Obtaining optimal peel color of fresh Florida citrus

By Mark A. Ritenour and Fernando Alferez

Color development in citrus during fruit maturation is a complex process that involves chemical and physiological changes. This includes chlorophyll (green pigments) breakdown and carotenoid (orange and yellow pigments) biosynthesis. The final color of each citrus variety mainly depends on the final composition of carotenoids, with citrus being among the richest fruit sources of carotenoids (provitamin A). Pigment concentrations in citrus depend on both internal genetic factors and external environmental factors, such as temperature.

Consumers are trained to expect vivid orange to yellow peel color of fresh citrus (depending on the variety) even though peel color has little to do with the fruit's internal maturity or quality. Instead, peel color changes are induced when night temperatures drop below 55° F. In the tropics, where

Figure 1. Commercial citrus degreening room

night temperatures never drop this low, fruit remain green. Even fruit that have developed excellent peel color in the field can turn green again (regreen) if not harvested by the time warm night temperatures return in the spring.

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Unfortunately, field temperatures in Florida, especially in the southern half of the state, often do not drop low enough for adequate peel color development of early-season citrus varieties — even after the fruit are mature and ready to eat. Researchers found a natural, gaseous plant hormone called ethylene is responsible for inducing peel color change. Harvested fruit can be exposed to this hormone to stimulate color change in the packinghouse. This process is called degreening (Figure 1, page 14).

While ethylene is also used commercially to ripen fruit like bananas and tomatoes, often at concentrations of 100 parts per million (ppm) or more, fresh citrus is usually degreened with only about 3 to 5 ppm. Unlike the ripening process, however, ethylene degreening does not significantly alter the internal quality of the fruit.

The following factors should be managed carefully during degreening to maximize fruit peel coloration and minimize possible detrimental effects on shelf life.

TEMPERATURE

In general, maintaining temperatures of 82 to 85° F are recommended for degreening in Florida. These temperatures stimulate the fastest breakdown of chlorophyll. Never degreen at higher temperatures because they not only slow degreening, but greatly speed fruit respiration and deterioration. Degreening at lower temperatures lengthens degreening time but enhances carotenoid

production, which improves overall fruit color. If heating and/or cooling is available, locate the thermostat between the air stream and the fruit to prevent accidental overheating or freezing of the fruit.

ETHYLENE

No more than 3 to 5 ppm ethylene is needed for the fastest degreening; higher concentrations only promote decay. Accurate metering of ethylene into the rooms is essential, often accomplished using a needle valve. After conditions in the degreening room have stabilized, ethylene concentrations are usually measured using a portable ethylene analyzer.

HUMIDITY

Because fruit in degreening rooms is exposed to relatively warm temperatures, maintaining high relative humidity (RH), around 90 to 95 percent, is recommended to minimize fruit water loss. There are many commercial humidification systems available but be careful not to set humidity so high that moisture

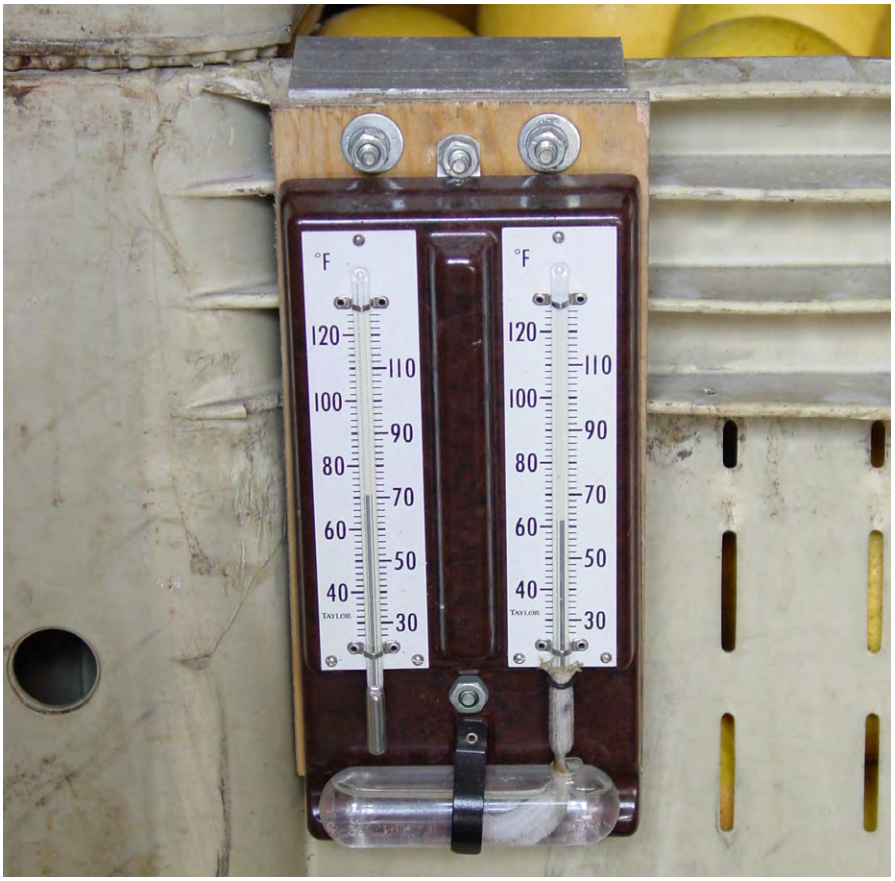

Figure 2. Wet and dry bulb thermometer for measuring relative humidity

condenses on the fruit, which promotes decay. Moisture should be added to the air stream between the heat exchanger (if used) and the fruit. Humidity can be measured using digital sensors (humidistats) or wet and dry bulb thermometers (Figure 2, page 16) placed in the air stream returning to the fans. Cardboard boxes weaken by absorbing air moisture, so RH should be lowered to around 85 percent if cardboard containers are used instead of plastic bins or totes.

VENTILATION

Fresh citrus fruit are comprised of living cells and continue respiration after harvest, taking in oxygen and giving off carbon dioxide (CO_2). Therefore, if the room is not properly ventilated, CO_2 concentrations build up and reduce the ability of ethylene to stimulate color change, since they are antagonistic. To keep CO_2 levels low (<0.1 percent), the room should be ventilated to receive one air change per hour, based on the volume of the empty room. A constant supply of fresh air is preferred to periodically

opening rooms for ventilation because control of temperature, humidification and ethylene concentration is lost with the latter.

AIR CIRCULATION

Air movement helps maintain uniform temperatures and gas concentrations within the room and should provide a minimum of 10 cubic feet per minute (CFM) per field box or 100 CFM per 10-box bin.

CULTIVAR

Citrus cultivars vary in peel coloration related to field and degreening environments. While some newer selections color well (i.e., Sugar Belle), others (i.e., Tango) color slowly in Central and South Florida and are difficult to degreen after harvest. This illustrates the complexity of developing effective and optimal degreening protocols for some newly adopted varieties and needs continuing research.

See edis.ifas.ufl.edu/hs195 for more details on degreening fruit in Florida, including operational considerations and safe handling of ethylene gas.

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