STRESSED OUT BY SUNBURN? HERE'S SOME RELIEF

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ABSTRACT

A new fruit surface temperature (FST) sensor has been invented (Patent Pending) at WSU that provides a new technology for growers who are interested in more effective control of their evaporative cooling (EC) systems. The new FST sensor can provide better protection from sunburn. The sensor also provides important information that a grower can use to better manage his EC system manually. Alternatively, the FST sensor can be used to control EC automatically through appropriate controllers.

INTRODUCTION

Sunburn is usually the major source of cullage in apples grown in Washington State. Losses due to sunburn average 8 to 12% most years. In 2003, losses were even higher. A recent study on cullage by Dr. Brunner and colleagues in Wenatchee confirmed that sunburn is normally the major cause of cullage, and that sunburn is underestimated in the packinghouse. This is due to many culled apples having two or more disorders. In this study, they observed an average of 2.5 defects per culled apple.

With a crop valued at over $1 billion dollars per year, a 10% loss equates to over $100 million lost per year to apple growers in WA state alone. Our research has shown that apples that are sunburned frequently develop other skin disorders as well. Some disorders appear before harvest and some appear later. Thus, a high priority should be given to reducing sunburn in the orchard.

Our research has established that several types of sunburn are caused by heat and/or light stress. Sunburn necrosis occurs when the fruit surface temperature (FST) reaches 126 ºF for only 10 minutes. At this FST, thermal death occurs. The most prevalent type of sunburn (sunburn browning) is induced when the FST reaches 114 to 120 ºF for 1 hour. Apple varieties differ in their tolerance to temperature stress (i.e. some sunburn at a lower FST than others). Damaging ultraviolet-B (UV-B) radiation also contributes to sunburn browning.

Many growers have installed evaporative cooling (EC) systems to reduce sunburn and other heat-induced disorders. Effective EC can reduce the FST several degrees Fahrenheit, and reduce sunburn substantially. However, many existing EC systems are not well designed or are poorly managed. There is little available currently other than air temperature sensors to aid growers in deciding when to turn EC on and off. Therefore, many growers turn on the EC earlier than needed and allow it to run longer than necessary. They also run the EC some days when EC is not required. These practices result in overuse of water and energy, and also can cause certain skin disorders to develop.

NEW FST SENSOR DEVELOPED To improve the efficacy of EC, we initiated research in 2001 to develop a fruit surface temperature (FST) sensor. In collaboration with the Washington Tree Fruit Research Commission, a new FST sensor (patent pending) has been developed and has been field tested during 2004 in several orchards. This sensor can be used by growers to manage EC systems for more effective sunburn protection and to conserve water and energy.

The new FST sensor is designed to simulate a real apple. A comparison of the FST sensor and the FST of a real apple are compared (Fig. 1). Note that the two upper lines are nearly superimposed upon one another. The upper line shows the FST as recorded from the FST sensor, and the line below it represents the FST of an actual apple to which a thermocouple had been attached. The FST on a hot day with clear skies exceeded 115 ºF between 1330 and 1630 hours. Our previous research established that some varieties of apples will sunburn when the FST reaches 115 ºF.

The two lower lines in Fig. 1 were recorded on a cloudy day. The FST of both the sensor and a real fruit were much lower, and reached 115 ºF for a short time only at 1630 hours (Fig. 1) when the sky became clear again. Therefore EC was not needed that day until late afternoon.

OPTIONS FOR USE OF THE FST SENSOR There are two major options for use of the new FST sensor. The first option is to use the sensor as a management tool. The sensor can be used with an inexpensive unit that transmits the FST via radiotelemetry from the sensor to a portable read-out unit that is carried by the user. A more expensive option is to connect the FST sensor to an AgWeatherNet unit (under development by Francis Pierce et al. at WSU-IAREC in Prosser, WA). The FST can be transmitted longer distances to the user's computer or other locations. In both instances, the user can employ this FST data to make better management decisions about when to activate and when to de-activate his EC.

The second option involves using the FST sensor to control an EC system. With an appropriate controller with two temperature set points, the EC can be activated when the FST reaches the higher set point, and turned off when the FST is decreased to the lower set point. This would involve direct control of solenoid valves and provides "real time" control of the EC system. Other alternatives involve controlling the irrigation pump directly and/or activating and deactivating a timer system when multiple zones are employed by the user.

Each of these options has been field tested successfully, but additional Beta testing of these options is planned for 2005.

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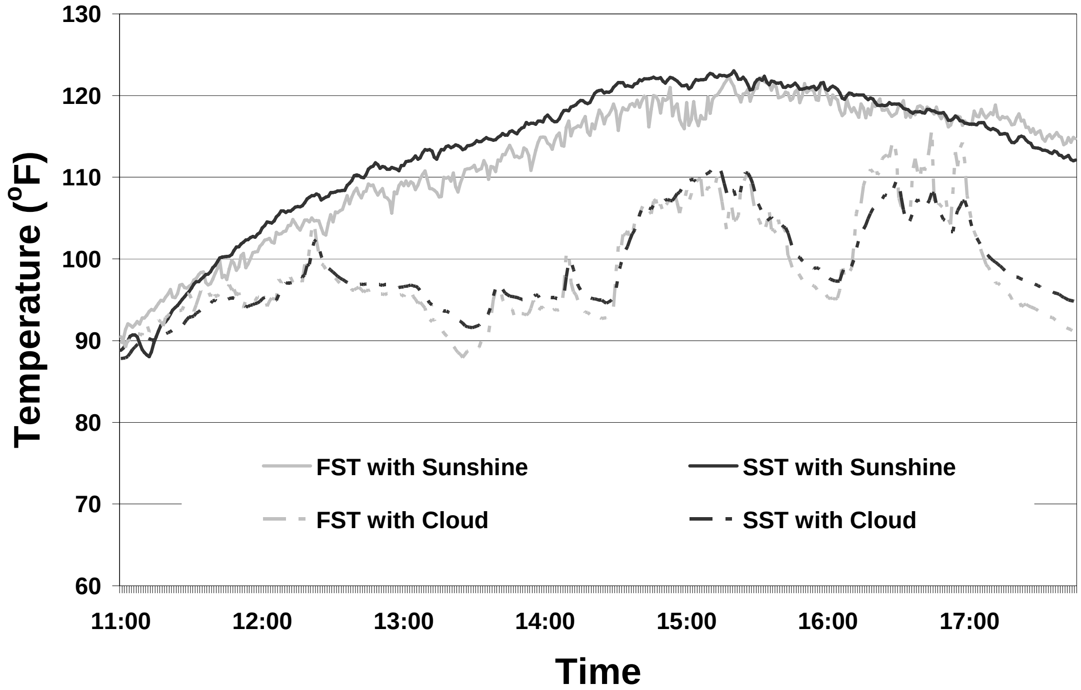

Fig. 1. Fruit surface temperature (FST) on a clear day and on a cloudy day (see gray lines). The sensor surface temperature (SST) on a clear day and on a cloudy day (see the darker lines). Note the close correlation between FST of a real apple as compared to the SST (sensor temp).