Cool, fall nights challenge fruit storability

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The highly desirable Honeycrisp apple is also one of the most tender apples we grow. It has an extreme sensitivity to low temperature that we usually see after harvest following some weeks of cold storage. However, if the temperatures in the orchard are low enough (beginning around 37°F, and worsening around 34°F), we can have fruit injury even before growers have a chance to harvest the fruit (Photo 1). Unfortunately, we do not know how many hours at these temperatures is required to trigger this disorder development in the field.

Photo 1. Honeycrisp fruit chilling injury can be found in the field before harvest. Left panel: soggy breakdown. Right panel: ribbon scald. Photo by Randy Beaudry, MSU.

There are numerous anecdotal reports that low temperatures in the orchard can cause chilling disorders before harvest. On Sept. 18, 2020, the skies were clear and the National Weather Service predicted temperatures in the 30's, and a high probability of Michigan's first frost of the year. At that point of the season, most of the Honeycrisp crop was still in the orchard and fruit just beginning to ripen. On an average year in the Grand Rapids, Michigan area, Honeycrisp are usually ready for harvest and storage by Sept. 15. Unfortunately, a ripening Honeycrisp is more susceptible to chilling injury.

To better understand how nighttime air and fruit temperatures changed during the predicted frost event, Michigan State University Extension personnel instrumented a Honeycrisp apple tree at a commercial orchard north of Grand Rapids with thermocouples. Thermocouples were either placed in the air 3 feet above the ground or were embedded into fruit. Fruit temperatures were collected for fruit at the top of the canopy (8 feet above ground), at the middle of the canopy (5 feet above ground) and at the

base of the canopy (2 feet above ground). Thermocouples were placed just under the skin of the fruit to collect fruit surface temperatures. For the fruit at the top of the tree, we also inserted a thermocouple into the fruit core to track inner fruit temperature.

The expectation was that the fruit at the top of the tree would be warmest during the day, but would cool to the lowest temperatures at night as they lost heat to the clear night sky. The question was how cool they would get relative to the night air. We found that those fruit at the top of the tree cooled to lower temperatures than those fruit in the middle or at the bottom of the canopy (Photo 2). In fact, these fruit cooled to temperatures 1 or 2 degrees below air temperatures due to radiation cooling.

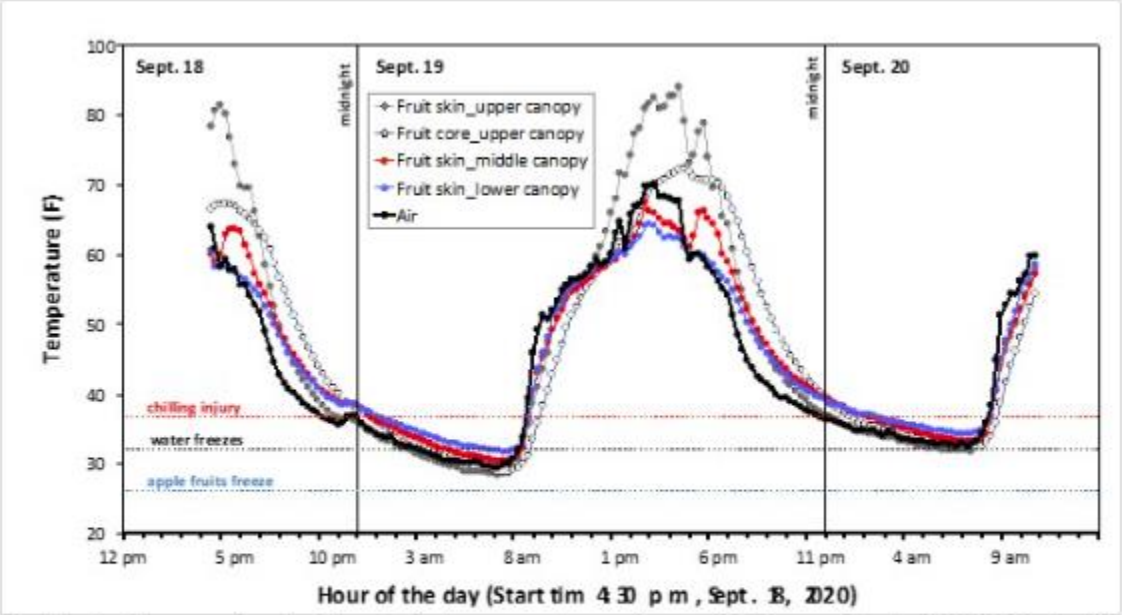

Photo 2. Honeycrisp fruit and air temperatures from 4:30 p.m. Sept. 18, 2020, to 11 a.m. Sept. 20, 2020. The fruit at the top of the tree (upper canopy) had both skin and core measurements. Those in the middle and lower portion of the canopy had only skin measurements.

The air temperature dropped below the temperature known to cause chilling injury in Honeycrisp for about 8 to 10 hours on the night of Sept. 18 and about 6 hours on the night of Sept. 19. More importantly, the temperatures of the fruit skin and core dropped below freezing for about 4 to 6 hours on Sept. 18. While apple tissue does not freeze until it is cooled to about 26° F, the extreme low temperatures were a worry for this sensitive variety.

To see if the affected fruit would develop injury, fruit were collected before and after the chilling event, and were then placed in storage for 2 months at either 32° or 37°.

The results showed there was more chilling injury in fruit that experienced 2 days of chilling, suggesting that ***low field temperatures slightly enhanced fruit sensitivity to chilling in storage***. Conditioning reduced chilling, but increased bitter pit incidence. ReTain increased the incidence of chilling. Storage at 32° F increased chilling injury relative to fruit stored at 37°.

Treatment	Observation
Bitter pit	
Non-conditioned	8%
Conditioning	12%
Chilling Injury	
0 days	1%
1 day	1%
2 days	2%
Non-conditioned	3%
Conditioning	0%
UTC	0%
ReTain	3%
32 F storage	11%
37 F storage	2%

What does this mean for us in New York?

In the Champlain Valley this year, there are still many Honeycrisp to be picked. On September 30, we recorded temperatures of 34° and 35° in some portions of Peru. 30° was reached on Monday October 3 in some parts of Peru, and similar conditions were forecasted for the Tuesday October 4th saw temperatures near 32°. We don't have a good understanding of how much risk this fruit has for chilling injury, but we may see some following these temperatures.

With these conditions in mind, we urge storage operators to be vigilant for developing symptoms of chilling injury on Honeycrisp. Pre-conditioning of Honeycrisp prior to storage is already a common recommendation. With this exposure to cool temperatures while hanging on the tree, it will be even more important to follow pre-conditioning guidelines to help lessen losses to chilling injury.