Kiwifruit Ripening Protocol
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**Determining Stage of Ripening**

- Fruit firmness is the best measurement of ripeness. Fruit firmness is defined as the force necessary to break the flesh tissues and it is related to different ripening stages.
- Fruit firmness of a mature fruit varies from 16-12 pounds. During ripening, softening occurs, thus fruit firmness decreases reaching values of 2-4 pounds. When fruit reaches 2-4 pounds it is considered ripe or “ready to eat.” This is the level that kiwifruit will achieve its best eating characteristics.
- Minimum shipping firmness is suggested as 5 pounds, but it varies according to packaging. Fruit with firmness below this level becomes more susceptible to physical damage during transportation and handling.

**How to assure Consumer Quality**

- Minimum Maturity (6.5% SSC).
- Maximum Maturity (< 14 pounds).
- Consumer Quality (> 12.5% RSSC).
- Buyers Quality (> 16.0% D.M.)
**IMMEDIATELY AFTER PACKING.**

**Ripening at the Shipping Point**

**Cold Ethylene Pre-Conditioning Treatment**

- Ethylene pre-conditioning treatment is required only on freshly harvested kiwifruit or those that have been in cold storage for less than 5 weeks.

- No ethylene is required for kiwifruit that has been stored for longer than 5 weeks.

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**Ripening at the Shipping Point**

**Cold Ethylene Pre-Conditioning Treatment**

- Ethylene applied at 100ppm by using the "shot system" for 6-12 hours within a 0 to 7°C (32 to 45°F) temperature range will induce ripening as indicated by uniform kiwifruit softening and starch conversion into sugars.

- Ethylene exposure can be shortened to 6 hours by using a catalytic generator (C2H4) or flow-through application system (label).

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**How to apply Ethylene?**

- **The Shot System**
- **The Flow-Through System**

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**Ripening Room Conditions**

- Place cold kiwifruit in a ripening room with good temperature and relative humidity control.

- The ripening room should be located far away from any packing facilities to avoid ethylene contamination of long-term storage kiwifruit.
CONTAINERS

The type of kiwifruit container with box liners do not interfere with the ethylene application.

Ethylene Penetration & Dehydration

To avoid or reduce fruit shriveling, kiwifruit should be placed in ripening rooms in tray pack or volume fill packages with polyliners.

POST-TREATMENT HANDLING

• Maintain treated kiwifruit below 36F.
• Ship and consume fast.
• Cold stored away from kiwifruit for long-term storage.
• Temperature setting will be set according to their relationship between post-treatment temperature and rate of softening.

Forced Air Cooling

Cooling down to ~36°F

Postharvest Life Potential of Cold Conditioned Kiwifruit

• Cold kiwifruit treated at near 0°C (32°F) and maintained at that temperature may be held up to 3-6 weeks.
• These cold treated kiwifruit will reach a firmness of about 3 pounds in 2 to 3 days after being transferred to 20°C (68°F).

RIPENING GUIDELINES FOR KIWIFRUIT RECEIVERS

• Determining stage of ripening
• Handling Conditioned kiwifruit
• Temperature ripening
• Ethylene ripening
Temperature Ripening (Handler/Receiver)

- As a general rule, non-preconditioned kiwifruit received in your warehouse which have been in storage <5 weeks or have a flesh firmness level of >8-10 pounds should be treated further by using ethylene treatment to enhance ripening at the warehouse or store levels.
- If the flesh firmness is >5 pounds, but less than 8-10 pounds, kiwifruit ripeness can be triggered and controlled at your warehouse by temperature management.
- Fruit which have been in storage equal to or more than five weeks or have a flesh firmness of less than 8-10 pounds can be ripened to optimum levels by temperature management.
- Get preconditioned kiwifruit (reliable source).
- The fruit temperature at retail storage should be adjusted according to the anticipated consumption schedule based on rate of softening.

Relationship between temperature and flesh softening on firm kiwifruit (6-9 lb) stored for more than 5 weeks to manage temperature ripening at shipping, retail, wholesale and store point.

Rate of Kiwifruit softening after cold ethylene preconditioning treatment (32-36°F) on cold Kiwifruit

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Pounds lost per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>32°F</td>
<td>1.2</td>
</tr>
<tr>
<td>41°F</td>
<td>1.4</td>
</tr>
<tr>
<td>55°F</td>
<td>1.5</td>
</tr>
<tr>
<td>68°F</td>
<td>2.7</td>
</tr>
<tr>
<td>77°F</td>
<td>3.0</td>
</tr>
</tbody>
</table>

Rate of Kiwifruit softening after warm ethylene treatment (68°F)

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Pounds lost per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>32°F</td>
<td>1.5</td>
</tr>
<tr>
<td>45°F</td>
<td>2.0</td>
</tr>
<tr>
<td>68°F</td>
<td>3.0 to 4.0</td>
</tr>
</tbody>
</table>

Handling Cold Ethylene Conditioned Kiwifruit at the Warehouse/Store

- Conditioned kiwifruit firmness must be tested upon arrival to the warehouse or retail store and handled according to its rate of softening and your rotation time.
- Fifteen kiwifruit may be taken from the upper corner box in the pallet. A mature kiwifruit is usually harvested and shipped with a flesh firmness of 16-12 pounds-force (hard). Conditioned kiwifruit should arrive at destination warehouses with firmness near 6-12 lbs-force but never lower than 4-5 lbs-force. Fruit arrival temperature should be lower or equal to 50°F.
- Kiwifruit should always be kept at low temperatures (below 45°F) except if they are going to be consumed within 3 days. Keep kiwifruit enclosed with liners as long as you can.
- Cold kiwifruit enclosed with liners should be moved to the retail market before they reach a firmness of lower than or equal to 4-5 lbs-force to avoid vibration and impact bruising damage during transportation and handling.
- After delivery to the retail store, when kiwifruit reach the room temperature of 20-25°C (68-77°F), conditioned kiwifruit will lose nearly 3 lbs-force per day. If kept at 7.5 to 0°C (45 to 32°F), kiwifruit will soften at a rate of <2.0 lbs-force per day.
- As kiwifruit reach 2-3 pounds and start to deteriorate during display (warm rack), kiwifruit can be placed in a cooler room overnight or transferred to a cold rack if it is available to prolong their postharvest life. Frequent rotation and placing the softest kiwifruit at the front of the display are advised.
- Consumers should be informed that conditioned kiwifruit or ready-to-eat (2-3 lbs-force) kiwifruit must be refrigerated if they are not eaten immediately.