

Cycle of Seminars for Technical and  
Commercial Improvement in Leading  
Export Fruit Species

**Avocado**

organized by the  
**Asociacion de Exportadores de Chile A.G. (ASOEX)**  
in conjunction with  
**Comité de Paltas Chile**  
May 3-4, 2006

Principales aspectos de postcosecha  
determinantes en la calidad y condición  
de la palta chilena de exportación

(Main determining aspects of postharvest in the  
quality and condition of avocado for export)

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Principales aspectos de postcosecha  
determinantes en la calidad y condición  
de la palta chilena de exportación



## *The continuum*

Always remember, there is a continuum from  
the grower to the consumer

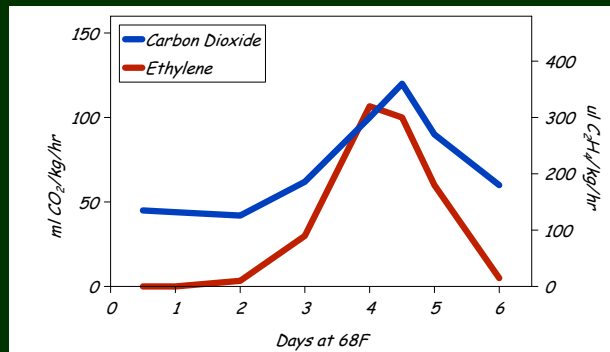
*The steps in the continuum*

*Grower - Packer - Distribution - Consumer*

*For this reason it is imperative that growers  
be involved at all levels of the industry*

## What we know about the avocado fruit

- 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'

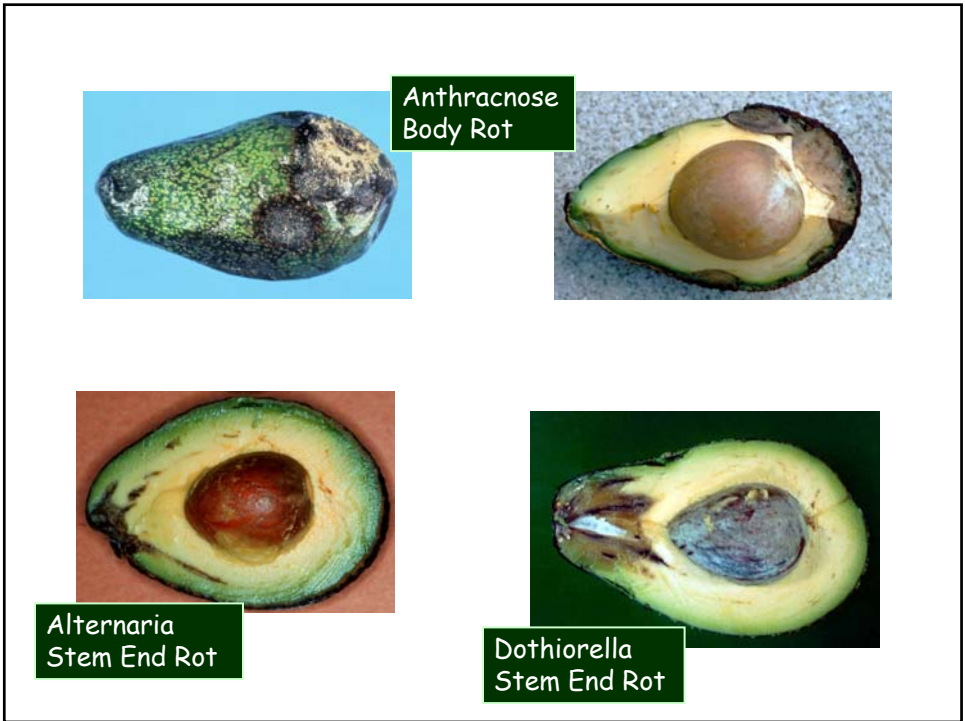
## Susceptibility to low storage temperatures



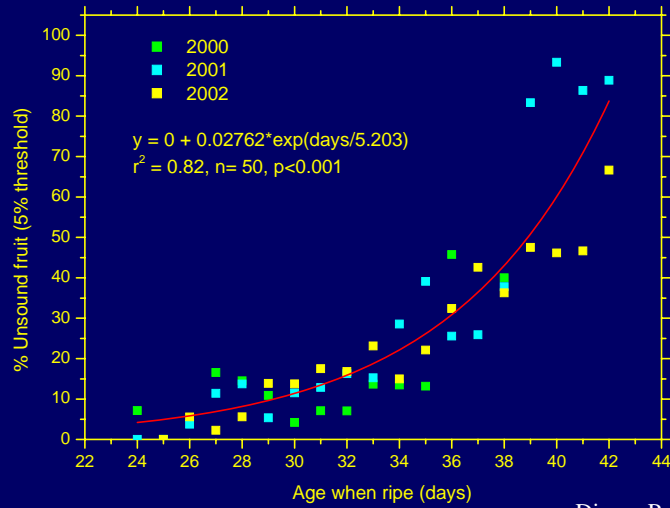
External Chilling Injury



Internal Chilling Injury



## Relationship between fruit age and unsound fruit



Dixon, Pak and Cutting

## There are problems with fruit arrivals



Who is at fault?  
*Remember the continuum*



## Grower Inputs

Need to work closely with  
your packhouse

Maturity – optimize shipping  
quality

Rainfall and decay

Temperature management  
at harvest

Speed at which fruit is  
moved to packinghouse



## Quality vs. Maturity

### Immature

- o Poor quality when ripe
- o More shriveling and physical damage

### Mature

- o Good quality when ripe
- o Longest postharvest life

### Overmature

- o Too soft, poor flavor
- o More Physiological disorders

## Fruit quality to consumers is limited by harvest maturity:

- Immature - watery, shriveling, inconsistent ripening, physiological disorders, susceptible to decay
- Overmature - can be dry, rancid, seed germinating and more susceptible to decay



## Physiological disorders accentuated with low maturity fruit

External Chilling Injury



Flesh Discoloration



## Checkerboarding (Ripening Variability)



Difficult to predict time of ripeness

Great variation in the days to ripe within a package even with ethylene treatment

**RESULT:**

Lack of ripe uniformity means more loss at point of purchase

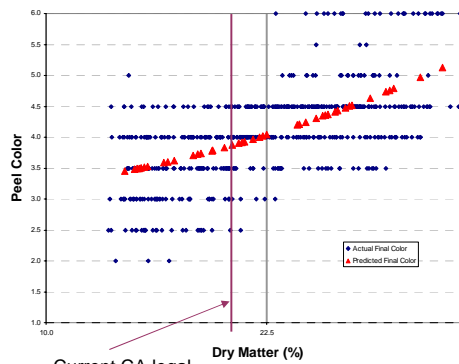
# Poor RIPE Skin Colouration



Relationship between dry matter and final peel color

$$\text{Final Peel Color} = 3.06261 - 0.00264DW + 0.0020DW^2$$

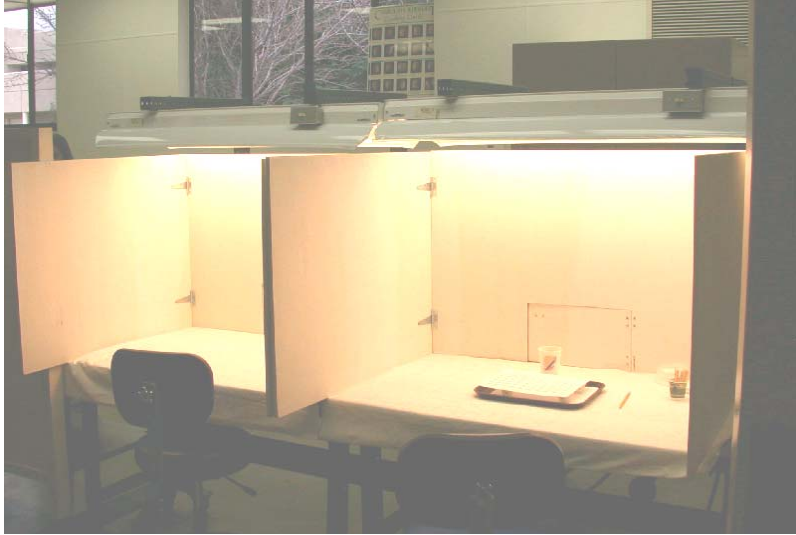
where DW = Dry weight  
 $R^2 = 0.621$  \*\*\*



Current CA legal minimum



Sabor !



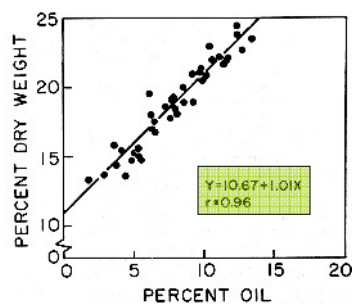
## Determination of fruit maturity

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Using dry matter as the  
standard reference when talking  
about fruit maturity

## Correlation between oil and dry matter

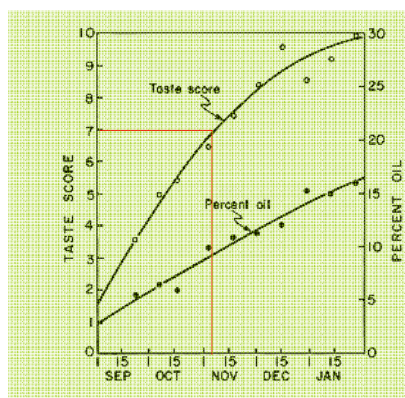
- Lee et al, 1983, J. Amer. Soc. Hort Sci.
- Demonstrated relationship between oil and dry matter
- Basis of recommendation to CA industry to switch to dry matter
- Now internationally used for maturity standard



Relationship between percent dry weight and percent oil during development and maturation of 'Hass' fruit at Escondido.

## Relationship between oil and acceptability

- Lee et al, 1983, J. Amer. Soc. Hort Sci.
- Minimum acceptable taste score = 7
- HASS variety
  - Oil content = 11.2%
  - Dry weight equivalent = 22.8%

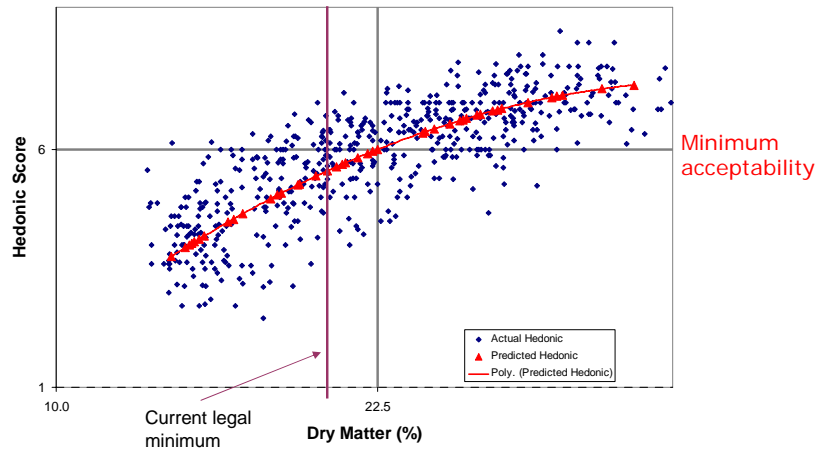


Taste and oil development during maturation of 'Fuerte' fruit grown at Irvine.

California 2002-03  
results with Ventura Co.  
Hass fruit

### Regression analysis

Hedonic Score =  $2.92669 + 0.57765DW - 0.0008DW^2$   
where DW = Dry weight  
 $R^2 = 0.867^{***}$



## Maturity work in Chile

Relationship to dry matter and oil has been established

$$Y = 53.4838 - (0.5767x)$$

Y = % oil

x = % Humidity

9% oil dry matter equivalent = 22.9%

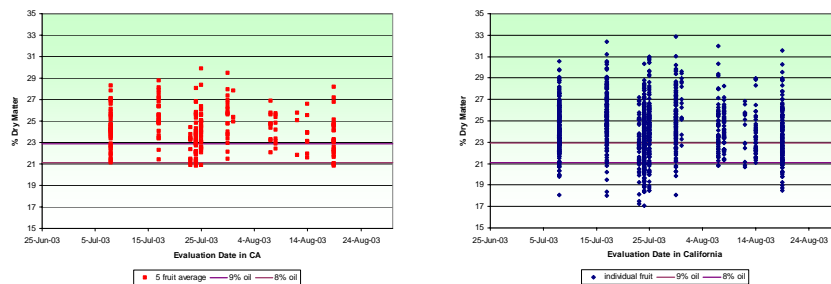
8% oil dry matter equivalent = 21.1%

# Dry matter testing of Chilean fruit after arrival in CA - 2003

Testing conducted by Avocado Inspection Program, CDFA upon arrival in California (early July to late August)

Results to be presented are from  
 1175 individual fruit  
 235 "average" samples of 5 fruit

## Average and Individual Fruit Dry Matter Values



For **5-fruit average** samples 3.4% of samples were BELOW 8% and 26.3% of samples were BELOW 9% oil equivalent

For **individual fruit** samples 9.7% of samples were BELOW 8% and 30.7% of samples were BELOW 9% oil equivalent

Minimum measured – 17.1%; Maximum measured – 32.9%

*Need to ask – what are the consequences of having nearly 1/3 of fruit arriving in CA below the Chilean standard for maturity*

Source: Associated Marketing  
Special report to CAC 11/01 - 7/02

- *Product satisfaction held at 81% of purchasing....*
- *Early months of the crop year (N-J) may furnish the market with a highly disproportionate share of annual buyers... This surely suggests the special importance of marketing quality product during the early months of the season*
- *Avocados held high repeat rate - buyers highly concentrated (22% of households account for 46% of purchases)*

## Consumer Satisfaction

Overall satisfaction - 81%

HOWEVER, from November to January 2000-01, satisfaction claims were *below* the annual average and among the lowest of the year.

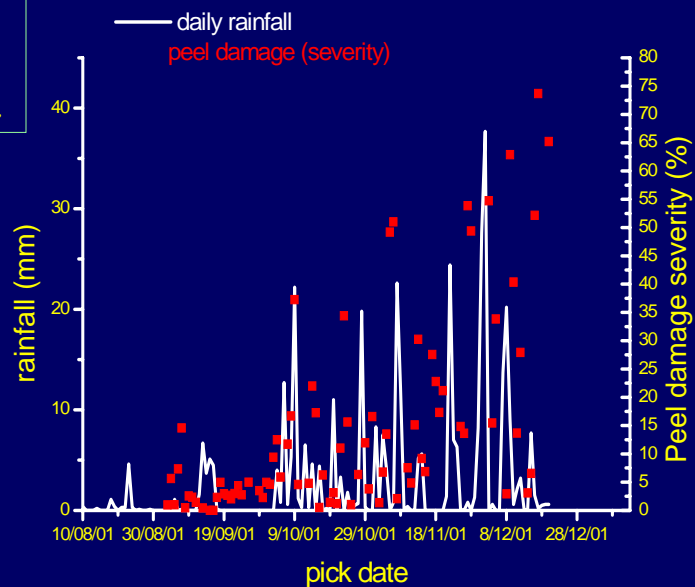
This strongly suggests the importance of *early season avocado quality* if high repeat performance may be expected to follow.

Too, it suggests the need for *increased product identification* designed to convey a consistent quality and upon which the consumer may learn to rely.

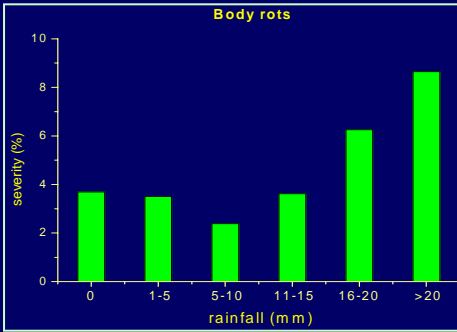
## Things to consider:

- At retail level, fruit from all exporters are mixed together - loss of identity
- Increasing importance of discount, club stores
- Importance of maintaining Food Service (currently 30% of CA fruit)
- Consumer satisfaction results
  - Repeat buyers
  - "Expectations" of the consumer

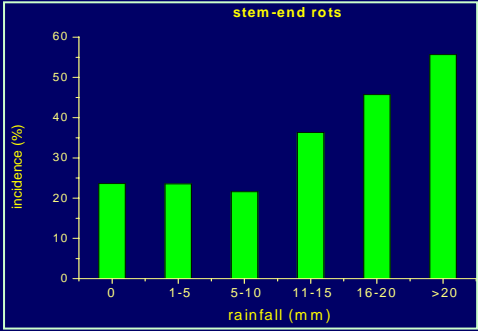
### Relationship between rainfall and peel damage



Dixon, Mandemaker, Pak and Cutting



Influence of rainfall prior to harvest on Decay

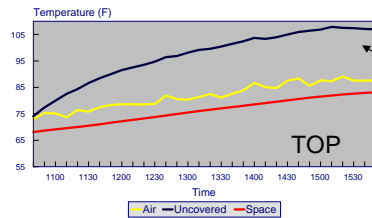


Dixon, Mandemaker, Pak and Cutting

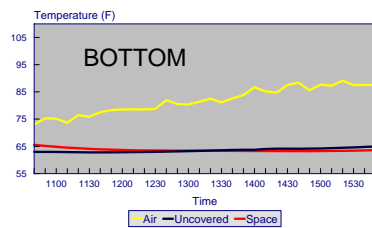
The importance of temperature management when harvesting

*From the grove onward*

## Protecting the fruit after harvest from high temperature has implications in the market place



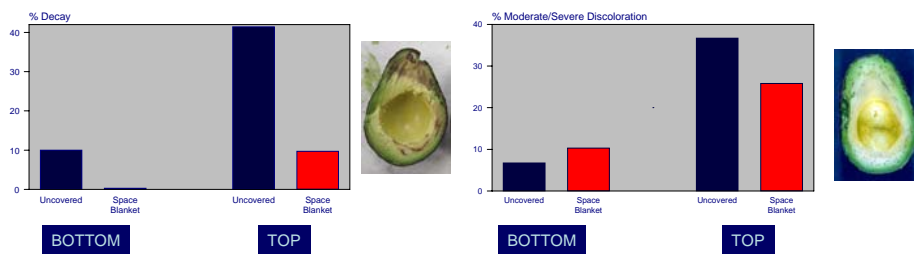
During the course of the day, fruit in the TOP 12" of the bin with no protection can reach temperatures in EXCESS of 35C whereas covered bins or those held in the shade can maintain temperatures close to ambient



Fruit at the BOTTOM of the bin stay cool during the day

Source: Arpaia, M. L., 1994; 'Hass' fruit harvested from Riverside county.

## What is the outcome of high temperatures in the field after harvest?



Fruit from the BOTTOM of the bin (lower temperatures) had lower decay and less chilling injury after storage at 5C and ripening.

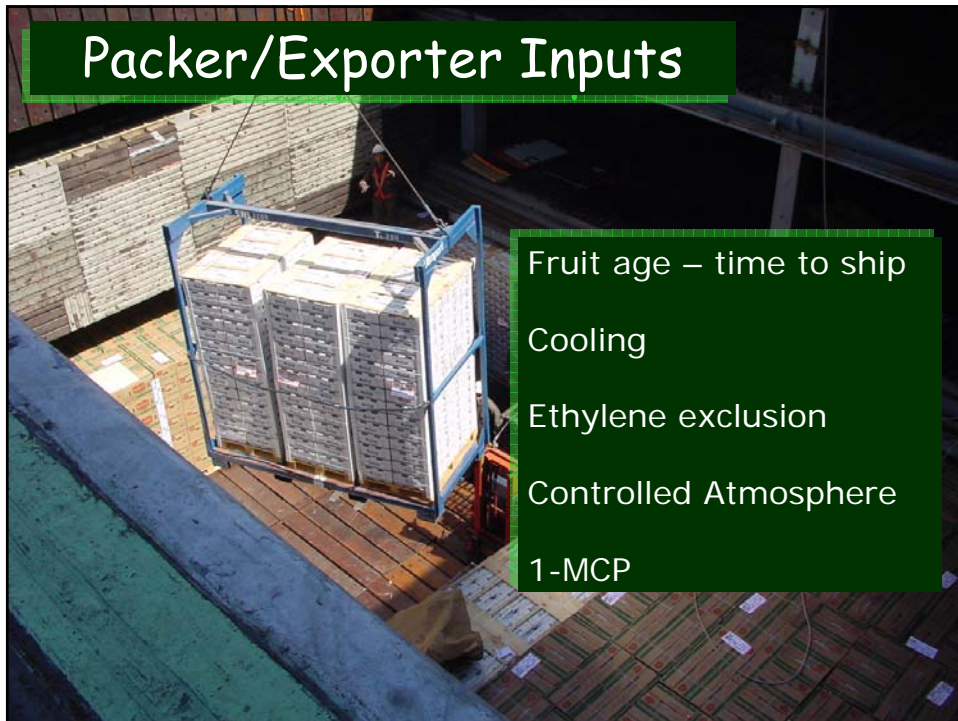
However, fruit from the TOP of the bin, which were warmer, had higher levels of both decay and chilling injury. This is especially true for the fruit which came from the uncovered bins.

Source: Arpaia, M. L., 1994; storage was for 6 weeks at 5C.

## Considerations in the grove

- Keep fruit in a cool place, out of the sun
- Handle the fruit gently
- Work with packinghouse to minimize delays from time of harvest to cooling
- Avoid picking when temperatures are high especially with late season fruit
- Avoid picking during or shortly after

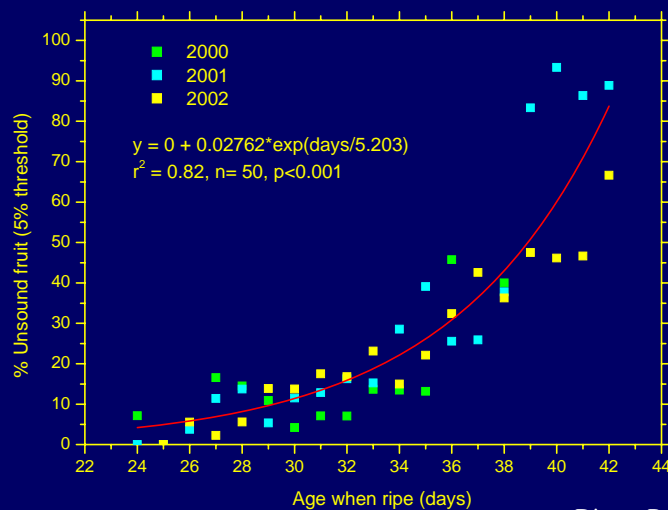
## Packer/Exporter Inputs



## Avocado Storage and Transit

- California fruit marketed within 1 - 2 weeks of harvest; storage at 5C
- US imports arrivals vary in time after harvest:
  - <10 days (Mexico)
  - 12 - 21 days (Chile)
  - approximately 28 days (New Zealand)
- Fruit quality has been mixed on longer transit times.....
- 1-MCP ????????????

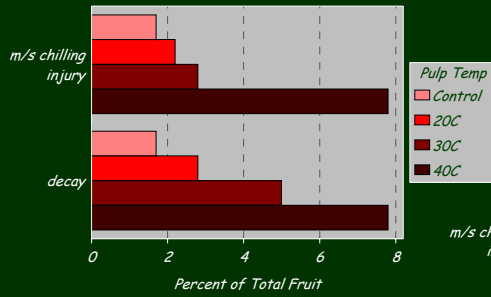
## Relationship between fruit age and unsound fruit



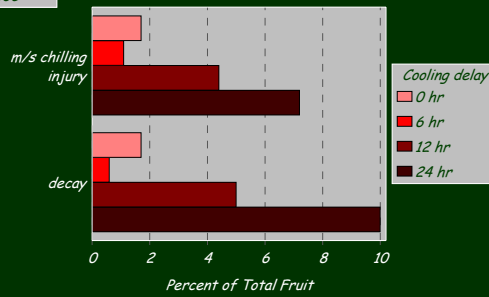
Dixon, Pak and Cutting

## Short Duration High Temperature Effects on 'Hass' Fruit Storage and Quality (Arpaia, 1994)

*Pulp temperature effects during delayed cooling on fruit quality following 4 weeks at 5C*



*Delayed cooling effects on fruit quality following 4 weeks at 5C*



## Physical damage and chilling

Lenticular damage



External chilling



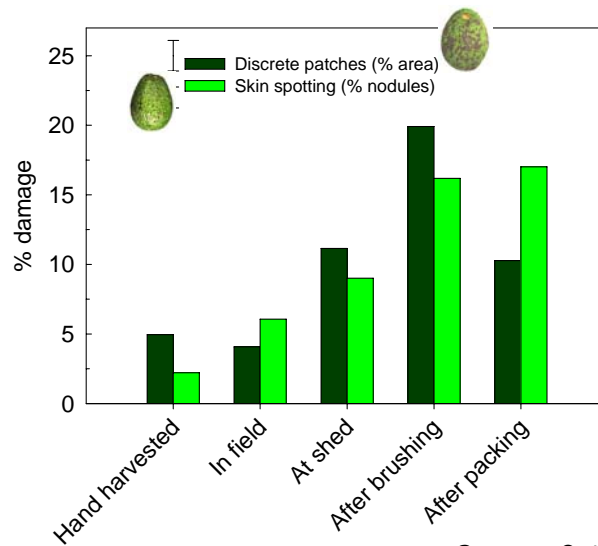
Source: Cutting, Dixon, Pak

## Physical damage and chilling



Source: Cutting, Dixon, Pak

## Physical damage and chilling



Source: Cutting, Dixon, Pak

## 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



## Destination Market Inputs



Delays in handling including  
inspection at port

Market movement

Ethylene ripening

# Market Fruit Quality Surveys



Conducted in collaboration with CAC Merchandising Staff



Example of fruit shriveling



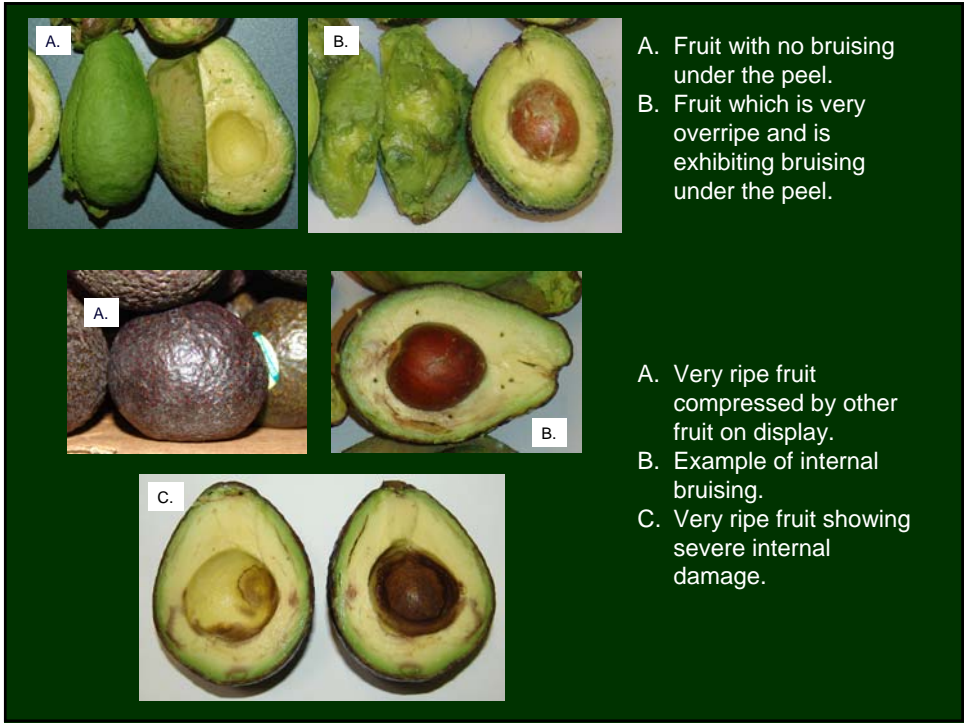
Example of an overripe fruit with stem end rot, body rot and internal bruising

Example of a stem end rot

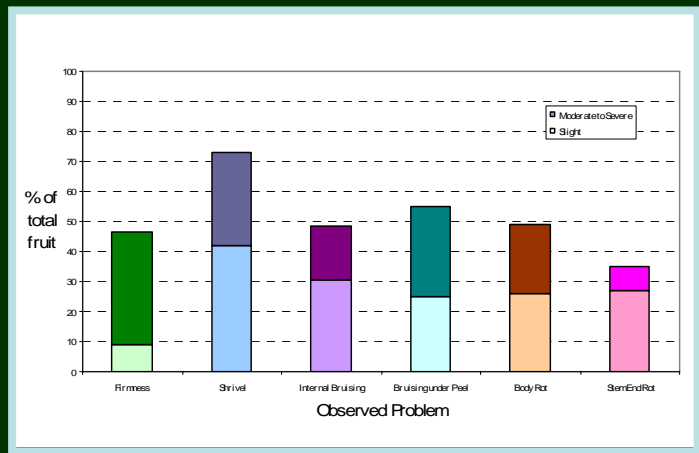


Example of body rots





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



Market Survey, 2005

## Solving problems at the marketplace

- Ethylene treatment of fruit increasing and becoming an important tool to make the avocado more consumer friendly
- Consequence of handling ripe fruit – MORE Physical damage
- A problem NO MATTER the source – an opportunity to work with other industries
- Coordination with HAB?



## 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

## Looking to the future

- Greater international coordination
- New varieties with improved attributes
- Better orchard management
- New postharvest technologies to assist in maintaining fruit quality

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*The steps in the continuum*

*Grower - Packer - Distribution - Consumer*

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