Improving branching of apple trees from nursery to orchard

Jon Clements, U of Massachusetts
Win Cowgill et al, Rutgers University
ifruiittree.org
Why?

- Transplant shock caused by a high scion to root ratio helps keep trees within this tight spacing.
- It also contributes to significant fruit bud differentiation the year of planting.
- Trees with scaffolds provide bearing surface for production in the second leaf.
- Early bearing is essential to help pay for increased tree numbers and establishment costs.
- Terence Robinson, Cornell University
Why?

- Hi-density systems need early production!!!
Using Heading vs. Notching With or Without BA Application to Induce Branching in Non-feathered, First-leaf Apple Trees

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Winfred P. Cowgill, Jr.
New Jersey Agricultural Experiment Station, Rutgers University
The Use of Plant Growth Regulators for Branching of Nursery Trees in NY State

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\textsuperscript{2}Department of Horticulture, Cornell University, Geneva, NY

New York Fruit Quarterly
Summer, 2011

Figure 3. Effects of cyclanilide (Tiberon) and/or benzyl adenine (Maxcel) on final number of feathers of Empire, Fuji, McIntosh, and Macoun apple trees grafted on B.9 rootstocks.
Studies and Recommendations for Branching Young Apple Trees

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Stockbridge School of Agriculture, University of Massachusetts

Terence Robinson
Cornell University

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Increasing Branching of Newly Planted Apple Trees in the Orchard, an Update

Jon Clements
Center for Agriculture, Food, & the Environment, University of Massachusetts

Figure 1. Total number of shoots (greater than 2 inches) for trees treated with Maxcel versus control trees.
Objectives

• Identify PGR programs to successfully branch apples trees in the nursery
  – i.e., current season’s growth

• Use PGR’s to branch newly planted apple trees
  – i.e., primarily 1-year old wood (but also 2-year old wood)
Conducted at Adams County Nursery, Ellendale, Delaware
<table>
<thead>
<tr>
<th></th>
<th>Golden Delicious</th>
<th>Macoun</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tiberon</strong></td>
<td>50 and 100 ppm; 2 or 1 Applications</td>
<td><strong>Tiberon</strong></td>
</tr>
<tr>
<td><strong>Maxcel</strong></td>
<td>500 and 1,000 ppm; 2, 4 and 5 Apps.</td>
<td><strong>Maxcel</strong></td>
</tr>
<tr>
<td><strong>Promalin</strong></td>
<td>500 ppm; 2 and 4 Apps</td>
<td><strong>Promalin</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Fuji</th>
<th>Macoun</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tiberon</strong></td>
<td>50 ppm; 2 Applications</td>
<td><strong>Tiberon</strong></td>
</tr>
<tr>
<td><strong>Maxcel</strong></td>
<td>300, 400 and 500 ppm; + and – Surfactant; 3 and 4 Applications</td>
<td><strong>Maxcel</strong></td>
</tr>
<tr>
<td><strong>Promalin</strong></td>
<td>500 ppm; 4 Application</td>
<td><strong>Promalin</strong></td>
</tr>
</tbody>
</table>
Feathers Starting
Number of Shoots on Macoun after treatment in 2012

- UTC, 0 Sprays
- Tiberon 50ppm, 2 Sprays
- Maxcel 500ppm, 3 Sprays
- Promalin 500ppm, 4 Sprays
- Maxcel 1000ppm, 3 Sprays
Average tree height (cm), October 2012 of Macoun
Phytotoxicity
Golden Delicious
**Chemical Treatments 2014**

<table>
<thead>
<tr>
<th>Fuji</th>
<th>Multiple Varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maxcel</strong>: 400 and 500 ppm; 4 or 5 Applications</td>
<td><strong>Maxcel</strong>: 400 ppm; 5 Applications</td>
</tr>
<tr>
<td><strong>Promalin</strong>: 400 and 500 ppm; 4 and 5 Applications</td>
<td><strong>Promalin</strong>: 400 and 500 ppm; 4 and 5 Applications</td>
</tr>
<tr>
<td>12 treatments, balanced with UTC</td>
<td>4 treatments to 40 trees on multiple varieties</td>
</tr>
</tbody>
</table>

**Multiple Varieties in Demonstration**

<table>
<thead>
<tr>
<th>Variety</th>
<th>Variety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambrosia</td>
<td>Aztec Fuji</td>
</tr>
<tr>
<td>Cameo</td>
<td>Crimson Crisp</td>
</tr>
<tr>
<td>Empire</td>
<td>Enterprise</td>
</tr>
<tr>
<td>Gala</td>
<td>Goldrash</td>
</tr>
<tr>
<td>Honeycrisp</td>
<td>Pink Lady</td>
</tr>
<tr>
<td>Royal Court</td>
<td>Ruby Mac</td>
</tr>
<tr>
<td>Suncrisp</td>
<td></td>
</tr>
</tbody>
</table>
2014 Fuji Number of Feathers

Number of Feathers

- Untreated
- Maxcel
- Promalin
2014 Fuji Tree Height

Tree Height (cm)

- Untreated
- Maxcel
- Promalin
2014 of Tree Quality Rating of Fuji

Tree Quality Rating (0=Poor
5=Excellent)

- Untreated
- Maxcel
- Promalin
2014 ACN Variety Trial Tree Quality Rating

Tree Quality Rating (1=poor, 5=excellent)
Golden Del- 2012 ACN Trial-Rutgers Snyder Farm- October, 2014 2\textsuperscript{nd} leaf- Avg 413 BU/A
Yield (kg)

- Control
- Maxcel 500 ppm; 2 App.
- Maxcel 500 ppm; 4 App.
- Maxcel 500 ppm; 5 App.
- Promalin 500 ppm; 2 App.
- Promalin 500 ppm; 4 App.
- Tiberon 100 ppm; 1 App.
- Tiberon 50 ppm; 2 App.

Yield per tree (kg, 2014)
Adventures in branching 2015

Jon Clements
UMass Amherst

Win Cowgill
Rutgers University
2015 ACNursery

- 11 apple varieties
- Trees were visually rated in fall
  - 1 – no branching (whip)
  - 2 – some branching
  - 3 – adequate feathering
  - 4 – superior tree, 8-12 feathers, 4 to 5 feet tall
<table>
<thead>
<tr>
<th>Orchard</th>
<th>Variety</th>
<th>Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.N. Smith Farm East Bridgewater</td>
<td>Macoun and Cortland (both whips)</td>
<td>1. 5,000 ppm Promalin in white latex paint applied just before bud break</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. 5,000 ppm Maxcel in white latex paint applied just before bud break</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. 400 ppm Promalin in water applied just after bud break and repeated in app. 4 weeks</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. 400 ppm Maxcel in water applied just after bud break and repeated in app. 4 weeks</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. UnTreated Control</td>
</tr>
<tr>
<td>Tougas Family Farm</td>
<td>Gala (most with some feathers, but undesirable, cut back to stubs)</td>
<td>1. 5,000 ppm Maxcel in white latex paint applied just before bud break</td>
</tr>
<tr>
<td>Northboro</td>
<td></td>
<td>2. 400 ppm Maxcel in water applied just after bud break and repeated in app. 4 weeks</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Stoller Calcium 5X (3.2 oz. per gallon) in white latex paint applied just before bud break</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Stoller Calcium 5X (3.2 oz. per gallon) in water applied just after bud break and repeated in app. 4 weeks</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. UnTreated Control</td>
</tr>
<tr>
<td>Treatment</td>
<td>No. branches</td>
<td>Tree rating</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>400 ppm Macel in water</td>
<td>9 b</td>
<td>1.6 b</td>
</tr>
<tr>
<td>400 ppm Promalin in water</td>
<td>7 b</td>
<td>1.4 b</td>
</tr>
<tr>
<td>5000 ppm Maxcel in paint</td>
<td>16 a</td>
<td>2.4 a</td>
</tr>
<tr>
<td>5000 ppm Promalin in paint</td>
<td>10 b</td>
<td>1.8 ab</td>
</tr>
<tr>
<td>UnTreated Control</td>
<td>5 b</td>
<td>0.5 c</td>
</tr>
</tbody>
</table>

- 5000 ppm Maxcel in paint resulted in greatest number of branches compared to all other treatments and UTC which did not differ
- All branching treatments resulted in better tree rating than UTC
- For a hard to branch variety like Macoun, 5000 ppm Maxcel in paint was very effective at promoting branching and improving tree quality in the year of planting
Table 3. CORTLAND

<table>
<thead>
<tr>
<th>Treatment</th>
<th>No. branches</th>
<th>Tree rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>400 ppm Maxcel in water</td>
<td>17 ab</td>
<td>2.2 ab</td>
</tr>
<tr>
<td>400 ppm Promalin in water</td>
<td>17 ab</td>
<td>2.2 ab</td>
</tr>
<tr>
<td>5000 ppm Maxcel in paint</td>
<td>20 a</td>
<td>2.6 a</td>
</tr>
<tr>
<td>5000 ppm Promalin in paint</td>
<td>13 b</td>
<td>1.7 b</td>
</tr>
<tr>
<td>UnTreated Control</td>
<td>14 b</td>
<td>1.7 b</td>
</tr>
</tbody>
</table>

- Cortland was not as responsive to branching treatments than Macoun, but generally benefitted from the application of 5000 ppm Maxcel in paint, although that treatment did not differ from Maxcel and Promalin at 400 ppm applied in water (which did not differ from the UTC either).
Cortland
400 ppm Maxcel
400 ppm Promalin
<table>
<thead>
<tr>
<th>Treatment</th>
<th>No. branches</th>
</tr>
</thead>
<tbody>
<tr>
<td>400 ppm Maxcel in water</td>
<td>15</td>
</tr>
<tr>
<td>Calcium 5X in water</td>
<td>14</td>
</tr>
<tr>
<td>5000 ppm Maxcel in paint</td>
<td>15</td>
</tr>
<tr>
<td>Calcium 5X in paint</td>
<td>17</td>
</tr>
<tr>
<td>UnTreated Control</td>
<td>16</td>
</tr>
</tbody>
</table>

- There was no difference in branching treatments on these Gala compared to the UTC
- Undesirable feathers were cut back at planting, resulting in good branching on all the trees
Tim Smith

- Anecdotal (has not been tested)
- Macoun, Honeycrisp, McIntosh
- Maxcel® applied during 2nd-leaf in air blast sprayer to 1 and 2 year-old-wood
- 200 ppm at bloom +/-
3rd-leaf McIntosh
• 2nd-leaf Cortland
• Maxcel applied to this area at 200 ppm during “bloom”
• this result at end of current growing season
Macoun

- 2nd-leaf
- Maxcel applied to this area at 200 ppm with air blast sprayer during “bloom”
- this result at end of current growing season
## NON BEARING TREES (SUCH AS APPLES, PEARS AND SWEET CHERRY)
### FOLIAR APPLICATION

<table>
<thead>
<tr>
<th>Use</th>
<th>Application Rate: Concentration of a.i. in PPM</th>
<th>Product/ Acre</th>
<th>Application Method and Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>For increased branching of nursery stock and young trees, to improve branch angles, stimulate bud break and improve tree structure. (Not for use in California)</td>
<td>250-500 ppm spray concentration (refer to the dilution table for assistance).</td>
<td>128 oz/40 gal of water</td>
<td>Make the first of 3-4 applications at 28-30 inches of growth and continue on a 5-10 day schedule.</td>
</tr>
</tbody>
</table>

### LATEX APPLICATION

<table>
<thead>
<tr>
<th>Use</th>
<th>Application Rate: Concentration of a.i. in PPM</th>
<th>Product/ Acre</th>
<th>Application Method and Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apples (Nursery and Young Orchard)</td>
<td>5,000-7,500 ppm (0.2-0.33 pint MaxCel per pint of latex paint)</td>
<td>Do not apply more than 320 oz of MaxCel (20 pints) per acre per season.</td>
<td>Apply in the spring when terminal buds begin to swell but before shoots emerge. At the point where branching is desired, uniformly apply the MaxCel latex paint mixture with a brush or sponge to cover the bark surface thoroughly. Apply only to one year old wood.</td>
</tr>
</tbody>
</table>

### Additional Instructions:
- Do not use on trees with fruit intended for harvest.
- Use is not restricted to just the nursery location, but can also be used on young non-bearing trees planted in an orchard.
- Use a backpack sprayer with a single nozzle directed to the shoot tips of each tree.
- Timing of the second to fourth sprays should be when the leader adds five inches of new growth after the last spray (about every 7-10 days).
- Best results are obtained when applied in the morning when temperatures are cooler. Avoid spraying in the afternoon if temperatures are 90°F or more.
- Do not tank mix with streptomycin or apply streptomycin on the same day.

### NOTE: Do not apply the MaxCel/latex paint mixture after bud break. Applications after buds have broken have been known to cause some injury to the tender shoot tips and fail to promote shoot growth from that point.

### NOTE: Any type of application of MaxCel to non-bearing pears and non-bearing sweet cherries has a one year pre-harvest interval.
McCartney, Steve (NCSU)
Recommendation

• Maxcel (or Promalin) applied @ 400-500 ppm, multiple applications, to this year’s growth (in nursery or orchard)
Recommendation

- Maxcel (or Promalin) in latex paint @ 5,000 ppm applied to 1-year-old wood BEFORE bud swell
Recommendation

• Include notching with Maxcel/Promalin @1500 ppm on 2-year-old wood at bud-swell (do not apply to green tissue!)

• I might try this on 1-year-old wood too in lieu of paint, but be careful!
Recommendation

- Consider directed airblast spray applications of Maxcel @ 200 ppm (1 gallon per 100 gallons) to tops of 2nd-leaf trees where more branching is desired
Thanks

• Win Cowgill and crew for ACNursery 2012-15
• Chris Smith, C.N. Smith Farm, E. Bridgewater, MA
• Mo & Andre Tougas, Tougas Family Farm, Northboro, MA
• Tim Smith, Apex Orchard, Shelburne, MA
• Valent Biosciences
• International Fruit Tree Association
New Technology in Apple Scab & Fire Blight Management “Summit”

- Monday, March 14, FDR Library, Hyde Park, NY
- 10 AM to 3 PM
- RIMpro Cloud Service (http://www.rimpro.eu)
- Marc Trapman and Vincent Philion
- Rosenberger, Cox, Cooley and Clements
- FREE 2016 subscription to RIMpro ($200 value)
- Pesticide credits will be offered!
- http://redtomato.org/summit/