Influence of Gibberellic Acid (GA$_3$) on Fruit Quality of Sweet Cherries

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Presentation Outline

- Introduction
- Historical perspective of gibberellic acid (GA) use increase the firmness of sweet cherries
- Current labeled products and recommendations
- Other effects of GA
- Data from Ontario
University of Guelph - Simcoe and Vineland Research Stations
Major Fruit Producing Areas of Ontario (Source: OMAF)
<table>
<thead>
<tr>
<th>PGR</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Auxin</strong></td>
<td>Cell enlargement, Apical dominance, Rooting promotion, Fruit thinning, Fruit drop prevention</td>
</tr>
<tr>
<td><strong>Gibberrellin</strong></td>
<td>Firmness, cell enlargement, seedlessness, cause fruit set, flower induction, flower reduction (thinning), break dormancy, Increase seed germination, delay of senescence, modify sex expression</td>
</tr>
<tr>
<td><strong>Cytokinin</strong></td>
<td>Cell division, Counteract apical dominance, Branching agent, Delay of senescence, Cause fruit abscission</td>
</tr>
<tr>
<td><strong>Ethylene</strong></td>
<td>Ripening agent, Causes leaf &amp; fruit abscission, Promotes radical growth</td>
</tr>
<tr>
<td><strong>Abscisic Acid</strong></td>
<td>Promotes leaf &amp; fruit abscission, Regulates dormancy in perennials, Controls hydric status through stomata opening control</td>
</tr>
</tbody>
</table>

Dr. Silvan Witwer
Dr. Ed Proebsting of WSU was one of the first to report on the use of GA on sweet cherries to delay maturity and improve quality (firmness) (Proebsting, 1972 WSU Extension Multilith 3520).
<table>
<thead>
<tr>
<th>Function</th>
<th>Products Available</th>
<th>Research Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Inhibit Flowering</td>
<td>GA$_3$, GA$_4$, GA$_7$</td>
<td>Apples, Peaches, Cherries</td>
</tr>
<tr>
<td>2. Promote Flowering</td>
<td>Ethrel, NAA</td>
<td>Apple</td>
</tr>
<tr>
<td>3. Influence fruit ripening and quality</td>
<td>GA$_3$, GA$_4$, GA$_7$, Ethrel, Retain</td>
<td>Cherries, Apples, Peaches</td>
</tr>
<tr>
<td>4. Fruit thinning</td>
<td>Carbaryl*, NAA, BA, Surfactants,</td>
<td>Apple, Peach</td>
</tr>
<tr>
<td>5. Influence ethylene synthesis</td>
<td>Ethrel, MCP, ReTain</td>
<td>Apple, Peach</td>
</tr>
<tr>
<td>6. Fruit finish</td>
<td>GA, Koalin Clay*</td>
<td>Apple</td>
</tr>
<tr>
<td>7. Change fruit shape</td>
<td>Benzyl adenine (BA)</td>
<td>Apple</td>
</tr>
<tr>
<td>8. Reduce Preharvest drop</td>
<td>NAA, ReTain</td>
<td>Apple, Peach</td>
</tr>
<tr>
<td>9. Reduce Vegetative growth</td>
<td>Apogee</td>
<td>Apple, Peach</td>
</tr>
</tbody>
</table>

* - these products are not plant growth regulators
Use Pattern

Timing:
- Late stage II, pit hardening (translucent green to straw colour)
- Use sufficient water volume to ensure thorough wetting

Concentration
- 42 – 126 ppm \( \text{GA}_3 \) (16-48 grams ai/acre)
- \([\$61 - \$183/acre; 100 gallons/acre]\)

Other Effects/Precautions
- Avoid overdosing lower canopy
- Avoid unusually warm/cold days
- Less effective on early ripening cultivars
- Excessive concentrations can reduce return bloom
Benefits of GA on sweet cherries

GA has been shown to:

- Improve fruit firmness
- Increase soluble solids
- Increase fruit weight
- Delay fruit maturity by 3-5 days
- Greener stems
- Improved storage life
- Results on reducing rain-induced fruit cracking are contradictory

Mechanism by which GA affects cherries

- Various (100+) isomers of GA naturally exist in plants.
- Commercially registered GA contains isomer GA$_3$ that is very active in woody plant species including sweet cherries.
- Delays maturity and influences ripening enzyme activity and function.
- (GA$_4$ and GA$_7$ are used in apples.)
Materials and Methods - 2004

Plant Material
- 19-Yr old Terhanivee, Vandalay
- 6.5 x 7.5m free standing
- Sprays applied by handgun to drip

Treatments
1. Untreated
2. Actival (20 mg/L GA$_3$)
3. ProGibb (20 mg/L GA$_3$)
4. MaxCell (50 mg/L 6-BA) applied twice
5. Treatment 3 & 4
Flesh firmness was measured on 25 fruit, 2 sides.

Fruit texture Analyzer Model GS-14, GÜSS, South Africa.

3 mm probe, depth of 1mm (did not penetrate skin).
Firmness Results

- Activol increased firmness of Terhanivee, but not Vandalay
- Progibb increased firmness of both cultivars
- Fruit firmness was unaffected by Maxcel
- Combination of Progibb and Maxcel similar to Progibb alone
No significant treatment effect on fruit weight

Fruit was variable and treatment effects were inconsistent
Fruit Colour (1st harvest)

- All treatments delayed colour development of Terhanivee in comparison with untreated controls
- Activol and Progibb were less effect in delaying colour development of Vandalay.

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Fruit Cracking

No significant treatment effect on:

- Fruit cracking
- Marketable fruit
2003 Data
GA resulted in significantly firmer fruit
No effect of Maxcel
Tehranivee (later cv.) more responsive to GA$_3$ than Vandalay
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Fruit Weight

- in 2003, GA did not influence fruit weight of either cultivar
2007 Data
Table 1. Effect of giberillic acid treatment on fruit colour and firmness of 'Hedelfingen' cherries. Vineland, 2007.

<table>
<thead>
<tr>
<th>GA&lt;sub&gt;3&lt;/sub&gt; (mg/L)</th>
<th>Timing</th>
<th>Formulation</th>
<th>Firmness (kg)&lt;sup&gt;2&lt;/sup&gt;</th>
<th>Colour L value (lightness)</th>
<th>Mean fruit weight (g)</th>
<th>Brix (°)</th>
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<tbody>
<tr>
<td></td>
<td>1st pick (July 11)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Untreated</td>
<td>-</td>
<td>-</td>
<td>0.16 c</td>
<td>31.5 d</td>
<td>7.6</td>
<td>16.3</td>
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<tr>
<td>20</td>
<td>straw colour</td>
<td>Progibb 40%</td>
<td>0.18 b</td>
<td>34.7 b</td>
<td>7.5</td>
<td>17.8</td>
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<tr>
<td>40</td>
<td>straw colour</td>
<td>Progibb 40%</td>
<td>0.19 a</td>
<td>34.5 b</td>
<td>7.7</td>
<td>17.9</td>
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<tr>
<td>80</td>
<td>straw colour</td>
<td>Progibb 40%</td>
<td>0.20 a</td>
<td>35.3 a</td>
<td>6.3</td>
<td>16.2</td>
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<tr>
<td>20</td>
<td>10 prior to straw colour</td>
<td>Progibb 40%</td>
<td>0.18 a</td>
<td>33.5 c</td>
<td>7.3</td>
<td>17.0</td>
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<tr>
<td>20</td>
<td>straw colour + 10 days prior</td>
<td>Progibb 40%</td>
<td>0.17 b</td>
<td>34.8 ab</td>
<td>6.9</td>
<td>15.9</td>
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<tr>
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<td>Progibb 4%</td>
<td>0.17 b</td>
<td>33.0 c</td>
<td>6.3</td>
<td>16.0</td>
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<td>Progibb 4%</td>
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<td>16.0</td>
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<tr>
<td></td>
<td>Significance</td>
<td></td>
<td>***</td>
<td>***</td>
<td>ns</td>
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<tr>
<td>LSD (p=0.05)</td>
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<td>0.5</td>
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<td>0.7524</td>
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<td>2nd pick (July 18)</td>
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<td>Untreated</td>
<td>-</td>
<td>-</td>
<td>0.10 e</td>
<td>31.0 d</td>
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<td>10 prior to straw colour</td>
<td>Progibb 40%</td>
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<td>32.4 b</td>
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<td>***</td>
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<td>*</td>
<td>ns</td>
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<tr>
<td>LSD (p=0.05)</td>
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<td>0.0154</td>
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</tbody>
</table>

3 mm probe
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B - July 18th Harvest

Firmness (N)

0.0 1.0 1.2 1.4 1.6 1.8 2.0

A - July 15th Harvest

Firmness (N)

0.0 1.0 1.2 1.4 1.6 1.8 2.0

B - July 22nd Harvest

Firmness (N)

0.0 1.0 1.2 1.4 1.6 1.8 2.0

A - July 11th Harvest

Firmness (N)

0.0 1.0 1.2 1.4 1.6 1.8 2.0

2007

2008
‘Hedelfingen’ fruits on July 11th 2007 (1st harvest)
Summary of Gibberellic Acid use on Sweet Cherries…

- Progibb has **consistently** increased fruit firmness and has typically delayed harvest 3-5 days.
- Effects on fruit red colour at harvest have been marginal.
- Inconsistent treatment effects on fruit weight, soluble solids, and rain cracking.
- Progibb 40% was more effective than Progibb 4% in enhancing fruit firmness and size.
Further Information

The MSU Fruit Management Guide - E-0154

Crop Protection Guide for Tree Fruits in Washington

• NY Fruit Production Guide
Growth Regulator Information

- PGR Use on Sweet and Tart Cherries
- Updated Thinning and PGR Information
http://www.plant.uoguelph.ca/treefruit
Acknowledgements

Debbie Norton
Summer students
Vineland Farm Crew

Ontario