

Initial Cooling

Chapter 11 and Commercial Cooling of Fruits, Vegetables and Flowers

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Cooling Begins in the Field

- Prevent heating in the field.
- Shorten time before cooling begins.

2

Shade product to
reduce heat gain
and moisture loss



3

Carrot Receiving



4

Use frequent, scheduled pick up



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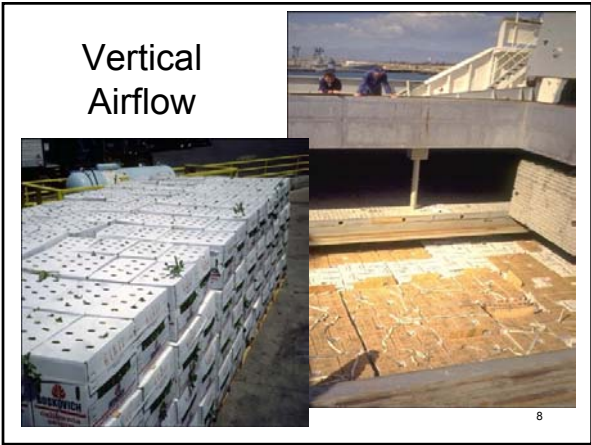
Transport Cooling

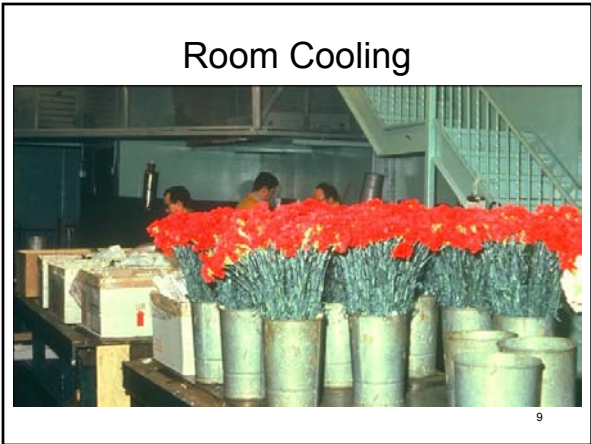
Product temperature drop is rare in trailers.



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Room Cooling

- 100 cfm per ton of product.

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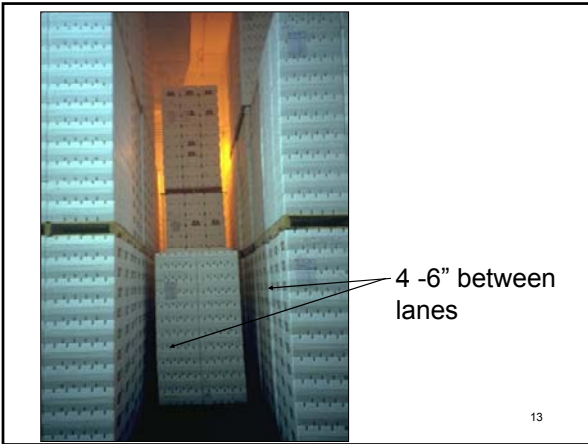


Ceiling fans

Room Cooling

- 100 cfm per ton of product.
- Space stack product.

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Room Cooling

- 100 cfm per ton of product.
- Space stack product.
- Well vented boxes.

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Sloped sides Vents

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Room Cooling

- 100 cfm per ton of product.
- Space stack product.
- Well vented boxes.
- Lowest possible air temperature.

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Highest Freezing Temperature

| | °C | °F |
|-------------|------|------|
| Apples | -1.5 | 29.3 |
| Cherries | -2.1 | 28.8 |
| Pear | -1.7 | 29.2 |
| Asparagus | -0.6 | 30.9 |
| Lettuce | -0.2 | 31.7 |
| Cauliflower | -0.8 | 30.6 |

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Room Cooling

Pallets of tight fill plums in corrugated boxes

| Vents | Box spacing | Stacking | Longest cooling time (hr) |
|-------|-------------|----------|---------------------------|
| none | none | cross | 84 |
| 4% | none | register | 22 |
| 4% | 1" | register | 18 |

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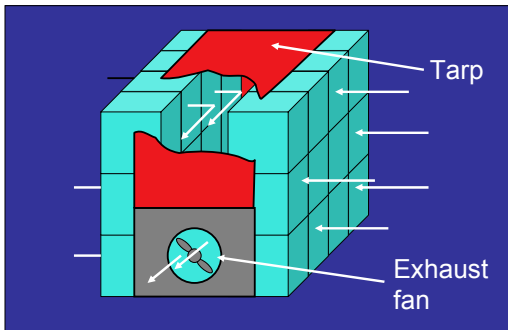
Forced Air Cooling

Pallets of tight fill plums in corrugated boxes

| Vents | Box spacing | Stacking | Longest cooling time (hr) |
|-------|-------------|----------|---------------------------|
| 4% | none | register | 3 - 6 |

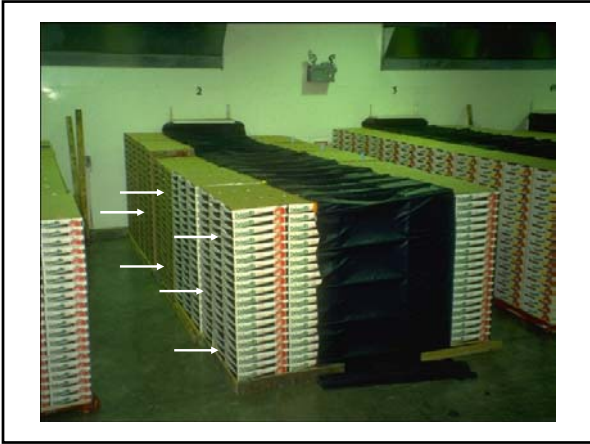
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Forced Air - Tunnel

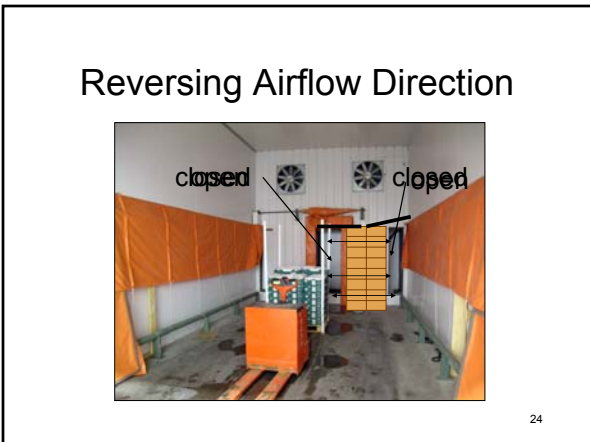




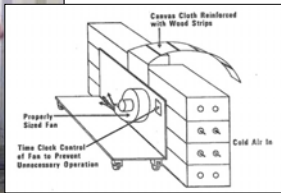
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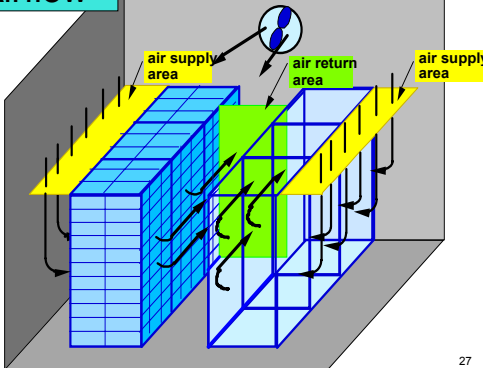
Portable Fan & Tarp



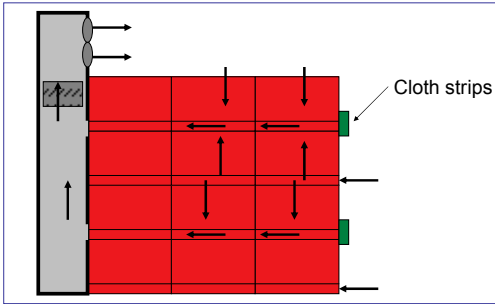
Small Scale Forced Air



Airflow



Forced Air - Serpentine



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Gravity
operated
louver

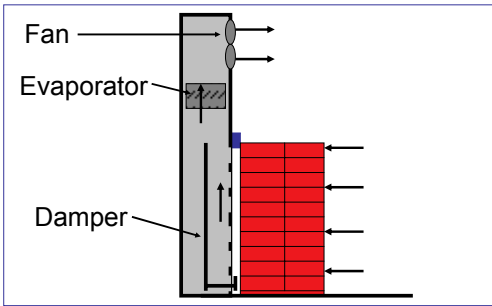
Seal

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Operating
serpentine
cooler



Forced Air - Cold Wall

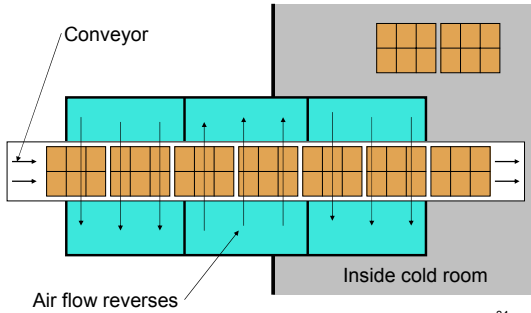


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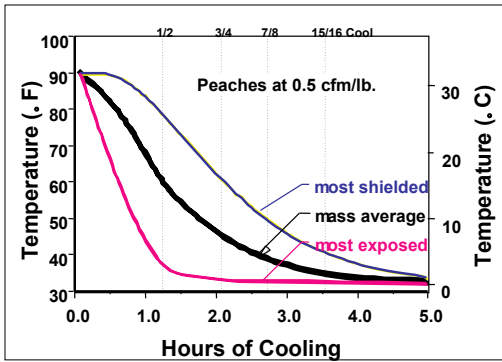
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Continuous Forced Air

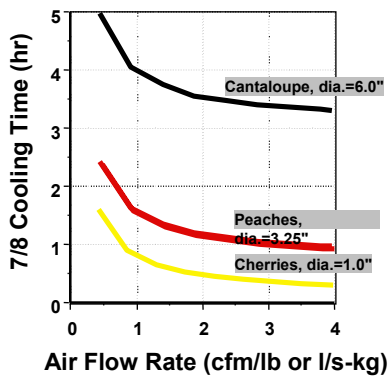


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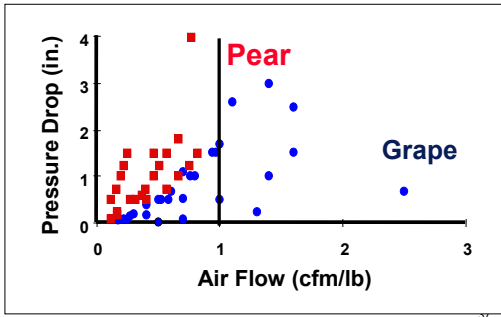
Forced Air Cooling



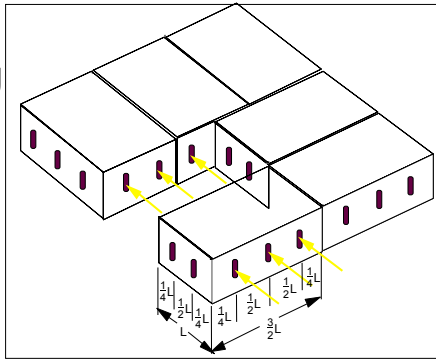
Forced Air Cooling



Pressure Drop vs. Airflow



Box Venting



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Venting



Poor

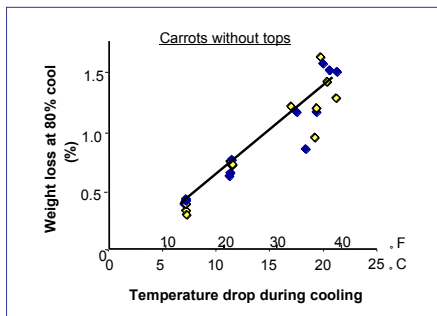
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Bagged Grapes



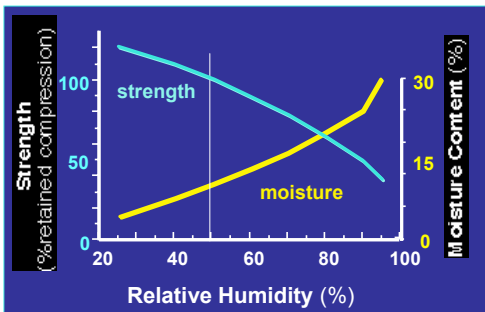
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Moisture Loss in Forced Air Cooling



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Fiberboard Strength



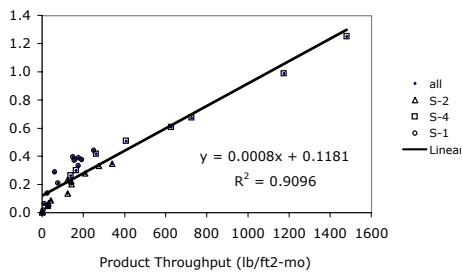
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Electricity Use in Forced Air Cooling

| | Electricity Use (%) |
|---------|---------------------|
| Product | 36 |
| Fans | 30 |
| Lights | 16 |
| Walls | 14 |
| Lifts | 4 |

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Product Throughput



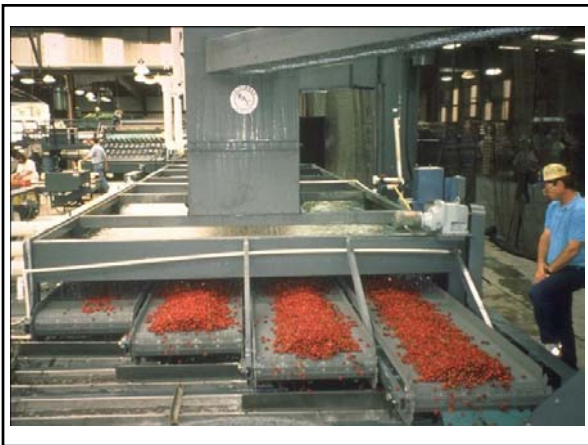
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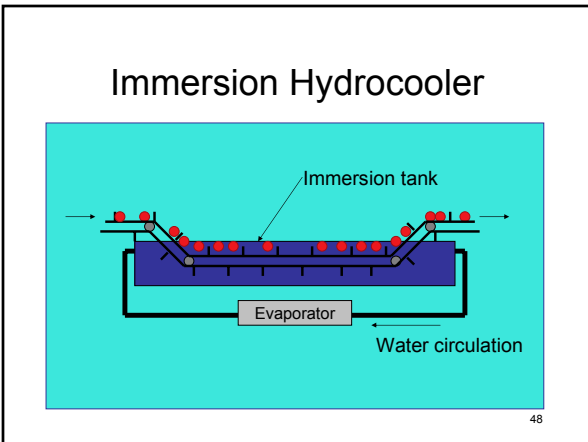
Hydrocooling



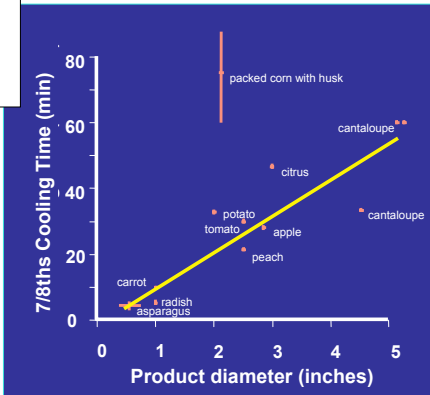
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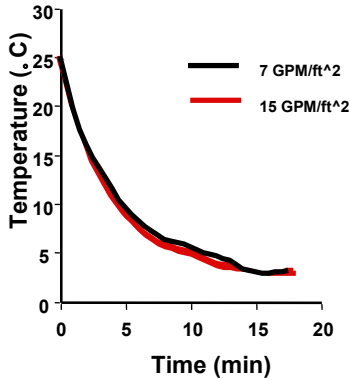




Hydro Cooling Time



Cherry Hydro-cooling



Moisture Loss in Hydrocooling

Gain 0.5 % to lose .05%

Water Beating Damage



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Control pH and Chlorine Levels



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Package Icing



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Ice solidifies & melts away from product

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Liquid Ice Machine



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Manual Liquid Icing



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Iced Boxes at Market

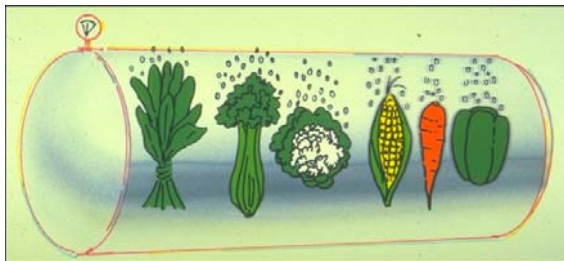


Small Ice Machine



Vacuum Cooling

At 25mm Hg water boils at 20°C



10 Pallet Vacuum Cooler



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Cools product that can release moisture quickly



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Moisture Loss in Vacuum Cooling

- Lose 2.0 to 4.0 %
- 1%moisture loss for each 11°F (6°C) of temperature drop

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Water Spray Vacuum Cooling



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Cold Rooms



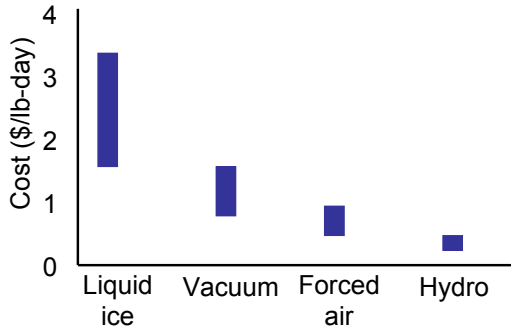
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Selecting a Cooling System

- Product requirements.
- Product mix.
- Temperature requirements.
- Cooler cost.

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Capital Cost



Energy Use

