



León, Mexico
23-25 Sept 2008

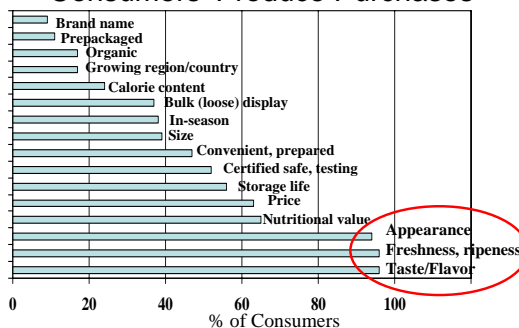
Impact of Ripening & Storage Conditions on Ripe Tomato Quality



Marita Cantwell
Dept. Plant Sciences
Univ. California, Davis, CA 95616
micantwell@ucdavis.edu;
http://postharvest.ucdavis.edu



Factors that influence U.S. Consumers' Produce Purchases



Fresh Trends, 1990. Vance Research Services.

Tomato Quality Attributes



- **Size, shape**
- **Condition**
 - no damage
 - no decay
- **Texture**
 - Firmness, mealiness, juiciness, slice integrity
- **Color**
 - Red color and lycopene content
- **Flavor and Composition**
 - Sugars
 - Acids
 - Aroma volatiles
 - Vitamins



Maturity & Ripening Stages

- 1 GREEN** The tomato surface is completely green. The shade of green may vary from light to dark.
- VR 2 BREAKERS** There is a definite break of color from green to bruised fruit Tannish-yellow, pink or red or 10% or less of the tomato surface.
- 3 TURNING** Tannish-yellow, pink or red color shows on over 10% but not more than 30% of the tomato surface.
- 4 PINK** Pink or red color shows on over 30% but not more than 90% of the tomato surface.
- 5 LIGHT RED** Pinkish-red or red color shows on over 60% but red color covers not more than 90% of the tomato surface.
- 6 RED** Red means that more than 90% of the tomato surface, in aggregate, is red

<http://www.tomato.org/>
<http://www.floridatomatoes.org/>

Shelf-life/Storage/Ripening Conditions

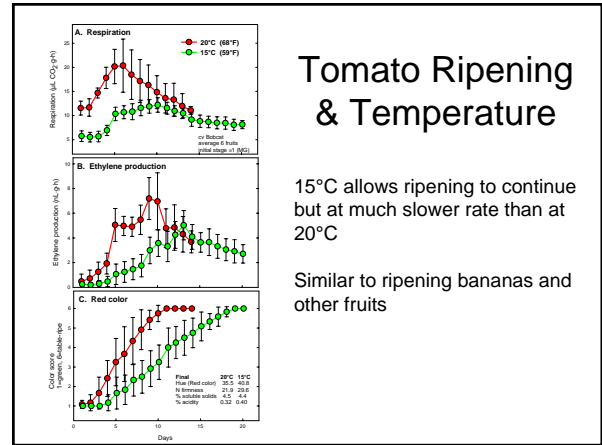
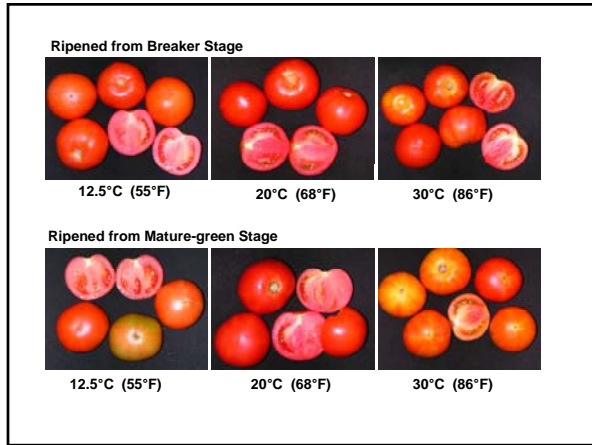
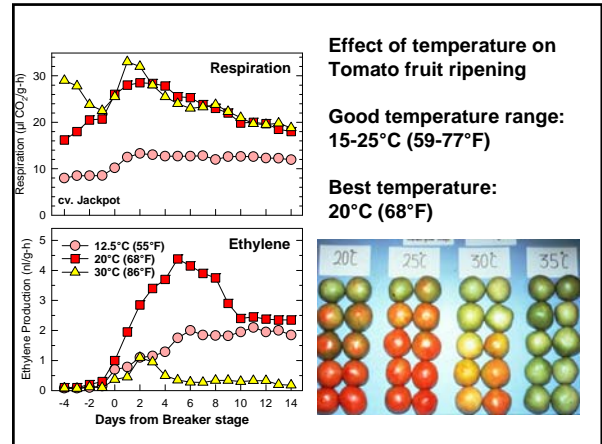
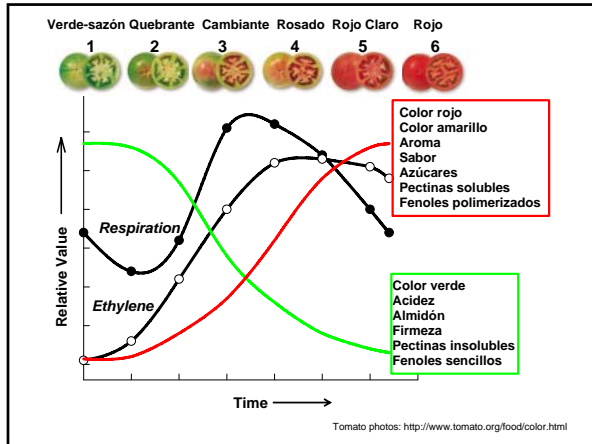
- ✓ Temperature and ripening of different tomato types; update conventional tomato chart
- ✓ Impact of lower than recommended storage temperature; slight chilling; differences among varieties
- ✓ Ripening Temperature and ethylene treatment
- ✓ Temperature and RH -Impact on firmness and gloss

Table 1. Effect of temperature on ripening rates of conventional tomatoes.

| Ripeness stage | Days to full red color at indicated temperature | | | | | |
|----------------|---|------------|--------------|------------|--------------|------------|
| | 12.5C 55F | 15C 59F | 17.5C 64F | 20C 68F | 22.5C 72F | 25C 77F |
| Mature-green | 18 | 15 | 12 | 10 | 8 | 7 |
| Breaker | 16 | 13 | 10 | 8 | 6 | 5 |
| Turning | 13 | 10 | 8 | 6 | 4 | 3 |
| Pink | 10 | 8 | 6 | 4 | 3 | 2 |

Ethylene Treatment for Ripening MG fruit

- Ethylene concentration: 10-100 ppm
- Temperature: 15-25°C (60 to 77°F) ←
- Relative humidity: 90-95%
- Duration: 24 to 72 hours ←
- Air circulation: sufficient for distribution of ethylene in ripening room
- Ventilation: sufficient to prevent accumulation of CO₂ which reduces effectiveness of ethylene



Tomatoes ripen into similar quality in temperature range from 12.5-20°C

| Temp. °C | Initial color | Days to TR | Weight loss % | Firmness N | Red color Hue | SS % | Sugar mg/ml | TA % | Vit. C mg/100ml |
|----------|---------------|------------|---------------|------------|---------------|------|-------------|------|-----------------|
| 20 | 2 | 13 | 4.3 | 27.0 | 35.0 | 4.0 | 18.3 | 0.26 | 21.8 |
| 12.5 | 2 | 32 | 4.2 | 18.2 | 38.3 | 4.0 | 17.8 | 0.26 | 24.3 |
| 20 | 3 | 11 | 3.4 | 23.0 | 35.9 | 4.0 | 20.8 | 0.26 | 27.4 |
| 12.5 | 3 | 22 | 3.0 | 28.5 | 39.4 | 4.2 | 19.5 | 0.28 | 29.9 |
| 20 | 4 | 7 | 2.2 | 25.5 | 37.2 | 4.0 | 20.2 | 0.29 | 26.6 |
| 12.5 | 4 | 18 | 2.2 | 26.3 | 37.6 | 4.1 | 19.9 | 0.27 | 30.3 |
| 20 | 5 | 5 | 2.0 | 23.0 | 39.7 | 3.9 | 19.4 | 0.28 | 27.4 |
| 12.5 | 5 | 18 | 2.3 | 20.5 | 37.5 | 4.2 | 22.7 | 0.26 | 29.3 |
| Ave. | 20C | 9 | 3.0 | 24.6 | 37.0 | 4.0 | 19.7 | 0.27 | 25.8 |
| Ave. | 12.5C | 22 | 2.9 | 23.4 | 38.2 | 4.1 | 20.0 | 0.27 | 28.4 |
| LSD.05 | | | 0.5 | 3.7 | 1.8 | 0.2 | 2.9 | ns | 3.5 |

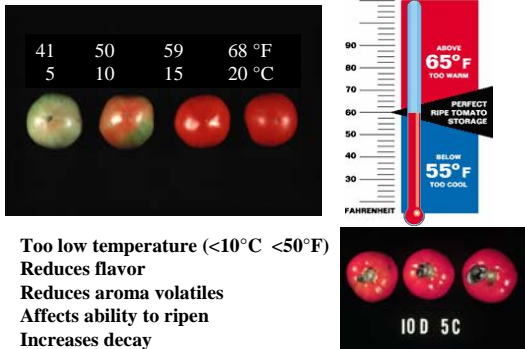
Cantwell, 2003 MCP#7, unpublished; cv Bobcat

Storage of Tomatoes

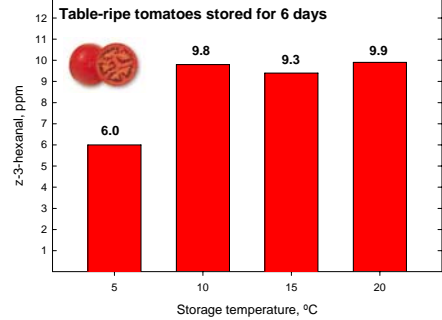
- 12.5°C (55°F)
- No lower than 10°C (50°F)
- 2-3 weeks
- Controlled atmospheres
3% O₂, <3% CO₂
Relative humidity ~85%

<http://postharvest.ucdavis.edu/Produce/ProduceFacts/Veg/tomato.shtml>

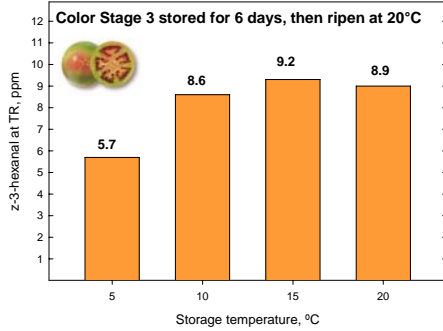
Avoid chilling temperatures for tomatoes



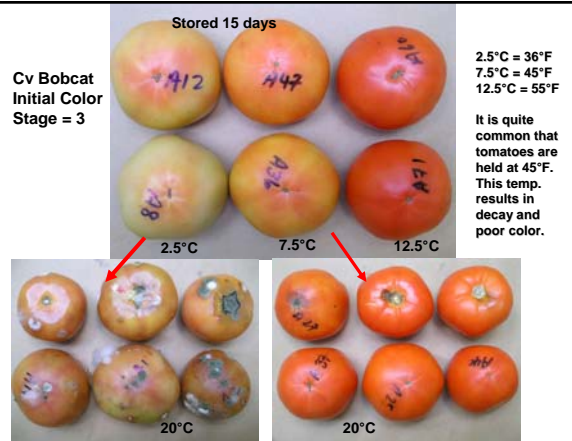
Low temperatures reduce aroma volatiles z-3 hexanal as example of important volatile



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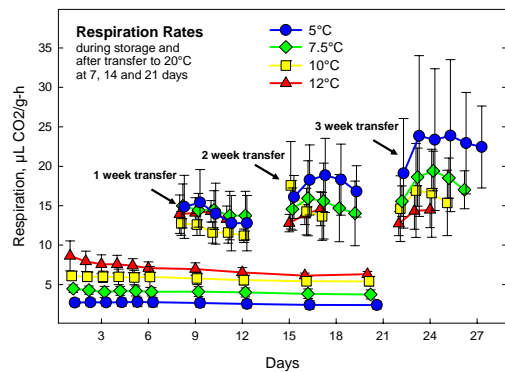


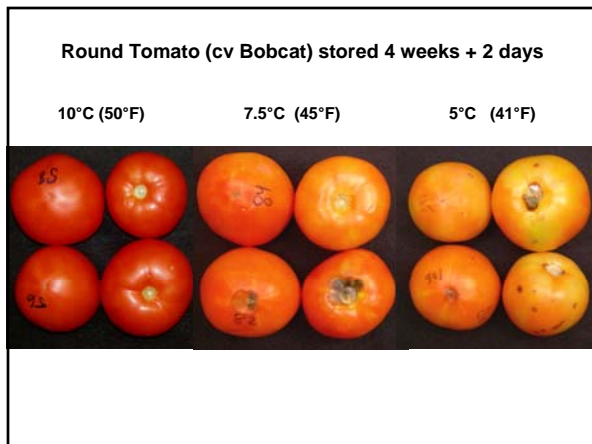
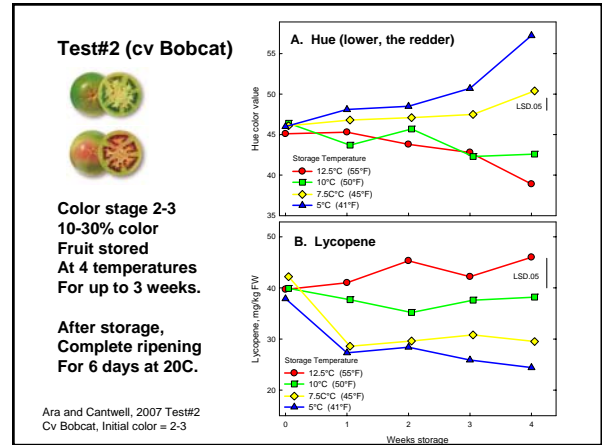
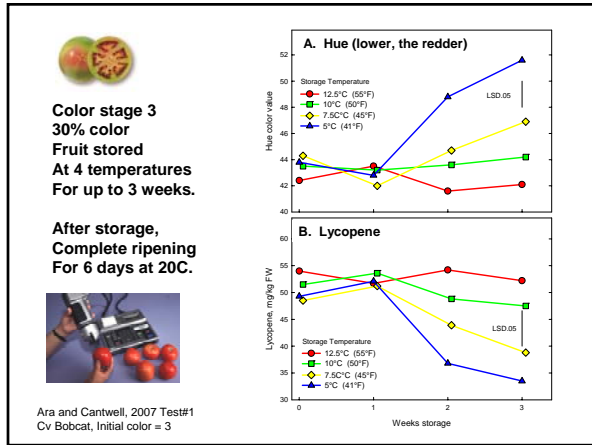
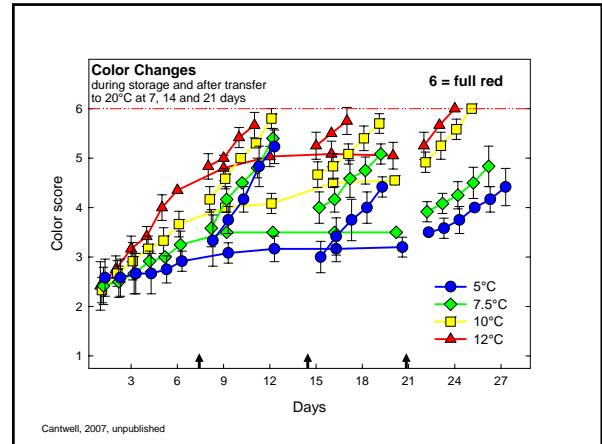
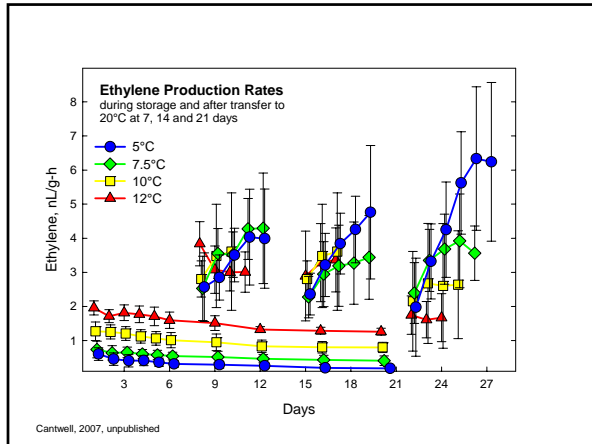
Cv Bobcat
Initial Color
Stage = 3



Consequences of Storing Tomatoes Below Recommended Temperatures

- Round Tomatoes, cv Bobcat, color stage 2-3
- Stored at 5, 7.5, 10 and 12.5°C for up to 3 weeks
- Transferred to 20°C to complete ripening maximum 7 days
- Evaluate
 - respiration and ethylene production rates
 - weight loss, decay, firmness, color
 - composition (%SS, acidity, sugars, lycopene, Vitamin C)
- Several experiments on rounds & grape tomatoes





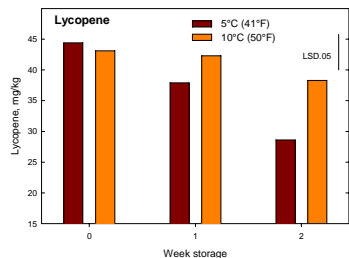
Greenhouse Round LSL Tomato stored at 5 and 10°C

- No changes over 2 weeks in 5 soluble solids, sugars, pH or acidity
- Decrease in firmness but no significant difference between temperatures
- Increase in weight loss and different between temperatures (1.3 and 0.7% after 2 wk at 10 and 5°C)
- Differences in red color values, lycopene, Vitamin C contents due to storage temperature

Greenhouse Round LSL Tomato stored at 5 and 10°C



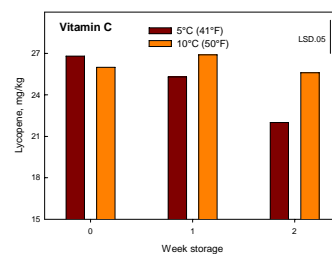
Initial color stage =5



Greenhouse Round LSL Tomato stored at 5 and 10°C



Initial color stage =5



Tomato Type & Composition

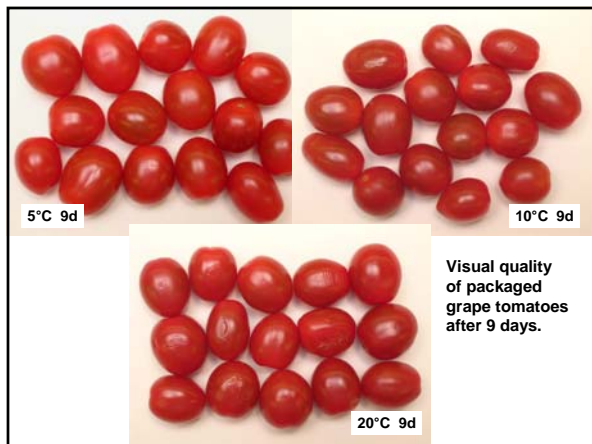
| Tomato Type | % Soluble Solids | % Titratable Acidity |
|----------------|------------------|----------------------|
| Grape | 7.55 | 0.62 |
| Cherry | 6.25 | 0.67 |
| Orange Cluster | 4.70 | 0.44 |
| Round | 4.65 | 0.33 |
| Roma | 4.25 | 0.31 |
| Round Cluster | 4.20 | 0.35 |



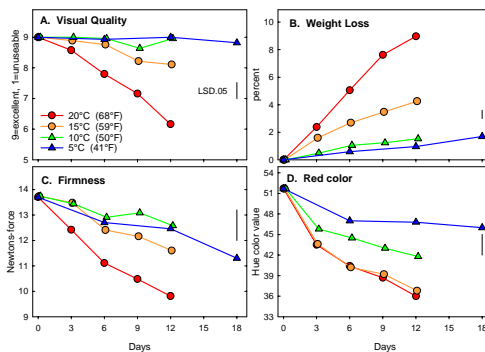
Data 2006 Test#2

Storage of Grape Tomatoes

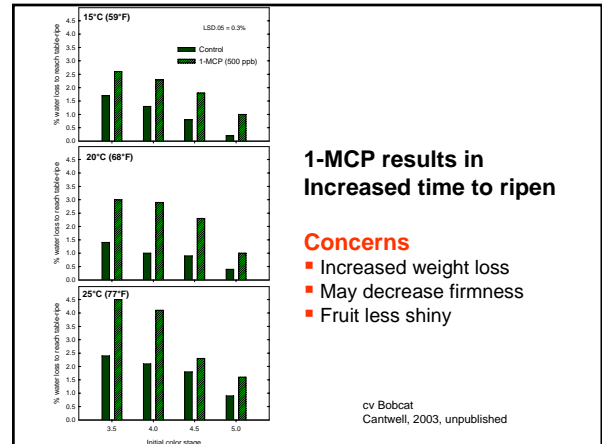
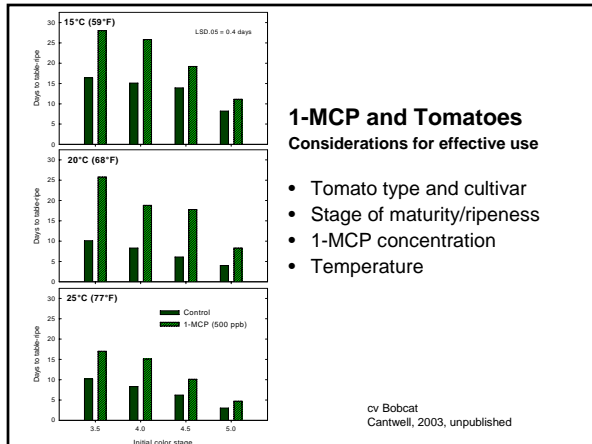
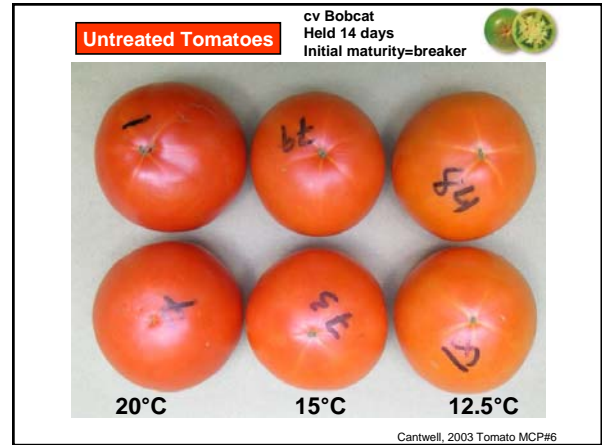
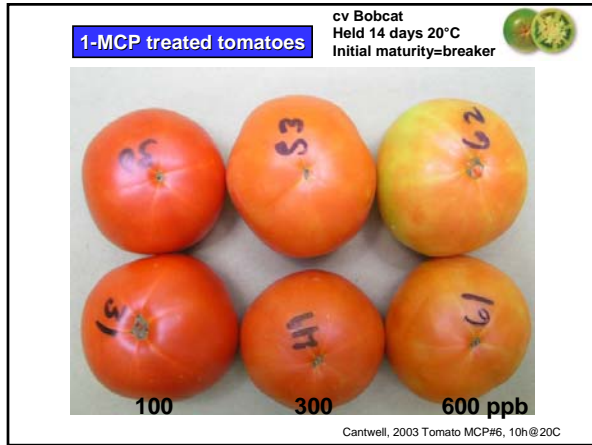
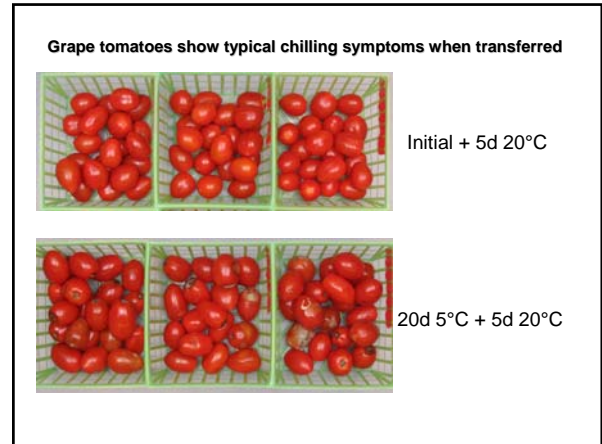
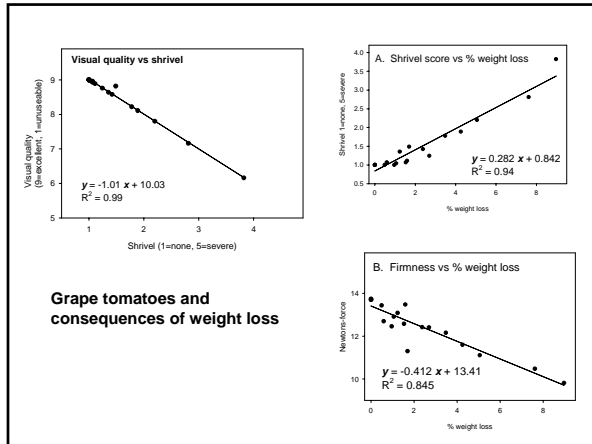
- Grape tomatoes respond to storage temperatures as do other tomatoes
- However, new marketing opportunities involve holding grape tomatoes at 5°C for long periods (as component of vegetable trays for example)
- Also grape tomatoes are very susceptible to water loss and symptoms of shrivel
- Therefore, as shown in some of the following data, fruit can be acceptable when stored at 5°C; transfer to a warm temperature after low temperature storage results in the expected chilling injury symptoms and decay



Visual quality of packaged grape tomatoes after 9 days.



Grape Tomatoes (cv Amsterdam) stored in consumer packaging and evaluated at 4 storage temperatures. Cantwell, unpublished, 2004.



Tomatoes and 1-MCP (SmartFresh™)

- 300ppb 1-MCP at 20°C \approx 12.5°C Storage
- 1-MCP is a powerful regulator of tomato fruit ripening
- Easy to overdose and have poor final quality
- Important to determine where 1-MCP can add value to the tomato category

Review Paper: The use of 1-MCP on fruits and vegetables.
C.B. Watkins. 2006. Postharvest Biology Technology 24: 389-409.

IMPORTANT FACTORS FOR Postharvest Quality of Tomatoes

- Variety
- Maturity at harvest
- Minimize physical injury
- Storage: temperature & duration
- Ripening conditions

