

## Maintaining Citrus Fruit Quality During Degreening

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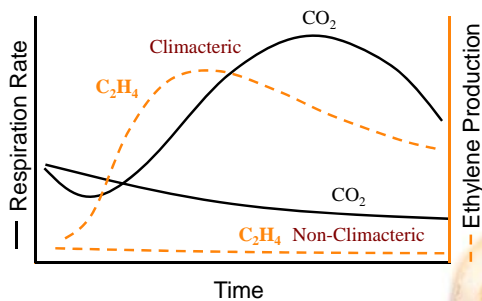


## Why is Degreening Necessary?

- Consumers associate green citrus fruit with immaturity (poor quality).
- Fruit color is due to the interaction of chlorophyll (green) and carotenoid (red – yellow) pigments.
- Color change in the field is especially stimulated when nighttime temperatures drop below 55F.

## Climacteric vs. Non-climacteric

Climacteric have increased respiration & ethylene production during “ripening”.



## The Goal

- Degreening does not affect internal quality of the fruit.
- Remove chlorophyll (green pigment).
- Promote anthocyanins (yellow-orange pigments).
- Temperature optimums are different.

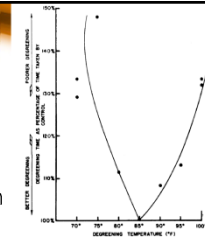


Fig. 1.—Effect of temperature on rate of degreening of Florida oranges. Adapted from Grierson and Newhall (12).

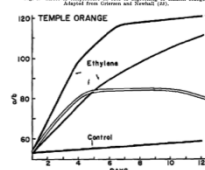


Figure 2.—Effect of temperature and ethylene on the color of postharvest 'Temple' fruit.

## Recommended Degreening Conditions

### Florida

Temperature	28 to 29°C (82 to 85°F)
Ethylene	5 ppm
Humidity	90 to 96%
Ventilation (keep below 0.1% CO <sub>2</sub> )	1 air change per hour
Air Circulation	100 CFM per 900 lb. bin (CFM = cubic feet per minute)

### California

Temperature	20 to 25°C (68 to 77°F)
Ethylene	5 to 10 ppm
Humidity	90%
Ventilation (keep below 0.1% CO <sub>2</sub> )	1 to 2 air changes per hour
Air Circulation	1 room volume per minute

## Temperature

Grierson & Newhall, 1953

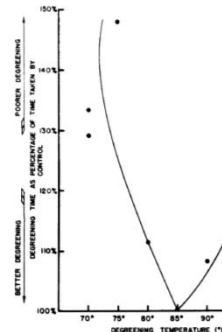


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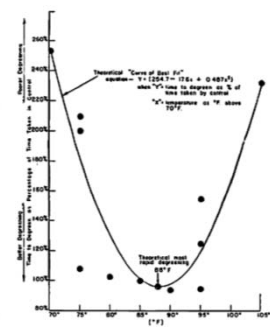


Fig. 3.—Effect of Temperature on Rate of Degreening of Marsh Grapefruit.

## Relative Humidity

TABLE 3.—EFFECT OF RELATIVE HUMIDITY DURING DEGREENING ON SUBSEQUENT DECAY OF HAMLIN ORANGES AND DUNCAN GRAPEFRUIT.

Fruit	Picking Date (1955)	Percent Total Losses at 3 Weeks from Picking		
		Low (45-75% R. H.)	Medium (80-90% R. H.)	High (90-100% R. H.)
Hamlin	Sept. 28	22.0	48.7	42.0
	Oct. 14	18.7	18.0	34.7
	Oct. 19	50.0	48.7	44.0
	Averages	30.2*	38.5*	40.2*
Duncan	Sept. 28	5.3	10.7	30.7
	Oct. 14	17.3	30.7	48.0
	Oct. 19	20.0	22.7	34.7
	Averages	14.2	21.4	37.8

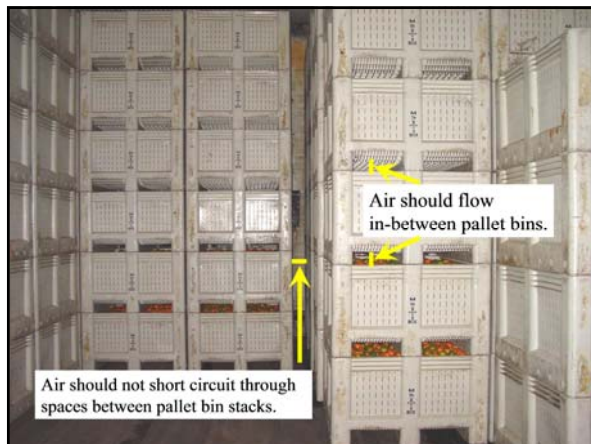
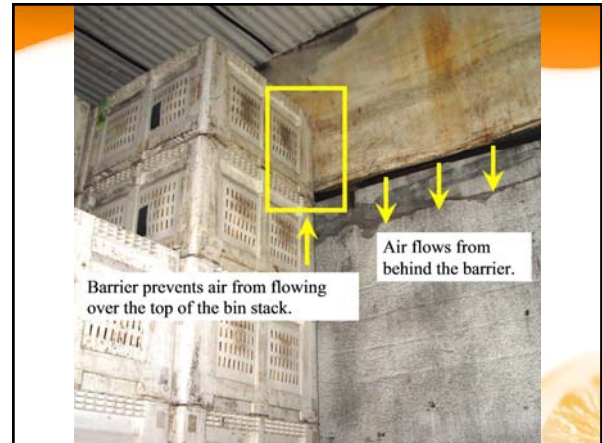
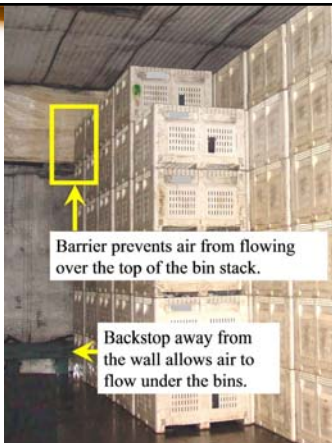
L.S.D.\*\* (5% level) 7.63  
(1% level) 11.96

\* Difference not significant.  
\*\* See explanatory note, Table 2.

## Ventilation & Carbon Dioxide

- Ventilation removes waste gasses (e.g., CO<sub>2</sub> and possibly peel oil vapor).
  - 1% CO<sub>2</sub> can about stop degreening.
- Ventilation also results in more uniform temperature throughout the room.
- Both result in faster and more uniform color development within the load.
- Continuous ventilation is often better than periodically opening the room.
- Excessive ventilation wastes ethylene and (when used) heating.

## Air Flow



## Potential Problems

- Ethylene and warm conditions promote tissue senescence.

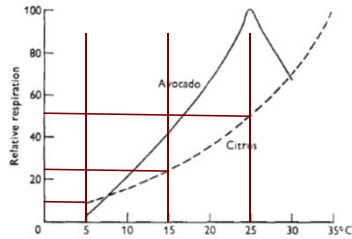


Fig. 141. The effects of temperature on the respiratory rates of avocado and citrus fruits. (From Biale and Young, 1962)

## Potential Problems

- Ethylene stimulates growth of some decay pathogens, such as *Diplodia* stem-end rot and Anthracnose.
- The warm and humid conditions experienced during degreening promotes decay.



## Potential Problems

- Ethylene can potentially be explosive (between 3% and 34%).



The Packer  
July 12, 1999

One worker was killed and several others injured in an explosion. The cause of the explosion is unknown, but firefighters believe it was caused by a gas leak from a propane tank. One worker was killed and several others injured in an explosion. The cause of the explosion is unknown, but firefighters believe it was caused by a gas leak from a propane tank. One worker was killed and several others injured in an explosion. The cause of the explosion is unknown, but firefighters believe it was caused by a gas leak from a propane tank.

## Potential Problems

- Temperatures too high – above 85F, slows rate of chlorophyll degradation, but increases fruit metabolism, decay, and breakdown
- Too much water in the rooms – fruit stays wet = slower degreening & increased decay pressure
  - Ethylene is not very soluble in water

## Potential Problems

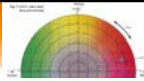
- Poor air circulation = uneven temperature distribution and local buildups of CO<sub>2</sub> in the room
  - Both = uneven color development



## What Inhibits Color Development?

- Warm weather
  - particularly warm nights
  - Regreening in the Spring
- Factors that promote vigorous growth
  - high rainfall
  - high nutrient levels (esp. N & K)
- Field oil sprays
- Peel oil (e.g., from brushing)
- Some scale insects (e.g., chaff & purple scale)

## Results



- Red grapefruit washed on a commercial packingline.

Days	Treatment	ab	hue	Wt. Loss (%)
4	Control	0.09 a	84.77 b	1.61 b
	HPW	0.06 b	86.30 b	1.91 b
	Brush	0.03 c	88.21 a	2.81 a
	B + HPW	0.02 c	88.91 a	2.93 a
P Value		0.0011	0.0017	<.0001

Waxing first will virtually stop further color development.

## Thank You!

- For more information, visit the UF Postharvest Website

<http://irrec.ifas.ufl.edu/postharvest/>