South African Cold Chain
a Practical Perspective
by Keith Roxburgh
Discussion Points

• Fruit Growing regions in South Africa
• Ensuring fruit quality
  ▪ Guidelines
  ▪ Thermocouples
  ▪ Protocols
• Challenges and solutions
Fruit Growing Regions in South Africa
Ensuring Fruit Quality

- Packing and Grading Guides
- Handling Guidelines for Packhouse, transport and cooling
- Time and Temperature Protocol
  - Industry
  - PPECB
  - Exporters
Guidelines

- Importer/End Customer specifications
- Based on South African research
- PPECB guidelines
- Exporters SOP
### PINK LADY®-Cripps' Pink

<table>
<thead>
<tr>
<th>Tolerance</th>
<th>SP Grade</th>
<th>SA Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality Factor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decay / Rots / Internal Defects</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Scald</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Shrive</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Greenness</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Blister pitted / Lenticel pit</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Injuries / Cold injury</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Fusarium (active)</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Watercore / Progressive Core rot</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Internal stem infection / Damage</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Chemical residues / Arthropods</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Major defects combined</td>
<td>3%</td>
<td>3%</td>
</tr>
</tbody>
</table>

**Minor defects combined**

<table>
<thead>
<tr>
<th>Colour chart</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fusarium (inactive)</td>
<td>0%</td>
<td>1 spot 5mm diam not more than 10% infected</td>
</tr>
<tr>
<td>Spider mite or Non-progressive stem mite</td>
<td>6%</td>
<td>6%</td>
</tr>
<tr>
<td>Calcium/Lead spot</td>
<td>A18</td>
<td>Max 3</td>
</tr>
<tr>
<td>Stem-end rot spot</td>
<td>A44</td>
<td>Max 6</td>
</tr>
<tr>
<td>Fruit russet</td>
<td>A37</td>
<td>Max 4 on one side</td>
</tr>
<tr>
<td>Berserch combined including,</td>
<td>&lt; 100mm²</td>
<td>&lt; 100mm²</td>
</tr>
<tr>
<td>W. Flower thrips, pansey spot,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>orchard, wind &amp; air marks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sunburn damage / Rough marks</td>
<td>25mm²</td>
<td>25mm²</td>
</tr>
<tr>
<td>Bruising - single</td>
<td>6 - 12mm (6%)</td>
<td>12 - 12mm (6%)</td>
</tr>
<tr>
<td>Bruising - &gt;12mm - 20mm</td>
<td>3%</td>
<td></td>
</tr>
<tr>
<td>Bruising - multiple</td>
<td>Combined a &lt;100mm²</td>
<td>Combined a &lt;100mm²</td>
</tr>
<tr>
<td>Sunburn - pink lady chart</td>
<td>Max 3</td>
<td>Max 3</td>
</tr>
<tr>
<td>Hallmarks - scattered</td>
<td>A50</td>
<td>Max 2</td>
</tr>
<tr>
<td>Hallmarks - isolated</td>
<td>A50</td>
<td>Max depth 2mm</td>
</tr>
<tr>
<td>Mismatch / Malformation</td>
<td>&lt;10mm off True to type</td>
<td>&lt;10mm off True to type</td>
</tr>
<tr>
<td>Hammering</td>
<td>Must not break up pink colour</td>
<td>Must not break up pink colour</td>
</tr>
<tr>
<td>Pigging</td>
<td>Allowed on pink colour</td>
<td>No.browning allowed. Mustn't detract from overall colour</td>
</tr>
<tr>
<td>Colour - Background colour</td>
<td></td>
<td>40%</td>
</tr>
<tr>
<td>Pale cream - no yellowing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minor defects combined</td>
<td></td>
<td>8%</td>
</tr>
<tr>
<td>Total major &amp; minor defects combined</td>
<td></td>
<td>8%</td>
</tr>
</tbody>
</table>

**Maturity**

| Pressure (11 mm probe) 2/3 fruit tolerance | 7.6 kg | 7.2 kg |
| Min Brix % (TSS)         | min 12% | min 12% |
| Acid levels              | 0.4 - 0.3 | 0.4 - 0.3 |

**Packaging requirements**

<table>
<thead>
<tr>
<th>Carton</th>
<th>Equivalent count</th>
</tr>
</thead>
<tbody>
<tr>
<td>A120</td>
<td>48 65 94 70 90 64 86 96</td>
</tr>
<tr>
<td>B120/C120</td>
<td></td>
</tr>
<tr>
<td>M12T</td>
<td>48 50 64 70 80 64 88 98</td>
</tr>
<tr>
<td>M19T</td>
<td>70 80 90 100 110 120 130 140 150 160 175</td>
</tr>
</tbody>
</table>

**Carton and Brand:** According to allocation. Marketing requirements: Refer to CARTON MARKING REQUIREMENT section.

**PLU Label:** General PINK LADY® plug

**PLU Labeling:** 85% minimum in any one tray for LB fruit. All pre-pack counts UL. According to allocation.

Bag: 80 lb flat 5 mm minimum unless otherwise specified. JS = blank, T1 = green

Tray: Black polystyrene unless otherwise specified for a particular target market. JS=untied pulp tray, T1 = pulp

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**SKETCH B / SKETS B**

**PALLETTISERING VAN M 9 APPLE CARTON**

Top sheet

Polypropylene straps / Polypropelen gordelband

Securing sheets on 1st, 6th and 11th layer for 134 mm cartons and 15T, 674T and 1074T for 144 mm cartons / Hengede op 1STE, 6DE en 11DE lag vkr 134 mm / Kamers op 1STE, 6DE en 10DE lag vkr 144 mm karrene

Corner boards / Hoekstukjes

Yellow block pallet / Groenblokpallet
Guidelines

The use of type T Thermocouples

- All grape and stone fruit pallets
- All summer pear varieties
- 25% of apples and winter pears
- Citrus - none
Type T Thermocouples
Grape Temperature Protocol

- Cut grapes in the cool of the day
- Deliver to packhouse or pre coolers within 2 hours of cutting
- Pre cool to 18 – 20°C
- Packshed temperature not to exceed 22°C
- Place full pallets in cold room within 6 hours
- Do not deliver pallets with berry temperature in excess of 28°C
- Cold store to cool to target temperature of minus 0.5°C within 72 hours
Time and temperature protocol

Minimum requirements that cold room must meet

• Temperature control and records
• Calibration of recording equipment
• Minimum Delivery Air Temperatures
• Product temperatures at load out

• Guidelines on measuring, recording, and management of temperatures during forced air cooling
• Accurate Fruit Pulp Temperature Measurement
Shipping Modes
Transport of chilled fruit
Transport of chilled fruit

- Transport by road in cold trucks to a cold room close to the port.
- Load into Reefer Container at source
  - Transport by
    - Road
    - Rail
Challenges and solutions

- Effective cooling
- How long are pallets standing without cooling
- Are temperatures being maintained during shipping
How effective is the cooling! (FAC)

- Forced air cooling (Deciduous)
  - Cold Damage
  - Uniform cooling of pallets
  - How quickly does a pallet cool

- Static cooling (Citrus)
How effective is the cooling

Trial at Groot Gariep Cold Room

Points 1 2 3 4 – probes placed in outer most berries
  • 5 – tradition thermocouple
  • 6 – stem temperature
  • 7 – cold air entering the stack
  • 8 – warmer air leaving the stack
Cooling curve

Trial Two
Coldest position in pallet stack
4.5 Kg boxes - Perforated bags
Tunnel Seven - Top rack Centre pallet
How effective is the cooling

Grape Pallet cooling times (minus 0.5°C)

- 4.5kg standard carton ~ 48 hours
- 9 kg 600 X 400 carton ~ 72 to 90 hours

- 30% quicker
Static Cooling

- Majority of citrus does not have effective forced air cooling
  - 3 to 7 days to cool
- Warm loading of containers and specialized reefers
  - 5 to 8 days
Beginning to end supply chain project. Air temperatures in several positions in a reefer container carrying citrus from Letsitele to a supermarket in Berlin, Germany.
How long are pallets standing without cooling

- What we thought
  - Cold trucks switching off coolers
  - Long times without cooling during off loading and stowing in cold room
  - No break in the cold chain once in the container
Cold Truck Transport

Start Date: 2008-12-09

Temperature (°C)

High Alarm 2 °C
Cold Truck Transport and storage in the port
Are Temperatures being maintained during shipment?
Beginning to end supply chain project. Letsitele to a supermarket in Berlin, Germany.
Several recorders left with the fruit up to the point of sale.