Harvesting

- Often the most traumatic time of a commodity’s life
  - Detachment from “food” and water
  - Force required to remove the commodity
    - Fingernail marks, finger pressure
    - Drops/impacts onto branches, harvesting bags, buckets, bins, trailers, other fruit etc.
    - Vibrations and jolts during transport on dirt/rough roads

The Harvesting Process

- Identify mature product for harvest using maturity/quality standards
- Detach the product from the plant
  - pull, cut, twist, shake, etc.
- Collect into picking bags, buckets, etc.

The Harvesting Process

- Accumulate product in field boxes, bins, trailers, etc.
  - Provide shade within the field
  - Minimize time before transport from the field

Types of Harvesting

- Hand Harvesting
  - Most fresh fruits & vegetables are hand harvested
  - Unique capability of eyes, mind & hand => product evaluation (field grading), rapid harvest and delicate handling
  - Product graded out in the field reduces cost of handling & disposing at the packinghouse (improved sanitation)
- Assisted Harvesting
  - Chemicals, ladders, platforms, picking baskets, knives, etc.
Types of Harvesting

- **Mechanical Harvesting**
  - Covered in later session
Field vs. Packinghouse Packing

- Field Packing (e.g. strawberries, head lettuce, grapes)
  - Less material to transport and dispose
  - Fewer handling steps => less mechanical damage
  - Smaller initial start-up cost
  - Requires large machinery in the field (soil compaction, trampled product, etc.)

- Field Packing (continued)
  - More dependent on weather
  - Requires skilled labor
  - Product in containers are more difficult to cool
  - Less control over quality
  - Cannot apply many postharvest treatments (e.g. waxes, fungicides, etc.)
Transportation

- Transport product away from field to processing/packing facility
  - Minimize time between harvest & transport
  - Avoid rough roads

Preparation for Market

- Economics must justify any postharvest handling practices. If a step does not add value to the crop, it is a waste of money!

- Objective:
  - Improve the value of the marketable crop
Preparation for Market
Order of events depends on the operation
- Receiving
- Dumping
- Sorting
  - Sizing
  - Grading
- Postharvest Treatments
- Packing
- Assembling – e.g. pallets
- Cooling

Different combinations of events are used depending on the commodity and economic factors.

Preparation for Market

Before & After

Receiving
- Provide shade to prevent heating and sunburn
  - Shade can also be provided within the field (e.g. cover with palm fronds or use shade cloth)
- Move into packing operation quickly

Cooling
- Minimize time between harvest and cooling
- Cooling before grading (e.g. in field containers):
  - Positive:
    - May extend storage life
  - Negatives:
    - Extra expense of cooling unmarketable product
    - Energy to cool will be lost if commodity is allowed to warm during packinghouse operations
    - Re-warming & condensation may cause additional decay
- Often, cooling occurs after packing

Dumping
- Wet – immersion or dumping into water.
  - Gentler on the product
  - Sanitation is important
  - Sodium sulfate used to float some products (e.g. pears)

Dry – product containers emptied onto a belt or roller conveyer
- Possibility of more mechanical injury
- Requires controlled dumping (note hydraulic cover) and padding to minimize impact injury
Removing unwanted material (sorting)

- **Sort as soon as possible**
  - Money is wasted whenever unmarketable product is handled/treated
- **Potentially pre-sort** to remove unmarketable fruit and other materials (e.g. twigs, leaves) before wash
  - Also keeps decayed material out of the packinghouse
Removing unwanted material (sorting)

- **Sizing** (weight, volume, length, diameter)
  - By eye
  - Diverging rollers or belts
  - Increasing hole sizes (belts or rings)
  - Digital weight sizers
  - Digital optical (image) sizers

**Presizing**

Removing unwanted material (sorting)

- **Quality grading** based on maturity, shape, color, defects, etc.
  - Most still accomplished by hand
    - Requires good lighting, uniform product flow, rotation of product, worker comfort, worker supervision and responsibility
  - Computer controlled machinery
    - Optical (image) grading equipment
    - Light reflectance/transmittance for internal defects or composition (e.g. sugars)

**Preparation for Market**

Postharvest Treatments

- *Wash* (sprays, brushes, etc.) to remove dirt, residues, etc. Water sanitation is critical
- *Drying* (air, sponge-roller)
- *Wax application* - reduce water loss, enhance appearance, reduce decay (carry fungicide)
- *Fungicide application*
  - *Curing* (e.g. potato, dry onions) - wound healing & reduced decay.
  - In field or in rooms
  - *Ripening/degreening* treatments
  - *Trimming* (e.g. lettuce, celery, cauliflower, etc.)
- *Quarantine (insect) treatments* (e.g. fumigation, hot water or air, cold treatments, controlled atmospheres, etc.)

Fungicide Drench (truck)

Fungicide Drench (bin)
Degreening

Wetting (+ SOPP)

Drying

Washing (High Pressure)

Waxing
Packing

• Machine vs. hand pack
• By commodity count or weight

• Volume fill
  – loose fill
  – tight fill
  – bagging
• Or place pack

http://www.stillwaterorchards.com/images/fruit4.jpg
Packaging Requirements of the Commodity

- Protect the commodity
  - Immobilize the product
  - Protect against crushing (stacking), impacts, vibration damage, etc. Possible use of trays, cups, liners, pads, etc.
  - Withstand packages stacked at least one pallet high
  - Maintain strength under high humidities (or free moisture in some cases)
  - Protect against contamination (fungi, insects, bacteria)
Packaging Requirements of the Commodity

- Provide (or modify) gas exchange
- Prevent/slow water loss
- Allow cooling and/or insulate from heating
  - Recommended 5% side venting (adequate air flow with good structural strength).
  - 3% venting in the top and bottom
  - Vents should align even when cross stacking
  - Internal packing should not restrict air movement
  - Provide insulation during non-refrigerated transport (e.g. cut flowers)

Packaging Requirements of the Marketing Chain

- Advertise the produce
- Provide information about the product (e.g. name, size, weight, grade, special treatments, etc.)
- Attractive package adds to product appeal

Unitizing in pallets, bins, etc.

- Reduces labor of handling individual cartons or products
  - E.g. handling watermelons one at a time vs. in bulk bins
  - Product at bottom must survive
  - Allows use of forklifts, cranes, etc.

- Protects the commodity (e.g. product shifting)
  - Systems such as gluing, interlocking packages, wrapping pallets, bracing, etc. help maintain unit integrity during transport
Palletizing

- Do not stack boxes beyond pallet edges
  - When cartons overhang, then the weight of the load is not on the corners (strongest part) = collapse of the load
- Use pallets that do not block the bottom vents of cartons

Quality Control (QC)

- One person should be responsible for an operation's QC and given enforcement authority
- Effective QC measures must be established throughout the entire postharvest system

Accumulating / Staging

Ripening