Mechanical Blossom Thinning of Peaches

John Cline
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Outline of Presentation

- Horticultural basis for thinning peaches
- Various strategies – past and present
- 2009 experiments
- 2010 experiments
- Future Research, Challenges and Opportunities
What is the impetus for developing better thinning methods for peaches

- Thinning is labour intensive ~ $500/acre
- Hand thinning is done ~45 DAFB, resulting in an enormous ‘waste’ in photosynthate
- Harvest efficiency – proportional to number of fruit per tree
Horticultural Basis for thinning Peaches

- Trees fruits produce an excessive number of flowers
- Only 5-10% flower set required to produce a commercial crop
- Maximize crop value
- Maintain tree growth and structure
Various Strategies of Thinning Peaches


B. Fruitlet Thinning
- Elgetol (Dinitro-ortho-cresol)
- Ethrel (Cline, Taheri, Coneva and others)
- Tree shaking (Leuty & Miller)
- Rope Thinning (Byers)

C. Flower Inhibition
- Gibberellic Acid (Coneva & Cline, 2006 HortScience 41:1596)
Rope Blossom Thinner

Photo courtesy of Dr. Bob Belding,
Phil Brown Welding, Michigan
Basis for Mechanical String Thinning

- Method to thin earlier (bloom)
- Non chemical approach
- For stone fruits there are few commercially accepted methods
- No registered blossom or fruitlet chemical thinners (unlike apple)
2009 Research Objectives

To assess the effectiveness of mechanical blossom thinning on:

- Reduction in hand thinning and cost savings
- Improvement in fruit size
- Effect on yield
Mechanical String Thinner

- Designed by Fruit-Tec, Germany
- Sold in North America by N.M. Bartlett Inc.
- Has front mount 3PH, fixed, or fork-lift mounts
- Model evaluated Darwin 300
Mechanical String Arrangements

9 Strings

- Autumn Glow (heavy) Pink 150 & 180 1
- Red Haven Pink 160 1
- PF17 Pink 180 1
- Saturn Pink 150 2
- Fantasia Shucks On 150 2

18 Strings

2 On, 2 Off

- Autumn Glow Pink 150 1

2 On, 2 Off Opposing

- Red Haven Pink 160 1
- PF17 Pink 180 2

Two On, Every Third Off

- PF17 Pink 180 2

2 On, 4 Off

- PF17 Pink 200 2
- White Lily Pink 180 2

Four On, Four Off

- Red Haven 200 1

Source: Penn State University
2009 Experiments
Catherina

- 8-yr old “Catherina”
- 1.8 x 6.6 m (841 t/ha)
- central leader
- Goal was to evaluate: speed of rotation (RPM), string configuration and to compare with hand thinning
Allstar

5-yr old “Allstar” peach
1.8 x 4.8 m (1121 t/ha)
Tall spindle

Goal was to evaluate:
speed of rotation (RPM), string configuration and to compare with hand thinning
Treatments

- Hand thinned control
- 180 RPM, 18 strings
- 180 RPM, 9 strings
- 240 RPM, 18 strings
- 240 RPM, 9 strings

Ground speed: 2.1 miles per hr
Timing: Full Bloom
Peach Measurements

- Percent blossoms removed
- Fruit set (on selected branches)
- Number of fruit thinned per branch
- Time required to hand thin
- Harvest: Number of fruit per tree, yield, fruit size, split pits,
Allstar: 37-58%  Catherina: 60-85%
• Mechanical thinning reduced fruit
• RPM greater effect than String configuration
Labour Savings

Hand thinning per Acre
- 77 hrs (Allstar)
- 20 hrs (Catherina)

Reduction
- 21-50% (Allstar)
- 10-50% (Catherina)

Savings (at $10 per hr)
- $160-290 (Allstar)
- $20-100 (Catherina)
Yield and Fruit Size

Total Weight per Tree
- No effect (Allstar)
- Mechanical thinning reduced yields 9 to 45% (Catherina)

Fruit size
- Mechanical thinning increased fruit size 8 – 15%

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Total fruit weight (kg/tree)</th>
<th>Fruit weight (adjusted for crop load) (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Allstar</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hand thinned control</td>
<td>24.4</td>
<td>147</td>
</tr>
<tr>
<td>180 RPM, 18 Strings</td>
<td>24.1</td>
<td>158</td>
</tr>
<tr>
<td>180 RPM, 9 Strings</td>
<td>21.9</td>
<td>155</td>
</tr>
<tr>
<td>240 RPM, 18 Strings</td>
<td>20.0</td>
<td>173</td>
</tr>
<tr>
<td>240 RPM, 9 Strings</td>
<td>20.9</td>
<td>167</td>
</tr>
<tr>
<td><strong>Significance</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ns</td>
<td></td>
<td>**</td>
</tr>
<tr>
<td><strong>P value</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.1624</td>
<td></td>
<td>0.0015</td>
</tr>
<tr>
<td><strong>Contrasts (P value)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effect of Hand vs Mechanical Thinning</td>
<td>0.1103</td>
<td>0.0005</td>
</tr>
<tr>
<td>Effect of 18 vs 9 strings</td>
<td>0.6302</td>
<td>0.1926</td>
</tr>
<tr>
<td>Effect of 180 vs 240 RPM</td>
<td>0.0926</td>
<td>0.0011</td>
</tr>
<tr>
<td><strong>Catherina</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hand thinned control</td>
<td>29.7</td>
<td>198</td>
</tr>
<tr>
<td>180 RPM, 18 Strings</td>
<td>27.1</td>
<td>ab 218</td>
</tr>
<tr>
<td>180 RPM, 9 Strings</td>
<td>34.6</td>
<td>a 219</td>
</tr>
<tr>
<td>240 RPM, 18 Strings</td>
<td>16.1</td>
<td>c 231</td>
</tr>
<tr>
<td>240 RPM, 9 Strings</td>
<td>23.1</td>
<td>bc 212</td>
</tr>
<tr>
<td><strong>Significance</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>P value</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.0061</td>
<td></td>
<td>0.015</td>
</tr>
<tr>
<td><strong>Contrasts (P value)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effect of Hand vs Mechanical Thinning</td>
<td>0.0237</td>
<td>0.1085</td>
</tr>
<tr>
<td>Effect of 18 vs 9 strings</td>
<td>0.0017</td>
<td>0.4446</td>
</tr>
<tr>
<td>Effect of 180 vs 240 RPM</td>
<td>0.1803</td>
<td>0.8209</td>
</tr>
</tbody>
</table>
2010 Experiments
2010 Peach Trial Overview

- Grower trial: Lepp Farms Inc., Virgil Ontario
- 6 year-old ‘Allstar’/Bailey rootstock
- Goal: compare mechanical thinning to hand thinning at the same rate at the same time
Step 1: Count blossoms before treatment

Step 2: Count blossoms after mechanical thinning

Step 3: Thin hand treatments to 50%
2010 Peach Trial - Materials & Methods

- Colorimeter
- Vernier caliper
- Penetrometer
- Refractometer
- Color
- Fruitlet size
- Sugar content
- Firmness

Color info
Peach Results - 2010 Field Season
Table 1. The effect of thinning treatment on percentage of blossoms removed, and subsequent percentage of fruit set for Allstar peaches on Bailey rootstock in Virgil, Ontario, Canada before June Drop 2010.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>% of blossoms removed</th>
<th>% fruit set</th>
</tr>
</thead>
<tbody>
<tr>
<td>180RPM</td>
<td>44 bc</td>
<td>51 ab</td>
</tr>
<tr>
<td>210RPM</td>
<td>58 b</td>
<td>35 c</td>
</tr>
<tr>
<td>240RPM</td>
<td>74 a</td>
<td>22 d</td>
</tr>
<tr>
<td>Hand1</td>
<td>37 c</td>
<td>58 a</td>
</tr>
<tr>
<td>Hand2</td>
<td>57 b</td>
<td>41 bc</td>
</tr>
<tr>
<td>Hand3</td>
<td>74 a</td>
<td>23 d</td>
</tr>
</tbody>
</table>

Trt effect

Estimates

| Mechanical vs. Hand | NS | NS |

*Means with the same letter are not significantly different at P = 0.05. Non-significant effects or comparisons are indicated by NS.*
Follow-up Hand Thinning

Table 2. The effect of thinning treatment of follow-up hand thinning at ‘June Drop’ for ‘Allstar’ peaches on Bailey rootstock in Virgil, Ontario, Canada 2010.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>No. fruit removed</th>
<th>Wt. of fruit removed, g</th>
<th>Avg. wt. of ind. fruit, g</th>
<th>Time spent thinning, sec</th>
<th>Time spent thinning, hours/acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>180RPM</td>
<td>283 a&lt;sup&gt;x&lt;/sup&gt;</td>
<td>4470 a</td>
<td>15.9 b</td>
<td>465 ab</td>
<td>59</td>
</tr>
<tr>
<td>210RPM</td>
<td>302 a</td>
<td>4639 a</td>
<td>15.4 b</td>
<td>510 ab</td>
<td>64</td>
</tr>
<tr>
<td>240RPM</td>
<td>236 ab</td>
<td>4007 a</td>
<td>17.3 ab</td>
<td>450 ab</td>
<td>57</td>
</tr>
<tr>
<td>Hand1</td>
<td>323 a</td>
<td>5314 a</td>
<td>16.7 ab</td>
<td>608 a</td>
<td>77</td>
</tr>
<tr>
<td>Hand2</td>
<td>223 ab</td>
<td>3959 a</td>
<td>18.2 ab</td>
<td>437 ab</td>
<td>55</td>
</tr>
<tr>
<td>Hand3</td>
<td>111 b</td>
<td>2128 b</td>
<td>19.4 a</td>
<td>285 b</td>
<td>36</td>
</tr>
</tbody>
</table>

Trt effect Estimates

| Mechanical vs. Hand | *       | NS      | **      | NS      |

<sup>x</sup>Means with the same letter are not significantly different at $P = 0.05$ (Tukey’s). Non-significant effects or comparisons are indicated by NS.
## Harvest Yields

### Table 3. The effect of thinning treatment on harvest yields of ‘Allstar’ peaches on Bailey rootstock in Virgil, Ontario, Canada 2010.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>No. of fruit per tree</th>
<th>Wt. of fruit per tree, kg</th>
<th>Avg. wt. of ind. fruit, g</th>
</tr>
</thead>
<tbody>
<tr>
<td>180RPM</td>
<td>197 ab¹</td>
<td>25.3 ab</td>
<td>128 b</td>
</tr>
<tr>
<td>210RPM</td>
<td>145 abc</td>
<td>20.3 abc</td>
<td>141 ab</td>
</tr>
<tr>
<td>240RPM</td>
<td>91 c</td>
<td>13.3 c</td>
<td>145 ab</td>
</tr>
<tr>
<td>Hand1</td>
<td>220 a</td>
<td>28.1 a</td>
<td>131 ab</td>
</tr>
<tr>
<td>Hand2</td>
<td>190 ab</td>
<td>24.9 ab</td>
<td>135 ab</td>
</tr>
<tr>
<td>Hand3</td>
<td>107 bc</td>
<td>16.1 bc</td>
<td>150 a</td>
</tr>
</tbody>
</table>

Trt effect Estimates

Mechanical vs. Hand NS NS NS

¹Means with the same letter are not significantly different at $P = 0.05$ (Tukey’s). Non-significant effects or comparisons are indicated by NS.
Grading

Size Distribution for Each Treatment

Percentage of Fruit Within Each Size Category (%)

Treatment:
- 180 RPM
- Hand 1
- 210 RPM
- Hand 2
- 240 RPM
- Hand 3

Size Categories:
- < 2 3/8
- 2 1/2
- 2 5/8
- 2 3/4
- 2 7/8
- 3
- > 3

2011 OFVC Conference, St. Catharines, Ontario
Grading

Size Distribution for Each Treatment

Mechanical Hand

<table>
<thead>
<tr>
<th>Treatment</th>
<th>180 RPM</th>
<th>210 RPM</th>
<th>240 RPM</th>
<th>Hand 1</th>
<th>Hand 2</th>
<th>Hand 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of Fruit Within Each Size Category (%)</td>
<td>0</td>
<td>20</td>
<td>40</td>
<td>60</td>
<td>80</td>
<td>100</td>
</tr>
</tbody>
</table>

Legend:
- < 2 3/8
- 2 1/2
- 2 5/8
- 2 3/4
- 2 7/8
- 3
- > 3

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# Harvest Quality

**Table 4.** The effect of thinning treatment on harvest quality parameters of Allstar peaches on Bailey rootstock in Virgil, Ontario, Canada 2010.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Pressure, kg</th>
<th>Brix, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>180RPM</td>
<td>3.32 a&lt;sup&gt;x&lt;/sup&gt;</td>
<td>10.0 a</td>
</tr>
<tr>
<td>210RPM</td>
<td>3.51 a</td>
<td>9.8 a</td>
</tr>
<tr>
<td>240RPM</td>
<td>3.04 a</td>
<td>9.7 a</td>
</tr>
<tr>
<td>Hand1</td>
<td>3.71 a</td>
<td>9.8 a</td>
</tr>
<tr>
<td>Hand2</td>
<td>3.48 a</td>
<td>9.4 a</td>
</tr>
<tr>
<td>Hand3</td>
<td>3.65 a</td>
<td>9.9 a</td>
</tr>
</tbody>
</table>

Trt effect Estimates
Mechanical vs. Hand

NS NS

<sup>x</sup>Means with the same letter are not significantly different at $P = 0.05$ (Tukey’s). Non-significant effects or comparisons are indicated by NS.
Peach 2010 Summary

- No significant difference between mechanical and hand treatments for blossom removal or fruit set
- Hand thinning decreased no. of fruit removed, decreased the weight of fruit removed, and decreased time spent thinning at ‘June Drop’
- For both mechanical and hand treatments, lower magnitudes had more fruit per tree at harvest. The same was seen for fruit weight per tree. Hand3 treatment produced largest fruit (150g)
- More large fruit observed with increasing magnitude of thinning (grading)
- Firmness and sugar content unaffected by treatment
Where to go from here…

• Repeat trial

• Areas of interest:
  • Return bloom
  • Look at quality for each picking date
  • Other cultivars?
Future Research and Challenges

- Tree architecture (tall spindles, hedge row systems) will need to be adjusted to make best use of this technology

- Negative effects of leaf injury not fully understood
  - Since leaves are not typically out at bloom, less of a concern on peach than other tree fruit

- MT requires earlier pruning
  - Start with earlier ripening cultivars
  - Prune on warm, dry days to avoid spread of peach canker (*Leucostoma cincta* and *L. persoonii*)

- MT is strategy to be used in conjunction with hand thinning

- Potential for use on other stone fruit
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Niagara Peninsula Fruit & Vegetable Growers’ Association

NSERC CRSNG

Ontario Tender Fruit Producers’ Marketing Board