

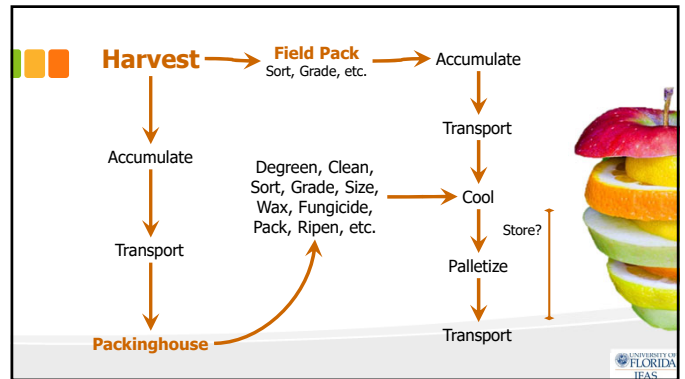
Harvest & Handling



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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




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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.




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The Harvesting Process

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




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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.





Figure courtesy of Steve Sargent

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Types of Harvesting

- Mechanical Harvesting

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Harvest





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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.)

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Field vs. Packinghouse Packing

- 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.)

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Transportation

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

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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





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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

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Preparation for Market

Before & After






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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



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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

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Dumping



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



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Dumping

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


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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

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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

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Presizing




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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)






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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.)

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Fungicide Drench (truck)




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Fungicide Drench (bin)

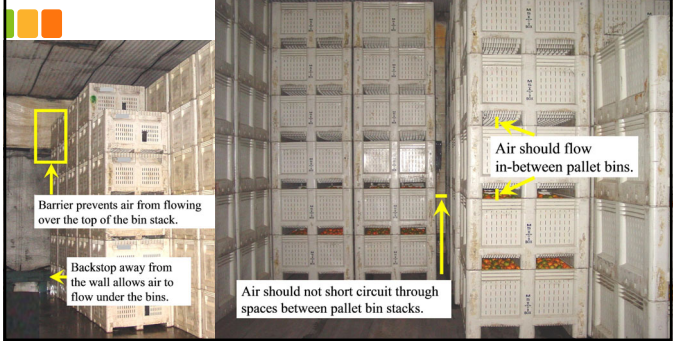



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Degreening



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Wetting
(± SOPP)



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Washing (High Pressure)



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Drying



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Waxing



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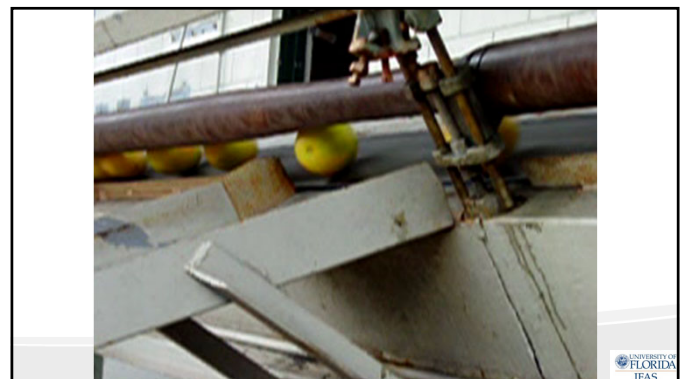
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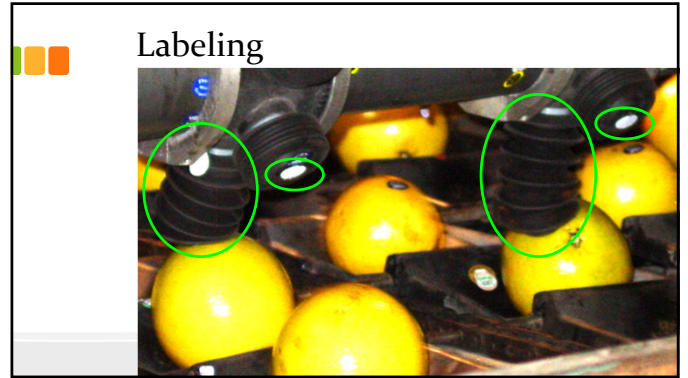
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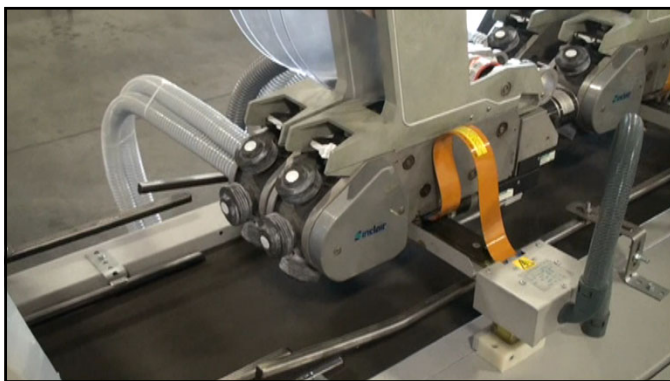
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Packing

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

COUNT

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Packing

- Volume fill
 - loose fill
 - tight fill
 - bagging
- Or place pack

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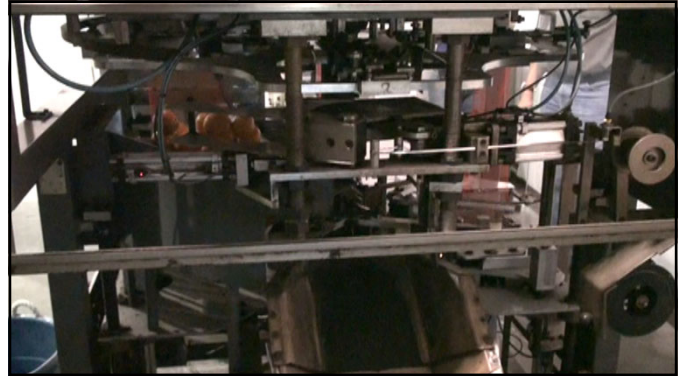
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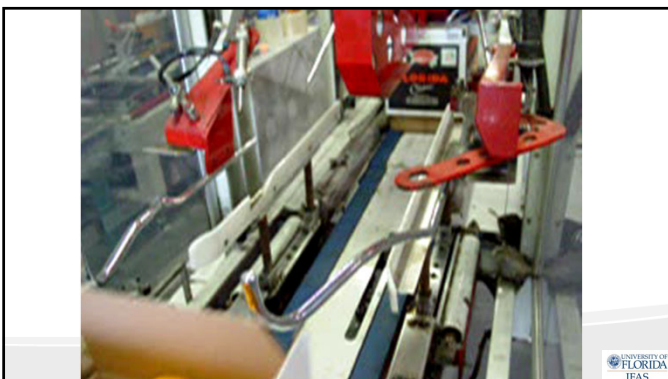
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Packaging Requirements of the Commodity

- **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)



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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)

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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

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Packaging Requirements of the Marketing Chain

- Appropriate dimensions
 - Fit more than one grade of crop
 - Fit common types of transport (e.g. trucks, rail, shipping containers, etc.)
- Design to fit standard 40" x 48" pallet
 - Generally 8 or 10/layer

Figure courtesy of Steve Sargent

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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.

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Unitizing in pallets, bins, etc.

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

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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



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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



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Accumulating / Staging



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Ripening



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