Managing Fruit Quality and Preharvest Drop

Tom Kon · Chris Clavet · JD Obermiller
Outline

I. Preharvest Drop: Overview and Current Management Recommendations

II. Evaluating alternative application strategies for aminoethoxyvinylglycine (AVG; Retain) in the SE

III. Effects and interactions of AVG (ReTain) and GA$_{4+7}$ on ‘Gala’ fruit quality and cracking potential
Objectives of Stop Drop Sprays

- Preventing losses to preharvest drop
  - Variety sensitivity
  - Fruit drop is variable from year-to-year
  - Yield loss of 30% is common at beginning of harvest (Arseneault and Cline 2016)
- Marketing: early and late
- Fruit size targets
- Managing harvest
  - Scheduling labor
  - Varieties with similar harvest dates
  - Pick-your-own
Delaying Harvest will Increase Fruit Size

Gala (2008)

Mean fruit diameter (mm)

Days after bloom

diameter increased only 0.3 mm per day

Slide from: S.A. McArtney et al.
Management Options

- NAA (Fruitone L®; PoMaxa®; ReFine® 3.5WSG)
- AVG (ReTain®)
- NAA + AVG
- 1-MCP (Harvista™)
NAA: Blocks Stem Loosening

• Maturity is not delayed
  • Maturity is often advanced

• Fruit respond in 2-3 days
  • “Rescue” option, but
  • Doesn’t firm up those already loose

• 2 timings:
  • Just before drop starts: 10 to 20 ppm
  • “pre-loading” 4 weekly sprays at 5 ppm
NAA: Keys to Success

- Monitor drop and time spray accordingly
- Can be applied as part of cover sprays
- Avoid spraying in hot weather
- Split applications can help
ReTain® (AVG): Ethylene Production Inhibitor

- Delays maturity:
  - Red color development
  - Stem loosening
  - Flesh softening, starch-sugar conversion
  - Delays stem-end cracking, water core

- Delays Pre-harvest drop
ReTain: Keys to Success

• Timing of spray
  • Split applications don’t help – single pouch

• Coverage and absorption
  • Use 100% organosilicone surfactant
  • 100 GPA
  • Best results in smaller trees

• Stressed trees are poor candidates
Timing ReTain Sprays

• 4-3 weeks before anticipated harvest
• Early varieties: adjust harvest date estimate in early seasons
• Wait for good spray conditions and 6 hours drying time
• Delayed timing for multiple harvests
  • Targeting later pickings
  • First pick is not delayed
  • Apply 1-2 weeks before start of harvest

• Rate: 1 pouch – label change permits up to 2 pouches/acre
NAA + AVG: Provides greatest drop control and control of fruit softening (McArtney et al.)

Red Delicious Fruit Drop

**Graphs:**
- **Cumulative fruit drop (%):**
  - **Y-axis:** 0 to 100
  - **X-axis:** Weeks after normal harvest
- **Legend:**
  - Control
  - AVG125 - 4 wks
  - NAA20 - 2 wks
  - AVG125 + NAA 20 - 2 wks
  - AVG62.5 + NAA20 - 2 wks

**2008:**
- Control shows the least cumulative drop.
- AVG125 - 4 wks has a higher cumulative drop than Control.
- NAA20 - 2 wks has a moderate cumulative drop.
- AVG125 + NAA 20 - 2 wks and AVG62.5 + NAA20 - 2 wks show a significant cumulative drop.

**2009:**
- Control shows a steady increase in cumulative drop.
- AVG125 - 4 wks has a higher cumulative drop than Control.
- NAA20 - 2 wks has a moderate cumulative drop.
- AVG125 + NAA 20 - 2 wks and AVG62.5 + NAA20 - 2 wks show a significant cumulative drop.
Harvista™

• Sprayable formulation of 1-MCP
• Delivered through a proprietary in-line injection system
• Application timing based on starch index; cv dependent
• Some Henderson County, NC growers used in 2017

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Nicholas Michalisin
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Objectives

Determine the efficacy of double pouch ReTain (AVG) programs on fruit drop and fruit quality of: Red Delicious and Auvil Fuji
Average Monthly Temperature – Mills River, NC

Number of days with low temperatures < 50 F in 2017

- JUL: 0
- AUG: 0
- SEP: 6
- OCT: 21
- NOV: 47

10 Year Avg.
2017 Average
## Treatments applied to ‘Oregon Spur II Red Delicious’/‘M. 111’

<table>
<thead>
<tr>
<th>Treatment ID</th>
<th>Formulation</th>
<th>No. of Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Control</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>ReTain® (333 g/acre)</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>ReTain® (333 g/acre)</td>
<td>2</td>
</tr>
</tbody>
</table>

Treatments were applied to two tree plots (6 replicates) using a tractor mounted, pto-driven air blast sprayer calibrated to apply 100 gallons per acre.

All chemical treatments were applied in an aqueous solution with 0.1% (v:v) organosilicate surfactant (SYL-COAT®; Wilbur-Ellis; Aurora, CO).
Effects of Application Rate on Cumulative Fruit Drop

Cumulative fruit drop (%)

Weeks after normal harvest

- Control
- ReTain: 3 WBAH
- ReTain: 3+1 WBAH
Effect of application number of aminoethoxyvinylglycine (AVG) on firmness of 'Oregon Spur II Red Delicious' apples in 2017.

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Control</td>
<td>--</td>
<td>15.7</td>
<td>14.4</td>
<td>13.1</td>
<td>12.4</td>
<td>12.3</td>
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<tr>
<td>ReTain</td>
<td>1</td>
<td>16.1</td>
<td>15.2</td>
<td>14.3</td>
<td>13.4</td>
<td>12.5</td>
</tr>
<tr>
<td>ReTain</td>
<td>2</td>
<td>16.3</td>
<td>15.7</td>
<td>15.0</td>
<td>14.1</td>
<td>13.4</td>
</tr>
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</table>
Effect of application number of aminoethoxyvinylglycine (AVG) on starch rating of 'Oregon Spur II Red Delicious' apples in 2017.

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Control</td>
<td>--</td>
<td>4.3</td>
<td>6.9</td>
<td>7.3</td>
<td>7.5</td>
<td>7.6</td>
</tr>
<tr>
<td>ReTain</td>
<td>1</td>
<td>4.0</td>
<td>6.2</td>
<td>7.0</td>
<td>7.3</td>
<td>7.6</td>
</tr>
<tr>
<td>ReTain</td>
<td>2</td>
<td>3.7</td>
<td><strong>5.5</strong></td>
<td><strong>6.</strong></td>
<td><strong>7.0</strong></td>
<td>7.5</td>
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</tbody>
</table>
Objectives

- Effect of application rate and timing of aminoethoxyvinylglycine (AVG) on fruit quality and fruit drop on ‘Auvil Fuji’ apples
## Treatments applied to ‘Auvil Fuji’ apple trees.

<table>
<thead>
<tr>
<th>Treatment ID</th>
<th>Formulation</th>
<th>No. of Applications</th>
<th>Application Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Control</td>
<td>0</td>
<td>--</td>
</tr>
<tr>
<td>2</td>
<td>ReTain® (666 g/acre)</td>
<td>1</td>
<td>2 WBH</td>
</tr>
<tr>
<td>3</td>
<td>ReTain® (666 g/acre)</td>
<td>1</td>
<td>4 WBH</td>
</tr>
<tr>
<td>4</td>
<td>ReTain® (333 g/acre)</td>
<td>2</td>
<td>2 + 4 WBH</td>
</tr>
</tbody>
</table>

Treatments were applied to two tree plots (6 replicates) using a tractor mounted, pto-driven air blast sprayer calibrated to apply 150 gallons per acre.

All chemical treatments were applied in an aqueous solution with 0.1% (v:v) organosilicate surfactant.
Effects of Application Rate and Timing on Cumulative Fruit Drop

Cumulative fruit drop (%)

Weeks after normal harvest

Control
ReTain 2WBH
ReTain 4WBH
ReTain 2+4WBH
Effect of application timing of aminoethoxyvinylglycine (AVG) on firmness of ‘Auivil Fuji’ apples in 2017.

<table>
<thead>
<tr>
<th>Formulation</th>
<th>Timing</th>
<th>29 Aug.</th>
<th>5 Sept.</th>
<th>12 Sept.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>--</td>
<td>13.8</td>
<td>13.6</td>
<td>12.6</td>
</tr>
<tr>
<td>ReTain</td>
<td>2 WBH</td>
<td>14.1</td>
<td>13.8</td>
<td>13.3</td>
</tr>
<tr>
<td>ReTain</td>
<td>4 WBH</td>
<td>14.1</td>
<td>13.9</td>
<td>13.3</td>
</tr>
<tr>
<td>ReTain</td>
<td>2 + 4 WBH</td>
<td>13.9</td>
<td>13.9</td>
<td>13.1</td>
</tr>
</tbody>
</table>
Effect of application timing of aminoethoxyvinylglycine (AVG) on starch rating of ‘Auvil Fuji’ apples in 2017.

<table>
<thead>
<tr>
<th>Formulation</th>
<th>Timing</th>
<th>29 Aug.</th>
<th>5 Sept.</th>
<th>12 Sept.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>--</td>
<td>6.1</td>
<td>7.0</td>
<td>7.3</td>
</tr>
<tr>
<td>ReTain</td>
<td>2 WBH</td>
<td>5.9</td>
<td>6.9</td>
<td>7.2</td>
</tr>
<tr>
<td>ReTain</td>
<td>4 WBH</td>
<td>6.1</td>
<td>6.9</td>
<td>7.5</td>
</tr>
<tr>
<td>ReTain</td>
<td>2 + 4 WBH</td>
<td>6.0</td>
<td>7.1</td>
<td>7.2</td>
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</tbody>
</table>
Objective

Determine effects and interactions of application number and rate of aminoethoxyvinylglycine (AVG) and GA$_{4+7}$ (ProVide) on fruit quality and stem-end cracking of ‘Gala’
## Treatments applied to ‘Ultima Gala’ apple trees.

<table>
<thead>
<tr>
<th>Treatment ID</th>
<th>Formulation</th>
<th>No. of Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Control</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>ReTain® (83 g/acre)</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>ReTain® (110 g/acre)</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>ReTain® (167 g/acre)</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>ProVide (50 ppm)</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>ReTain® (83 g/acre) + ProVide (50 ppm)</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>ReTain® (110 g/acre) + ProVide (50 ppm)</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>ReTain® (167 g/acre) + ProVide (50 ppm)</td>
<td>3</td>
</tr>
<tr>
<td>9</td>
<td>ReTain® (167 g/acre)</td>
<td>1</td>
</tr>
</tbody>
</table>
Main effects

• $GA_{4+7}$ (ProVide) did not influence stem end splitting or any other response in this trial
• AVG (ReTain) was an influential factor
Effect of application number and rate on stem end splitting

![Graph showing the incidence of stem end splitting (%) against Retain rate with data points for H2 and Retain H2.]
Effect of application number and rate on stem end splitting: bucket test

Incidence of stem end splitting (%) vs. ReTain Rate

- H3
- ReTain H3
- H5
- ReTain H5
Effect of Application Number and Rate on Starch
Effect of application number and rate of aminoethoxyvinylglycine (AVG) on firmness of ‘Gala’ apples in 2017.

<table>
<thead>
<tr>
<th>Formulation</th>
<th>Rate</th>
<th>17 Aug.</th>
<th>30-Aug</th>
<th>14 Sept.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>--</td>
<td>16.0</td>
<td>13.8</td>
<td>--</td>
</tr>
<tr>
<td>ReTain</td>
<td>83 g/A</td>
<td>18.0</td>
<td>16.2</td>
<td>13.6</td>
</tr>
<tr>
<td>ReTain</td>
<td>110 g/A</td>
<td>17.5</td>
<td>15.5</td>
<td>13.6</td>
</tr>
<tr>
<td>ReTain</td>
<td>167 g/A</td>
<td>17.8</td>
<td>16.0</td>
<td>14.7</td>
</tr>
</tbody>
</table>
Summary

- Double pouch ReTain programs showed promise in delaying fruit maturity and preharvest drop
  - Pending upon labor availability, market,
- Applying double pouch (or single) ReTain too late will reduce product efficacy
  - Can be a challenge in years with advanced maturity
  - Addition of NAA?
- Multiple applications of low rates of ReTain reduced stem-end splitting potential and delayed maturity
  - GA4+7 did not
Acknowledgements

- Greg Nix – Apple Wedge Packers
- Richard Staton – Richmind Orchards
- Valent USA
Thank you for your attention!!