### Domestic Production

- California produces >99% of table grapes grown in the U.S.
  - CA industry composed of 475 farming operations
  - 1st vineyard was planted by William Wolfskill in 1839
  - > 80 varieties produced from May to January
- ~40% of the crop is exported to over 65 countries worldwide.
  - Top 3 export markets: Canada, Mexico, Hong Kong
- Per capita consumption in the U.S. is 8.4 lbs per capita (2.5 lbs per capita, 1970).

### Harvest Preparation

- Treat avenues to prevent dust
- Withhold irrigation
- Level soil
- Remove high cover crops
- Prune some long canes; remove some leaves

### Table Grape Maturity

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Soluble Solids</th>
<th>Sugar Acid Ratio</th>
<th>Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Thompson Seedless</td>
<td>17.0%</td>
<td>20:1</td>
<td>15%</td>
</tr>
<tr>
<td>**Thompson Seedless</td>
<td>16.5%</td>
<td>20:1</td>
<td>15%</td>
</tr>
<tr>
<td>Flame Seedless/Ruby Seedless</td>
<td>16.5%</td>
<td>20:1</td>
<td>No</td>
</tr>
<tr>
<td>Italia</td>
<td>16.5%</td>
<td>20:1</td>
<td>No</td>
</tr>
<tr>
<td>Superior Seedless/Perlette</td>
<td>15.5%</td>
<td>20:1</td>
<td>14%</td>
</tr>
</tbody>
</table>

*Varieties grown north and west of the San Gorgonio Pass.
**Varieties grown south and east of the San Gorgonio Pass

CDFA, 2011
Trimming

Transport to roadside

Packing

- Field Packing
- Shed Packing

Providing "shade" during packing is very important

Potential considerations:
- Ambient Temperature: may be HOT
- Delay in getting to cooling facility
- Uneven lighting – detection of problems

Trimming & box filling
Harvest containers vary

Cleanliness is CRUCIAL

0.2-1.5% water loss during picking and packing

Temperature/Time Dependent

Table grape stem condition after cooling delays (32°C/90°F, 80% RH) + 6 days (0°C/32°F, 80% RH)

Shed packing
Placement of SO₂ pad

Table Grape Containers
- TKV (wood end)
- EPS Foam
- Returnable Plastic (RPC)
- Corrugated

Consumer Packaging

Master Containers
Plain pack/EPS foam
Bagged/TKV
Wrapped/Corrugated
Table Grape Storage

- Pulp Temperature: -0.5 – 0°C
- Room Temperature: -1°C
- Relative Humidity = 95%
- Airflow: 20-40 cfm/ton during storage
- \( \text{SO}_2 \) fumigate weekly or use storage pads to control Gray Mold (Botrytis cinerea)

Gray mold caused by *Botrytis cinerea*

**Modes of *B. cinerea* infection**

- Infection pathways (Elmer & Michailides 2004)
  1. Conidial infection of the style and ovules
  2. Conidial infection of the stamens and/or petals
  3. Fruit infection via the pedicel *
  4. Conidial accumulation within the developing bunch
  5. Conidial infection of fruit *This happens when it rains*
  6. Conidial accumulation on fruit and dispersal to insect or picking wounds *Most common under dry conditions*

**Effect of storage temperature on decay development**

- Infection at 3.9°C
- Infection at 1.7°C
- Infection at 0.5°C
Goals of fumigation

• Initial fumigation to control surface infection
• Weekly fumigation to control spread of latent Botrytis infection (nesting)

Dosage Considerations

For SO₂ measured as ppm-hour

CT = average SO₂ concentration (ppm) x fumigation time (hours)

A CT of 100 ppm-hours kills both spores and mycelia of *Botrytis cinera*

Initial Fumigation

• Prior Shed Packing
• After Packing
  – Injection into individual packages
  – During Forced Air Cooling (defrost afterwards)

Fumigation during cooling

• Efficient use of both cooling timing and SO₂ distribution throughout room
• Forced air ensure good penetration even to center boxes within pallet
• With good room design, should produce >80% penetration
• Measured as the room air CT product (conc x time)

Injection into individual package as compared to fumigation prior to packing
**Storage/Transit**

- **Room Fumigation (Passive)**
  - Use higher air flows during initial fumigation
  - Good air circulation patterns necessary to insure good distribution

- Use of SO$_2$ pads – allows for slow release during storage or transit
  - Rate of gassing temperature dependent

**Berry Bleaching from Sulfur dioxide**

- Mostly red cultivars
- Sulfite harms flavor

**High rates of SO$_2$ caused these early season ‘Thompson Seedless’ grapes to brown**

SO$_2$ expressed as a c x t product in a one hour fumigation. Grapes stored 10 days at room temperature before these pictures were taken.

**Damaged berries and SO$_2$ residues**

- SO$_2$ highly soluble in water
- Damaged berries will accumulate higher residues
- Good grading in field and during packing is very important
- Minimizing damage during handling

**Sulfur dioxide fumigation controls gray mold – is an alternative needed?**

- Sulfur dioxide is not allowed on ‘organic’ grapes
- Sulfur dioxide can harm berry appearance and flavor
- Regulatory issues with transportation and storage, worker safety, residue limits in grapes, and its discharge to air
- Fenhexamid (Elevate) within 24 hours of harvest

*Smilanick et al.*

**Kiwifruit Handling**
**Kiwifruit Bird**

- Kiwifruit are native to the Yangtze River Valley of Northern China
- Missionaries brought seeds from China to New Zealand
- Top 4 producers accounting for 82% of world production: Italy, New Zealand, Chile, Greece, France (2012)

**USA Kiwifruit (#9)**

- 97% grown in California
- Kiwifruit ranks 67 out of over 300 commodities
- 25% of crop exported
  - Mexico
  - Canada
  - Korea

---

**The ‘Hayward’ variety is still the #1 cultivar**

---

**Determining minimum maturity**

---

**Starch**

<table>
<thead>
<tr>
<th>Harvest</th>
<th>Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mature</td>
<td>Ripe</td>
</tr>
<tr>
<td>Starch</td>
<td></td>
</tr>
<tr>
<td>Sugars</td>
<td></td>
</tr>
</tbody>
</table>

- SSC = 6.5%
- SSC = 15%
How to assure Consumer Quality

- Minimum Maturity (6.2% SSC)
- Maximum Maturity (<14 pounds)
- Consumer Quality (>12.5% RSSC)
- Fruit Handler Quality (>15.1% DW)
Packinghouse Operations

Cleaning → Brushing → Sepal Removal

Postharvest Diseases

Botrytis cinerea

Penicillium expansum

Postharvest Fungicides:
- Fenhexamid (Elevate)
- Fludioxonil (Scholar)

Sorting
The type of kiwifruit container with box liners do not interfere with the ethylene application.

Temperature Management (32°F, 90% R.H.)
**Storage Potential**

Pericarp translucency or Internal breakdown

Fruit of lower maturity more prone to this problem

---

**Softening in air storage:**

- Ethylene – accelerates softening
- Temperature – 0C
- Speed of cooling – should be < 24 hours
- Fruit maturity – more mature: more sensitive

---

**Temperature and Ethylene influences softening**

---

**Duration of exposure influences softening**

---

**Controlled Atmosphere Success Depends Upon:**

- Ethylene exclusion
- Temperature – 0C
- Rapid establishment - < 1 week
- Continual monitoring to maintain optimum O₂ and CO₂ levels

---

**Ethylene in CA storage also detrimental**

---
Ethylene duration in CA storage 
(2% O₂, 5% CO₂)

Thanks for your attention

Thanks to J. Thompson, D. Luvisi, J. Smilanick, A. Kader, C. Crisosto, A. Woolf for sharing parts of this presentation