

## Ripening Avocados

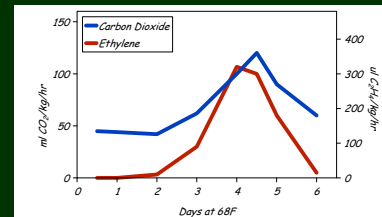


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## What we know about the avocado and why it responds to ethylene

- A climacteric fruit showing an increase in respiration and ethylene production during ripening
- Influenced by maturity, time after harvest, temperature and atmosphere



Adapted from Eaks (1978) for 'Hass'

## The avocado is susceptible to low temperatures



External Chilling Injury



Internal Chilling Injury



Body Rot

## The avocado is susceptible to postharvest decay



Stem End Rot

## Why Ripen Avocados?



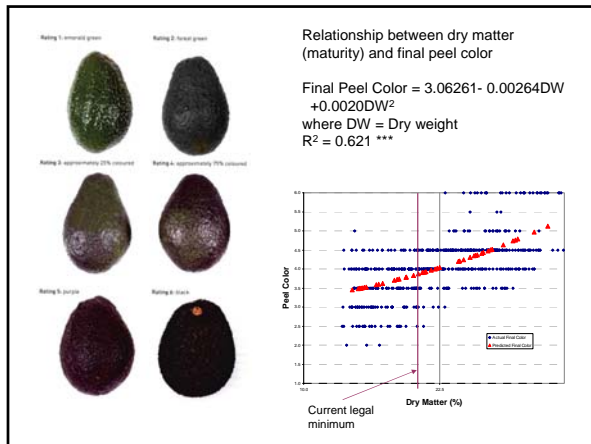
Untreated, fruit ripening may range from a few days to even weeks within a carton

Increase Uniformity  
Decrease Checkerboarding

## Factors that you can't control but should think about

- Preharvest Influences
- Small fruit sizes (why is the fruit small????)
- Maturity
- Age of fruit (days from packing)
- Temperature history (harvest, precooling and post packing management)

*Realize that all these variables will influence the ripening behavior of the fruit*



## Factors under your control

*Educate yourself about the potential differences between varying sources of fruit - there are differences*

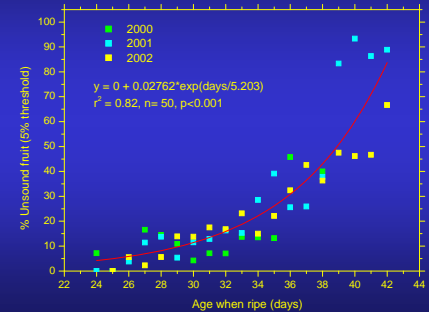
- Pre-ripening inspection
- Ripening management
- *Postripening management*

## Pre-ripening inspection

### What to know

- Age of fruit (days from pack)
- Source of fruit (country and relative maturity; shipping conditions, 1-MCP)
- Temperature and stage of arrival ripeness (firmness)
- Keep a log of your observations
- Assess if any external decay or chilling injury present
- Destructive sampling is necessary for good quality control - use common sense

## Relationship between fruit age and unsound fruit



## Ripening Management

- Uniform heating and cooling is **ABSOLUTELY ESSENTIAL**
- Refrigeration needs to control the heat (6000 BTU/pallet)
- Forced air ripening is critical (1000 cfm/pallet)
- Venting (preferably flow through, keep CO<sub>2</sub> below 1%)
- Source of Ethylene - as low as possible; physiologically you only need ~10 ppm
- Fruit needs to be easily accessible in ripening room for monitoring; especially if fruit is of varying arrival condition or multiple lots of fruit
- Keep good records

## Ripening Management When do you turn off the gas?

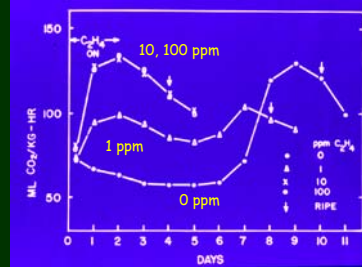
- You don't need the gas until ripe; a short duration treatment will "trigger" ripening
- Fruit may soften but may not color - maturity and other factors involved
- The best way to gauge the rate of softening is with a penetrometer...not your fingertips or buttons "popping"
- Fruit maturity is an important variable

*The penetrometer is a tool to judge the relative stage of ripeness*

## Ethylene dose considerations

- Ethylene concentration
  - >20 ppm; no more than 100 ppm
- Fruit Maturity
  - Less mature; longer treatment
- Time after Harvest
  - With increasing time after harvest; shorter durations needed

## How much to apply?



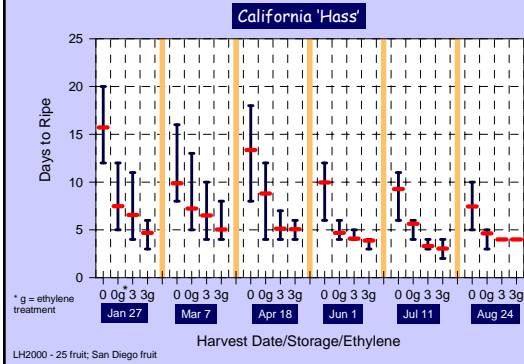
- Short exposures to ethylene can trigger ripening
- Threshold is believed to be around 10 ppm
- Commercial application of 20 - 100 ppm is recommended

Source: I. L. Eaks, UC, Riverside

## Time after harvest

- Ethylene has maximum benefit within 1-2 weeks of harvest
- Imported fruit if conventional shipment will need less time (24 hours or less)
- Imported fruit if CA shipped or 1-MCP treated may need longer treatment times

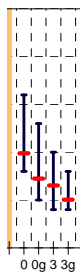
Note the affect of **maturity**, **storage** (3 wks @ 41F) and **ethylene** (50ppm) on the amount of days to ripe to <1.5 lbf at 68F as well as the variability of the data (checkerboarding)



\* g = ethylene treatment

LH2000 - 25 fruit; San Diego fruit

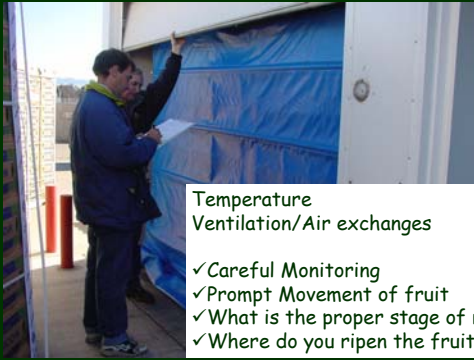
Even within lots of fruit there is variability in ripening  
 – a way to control this is sorting by degree of ripeness into different categories



## Suggested treatment times for California 'Hass' avocados

- Early season fruit (November - February) 36 - 72 hours
- Mid-season fruit (March - June) 24 - 36 hours
- Late season fruit (July - October) 8 - 24 hours

## Management Issues



### Temperature Ventilation/Air exchanges

- ✓ Careful Monitoring
- ✓ Prompt Movement of fruit
- ✓ What is the proper stage of ripeness?
- ✓ Where do you ripen the fruit?

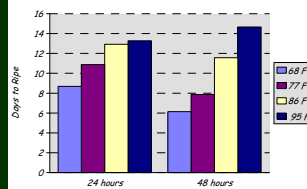
## Temperature Management

- Avocados have a VERY high rate of respiration during ripening = **HEAT**
- Efficient warming/cooling of fruit essential
- Airflow essential to maintain proper pulp temperature (68F; 20C)

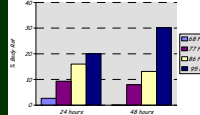
### Impact of high temperatures

- Delayed/uneven ripening
- Increased decay

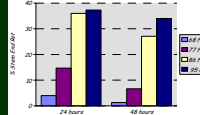
Temperature influences the "days to ripe"  
(Control = 13.93 days). All fruit ripened at 68F.



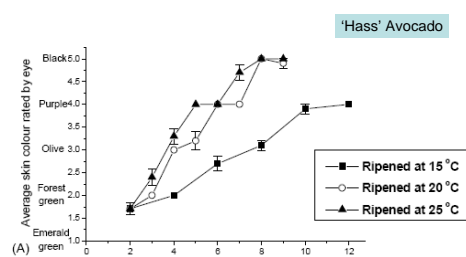
Temperature influences the incidence of body-ripen  
(Control = 6.7%). All fruit ripened at 68F.



Temperature influences the incidence of stem and rot  
(Control = 11.4%). All fruit ripened at 68F.



High temperatures during treatment are **DETRIMENTAL**.  
The outcome is **delayed or inhibited ripening and increased decay**.  
Keep temperatures below 70F (21 C)



Ripening temperature influences final peel color

Cox et al., 2004, PH Biol. Tech.

## Ventilation

- Buildup of carbon dioxide (inhibits ethylene action)
- Airflow essential to maintain proper pulp temperature (68F)

Preliminary data suggests that short durations of high carbon dioxide (up to 3%) can be tolerated but will slow overall ripening

## Managing Ripe Fruit

- Decay increases with increasing ripeness; accelerates in "overripe" fruit
- Don't hold fruit for long periods of time that are partially ripe - increased chilling injury
- Bruising increases with advancing ripeness - Protect fruit
- Peel color at "slicing" or "guacamole" ripe does not necessarily mean the fruit needs to be completely black!

*These are issues wherever fruit are ripened*

## The outcome of "ripe" fruit

Ripe fruit at retail level has greatly increased consumption, HOWEVER.....

- Greater challenge in temperature management
- Fruit sensitivity to damage greatly enhanced



Example of fruit shriveling




Example of an overripe fruit with stem end rot, body rot and internal bruising

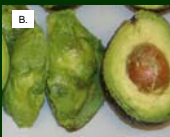


Example of a stem end rot




Example of body rots


**A.** 


**B.** 

A. Fruit with no bruising under the peel.

B. Fruit which is very overripe and is exhibiting bruising under the peel.

**A.** 

**B.** 

**C.** 

A. Very ripe fruit compressed by other fruit on display.

B. Example of internal bruising.

C. Very ripe fruit showing severe internal damage.

## Considerations for successful avocado ripening

- **Temperature management is CRITICAL**
  - Too high; ripening inhibited and increased decay
  - Too low; ripening is slowed and lose benefit
- **Fruit Maturity**
  - More mature; less time
- **Time after Harvest**
  - After storage; less time
- **Avoids delays in marketing**
- **Minimize fruit handling**

### Checklist

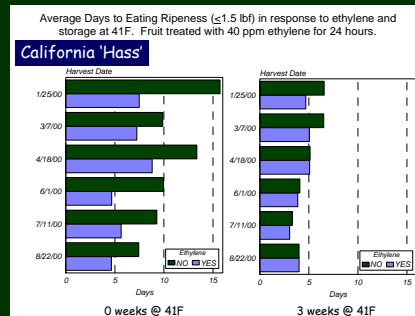
- Know the history of the fruit
- Quality; don't use stressed fruit
- Standardize fruit size and maturity
- Uniform warming and cooling
- Careful monitoring; don't overripen

**CONSUMER/MARKET Education**

## Additional information

- **Contact me**  
arpaia@uckac.edu
- **UC Davis Postharvest Center website**
- **California Avocado Commission website**  
information on avocado ripening  
industry research reports (go to grower section)
- **General information on avocados**  
www.avocadosource.com

## Time after harvest



Time after harvest decreases the impact of ethylene

## Postripening Management

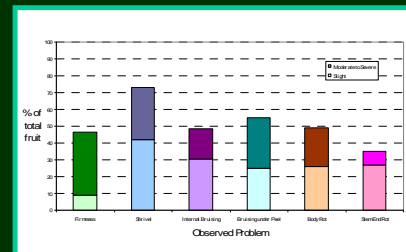
- **Temperature** and softening rate
- Chilling injury susceptibility
- Move fruit as quickly as possible to end user
- Protect the fruit from damage

## Important considerations

- Know storage conditions
- Delivery schedule to end user
- Know the demographics of your market; i.e. how fast fruit moves at individual stores
- Know how fruit is displayed (refrigerated or not)



The average incidence of fruit quality problems judged to be either slight or moderate to severe



Market Survey, 2005