

Temperature Management and Shipping Operations



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1

QUALITY MAINTENANCE: Harvest & Handling

The focus was on two primary concerns:

- *Minimizing mechanical injury*
- *Cooling rapidly*

2

OPTIMIZING TEMPERATURE MANAGEMENT

High-quality fruits and vegetables can be successfully marketed, however:

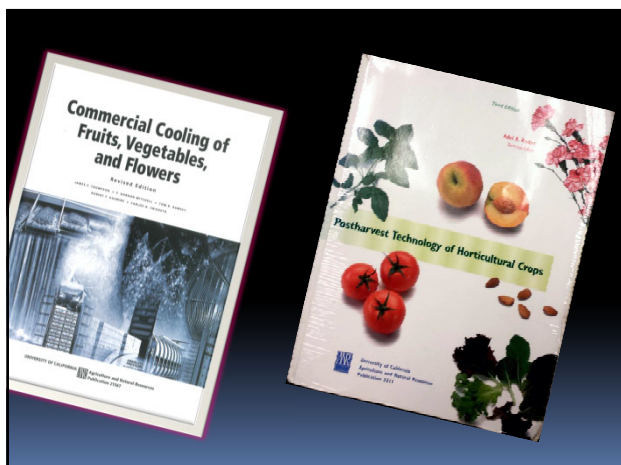
- Greater care is necessary during harvest and handling operations to minimize damage
 - Use appropriate harvest containers
 - Carefully train & supervise workers
- Effective cooling methods are critical
 - Avoid delays in field, packinghouse
 - Cool rapidly & thoroughly

3

Cooling and Storage

- **Determine optimal conditions**
 - Storage temperature; relative humidity
 - Cooling method; atmosphere
- **Rapidly cool within a few hours of harvest (7/8 Cooling)**
- **Cool efficiently**

4



5

*This is **NOT** Cooling*




6

TEMPERATURE MANAGEMENT

1) During harvest and handling

- Minimize time in the field
 - Once harvested, fruit temperature will increase
 - Place in the shade until transported
- Covering with tarps can promote warming by trapping the heat




7

TEMPERATURE MANAGEMENT :

Importance of shade:

- After 1 hour in the sun, cantaloupe pulped:
 - top layer: 97°F
 - second layer: 74°F
- This extra heat
 - Increases moisture loss and respiration
 - Increases cooling time and expense later



8


Shaded collection station



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Field lug design affects temp mgmt:

- Cross-brace supports underneath
- Short height (more product per pallet)
- Good ventilation for natural ventilation



10

Quickly transport to covered holding area




11

COOLING IS CRITICAL TO EXTEND QUALITY

After 24 hours at ambient:

- Note bruise
- Unseen losses:
 - ↓ flavor
 - ↓ Vit. C



12

2) Cooling delays can lower postharvest quality

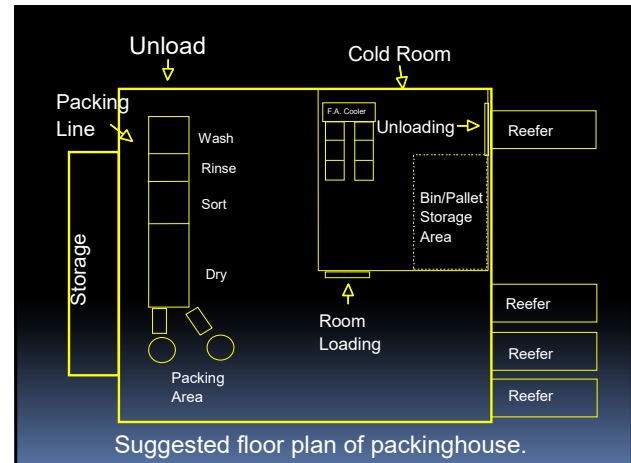
Strawberries with a 6-hour delay to cooling had poorer quality than those cooled more quickly after 1 week of storage:

- Significantly softer, more shriveled, had less attractive color
- Lower SSC, acidity, and Vitamin C levels



Nunes et al., 1995

13



14

3) Effective Cooling

Storage conditions for maximum shelf life are crop-dependent:

- Lowest Safe Temperatures for Tropical Fruits:
 - 39 °F (lychee)
 - 41 °F (carambola)
 - 53 °F (mango; avocado; mamey sapote)
 - 57 °F (banana)
 - 58 °F (pineapple)
- Relative Humidity: 90 to 95%
- Shelf life: 2 to 4 weeks

15

3) Effective Cooling

Storage conditions for maximum shelf life are crop-dependent:

- Lowest Safe Temperatures for Vegetables:
 - 32 °F (broccoli; lettuce; sweetcorn;)
 - 40 °F (snap bean)
 - 45 °F (bell pepper; chayote)
 - 50 °F (basil; cucumber; okra)
 - 53 °F (mature-green tomato)
- Relative Humidity: 90 to 95%
- Shelf life: 1 to 4 weeks

16

Cooling in the good 'ole days



Pony reefers were used to transport the strawberries to northern markets. These were actually two crates, one inside the other.

The outside crate held a layer of ice, and the inside crate held the fruit. Dec. 1926.

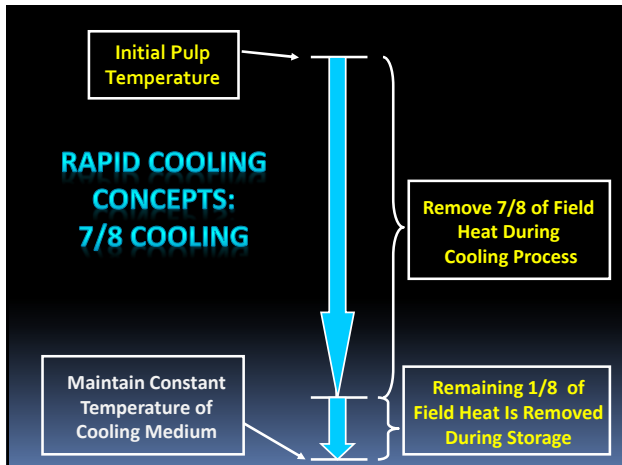
(Photo courtesy of Gulf Coast Research & Education Center.)

17

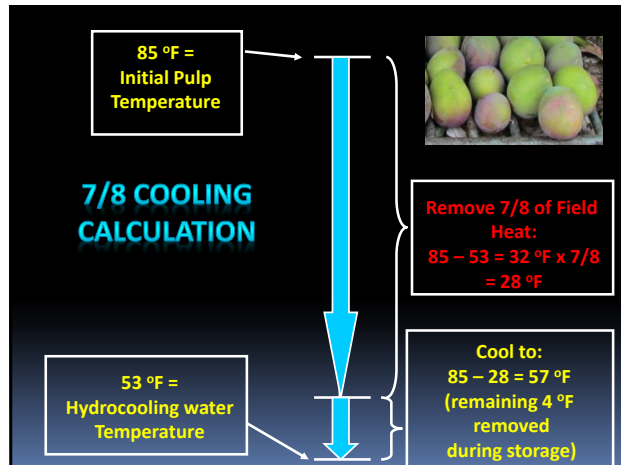
Cooling rate is determined by the 3 T's:

- **T**ime of exposure to the cooling medium
 - Longer = cooler
- **T**emperature of the cooling medium
 - Lower = faster
- **T**urbulence (contact & mixing)
 - Better contact = faster

18



19



20

- ### Cooling Methods
- Room cooling
 - Slowest – 12 or more hours
 - Loses most moisture
 - Forced-air cooling
 - Faster – 1 to 2 hours
 - Less moisture loss
 - Hydrocooling
 - Fastest – 20 to 30 minutes
 - Hydrates – no moisture loss. CAUTION: must be sanitary
 - Vacuum cooling
 - Fastest process
 - Primarily for leafy crops – moisture loss can be an issue

21



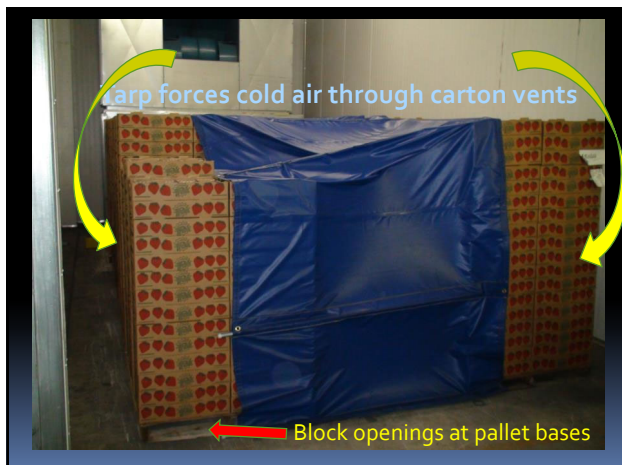
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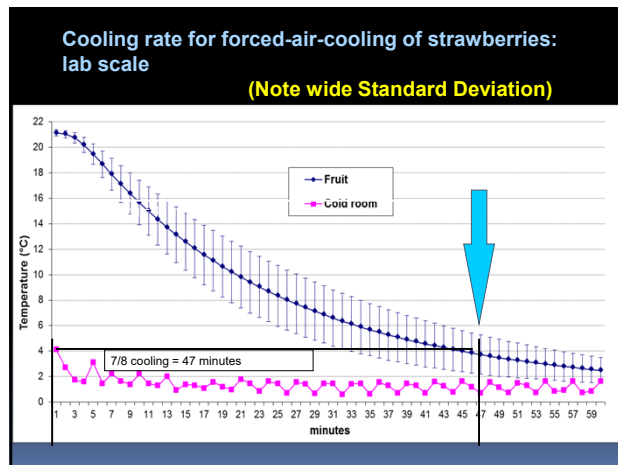
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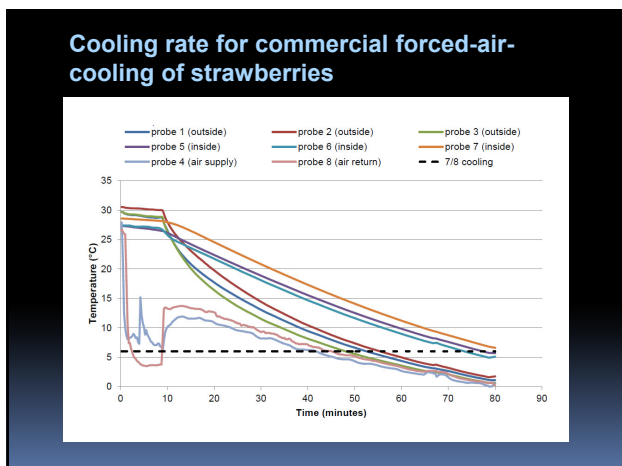
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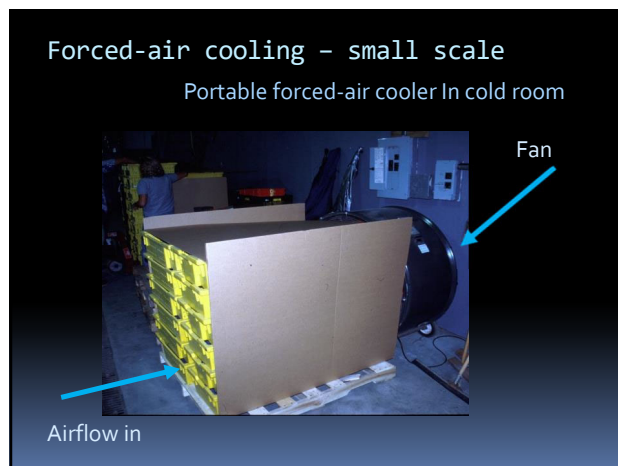
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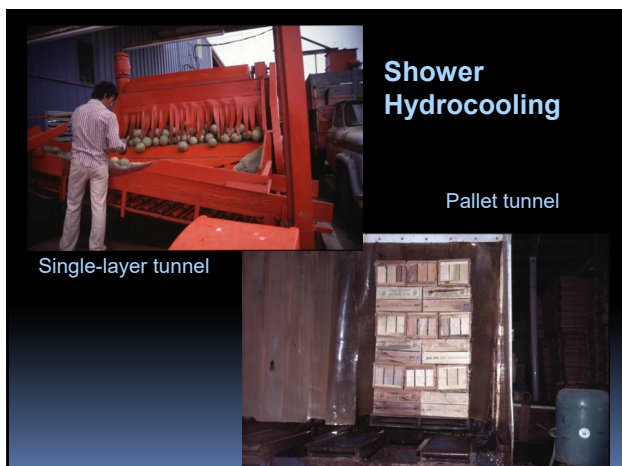
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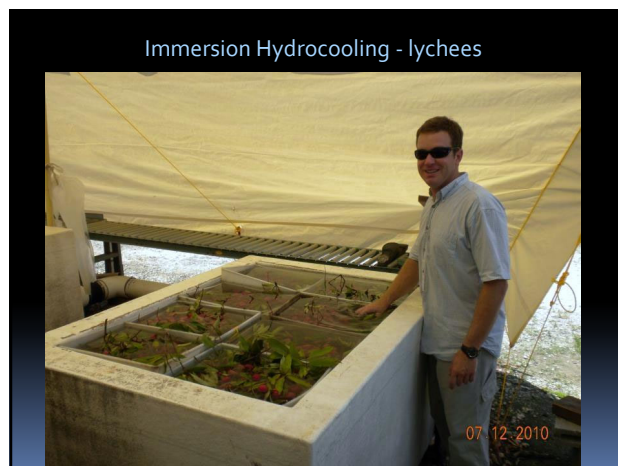
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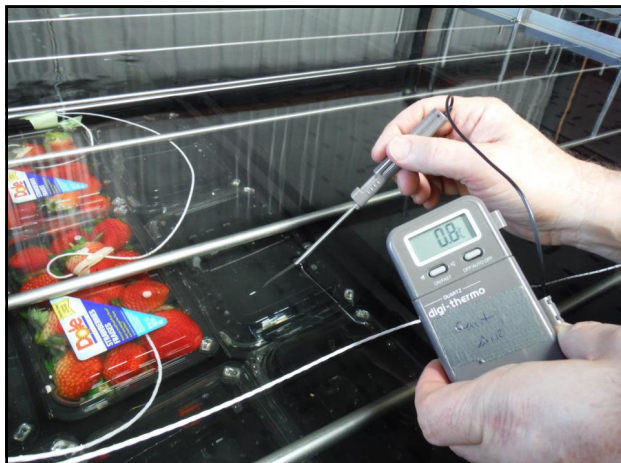
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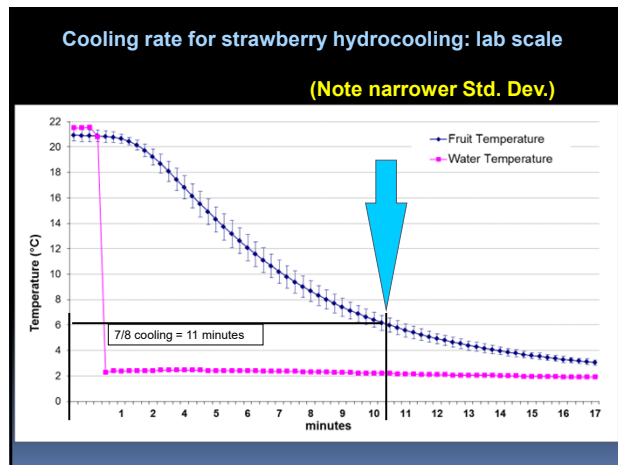
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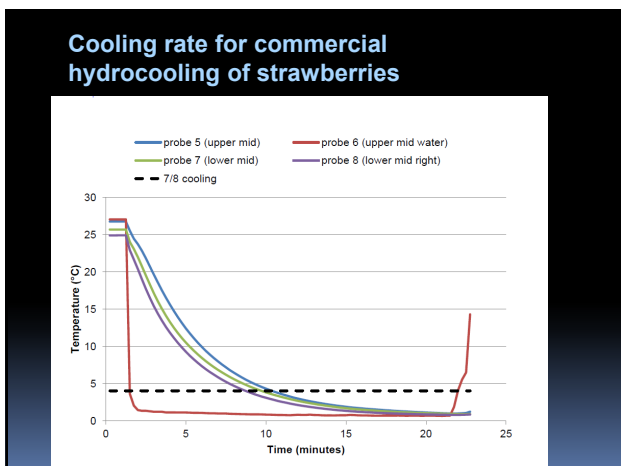
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39

Sanitation of cooling water is critical!!!

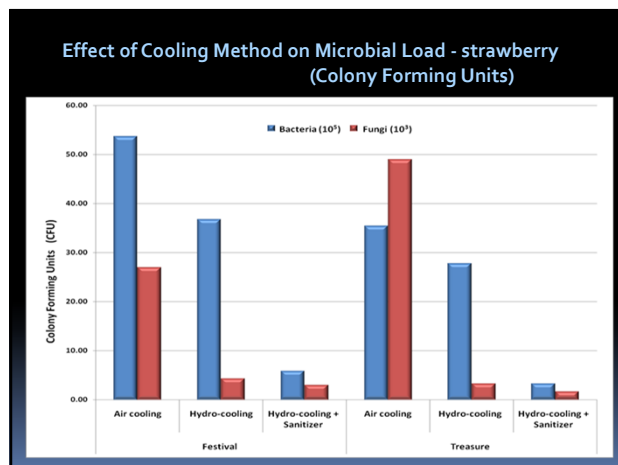
- Surrounding water can infiltrate into the fruit.
- Note blue dye infiltrated into tomato stem scar.

J. Bartz

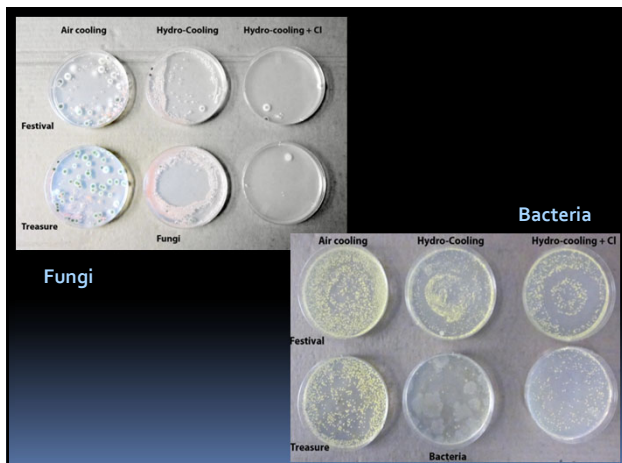
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48



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50

Shipping Operations

Maintain the "cold chain"

51

The "Cold Chain":

- Following cooling maintain crop temperature/RH during each shipping and handling operation: no breaks in the Cold Chain
- Consists of a series of critical points which should be implemented according to Good Manufacturing Practices (GMPs) and vigilantly maintained

52

Shipping Operations

Avoid using unrefrigerated loading dock

53

Temperature Management during Shipping Operations

Load and unload directly from the cold room

54

Temperature Management during Shipping Operations



Load and unload directly from the cold room

55

Proper loading in the trailer is critical

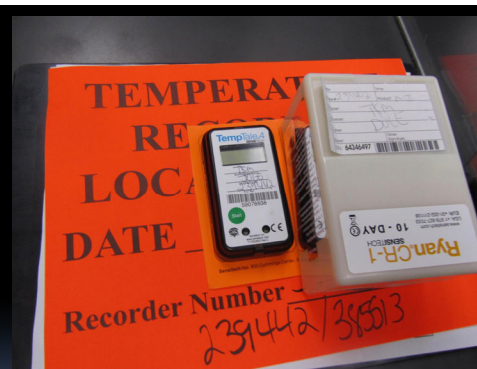


56

Proper loading in the trailer is critical



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Portable recorders in trailer track air temperature

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- Keep cool as long as possible
- Avoid having to re-cool



Breakbulk Cargo Shipping: "lift-on, lift

59



Container Shipping

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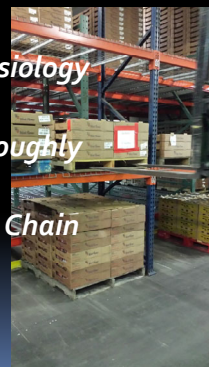
Looking down into the hold of the ship



61

Temperature Maintenance

- Consider crop physiology
- Cool quickly, thoroughly
- Maintain the Cold Chain



62

Questions??



63