Citrus Degreening

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What is degreening?
The process of exposing “green” citrus fruit with low levels of ethylene to enhance coloration

Success is dependent on:
• Initial Peel color
• Temperature
• Duration of exposure

Chlorophylls
Photosynthetic carotenoids
Chloroplast
Thylakoids
NON-Photosynthetic carotenoids
Chromoplast

Coloration stops when C$_2$H$_4$ is stopped
Preharvest Factors Affecting Degreening

- Fruit Maturity, Tree Vigor, and Climatic Effects
- Cultural Practices

Preharvest Factors Affecting Degreening

Fruit Maturity, Tree Vigor, and Climatic Effects

- Immature fruit may be poorly colored
- Fruit from trees that are vigorously flushing are more difficult to degreen
- Natural color break needs to have been initiated
  - 7 - 13 C (45 – 55 F) night temperatures
- For best color development in CA valencia orange need
  (Young and Erickson, 1961)
  - 20C (68F) day; 7C (45F) night; 12C (54 F) soil

Cultural Practices

- Rootstock
  - Affects tree vigor and may therefore affect color break
- Spray Programs
  - Summer oil insecticide sprays may delay color break
  - Gibberellin application
- Fertilization Practices
  - High Nitrogen which increases tree vigor, thereby affecting color break

Grierson and Newhall (1960)

The Degreening Atmosphere

- Ethylene
- Temperature
- Humidity
- Air Circulation
- Ventilation and Atmospheric Composition
The Degreening Atmosphere - Ethylene

- Results in the destruction of chlorophyll and the development of carotenoids
- Will stimulate respiration; with low ethylene levels effect is transitory
- May stimulate volatile production
  Greater stimulation in green vs yellow lemons (Norman and Craft, 1968)
- May enhance decay especially stem end rots as well as anthracnose
- Hastens button senescence
- Literature for the most part indicates that it is unnecessary to exceed 5 ppm, lower concentrations may be equally effective depending on cultivar

The Degreening Atmosphere - Humidity

- Low R.H. may result in soft fruit and loss of size
- Very low humidity may inhibit process
- Low R.H. may accentuate physical blemishes and increase stem end rind breakdown
- Best results with 90-95%
The Degreening Atmosphere - Temperature

- De-greening temperature varies with growing region
  - 29°C in FL vs. 20-21°C in CA

- High temperatures inhibit carotenoid pigments (>30°C; 86°F)

The Degreening Atmosphere – Air Circulation

Good air circulation is required

- to equalize conditions of temperature, humidity, ethylene through entire room
- to uniformly deliver ethylene to every fruit
- to remove unwanted products such as carbon dioxide and volatiles (?) from room

The Degreening Atmosphere – Atmospheric Composition

High carbon dioxide can inhibit ethylene

Threshold values of CO₂ inhibitory effect is unclear
- 1% - FL orange and grapefruit degreening rooms (Grierson and Newhall, 1960)
- 2.5%, Shamouti oranges; 5%, lemons (Cohen, 1973) in controlled environment

Oxygen concentration may have some influence; reports are confusing

Other Factors Affecting Degreening

Packinghouse Treatments

- Bin Drenching
- Washing
  Increases time for degreening?
- Waxing
  Inhibits
- Color Sorting
  Increases efficacy of treatment
Ethylene Degreening
What do we degreen?

- Early season navel oranges
- Re-greened valencia oranges
- Lemons
- Mandarins

Degreening
- Early season navels
- Late season valencias

1 - 5 ppm ethylene
68 - 70 F; 90 - 95% RH
<1% CO₂

Degreening of Mandarins
Mainly early season satsumas harvested before the onset of cool temperatures

Source: J. Smilanick
Blue Mold
P. italicum

Green Mold
P. digitatum

Caused by wounding during harvesting and handling
Sporulation - direct loss and necessitates repacking

Desert lemons harvested in August - October
Coastal lemons on a more limited basis

Lemon Degreening

Ethylene Degreening
Recommended Conditions

- Ethylene: 1-5 ppm
- Temperature:
  - 20-21°C (68-70°F) in CA
  - 28-29°C (82-84°F) in FL
- Humidity: 90-95%
- Ventilation: 1 air exchange/hour
- Carbon Dioxide: reports varies, <1%
Thank you for your attention