**Color Separation of Florida Citrus Prior to De-greening**

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**Fruit Process Operations**

**Alternative**
- Pre-grade
- Drench
- Degreen
- Wash

**Conventional**
- Drench
- Degreen
- Wash

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**Grading facility**

- Pre-packhouse fungicide
- Size, density, color and severe blemish

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**Initial study with the objectives:**

- Determine the feasibility of citrus fruit color separation before de-greening  
- Determine the percent of fruit that may bypass de-greening or be de-greened for shorter periods

[Note: initial tests with Fallglo tangerines in Fall 2003]

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**Automatic Grading Parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Technology Status</th>
<th>Constraints</th>
<th>Field Run (unwashed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>Proven</td>
<td>Standards (function of market, camera view (CV))</td>
<td>?</td>
</tr>
<tr>
<td>Blemish</td>
<td>Proven</td>
<td>Standards (market, blemish, CV)</td>
<td>Doubtful</td>
</tr>
<tr>
<td>Density</td>
<td>Proven</td>
<td>Volume calculation, edge detection (ED), CV, accurate mass</td>
<td>Probable</td>
</tr>
<tr>
<td>SSC (Brix level)</td>
<td>Proven-NIR</td>
<td>Cost, temp. correction, peel compensation, speed</td>
<td>Probable</td>
</tr>
<tr>
<td>Size</td>
<td>Proven</td>
<td>Axis consideration (AC), ED</td>
<td>Probable</td>
</tr>
<tr>
<td>Shape</td>
<td>Proven</td>
<td>CV, ED, AC</td>
<td>Probable</td>
</tr>
</tbody>
</table>

General disclaimer: Higher accuracy and throughput desirable for all of the above
Color Space
(hue, saturation, intensity)

Color Space Definition

Color Drop Assignments

<table>
<thead>
<tr>
<th>Drop Assignment</th>
<th>Dark Green</th>
<th>Light Green</th>
<th>Yellow</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 Dark Green</td>
<td>&gt; 10 %</td>
<td>&gt; 40 %</td>
<td>--------</td>
</tr>
<tr>
<td>#2 Light Green 1</td>
<td>5 – 10 %</td>
<td>30 – 40 %</td>
<td>--------</td>
</tr>
<tr>
<td>#3 Light Green 2</td>
<td></td>
<td>15-30 %</td>
<td>--------</td>
</tr>
<tr>
<td>#4 Light Green 3</td>
<td></td>
<td>5 – 15 %</td>
<td>&gt; 25 %</td>
</tr>
<tr>
<td>#5 Yellow</td>
<td>Default (&lt; 5 %)</td>
<td>Default (&lt; 5 %)</td>
<td>Default (0-100 %)</td>
</tr>
</tbody>
</table>

Initial Color Distributions

Fallglo tangerines
3 tests- Fall 2003

Initial Distribution, Test #2

Drop 1 (31.5%) Drop 2 (20.7%) Drop 3 (19.2%) Drop 5 (14.2%) Drop 4 (14.4%)

24 Hr Degreening Distribution, Test #2

Drop 1 (0.6%) Drop 2 (2.5%) Drop 3 (2.5%) Drop 5 (87.2%) Drop 4 (6.3%)

48 Hr Degreening Distribution, Test #2

Drop 1 (0.3%) Drop 2 (1.0%) Drop 3 (2.4%) Drop 5 (93.6%) Drop 4 (2.6%)

0 hr 24 hr 48 hr De-greening Time
General Conclusions

-Preliminary

- Field-run fruit can be separated readily, based on color, with current optical grading equipment.
- Initial tests with Fallglo tangerines indicated that 14 to 44% of fruit had adequate color for immediate packing.
- Extending the de-greening time from 24 to 48 hr (test #2), 12 to 24 hr (test #3) provided only a slight improvement in color grade improvement. Percent of Fallglo fruit categorized as dark or light green dropped from 3.1 to 1.3% (test #2) with an additional 24 hr de-greening.
- Late season harvested fruit had a significantly higher percent of fruit with acceptable color, yet the dark green fruit was more difficult to de-green.

Advantages/Disadvantages

Field –run fruit grading

Advantages
- Enhance fruit quality as de-greening time is eliminated or minimized
- Facilitate better use of de-greening room space (e.g. all fruit with 24 hr requirement in one area)
- Efficient use of packingline and de-greening rooms - a higher percent of the fruit handled would be packable grade(s)

Disadvantages
- Additional handling step out of pallet bins
- Available fruit to pack may be limited at some times, a priori de-greening time may be difficult to estimate
- May not totally replace current pre-grade operation

Acknowledgements

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Thank you for your attention