

Degreening Difficult-to-Degreen Citrus Fruit:

Can it be done?

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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 stimulated when nighttime temperatures drop below 55F



Pre-harvest Factors Against Degreening

- 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)

The Goal

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

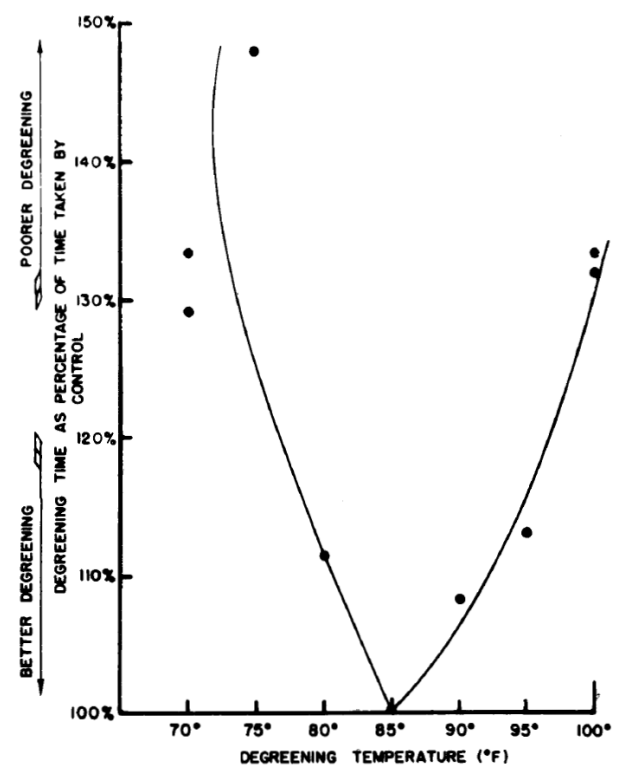


Fig. 3.—Effect of temperature on rate of degreening of Hamlin oranges. Adapted from Grierson and Newhall (23).

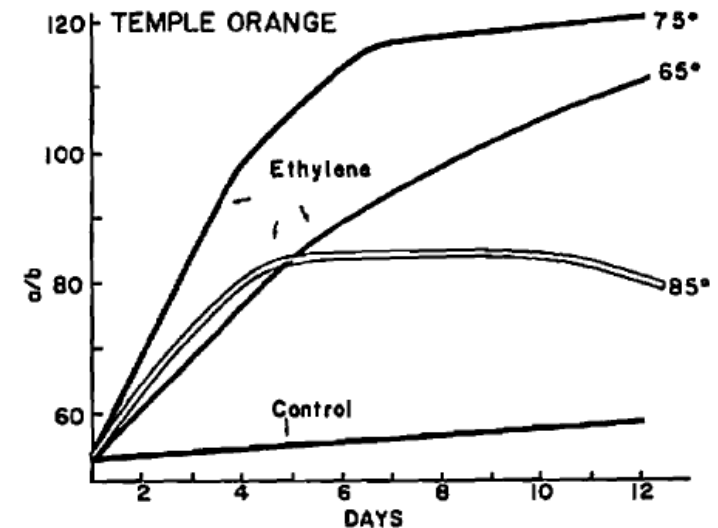


Figure 2.—Effect of temperature and ethylene on the color of post-harvest 'Temple' fruit.

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 ₂)	1 air change per hour
Air Circulation (CFM = cubic feet per minute)	100 CFM per 900 lb. bin

Potential Problems

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



Potential Problems

- **Temperatures too high – above 85F, slows rate of chlorophyll degradation, and increases fruit metabolism, decay, and breakdown**



Temperature

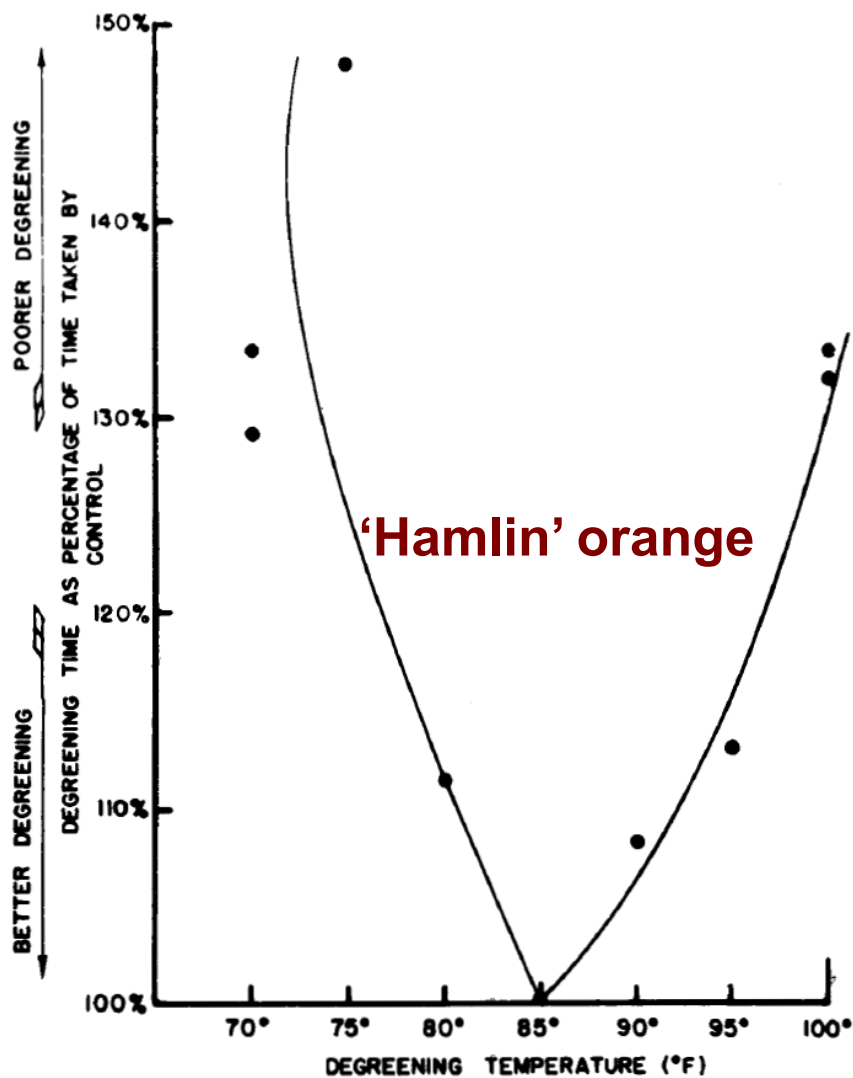


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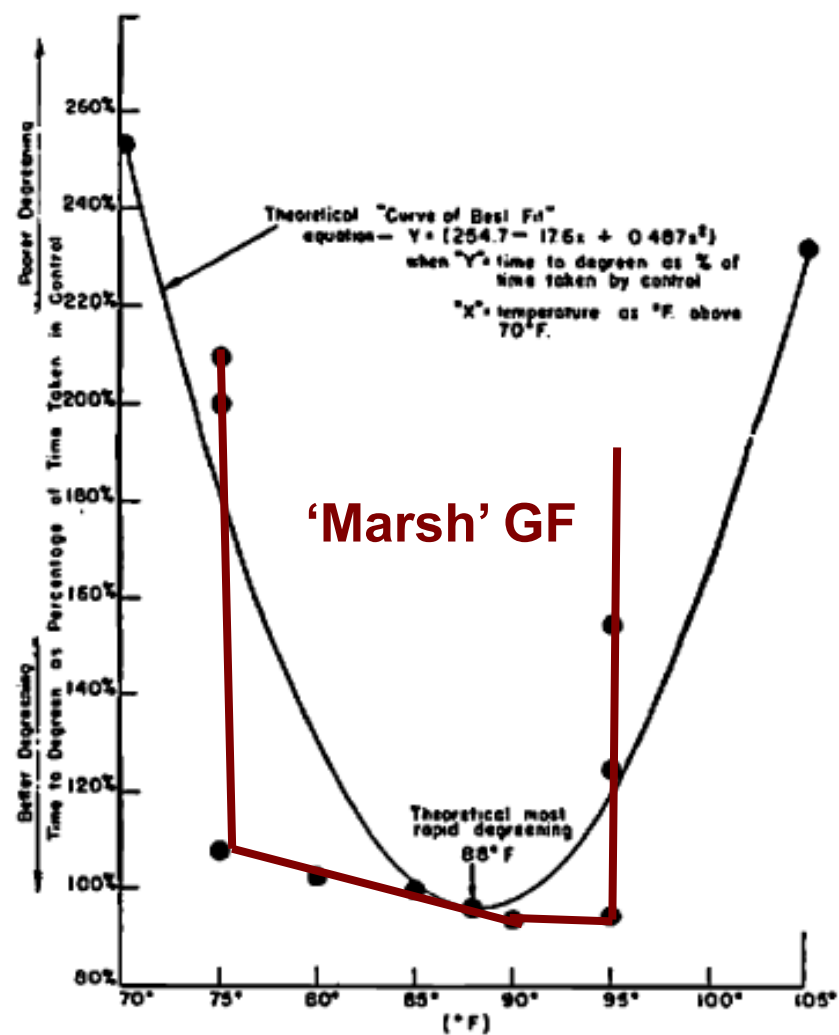


Fig. 3. Effect of Temperature on Rate of Degreening of Marsh Grapefruit.

Potential Problems

- Ethylene and warm conditions promote tissue senescence.

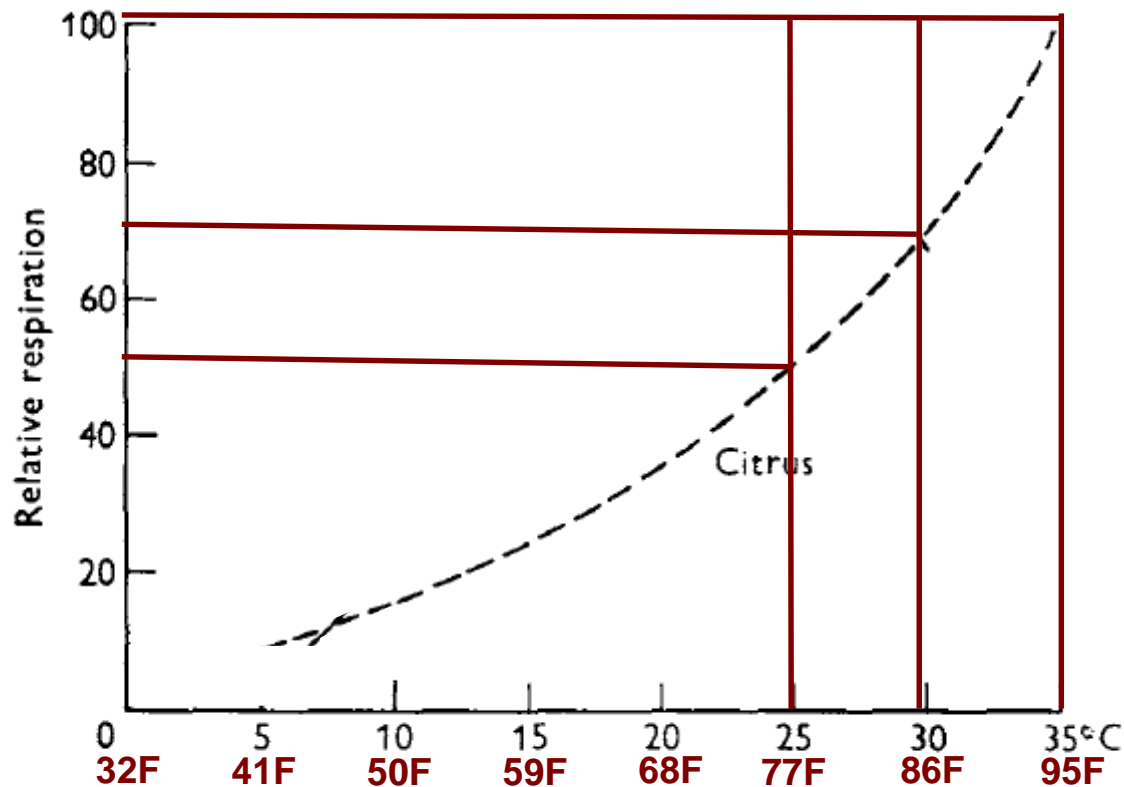


Fig. 141. The effects of temperature on the respiratory rates of avocado and citrus fruits. (From Biale and Young, 1962.)

Potential Problems

- Temperatures too high – above 85F, slows rate of chlorophyll degradation, but increases fruit metabolism, decay, and breakdown
- **Poor ventilation & air circulation = uneven temperature distribution and local buildups of CO₂ in the room**
 - **Both = uneven color development**



Ventilation


- Removes waste gasses (e.g., CO₂ and possibly peel oil vapor)
 - **1% CO₂ can about stop degreening**
- Continuous ventilation is better than periodically opening the room
- Excessive ventilation wastes ethylene and (when used) heating

Potential Problems

- Poor air circulation = uneven temperature distribution and local buildups of CO₂ in the room
 - Both = uneven color development



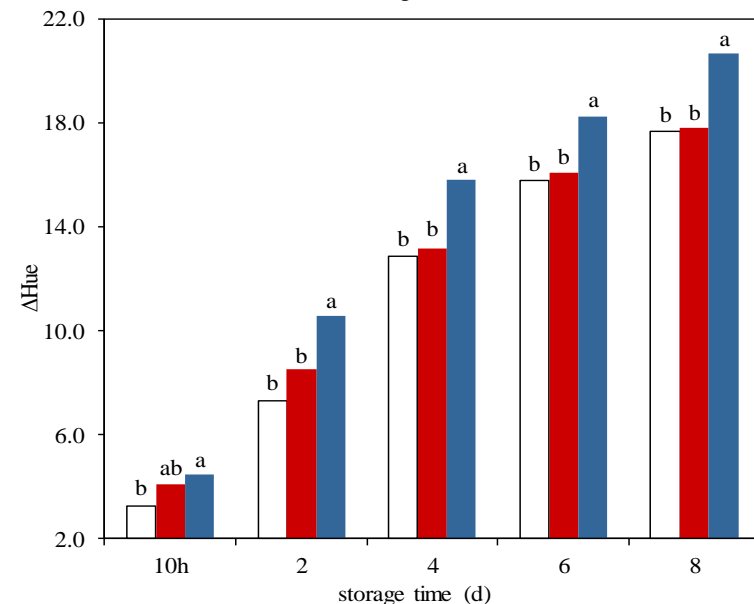
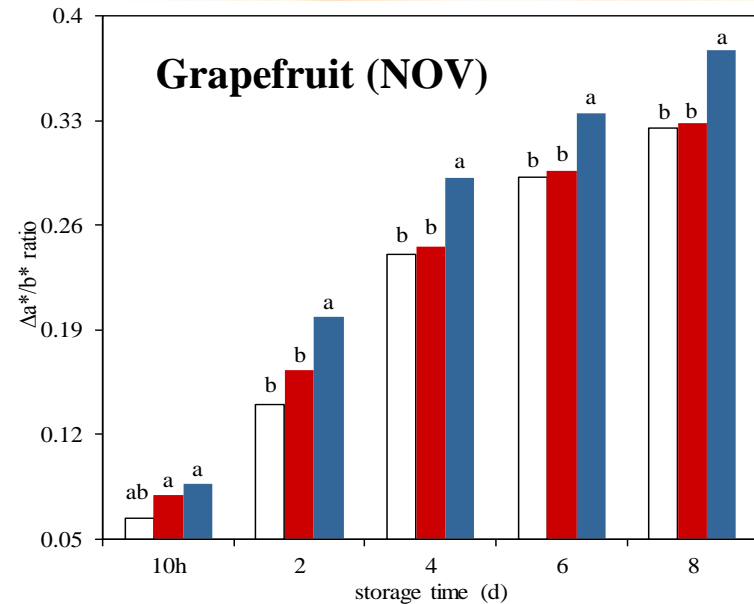
Potential Problems

- Temperatures too high – above 85F, slows rate of chlorophyll degradation, but increases fruit metabolism, decay, and breakdown
 - Poor ventilation & air circulation = uneven temperature distribution and local buildups of CO₂ in the room
 - Both = uneven color development
 - **Too much water in the rooms – fruit stays wet = slower degreening & increased decay pressure**
 - Ethylene is not very soluble in water
- 

Use of LED Lights

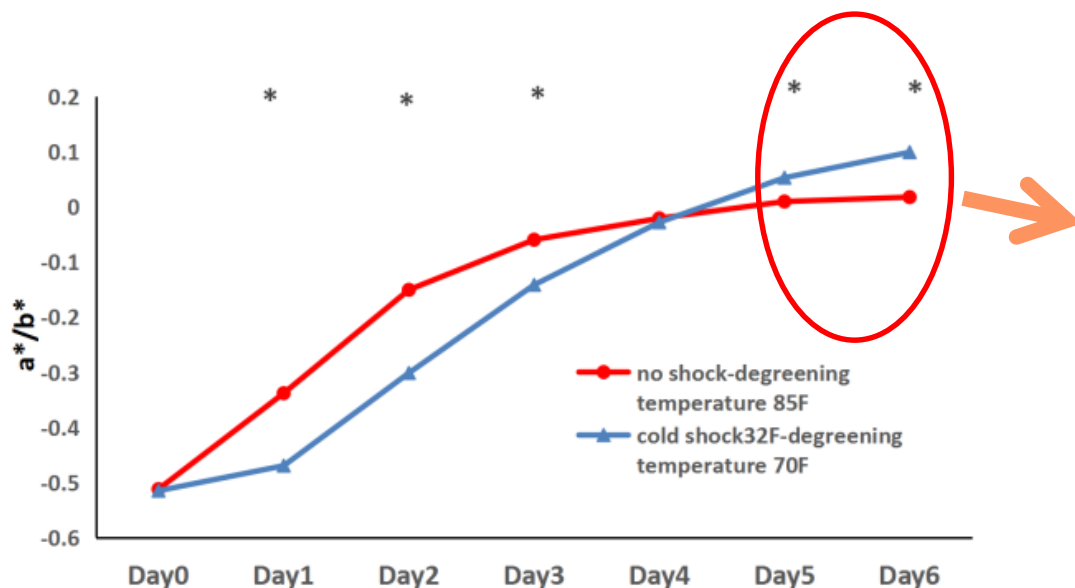
Dr. LiLi Deng

- Fruit first dipped for 1 min in 1,000 ppm ethephon (releases ethylene)
- Blue LED light significantly improved coloration (hue & a/b)
- Yes: grapefruit, Nov-harvested
- No: Fallglo, Navel, or grapefruit harvest in Dec
- Red LED light had no effect
- Neither affected internal quality



Effect of cold shock on peel color

Dr. Suming Dai



**32°F cold shock
70 F degreening**

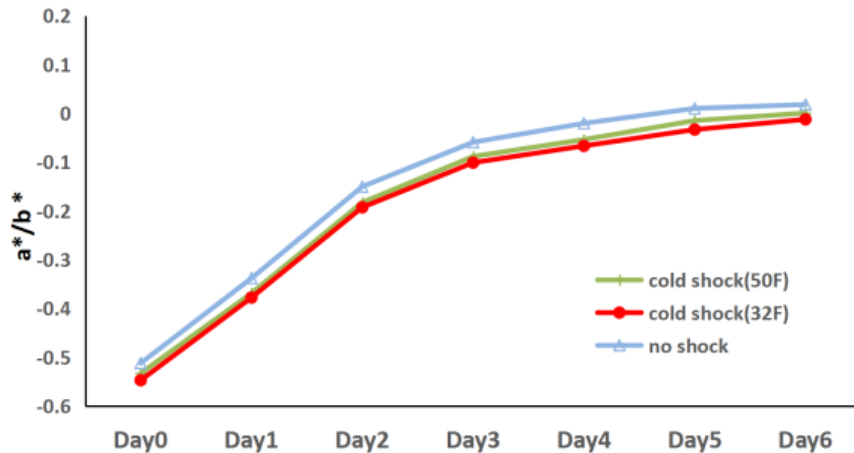


**no shock
85 F degreening**

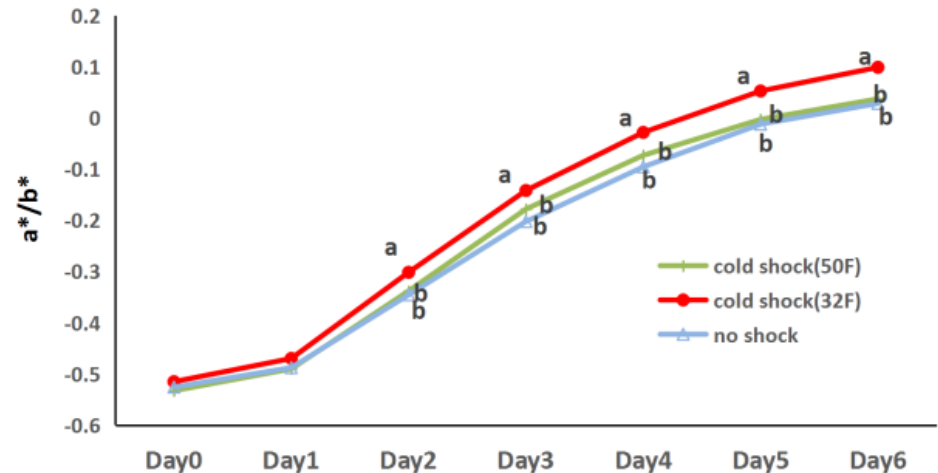
Cold shock resulted in better peel color than the commercial control after 4 days degreening

Cold Shock Effects Influenced by 3 Factors

- Degreening temperature
 - Cold shock was not effective when the fruit were degreened at the normal 85F



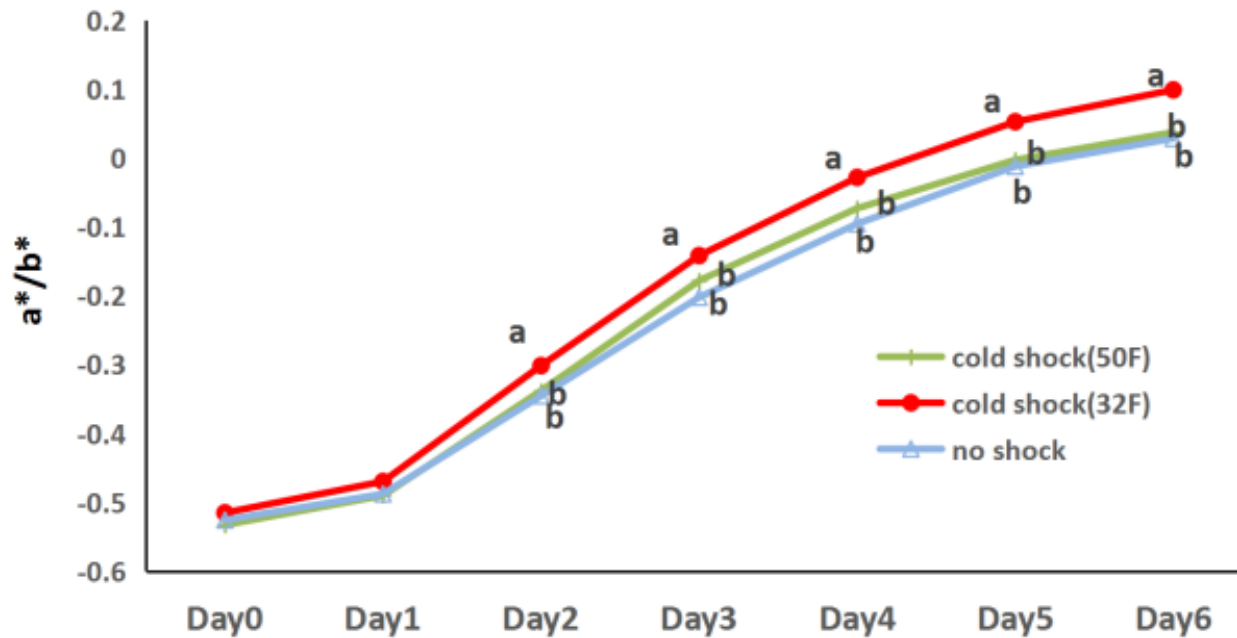
Degreened at 85F



Degreened at 70F

Cold Shock Effects Influenced by 3 Factors

- Degreening temperature
- **Cold Shock temperature**

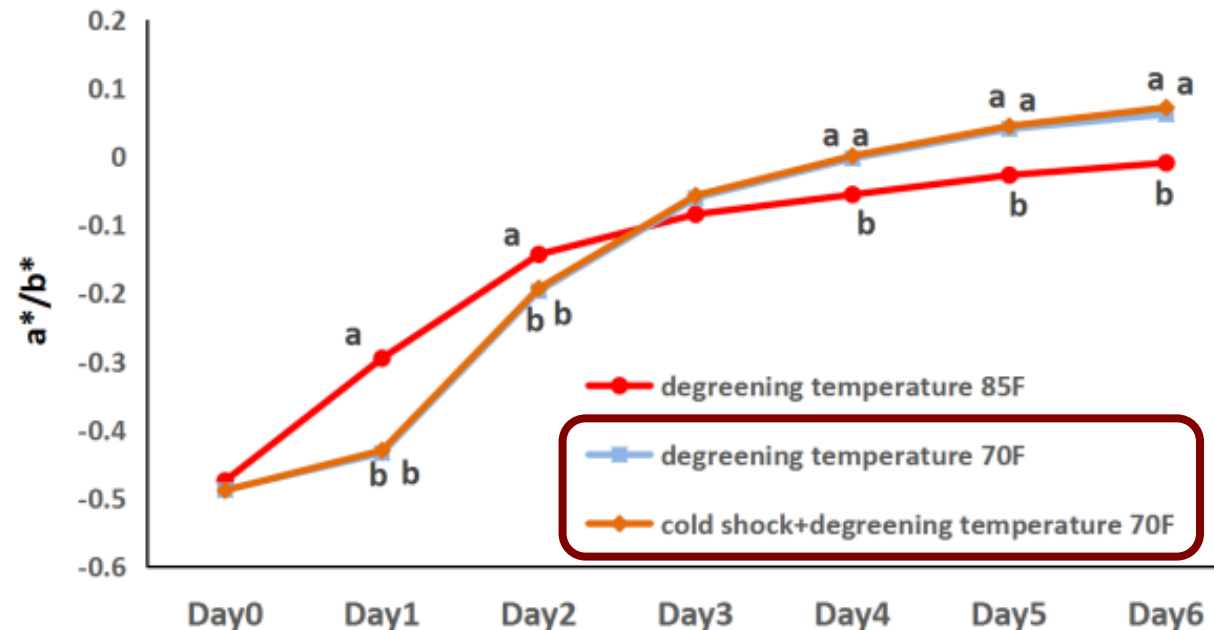


Degreened at 70F

Cold Shock Effects Influenced by 3 Factors

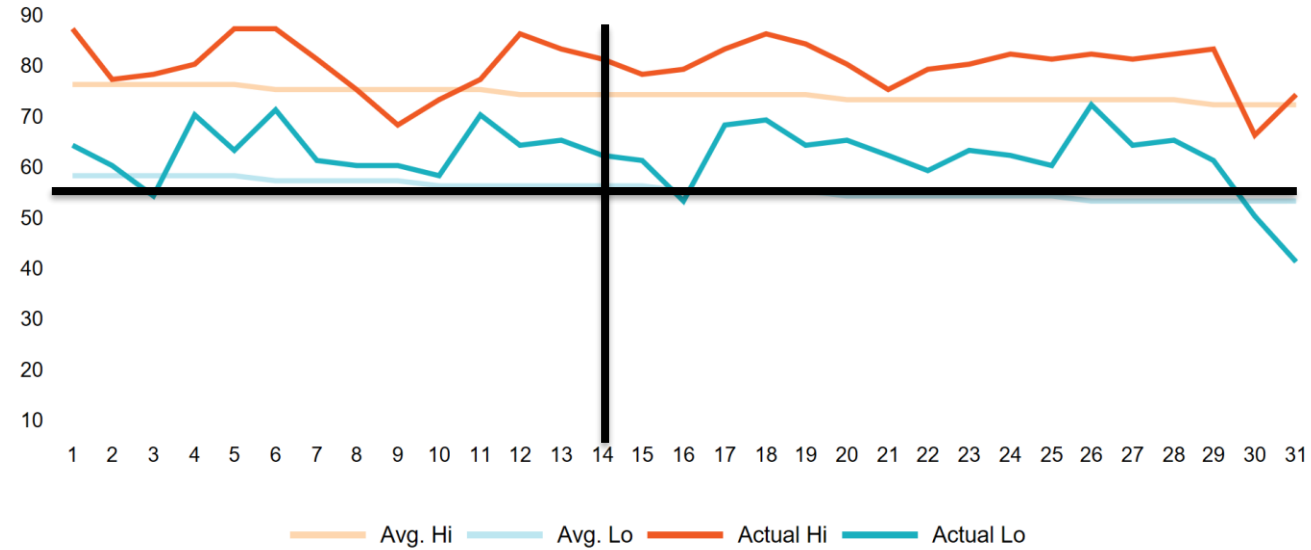
- Degreening temperature
- Cold Shock temperature
- Preharvest field temperatures
 - Cold shock eventually enhanced fruit color development on Vernia fruit harvested in Dec

– No cold shock benefit in January after cold temps in the field



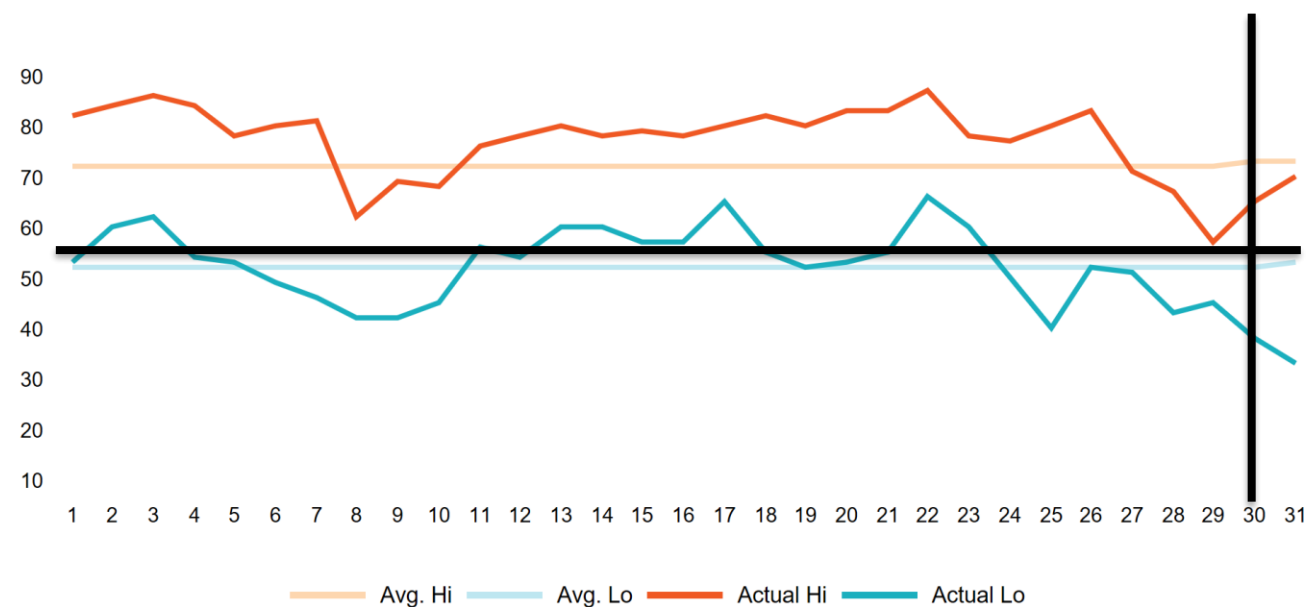
Temperature Graph December 2016

harvest



Temperature Graph January 2017

harvest



Fruit from second harvest experienced cold shock in the field

Conclusions

- Depending on citrus variety, degreening at cooler temperatures can improve final color
- A 15 hr, pre-degreening cold shock (32F) could improve final peel color of 'Vernia'
 - **Only worked when degreening at 70F, not at 85F**
 - **No benefit after natural cold temperatures in the field**
 - **Even after 6 days degreening, color was still not great**



Thank You!

- For more information,
visit the UF Postharvest Website

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