PGR Strategies for Improving Production Practices

Poliana Francescatto
PGRs – Their Roles and Uses

- Increasing fruit set (AVG/ReTain – cherries and pears; Promalin after frost damage)
- Fruit thinning (6BA, NAA, NAD, ACC, ABA)
- Growth control (Apogee, Kudos)
- Fruit russet control (GA4/7-ProVide)
- Fruit shape control, fruit finish (GA4/7 + 6BA – Promalin, ProGibb reduces blush in Golden and Granny)
- Fruit color improvement (MeJ-Blush, Stimplex)
- Fruit maturity and fruit drop control (Retain/NAA/Harvista, ProGibb - cherries)
Precision application of PGRs on Fruit crops

- Plant Growth Regulators (PGRs) are an investment
  - Unlike traditional crop protection products;
  - Increase value of crop.

- Plant response is often variable/inconsistent;

- Responses to PGRs are strongly influenced by:
  - Environment, application timing, rate, application volume, coverage, water quality, adjuvants
  - Cultivar, rootstock, tree age, tree vigor, crop load, training system, tree nutrition, application equipment
Precision application of PGRs on Fruit crops

- **Effects of Environment**

  **Temperatures before application**
  - CHO demand (cooler temps = less CHO demand = less stress)
  - Plant physiology process (pollen tube growth, cell division rates)

  **Temperatures during application**
  - Absorption & uptake (warmer temps = greater uptake (>50F but <85F for thinning)
  - Drying time
Precision application of PGRs on Fruit crops

- **Effects of Environment**

  *Temperatures after application*
  - Higher temperatures following application:
    *Increase response to post-blossom thinners*
    *Increase ripening response to Ethephon and NAA*
    *Decrease stop-drop response to Retain*

- **Humidity**
  - Increasing humidity increases absorption
    *Slow drying time*
    *Increases absorption from deposit*
Precision application of PGRs on Fruit crops

- **Rain**
  - wash-off if too soon after application
  - re-wetting of deposits (NAA – 2 days after application)

- **Effects of coverage**

  *What is your target? Flowers, leaves or fruit?*

  *Many PGRs have limited movement*

  (Retain, ProGibb, CPPU, Apogee)

- **Surfactants**
  - Reduce surface tension, increasing contact area
    - Do not apply surfactant when the purpose is to increase fruit set.
Summarizing...

High temperatures, slow drying conditions and healthy foliage will enhance absorption and increase plant response.

Cool temperatures, fast drying conditions, and damaged trees or foliage will decrease plant response.

If the weather is cool and humid, morning applications are best;
If it’s been hot and dry, an evening application will be most effective.
Ongoing PGRs Projects in Geneva

1) Validate the accuracy of the Precision Thinning Protocol using the carb and FGR model;
2) Develop improved thinning treatments for existing and new varieties;
3) Testing new compounds for fruit thinning;
4) Develop return bloom treatments to overcome biennial bearing;
5) Investigate a new strategy to control bitter pit;
6) Develop improved pre-harvest drop control strategies;
What we have found so far!!
NY1 – SnapDragon, NY2 – Rubyfrost, Sweetango
(Planted in 2010 - M9/337)
NY1 – SnapDragon, NY2 – Rubyfrost, Sweetango
(Planted in 2010 - M9/337)

Sprayed at 12mm

Fruit Number /tree

- NY1
- NY2
- Sweetango

Untreated Control
5 ppm NAA + 1pt Sevin/100 gal
10 ppm NAA + 1pt Sevin/100 gal
15 ppm NAA + 1pt Sevin/100 gal
50 ppm BA + 1pt Sevin/100 gal
75 ppm BA + 1pt Sevin/100 gal
100 ppm BA + 1pt Sevin/100 gal
75 ppm BA + 7.5 ppm NAA
2oz 6oz 32oz 64oz
Untreated Control

15ppm NAA + 1pt Sevin at 12mm

Rubyfrost
Testing Metamitron (Brevis) for fruit thinning

- Sugar beet herbicide – photosynthesis inhibitor
- Can cause phytotoxicity in very high rates (leaf damage)
- Applied at normal thinning window
- Works best in carbohydrate deficit
- Registered in EU, to be registered in the US in the near future
# Efficacy of metamitron in Geneva –2015

**Brevis® 15% - Sugar beet herbicide**

**Location:** Experimental orchard at Cornell Station in Geneva, NY

**Variety/age:** Crimson Gala/M9 – 17 years old (1998)

**Tree density:** 558 trees/acre

**Petal Fall:** 05/18/15 and 12mm: 05/21/15

**Treatments:**

<table>
<thead>
<tr>
<th>Treatment</th>
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<tbody>
<tr>
<td>Control</td>
</tr>
<tr>
<td>Metamitron 200 ppm PF</td>
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<tr>
<td>Metamitron 300 ppm PF</td>
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<tr>
<td>Metamitron 400 ppm PF</td>
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<tr>
<td>Metamitron 300 ppm+ 100ppm BA PF</td>
</tr>
<tr>
<td>Metamitron 200 ppm 12mm</td>
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<tr>
<td>Metamitron 300 ppm 12mm</td>
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<tr>
<td>Metamitron 400 ppm 12mm</td>
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<tr>
<td>Metamitron 300 ppm+ 100ppm BA 12mm</td>
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<tr>
<td>BA 100 ppm + 1pt Sevin 12mm</td>
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</tbody>
</table>
Efficacy of metamitron in Geneva –2015

![Graph showing fruit number per tree for different treatments.](Image)

- Untreated Control
- 200ppm Metamitron
- 300ppm Metamitron
- 400ppm Metamitron + 100ppm BA
- 200ppm Metamitron
- 300ppm Metamitron
- 400ppm Metamitron + 100ppm BA
- 300ppm Metamitron + 100ppm BA
- 100ppm BA (Maxcel) + 600ppm Carba r1

*Note: The treatment marked with an asterisk (*) has significantly higher fruit number per tree compared to the untreated control.*
Results from Brazil

Untreated trees

100 ppm Metamitron + BA 60 ppm at petal fall
Testing ACC for fruit thinning

• Precursor of ethylene
• Works well as pome and stone fruit thinner
• Applied up to 20 mm fruitlet size (after thinning window - RESCUE THINNER)
• Not registered, to be registered in 5-6 years from now
• “Works also as apple coloring agent (ethylene effect) – to counteract ReTain’s color depressing effect”
Testing new compounds for fruit thinning
Determine the effect of ACC on fruit thinning of Golden Delicious and Cameo.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Date of Application</th>
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<tbody>
<tr>
<td>Untreated Control</td>
<td></td>
</tr>
<tr>
<td>150 ppm ACC + Silwet</td>
<td>18mm</td>
</tr>
<tr>
<td>300 ppm ACC + Silwet</td>
<td>18mm</td>
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<tr>
<td>450 ppm ACC + Silwet</td>
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<tr>
<td>Ethephon 2pt/100gal + 1 pt oil/100gal</td>
<td>18mm</td>
</tr>
<tr>
<td>64oz Maxcel + 150 ppm ACC + Silwet</td>
<td>18mm</td>
</tr>
<tr>
<td>64oz Maxcel + 1 pt Sevin/100 gal at 10mm then later</td>
<td>10mm</td>
</tr>
<tr>
<td>150 ppm ACC + Silwet at 18mm</td>
<td>18mm</td>
</tr>
<tr>
<td>64oz Maxcel + 1pt Sevin/100gal +1pt oil/100 gal</td>
<td>18mm</td>
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</tbody>
</table>

It seems the effect of ACC is cultivar-dependent.
Golden no leaf drop occurred
Cameo = noticeable, but not damaging, leaf drop at the highest rate of ACC
ACC – rescue thinning
Spray at 18mm fruit size

Golden = no leaf drop occurred
Cameo = noticeable leaf drop at the highest rate of ACC.
64oz Maxcel + Sevin at 10mm + 150ppm ACC + Silwet at 18mm
ABA

• ABA is a mild apple/pear thinner
• Good combination partner for other chemicals (6-BA)
• Works best in carbohydrate deficit
• Applied at 150-400 ppm
• Registered as grape coloring agent, under evaluation for apple and pear post-bloom thinning (and for ORGANIC production, as well!)
Improving Apple Color

2 applications each treatment – 4 and 2 weeks before harvest
Untreated control

Blush or Stimplex
(4 + 2 WBH)

No effect on fruit size
No effect on fruit drop
No effect in fruit quality (SS and firmness)
Apple Flower Development

Foster et al., 2003
**Stage 0**

Vegetative stage
Flat meristem

**Stage 1**

Domed apex (meristem)
Flower initiation

Fotos: MEV. Barra: 100µm
Source: Francescatto, P. 2014
Flower initiation in apples

Stage 2 (floral commitment)

- **Braeburn**
- **Royal/Gala**
- **Pacific/Rose**
- **Fuji**

Flower induction

Flower initiation

Fitted/response/probability

- 0
- 0.1
- 0.2

30 July
60 July
90 July
120 DAFB
150 October
180 October

Fonte: Hoover et al. (2004)
Hormonal balance

Production sites of flower inhibitors (GAs and Auxins)

Ga7 > Ga3 > Ga4

> seeds
> flower inhibition

GA3
GA4

Floral inhibition

GA1
GA3

> Shoot growth
> Flower inhibition

Flower induction
Cytokinins (BA)
Ethylene
Control of Biennal Bearing
To promote return bloom of apple trees cvs. Honeycrisp and Fuji – (and pears)

<table>
<thead>
<tr>
<th>Trt No.</th>
<th>30 DAFB</th>
<th>37 DAFB missed</th>
<th>44 DAFB</th>
<th>51 DAFB</th>
<th>58 DAFB</th>
<th>65 DAFB</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Untreated control</td>
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<tr>
<td>2.</td>
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<td>3.</td>
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<tr>
<td>4.</td>
<td>Ethephon +NAA</td>
<td>Ethephon +NAA</td>
<td>Ethephon +NAA</td>
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<td>5.</td>
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<td>NAA</td>
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<tr>
<td>6.</td>
<td>NAA</td>
<td>NAA</td>
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<td>Ethephon</td>
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<tr>
<td>7.</td>
<td>Ethephon +NAA</td>
<td>Ethephon +NAA</td>
<td>Ethephon +NAA</td>
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<td>8.</td>
<td>NAA</td>
<td>NAA</td>
<td>NAA</td>
<td>Ethephon +NAA</td>
<td>Ethephon +NAA</td>
<td>NAA</td>
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Results – to be analyzed in 2016

Small doses
Pre-harvest drop control:
To study the effect of Retain and/or Harvista on fruit drop control and fruit quality;

Variety: McIntosh Marshalls/M9
19 year old trees

- % Fruit drop (from 9/14 (2WBCH) to 10/27;
- Fruit quality at harvest (color, firmness, starch, sugar) – 5-6 weekly picks;
- Fruit quality after regular cold storage (firmness, sugar and disorders)
1) Untreated control
2) 2 pouch Retain (4WBH)
3) 2 pouch Retain (3WBH)
4) 1 pouch Retain (4WBH)
5) 1 pouch Retain (3WBH)
6) 1 pouch Retain (4 + 2WBH)
7) 1 pouch Retain (3 + 1WBH)
8) ½ pouch Retain + 10ppmNAA (3 + 1WBH)
9) 60g i.a. Harvista (1WBH)
10) Harvista (10 days BH + 3 days BH)
11) ½ pouch Retain (3WBH) + Harvista (1WBH)

Variety: McIntosh Marshalls

Predicted Harvest

2,5 weeks – good firmness and fruit drop control

Cumulative Fruit Drop (%)

Thank you!!

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