranging from late March to early May, are often subjected to damaging temperatures to the expanding floral buds, flowers, and developing fruit. During early February in 2012, a two-night freeze caused significant damage in fields in north and central Florida. Normally, freezes during this time frame do not pose a significant threat to commercial fields, unless temperatures are 20 °F or lower. This is because the floral buds generally have not expanded to the point where temperatures in the mid 20s to the freezing mark would cause damage. Due to warmer than average temperatures, commercial blueberry crops had progressed to the point where significant bloom and developing fruit were present. Most growers consider 32 °F to be the critical temperature to freeze protect developing fruit. Since many growers in the region expected temperatures below 32 °F, they planned to utilize overhead irrigation to protect their crop. After the two nights of freeze, significant cold damage was reported. Much of the damage was associated with irrigation system failure or inadequate coverage. Growers who took wet bulb temperature into consideration as the trigger to begin applying overhead water typically fared better in the freeze.

Over the past 20 years, a significant commercial blueberry industry has developed in Florida. Florida is a major source of early season fresh blueberries, with an industry value consistently ranking in the top four among all blueberry producing states (Williamson et al., 2009). One of the main reasons why the Florida blueberry industry has expanded is its unique marketing window between the end of commercial production in the southern hemisphere and the beginning of harvest in other early season blueberry producing states such as Georgia, North Carolina, and California. Typically, the Florida blueberry marketing window is 1 Apr. to 15 May. Once other states begin harvest, the market prices fall drastically (Williamson et al., 2009).

The southern highbush blueberry cultivars that ripen in Florida's April to May market window typically have a fruit development period of 50 to 70 d, thus exposing vulnerable flowers and fruit to freezing temperatures that often occur from late January to March in many blueberry production regions in the state (Lyrene and Williamson, 2000). Longstroth (2008) demonstrated that highbush blueberry flowers can be damaged by temperatures of 27 to 28 °F, while green fruit are affected at 31 °F. For these reasons, Florida's commercial blueberry growers utilize overhead application of water to encase the crop in ice and maintain the temperature at 32 °F.

This paper is a review of the reasons why some growers experienced moderate to severe crop injury on a freeze event that occurred on 12 and 13 Feb. 2012.

Situation

During the winter of 2011–12, there were fewer than average freeze events in most of the Florida blueberry producing regions, but one that occurred from 12 to 13 Feb. resulted in significant damage. Typically, blueberry crop development in most Florida production regions has not progressed to the point of significant fruit set by early- to mid-February. Higher than average temperatures during winter 2011–12 had caused many cultivars in most production regions to bloom and set fruit 2 to 3 weeks early. When the freeze of 12–13 Feb. occurred, significant amounts of green fruit was present on most farms where temperatures reached the critical temperature of 31 °F (Longstroth, 2008).

Observations

The freeze of 12 Feb. was "advective," with high winds occurring in all production regions and temperatures falling to the mid to upper 20s. On 13 Feb. the wind dropped, resulting in a "radiation" freeze. With little to no wind, temperature inversion took place in many areas, resulting in somewhat colder temperatures. Most growers who had damage in their fields said that the majority of the damage occurred during the freeze of 12 Feb. that included high winds.

During that night, many growers were able to utilize their overhead irrigation systems to protect their crops. However, it appears that some growers did not monitor wet bulb temperatures to guide them as to when to initiate water application. Wet bulb temperature is the lowest temperature to which an air mixture can be cooled solely by the addition of water (Bucklin and Haman, 2009). Evaporative cooling typically causes the wet bulb temperature to be lower than the ambient temperature. Bucklin and Haman (2009) pointed out that when water is initially introduced to a field, the temperature will initially fall to the wet bulb value. For this reason, overhead irrigation should begin before wet bulb temperature drops to the critical temperature.

Williamson et al. (2012) demonstrate the effect of wind on increasing evaporative cooling and thus amount of water needed

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Table 1. Hourly average air temperature, wind speed, and wet bulb temperature from the Ocklawaha FAWN Station on Sunday, 12 Feb. 2012.

Time (24:00:00)	Temp (°F)	Wind speed (mph)	Wet bulb temp (°F)
2:00	39.3	8.8	32.7
3:00	36.1	12.2	29.7
4:00	33.6	10.2	27.7
5:00	31.9	8.7	26.7
6:00	30.5	7.1	25.9
7:00	30.0	7.6	25.3

to protect blueberry crops from freeze damage. Growers use this information when designing overhead irrigation systems that will be utilized for freeze protection.

In many blueberry production regions in central and northern Florida on 12 Feb. 12012, readings at Florida Automated Weather Network (FAWN) stations recorded high winds and wet bulb temperatures at the critical temperature of 31 °F, although the ambient temperatures were 5 to 8 °F higher (Table 1). This trend was observed at FAWN stations in most blueberry production regions. Blueberry grower feedback indicated that those who monitored wet bulb temperature and turned their irrigation systems on between 36 and 41 °F had less than 10% damage to green fruit. Those who turned on their irrigation systems between 32 and 36 °F reported 30% to 50% damage to green fruit.

Conclusion

By monitoring wet bulb temperature, growers can determine when to initiate overhead irrigation without the risk of lowering the ambient temperature in the field to a value lower than the crop critical temperature. Wind speed must be taken into account whenever utilizing overhead irrigation for freeze protection. Information in Williamson et al. (2012) should be consulted to be sure the irrigation system is providing an adequate amount to safely freeze protect the crop.

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