# Post-Harvest Technology Procedures

# Temperature management

- Vital heat released from the commodity should be considered in a temperature management programme.
- Product temperature is a determinant of respiratory rate.
- Each 10 $^{0}$C temperature reduction reduces respiratory activity by a factor of 2-4.
- Good cooling and temperature management practices are important to reduce physiological deterioration.
- Extends the shelf-life of horticultural commodities.

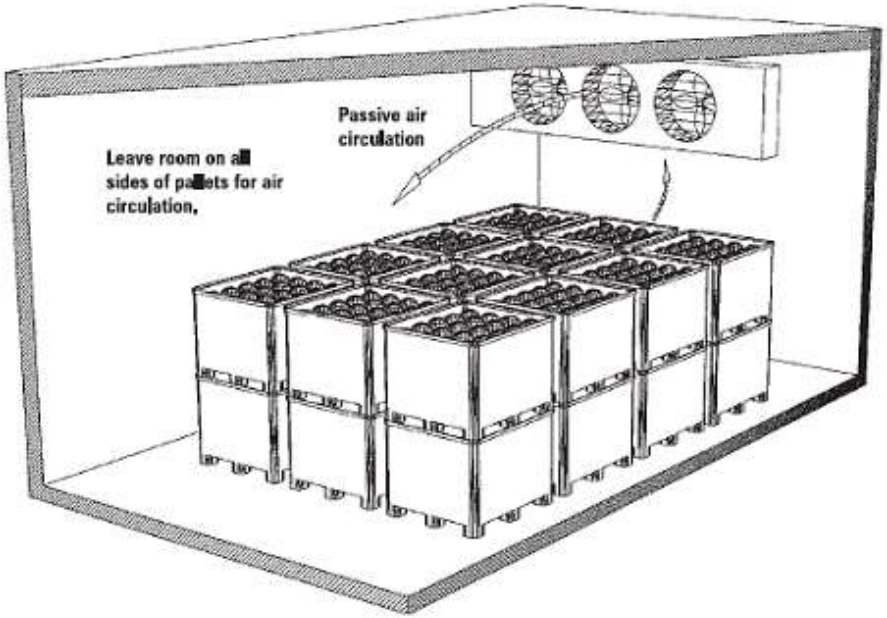
# Cooling methods

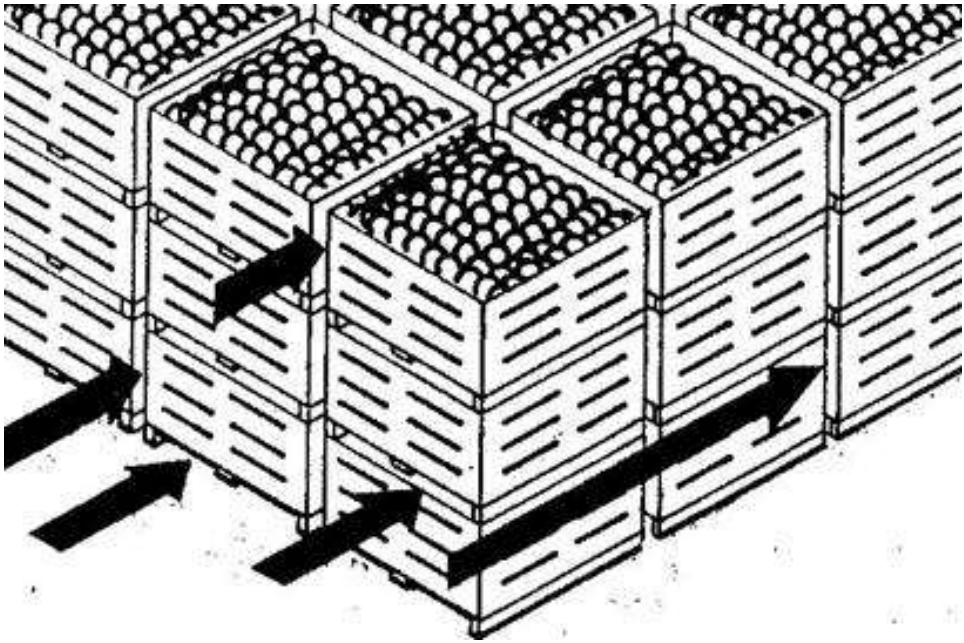
- Room cooling, forced-air cooling, hydro-cooling, package icing, vacuum cooling, top icing, channel-icing and mechanical refrigeration in transport vehicles.
- Users are concerned with the time to ‘complete cooling’.
- Times are referred as half-cooling and 7/8 cooling.
- Half-cooling is the time to cool the product halfway from its initial temperature to the temperature of the cooling medium.
- 7/8 cooling is the time required to cool the product 7/8 of the way from its initial pulp temperature to the temperature of the cooling medium.

# Cooling methods

- The cooling rate is influenced by the mass flow rate of the cooling medium.
- Package position and access to the cooling medium also affects the cooling rate.

# Room cooling



# Room cooling

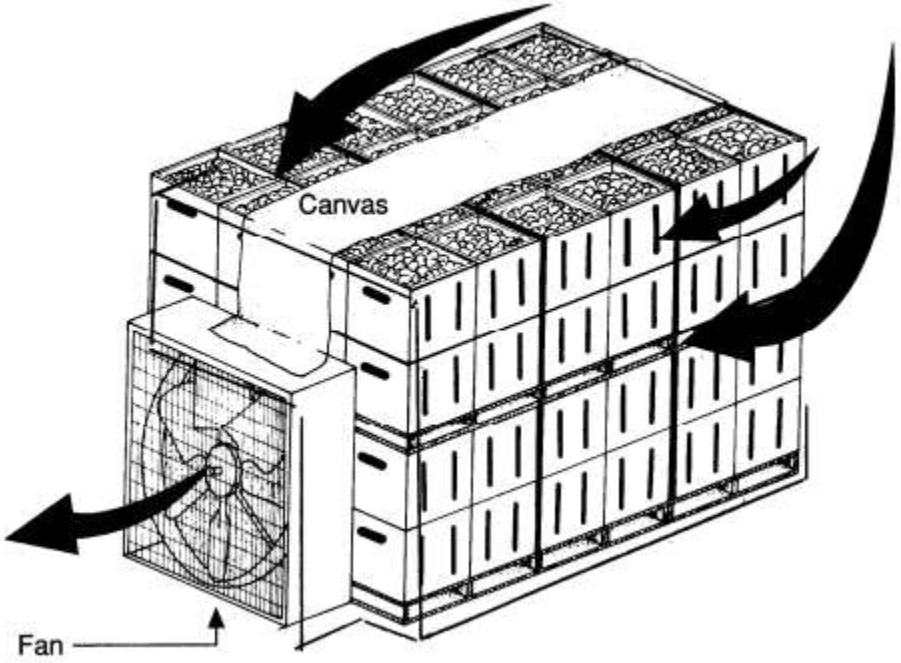
- Widely used cooling method.
- Containers of produce are placed in a cold room.
- Use for products with relatively a long storage life that are stored in the same room as they are cooled in.
- Produce can be cooled and stored in the same room.
- Too slow for most commodities, requires more space than is needed for good storage and can result in excessive water loss.
- Cooling requires days for packed products.

# Room cooling

- Containers should be stacked to allow cold air to contact all container surfaces.
- 60 -120 m/ minute of airflow.
- Require well vented containers.
- Cooling is by the heat conduction through the container walls.
- Commodities held in large containers are tightly unitized on pallets thus making inadequate air movement.

# Forced-air cooling

Figure 2. Forced-air Tunnel

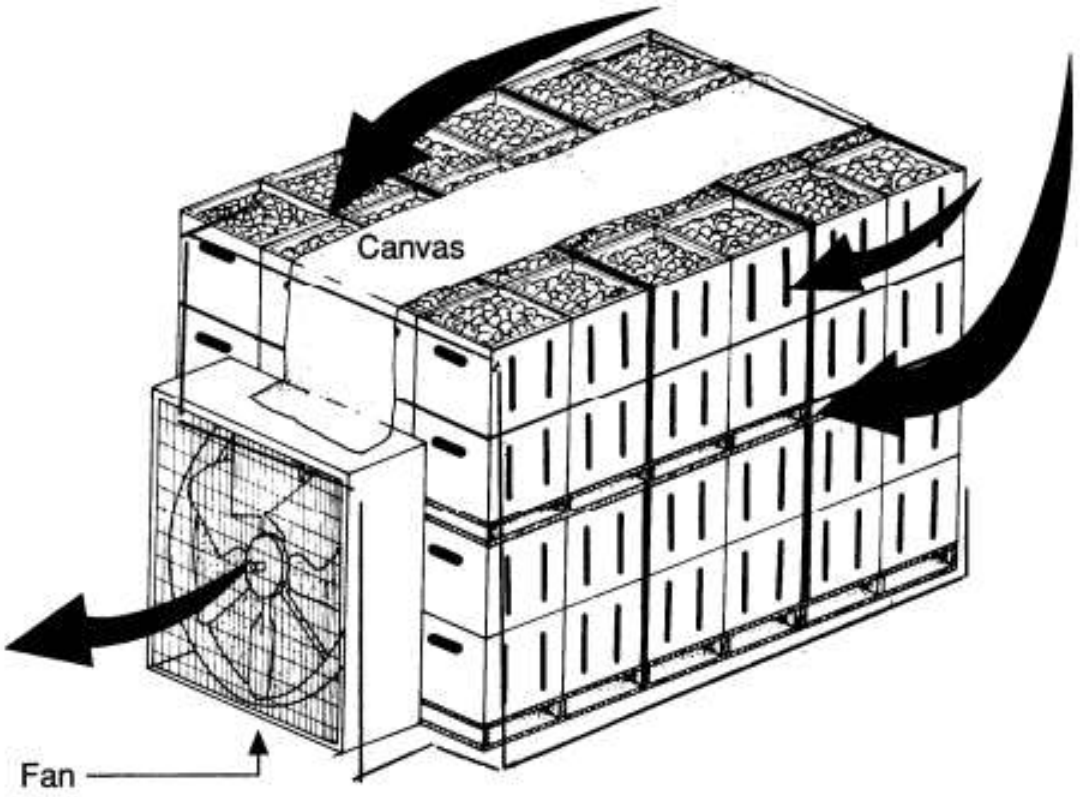


# Forced-air cooling

- Adaptable to a wide range of commodities.
- Provides cold air movement through the containers.
- Creates a slight pressure gradient to force air through the container vents.
- Speed of forced-air cooling is controlled by adjusting the volume of cold air passing over the product.
- Water loss and shrivel of the commodity are less than the room cooling but refrigeration systems need to provide high relative humidity.

# Forced-air cooling – forced-air tunnel

Figure 2. Forced-air Tunnel



# Forced-air cooling – cold room

# Vacuum cooling

# Vacuum cooling

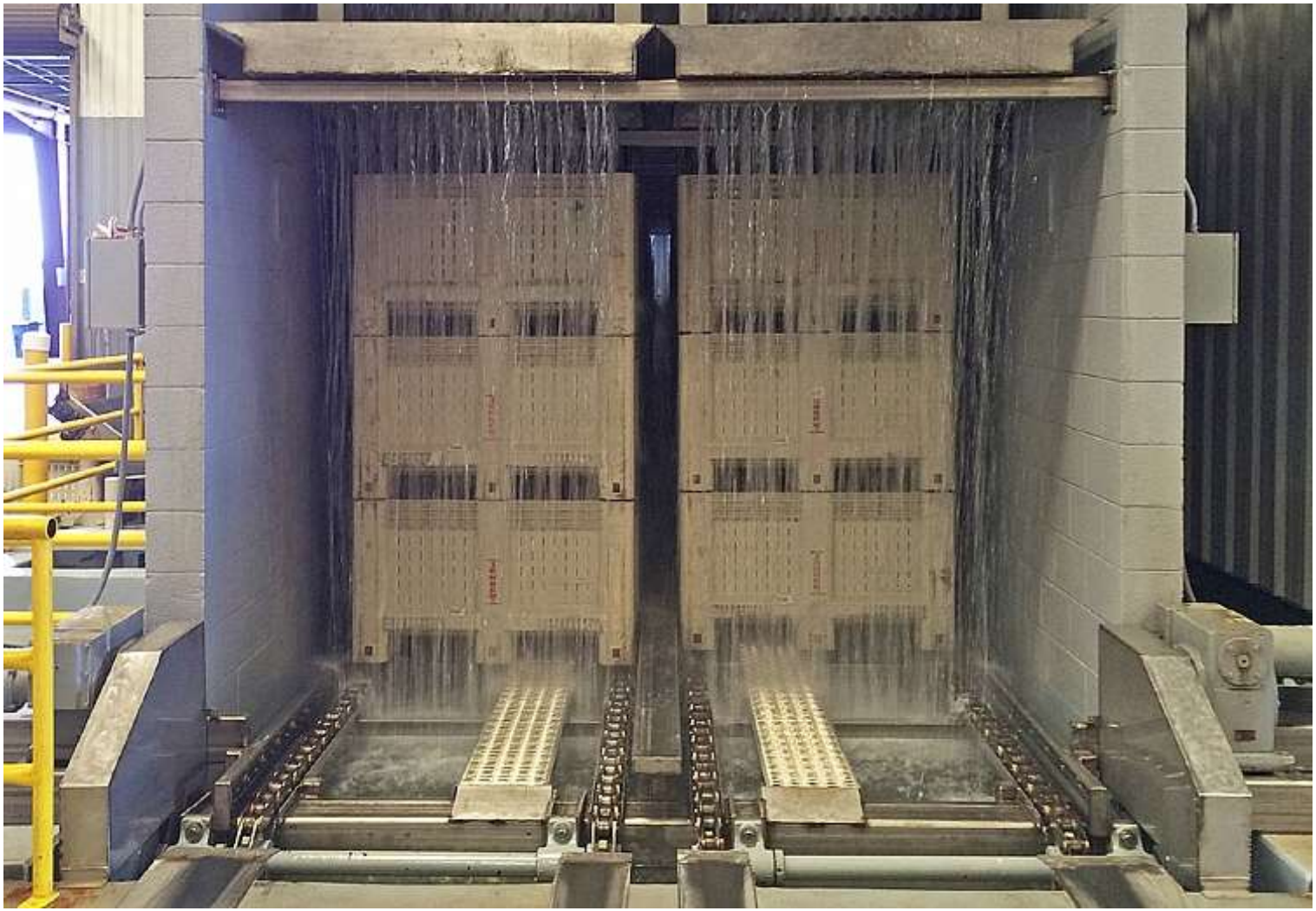
- Due to water evaporation from the product at very low air pressure.
- Suitable for leafy vegetables, mushrooms, carrots and bell peppers.
- Boxes of film-wrapped products can cool quickly.
- Air is pumped out of a large steel chamber containing the product.
- Boiling temperature of the water of the product lowers.
- Water evaporates quickly removing heat from the product.
- Causes about 1% product weight loss for each 6 $^{0}$C of cooling.

# Package icing

- By filling packed containers with ice in quantities that depend upon the initial product temperature.
- Cooling rate slows as the ice in contact with product melts.
- Ice keeps high relative humidity around the product.
- Package ice may be finely crushed ice, flake ice or liquid ice.

- Requires expensive, water tolerant and tight packages with enough holes to drain meltwater.
- Weight of ice increases freight load.
- During transporting mixed loads, water from melting ice can damage neighbouring boxes.

# Hydrocooling



# Hydrocooling

# Hydrocooling

# Hydrocooling

- Using cold water.
- Old and effective method of cooling fruits and vegetables in bins or in bulk before packing.
- Avoids water loss and adds water to the commodity.
- Less adapted to cooling packed commodities.
- Immersion in cold water and shower system is used to bring the commodity in contact with cold water.

- Efficient cooling depends upon the adequate water flow over the product surface (600-1000 L/min/$m^2$).
- In some areas, stream or well water is cold enough to complete cooling.
- Product, packages and packing material must be tolerant of wetting, not susceptible to water beating damage, and tolerant of chlorine which is used to sanitize water.
- Shower systems should be cleaned daily to avoid plugging.
- Typical cooling times are 10 min. to one hour depending on size of the product.
- Cooled product must be moved quickly to a cold room.

# Other methods

- High altitude cooling by utilizing naturally cool surrounding.
- Zeer pot cooling.

# Advantages of pre-cooling

- Inhibition of growth of decay causing organisms.
- Restriction of enzyme activity.
- Reduction of water loss from the commodity.
- Reduction of rate of respiration and ethylene liberation.

# Relative humidity management

- Influences water loss, decay development, some physiological disorders and uniformity of fruit ripening.
- Proper relative humidity for;

| | |
|---|---|
| ✓Fruits | 85-95% |
| ✓Vegetables | 90-98% |
| ✓Dry onions and pumpkin | 70-75% |
| ✓Some root vegetables | 95-100% |

# Measures to control relative humidity

- Adding of moisture to air by humidifiers.
- Regulating the air movement and ventilation in relation to produce load in the cold storage room.
- Maintaining the refrigeration coils within about $1^0$C of the air temperature.

# Measures to control relative humidity

- Providing moisture barriers.
- Wetting floors in the storage room.
- Adding crushed ice in shipping containers and retail displays.
- Sprinkling produce with water during retail marketing.

# Supplements to temperature and humidity management

- Helpful in extending the shelf-life harvested produce.
- Treatments include;
- Curing of certain root, bulb and tuber vegetables.
- Cleaning following by removal of excess surface moisture.
- Sorting to eliminate defects.
- Waxing and other surface coatings, film wrapping.
- Heat treatments.
- Treatment with post-harvest fungicides.
- Sprout inhibitors.

- Special chemical treatment (scald inhibitors, calcium, growth regulators, anti-ethylene chemicals for ornamentals).
- Fumigation for insect control.
- Ethylene treatment (degreening, ripening).
- Packing.
- Control of air movement and circulation.
- Control of air exchange and ventilation.
- Controlled or modified atmosphere.