Managing sweet cherry crop load

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Outline

• Need for crop load management
• What are crop load targets?
• When is the best time to thin?
• What tools are available?
• New ideas
Source-sink relationships
The need for thinning....

![Graph showing the relationship between fruit weight (g) and tree fruit:leaf area, with R^2 = 0.88.](image)
Carbohydrate competition:
fruit vs. shoots

RGR (cm/day)

No fruit
light crop
heavy crop

harvest

day of year

I
II
III

*
days after full bloom

Net assimilation (g/tree)

‘Bing’/’Gisela 5’

harvest

3 crop loads

0 40 60 80 100 120 140 160 180

0 200 400 600 800 1000
Optimizing fruit quality & quantity:

*Key point #1*

1. You can not increase the supply of resources in a tree (must balance the demands)
   - Need to learn more of effect of training system
   - Light interception and light distribution
Why is a cherry large or small?

Genetically small

Genetically large

Cell number difference

Cell size difference

Size range due to environment

Cell size difference
- Half the number of cells comprising an individual fruit at harvest are present at full bloom.

- Most cell division completed during mid-stage I (~17dafb).

- Final fruit size more strongly correlated with cell size than cell number....but cell number sets the potential for fruit size.
## Identify the best time to thin & targets

- Early thinning is beneficial
- 2 – 4 fruit per spur

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Fruit/tree</th>
<th>Fruit/tcsa</th>
<th>Fruit weight</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Crop load</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 bud/spur</td>
<td>1441 a</td>
<td>9.53 a</td>
<td>11.75 b</td>
</tr>
<tr>
<td>2 buds/spur</td>
<td>2157 b</td>
<td>13.54 b</td>
<td>11.56 b</td>
</tr>
<tr>
<td>4 buds/spur</td>
<td>3810 c</td>
<td>22.58 c</td>
<td>10.29 a</td>
</tr>
<tr>
<td><strong>Thinning time</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dormant</td>
<td>2192 ab</td>
<td>13.62 ns</td>
<td>12.28 b</td>
</tr>
<tr>
<td>Full bloom</td>
<td>2135 a</td>
<td>13.01</td>
<td>12.11 b</td>
</tr>
<tr>
<td>2 WAFB</td>
<td>2679 c</td>
<td>16.36</td>
<td>10.52 a</td>
</tr>
<tr>
<td>4 WAFB</td>
<td>2792 c</td>
<td>17.32</td>
<td>10.26 a</td>
</tr>
<tr>
<td>6 WAFB</td>
<td>2613 bc</td>
<td>15.78</td>
<td>10.83 a</td>
</tr>
</tbody>
</table>
Identify the best time to thin

- Clear advantage to earlier thinning
- Cell division vs. expansion?
- Sink strength?

Fruit weight (g)

Fruit yield (kg)

Control  Full Bloom  Shuck Fall  Straw  Stage III A
Thinning tools:

15-months of crop load management

- Gibberellic acid
- Loppers
- Chemical bloom thinners
- Mechanical bloom thinners
- Post-bloom thinners?
- Hand thinning
15-month growth & development cycle

GA → PRUNING → BLOOM → POST-BLOOM → HAND

MECH
## Thinning with GA?

Effect of treatments in previous year on ‘Bing’

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Yield (kg)</th>
<th>Weight (g)</th>
<th>Firmness (g/mm)</th>
<th>≥10.5-row (%)</th>
<th>crop value ($/tree)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>12.8 a</td>
<td>7.4 bc</td>
<td>275 c</td>
<td>51 b</td>
<td>31.7</td>
</tr>
<tr>
<td>30ppm, II</td>
<td>10.4 ab</td>
<td>7.4 bc</td>
<td>276 c</td>
<td>58 b</td>
<td>25.9</td>
</tr>
<tr>
<td>50, I</td>
<td>10.4 ab</td>
<td>7.2 c</td>
<td>291 bc</td>
<td>55 b</td>
<td>26.3</td>
</tr>
<tr>
<td>50, II</td>
<td>9.7 ab</td>
<td>7.4 bc</td>
<td>281 bc</td>
<td>52 b</td>
<td>24.0</td>
</tr>
<tr>
<td>50, I &amp; II</td>
<td>5.8 bc</td>
<td>7.9 abc</td>
<td>316 ab</td>
<td>77 a</td>
<td>16.2</td>
</tr>
<tr>
<td>100, I</td>
<td>4.6 c</td>
<td>8.2 ab</td>
<td>307 abc</td>
<td>87 a</td>
<td>13.7</td>
</tr>
<tr>
<td>100, II</td>
<td>6.3 bc</td>
<td>7.8 abc</td>
<td>311 abc</td>
<td>77 a</td>
<td>17.7</td>
</tr>
<tr>
<td>100, I &amp; II</td>
<td>4.7 c</td>
<td>8.4 a</td>
<td>329 a</td>
<td>87 a</td>
<td>13.8</td>
</tr>
</tbody>
</table>
Managing crop load with \( \text{GA}_3 \)

- Positive curvilinear response
- Little benefit from 30 & 50 ppm
- 11% improvement at 100 ppm
- Negative linear response
- Yield reduction from 30 & 50 ppm
Thinning with GA

• Improve quality and delay maturity of current season crop (50 ppm +)
• Effective to reduce floral density – Rate dependent
• Improve vegetative vigor
• Danger – potential subsequent crop failure
• Self-fertile, late-maturing cvs?
### GA: Fruit Firmness

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<tr>
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<tbody>
<tr>
<td>0</td>
<td>380 a</td>
<td>371 c</td>
<td>320 b</td>
<td>316 b</td>
<td>298 b</td>
<td>261 b</td>
</tr>
<tr>
<td>0+ surfact.</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>10</td>
<td>417 a</td>
<td>405 b</td>
<td>459 a</td>
<td>370 a</td>
<td>331 a</td>
<td>297 a</td>
</tr>
<tr>
<td>20</td>
<td>416 a</td>
<td>414 ab</td>
<td>448 a</td>
<td>377 a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>418 a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>30</td>
<td>419 a</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>30 (20+10)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>414 a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40 (20+20)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>40 (30+10)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>417 a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>417 a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60 (20+40)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>417 a</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

- **GA Consistently Improved Firmness**
- Response occurred at low concentrations
- Cultivars evaluated responded similarly
15-month growth & development cycle
Pruning for quantity and quality.....
Pruning strategies:

**Mazzard-rooted:**
- vigorous, not precocious
- get fruit on the tree ASAP
- mitigate excessive vigor
- thinning cuts
- summer pruning

**Gisela-rooted:**
- smaller canopies, very precocious
- get fruit off the tree ASAP
- maintain good vigor
- heading cuts
- dormant pruning – renew frequently
Trial compared:
1. Unthinned (control)
2. Manual spur thinning
3. Manual blossom thinning

Plant material: ‘Bing’ on Gi5 and Gi6
Target: 2000 fruit per tree
Thinned in year 1; unthinned in year 1
**Fruit per tree**

- **Year 1**
  - Control: a
  - Blossom thinned: b
  - Spur thinned: b
  - More fruit when spurs thinned

- **Year 2**
  - Control: a
  - Blossom thinned: a
  - Spur thinned: b
  - Fewer fruit when spur-thinned

*very close to target*  
*fewer fruit when spur-thinned*
Yield (kg/tree)

- Lower yield from thinned trees
- Blossom-thinned higher yielding (~ 1 ton/acre)

Year 1:
- Control
- Blossom thinned
- Spur thinned

Year 2:
- Lower yield from spur-thinned trees (~ 2 tons/acre)
- No difference between blossom-thinned or control
Fruit weight

- Improved by both thinning methods in year 1
- Blossom-thinning better than spur thinning

- No effect of treatment in year 2 despite 2 ton yield reduction in spur-thinned
Crop value ($/tree)

- improved by blossom thinning
- no benefit to spur thinning
Lessons:

• Both techniques reduced crop load and improved fruit quality in year of treatment

• Blossom thinning is preferable
  – Year 1 - higher yields & larger fruit
  – Year 2 - spur-thinning reduced yield w/o increasing quality
  – improved crop value
  – moderates F:LA on individual spur basis
15-month growth & development cycle

GA

POST-BLOOM

BLOOM

PRUNING

MECH

HAND
Chemical blossom thinning

Tergitol (1%)
ATS (2%)
FOLS (2%)
VOE (4%)
### ‘Rainier’/’Mahaleb’

<table>
<thead>
<tr>
<th></th>
<th>Fruit set (%)</th>
<th>Soluble solids (%)</th>
<th>Weight</th>
<th>≥50% red (%)</th>
<th>≥ 9.5-row (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>65 a</td>
<td>20.3</td>
<td>82</td>
<td>17 b</td>
<td></td>
</tr>
<tr>
<td>VOE</td>
<td>70 a</td>
<td>20.6</td>
<td>87</td>
<td>37 ab</td>
<td></td>
</tr>
<tr>
<td>ATS</td>
<td>44 b</td>
<td>20.8</td>
<td>90</td>
<td>68 a</td>
<td></td>
</tr>
<tr>
<td>FOLS</td>
<td>46 b</td>
<td>21.4</td>
<td>9.9 a</td>
<td>75</td>
<td>51 ab</td>
</tr>
<tr>
<td>Tergitol</td>
<td>41 b</td>
<td>21.6</td>
<td>8.9 ab</td>
<td>75</td>
<td>36 ab</td>
</tr>
</tbody>
</table>

- reductions in fruit set
- improvements in quality
`'Rainier'/'Gisela®6'`

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Fruit set (%)</th>
<th>Fruit weight (g)</th>
<th>Yield (kg)</th>
<th>Yield &gt;10.5-row (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>23.9 a</td>
<td>10.6</td>
<td>33.1 a</td>
<td>31.8 a</td>
</tr>
<tr>
<td>FOLS</td>
<td>14.0 b</td>
<td>10.3 a</td>
<td>20.0 b</td>
<td>19.3 b</td>
</tr>
<tr>
<td>Tergitol</td>
<td>13.3 b</td>
<td>10.1 a</td>
<td>13.4 b</td>
<td>13.2 b</td>
</tr>
<tr>
<td>ATS</td>
<td>16.1 b</td>
<td>11.0 a</td>
<td>21.8 b</td>
<td>21.6 b</td>
</tr>
</tbody>
</table>

- reductions in fruit set
- no improvements in quality
‘Skeena’/‘Gisela® 5’

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Fruit set (%)</th>
<th>Fruit weight (g)</th>
<th>Yield (%)</th>
<th>Yield &gt;10.5-row (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>81.1 a</td>
<td>7.5 ab</td>
<td>15.7 a</td>
<td>10.0 ab</td>
</tr>
<tr>
<td>FOLS</td>
<td>72.8 a</td>
<td>6.8 b</td>
<td>15.0 a</td>
<td>7.6 b</td>
</tr>
<tr>
<td>Tergitol</td>
<td>73.0 a</td>
<td>6.8 b</td>
<td>13.3 a</td>
<td>7.0 b</td>
</tr>
<tr>
<td>ATS</td>
<td>72.7 a</td>
<td>8.6 a</td>
<td>14.7 a</td>
<td>13.8 a</td>
</tr>
</tbody>
</table>

- no reductions in fruit set
- no improvements in quality
Thinner mode of action?
ATS application transfers pollen?...

Sweetheart treated with ATS

Sweetheart untreated
Mechanical thinning devices
Karen Lewis, Qin Zhang, Meng Wang

Darwin

Bonner

WSU
Hand-held
Handheld string thinner:

- Semi-selective
- Very effective
- Allows targeting heavy blossom areas
- Efficient
Manage pollinators?

**Fruit set throughout flowering**

- **Fruit set (%)**
  - Bloom Date: 30-Sep, 2-Oct, 4-Oct, 6-Oct, 8-Oct, 10-Oct, 12-Oct, 14-Oct
  - Values: 20, 27, 25, 39, 38, 37, 36, 39, 38, 43, 43, 63, 60, 50

- **Percent final crop**
  - Bloom Date: 30-Sep, 2-Oct, 4-Oct, 6-Oct, 8-Oct, 10-Oct, 12-Oct, 14-Oct
  - Values: 0.2, 0.3, 1.4, 4.9, 8.5, 5.7, 5.7, 2.9, 2.2, 0.7, 0.2, 0.1

- **% Flowers GDD^2**
  - Graph showing % flowers GDD^2 for different bloom dates.
Manage pollinators?
15-month growth & development cycle

- Pruning
- Bloom
- MECH
- Hand
- Post-bloom
Post-bloom thinning

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Fruit set (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>38 a</td>
</tr>
<tr>
<td>FOLS</td>
<td>27 b</td>
</tr>
</tbody>
</table>

- Inconsistent response
- Warrants further research

2005 - 2% FO + 2% LS @ 14 DAFB

2006 - Timings (2%FO + 3% LS)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Fruit set</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>72 a</td>
</tr>
<tr>
<td>14 DAFB</td>
<td>72 a</td>
</tr>
<tr>
<td>21 DAFB</td>
<td>71 a</td>
</tr>
<tr>
<td>14 + 21 DAFB</td>
<td>65 a</td>
</tr>
</tbody>
</table>
Investigate potential for post-bloom thinning

NAA, BA, MJ, ABA, Ethephon
‘Skeena’ post-bloom thinning

Fruit set (% of control)

Controls Hand thin 100 ppm 200 ppm 300 ppm

Mean

15-May: 'Skeena' post-bloom thinning

Fruit set (% of control)

11-May 16-May 21-May 26-May 31-May 5-Jun 10-Jun

100 ppm 200 ppm 300 ppm
Managing demand vs. improving supply
2006 Quincy: ‘Sweetheart’

- Extenday® applied full season
2006 Quincy: ‘Sweetheart’/‘Mazzard’

Fruit yield & quality (2nd year)

- Improved light relations
- Improved carrying capacity
Future of crop load management?
Low volume applications: (95-110 L/ha)
1. Supplemental pollination in addition to ‘normal’ practices

2. Replacement pollination in absence of pollinators & pollenizers
Results: Spring 2015

Regina/’Gisela6’

- 20% increase in fruit set
- Block was previously unproductive
- Grower decided to keep orchard
Orchards with no pollenizers nor pollinators

Tatura system: ‘Early Robin’/ ‘Gisela 12’