Packaging For Ripened Fruit

What is the right package?

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Choices in Master Containers

- Corrugated fiberboard
- Returnable plastic containers (RPC)
- Expanded polystyrene (EPS)
- Corrugated plastic
- Wood

Ripening & Initial Cooling

- Large vent areas (RPCs) may cause poor airflow distribution in FA systems.
- FA systems have poor air distribution when there is a mix of boxes with large and small vent areas.

Box Liners
Compression Damage Prevention

- Do not over fill box.
- Use boxes strong enough to support weight above them.

Moisture Absorption

- Corrugated and wood absorb water, can equal 1% of product weight.
- Plastic box liners or pallet covers reduce moisture loss, but interfere with temperature management.

Mechanical Damage Protection

- At 90% RH strength is 60% less than strength at 50% RH.
- Fatigue after 10 days of loading reduces strength by 35%.
- 10 days after packing strength may be 75% less than original.

Strength of Corrugated

Vibration Damage Prevention

- Use air ride truck suspension.
- Pack in consumer bags or suspended tray.
- Do not stow vibration sensitive products on the rear of a highway trailer.
Alternatives for protecting soft fruit

- Tight fill packaging is difficult to implement.
- Air ride suspension helps.
- Bagging fruit helps.
- But none of the above completely solve the problem nor do they work for very soft fruit.

Packages

- Clamshell w/ suspended tray
- Conventional clamshell
- Suspended Tray
- Paper pulp tray
- Plastic tray

Testing Procedure

Subject fruit to simulated cross-country highway truck transport, ASTM Method D4728-91 and Standard Practice D4169-94, assurance level I.

Pears

Avocados
Impact Damage Prevention

- Reduce hand palletizing and handling.
- Cost effective packaging is rarely effective in preventing impact damage.

Package Weight

<table>
<thead>
<tr>
<th></th>
<th>Corrugated</th>
<th>RPC</th>
<th>EPS</th>
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</thead>
<tbody>
<tr>
<td>Kg per 100 liters volume</td>
<td>2.2</td>
<td>3.3</td>
<td>0.97</td>
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</tbody>
</table>

Labeling

- Paper labels
- RFID

Rewarming

Netted oranges in corrugated or RPC boxes.

- Temperature Increase per Hour
  - Cardboard: 0.2, 0.4, 0.6, 0.8, 1.0
  - Reusable: 0.6, 0.8

Package Storage Before Use

- Many corrugated designs are stored completely flattened.
- EPS is stored fully formed.
- RPCs are not stored but delivered folded down.

Recycle

- Corrugated is widely recycled.
- EPS and polystyrene can be recycled but there may not be a cost effective system available.
- Wood is not usually recycled.
- Damaged RPCs are recycled by owner.
Cost

California for 2006 season

<table>
<thead>
<tr>
<th>Material</th>
<th>Cost</th>
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<tbody>
<tr>
<td>RPC</td>
<td>$1.05</td>
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<tr>
<td>Corrugated fiberboard</td>
<td>$1.25</td>
</tr>
<tr>
<td>Corrugated plastic</td>
<td>$1.50</td>
</tr>
<tr>
<td>EPS</td>
<td>$1.55</td>
</tr>
<tr>
<td>Wood</td>
<td>$1.62</td>
</tr>
</tbody>
</table>

Modified Atmosphere Packaging

- MAP is usually more expensive than conventional packaging but can reduce weight loss and extend shelf life.