





### What we know about the avocado fruit

- It is 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 graph shows the production of Carbon Dioxide (ml CO<sub>2</sub>/kg/hr) and Ethylene (μg/kg/h<sup>2</sup>) over a 6-day period at 68°F. Both gases show a significant increase starting around day 3, peaking at day 4, and then declining. Carbon dioxide production peaks at approximately 120 ml/kg/hr, while ethylene production peaks at approximately 350 μg/kg/h<sup>2</sup>.

### Field Operations

- Minimum Maturity Standards
  - Dry Weight
- Harvesting Methods
- Bin Holding
- Multiple Harvests per year

### California switched to Dry Matter in 80's from oil content

*Relationship between dry wet and oil*  
 Also "raised" minimum maturity based on sensory evaluation

Work of Lee et al. (UCR)

The top graph shows a strong positive linear relationship between Percent Dry Weight and Percent Oil, with the equation  $Y = 0.67 + 1.01X$  and  $r = 0.96$ . The bottom graph shows Taste Score and Percent Oil increasing over time from September to January, with Taste Score reaching approximately 9 and Percent Oil reaching approximately 25% by January.

### Current California Minimum Maturity Standards

Dry Matter (%)	Variety
17.7	Bacon
18.7	Zutano, Reed
19.0	Fuerte
20.8	Hass
21.6	Pinkerton
22.8	Lamb Hass, GEM, Harvest
24.2	Gwen

#### Date/Size Maturity Releases

- Date/Size maturity releases allow avocados to move in a uniform manner.
- Avocados can still be harvested before the release dates, but they will be tested for minimum maturity standard.
- Regulated by CA Dept of Food and Ag.

### Dry matter determination in California

- 5-fruit bulk sample
- Core sample from middle of fruit
- Microwave drying to constant weight
- NIR for the future????



### Considerations in the grove

- Avoid picking when temperatures are high especially with late season fruit
- Avoid picking during or shortly after a rain event - more decay
- Keep fruit in a cool place, out of the sun; high temperatures can impact ripening and increase decay
- Minimize delays from time of harvest to cooling

### The link between the preharvest environment and fruit quality

**Quality does NOT improve after harvest**

Increasing body of evidence that many factors influence PH fruit quality and decay development

- Mineral nutrition, most notably N, Ca
- Rootstock via mineral distribution
- Canopy management strategies
- Plant growth regulators such as Sunny and Cultar
- Weather conditions just prior to harvest
- Fruit position on the tree

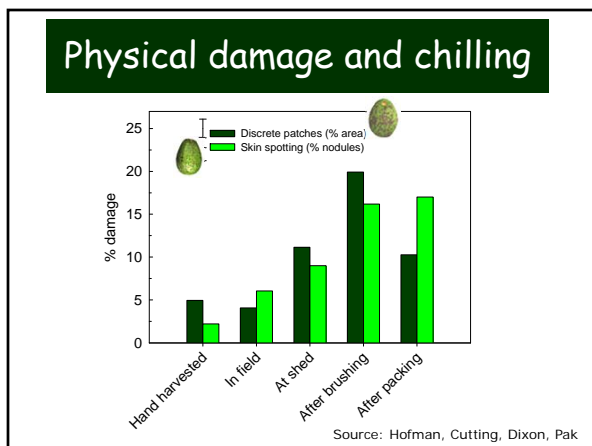
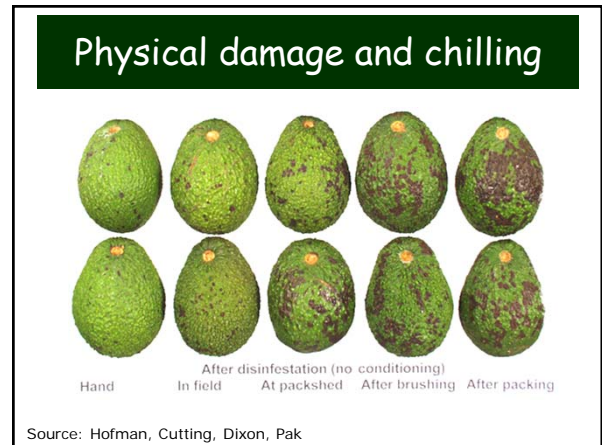
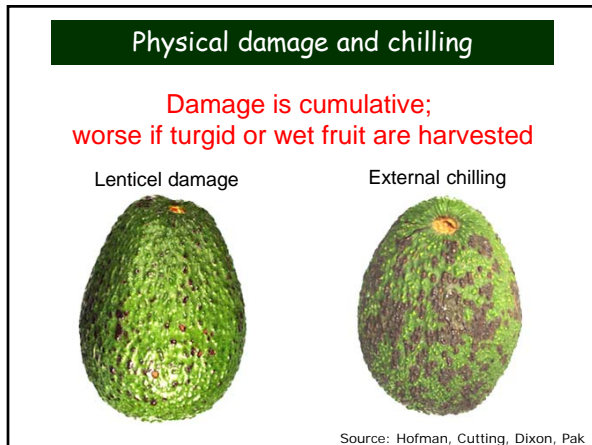
*All contribute to fruit quality; interact with each other  
 Important to understand interaction with fruit maturity*

### Packing Operations

- Bins cooled overnight
- Dry dump
- Brushing (waxing)
- Labeling/weight sizing
- Packing







- ### Avocado Storage and Transit
- California fruit marketed within 1 - 2 weeks of harvest; storage at 5C
  - US imports arrivals vary in time after harvest:
    - <5 days (Mexico)
    - 7 - 10 days Dominican Republic
    - 12 - 28 days (Peru/Chile)
    - approximately 28 days (New Zealand)
  - Fruit from Chile and New Zealand may be shipped in Controlled Atmosphere containers
  - Fruit quality has been mixed on longer transit times.....
  - 1-MCP ?


### Challenges in avocado postharvest handling



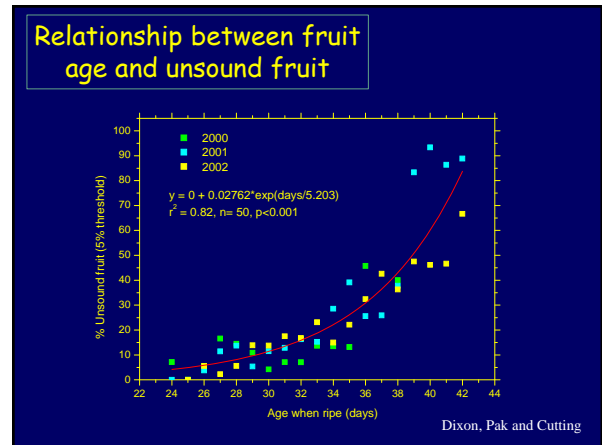
- Fruit maturity
- Fruit age - time to ship
- Cooling
- Ethylene exclusion
- Controlled Atmosphere
- 1-MCP
- Stage of ripeness when presented to the end user

### Ethylene - hastens deterioration

- Ethylene contamination
- Softening
- Physiological disorders
- Use of CA
- High CO<sub>2</sub> counteracts ethylene
- Slows softening
- Use of 1-MCP
- Can slow softening
- Development of disorders
- Risks** – overdose fruit; ripening



### There are problems with fruit arrivals

### "RIPE FOR TONIGHT"

- Increasing importance for both domestic and imported fruit
- Ethylene treatment can occur at packinghouse, distribution points or specialty handlers



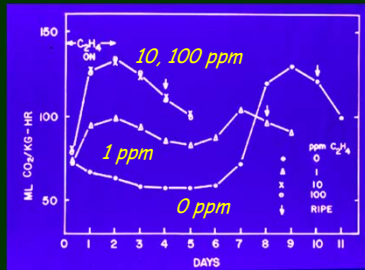
### Why Ripen Avocados?



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

**Increase Uniformity**  
**Decrease Checkerboarding**

## 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

## Ethylene dose considerations

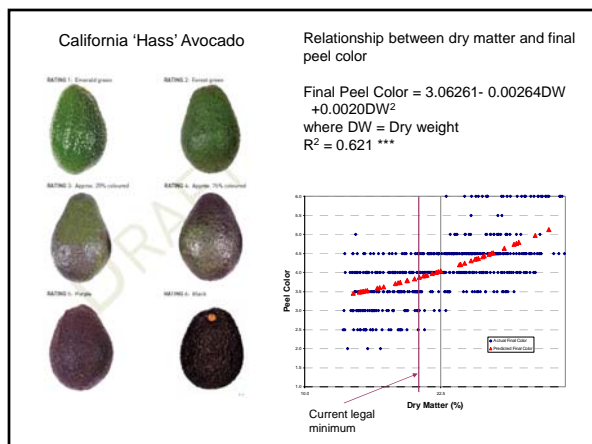
- Ethylene concentration
  - >20 ppm; no more than 100 ppm
- Fruit Maturity
  - Less mature; longer treatment
- Time after Harvest
  - With increasing time after harvest; shorter durations needed

## Time after harvest

- Ethylene has maximum benefit within 1-2 weeks of harvest
- Imported fruit (i.e. Chile) 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

## 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

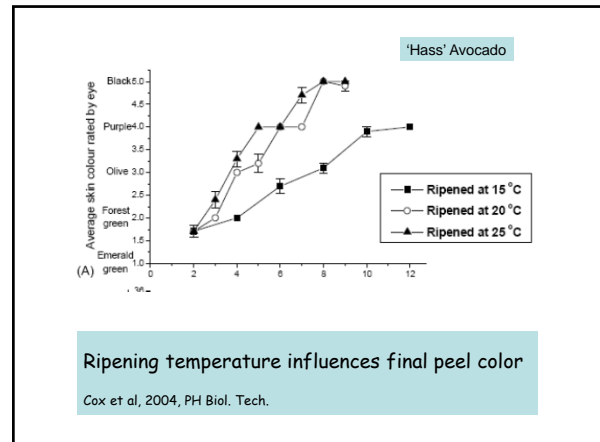
- ✓ Careful Monitoring
- ✓ Prompt Movement of fruit
- ✓ What is the proper stage of ripeness?
- ✓ Where do you ripen the fruit?

## Temperature Management

- Efficient warming/cooling of fruit essential
- Airflow essential to maintain proper pulp temperature (20C, 68F) and CO<sub>2</sub> < 1%

### Impact of high temperatures

- Delayed/uneven ripening
- Increased decay



## 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
- A problem NO MATTER the source – an opportunity to work with other industries



## Limitations to avocado postharvest handling

- Fruit maturity and quality at time of ripeness
- Time after harvest (fruit age)
- Stage of ripeness - more difficult to handle "ripe" fruit

## Additional information

- California Avocado Commission  
[www.avocado.org](http://www.avocado.org)
- Hass Avocado Board  
[avocadocentral.com](http://avocadocentral.com)
- Information on avocados in general from around the world  
[www.avocadosource.com](http://www.avocadosource.com)