Thinning Strategies for Improved Return Bloom and Fruit Quality

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U of I
How Many Fruits can an Apple Tree potentially Produces per Year?
Fruit Maturity

flashy
Purpose of Fruit Thinning

• Fruit thinning is done to increase fruit size and enhance repeat bloom the following year.
• Generally, the fewer the fruit that are allowed to develop on a tree, the larger those fruit will be.
• What impact does thinning have on the crop load?
• Thinning enhances return bloom the following year.

Figure 9. This chart shows the effect of time of fruit thinning after full bloom on formation of blossom buds for next year's crop. Fruit were hand thinned to one fruit per 70 leaves a points indicated by the black dots, 33 to 76 days after full bloom on the biennial-bearing Yellow Newtown in a good bearing year at Wenatchee, Washington. (After Harley et al., USDA Bull. 792).
Typical Biennial Bearing Cycle

On-year

Heavy bloom & initial fruit set

Off-year

Many flowers initiated

No/few resting spurs

Many resting spurs

Few flowers initiated

Poor or no fruit set
Relationship between number of leaves per fruit and harvest size of fruit

- In general, each apple fruit needs about 40 leaves for optimum size.
- However, variety, rootstock, and weather also have direct effect on fruit size.
Relationship between Crop Load, Fruit Size and Yield

- Fruit size and crop value increase as fruit load is reduced by thinning and pruning.
- In most varieties, generally there is a strong negative relationship between fruit load and crop value.

The best way to assess the economics of thinning is to convert crop yield/acre into $$$$/acre taking into consideration the increase in fruit size.
The Best Crop load is when the Value of the Crop is at its Maximum

![Graph showing the relationship between fruit size and yield with crop load.](image)
Objectives of Thinning

- Produce a crop of optimum value and ensure good return bloom.
- Minimize hand thinning
- Minimize the amount of chemicals used
- Maintain or improve fruit quality
- Reduce the risk of under or over-thinning
Thinning windows

1. Bloom thinning
2. Petal fall to when fruits are 7 to 12 mm
3. When fruits are larger than 15 mm

Thinning is done within 28 days from petal fall
Factors affecting thinning response

Fruit size. The best time to thin fruits is between 8 to 10 mm

Response to thinners depends on the following:
- Young trees
- Cloudy weather
- High humidity
- Frost
- Very low tree vigor
- Light pruning
- Strength of bloom. Competition between blossoms, especially if blossom are weak
- Pollination
- Heavy crop previous year
- Light (Shaded buds initiate and set poorly)
- Carbohydrate level
Factors Affecting Effectiveness of Thinners

- Type and concentration of thinner
- Fruitlette size
- Application process
  - Water volume, air speed, and droplet size
- Thinner uptake process
  - Cuticle thickness
  - Environment before, during and after application of thinner (temp., humidity, drying condition)
- Sensitivity of the tree
  - Bloom density
  - Carbohydrate level during bloom
    - Solar radiation,
    - Minimum and maximum temperature
Figure 8-10  Relationship of internal auxin levels in seed and rate of fruit drop of the apple. [After Luckwill, 1953].
Response of Chemical Thinners within a Season (T. Robinson)
Bloom versus Fruit Thinning

1. If you thin flowers then you are trusting good weather conditions and not expecting any frost, wind or wet weather that may have adverse effect on fruit set. However, when you thin small fruit you can adapt your thinning intensity.

2. Thinning flowers is a blind process, you can not choose the quality of the flower, while thinning of small fruit gives you the opportunity to remove weaker ones.
• The most effective time for fruit thinning is when the king fruit is large enough to resist the effect of the chemical thinner.

• In general, reduction in the number of fruit to 4 to 6 fruit per cm$^2$ of limb circumference is required for good fruit size and return bloom.
Carbohydrate Model in Two Locations

Benton Harbor 2015

Malusim Carbohydrate Model for Winchester, VA
May 2, 2013

- Recorded Data
- Intellicast.com forecast
- 4-day Running Average

Silver Tip  
Pink  
Petal Fall
### Cornell Apple Carbohydrate Thinning Model

**Weather Station:**
- Williamson (Demarree)

**Select Date:**
- 06/08/2013

#### Change green tip and/or bloom date and click “Calculate” to recalculate results.

<table>
<thead>
<tr>
<th>Green tip date</th>
<th>Bloom date</th>
<th>Calculate</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/13/2013</td>
<td>5/6/2013</td>
<td></td>
</tr>
</tbody>
</table>

#### Apple Carbohydrate Thinning Model Results

<table>
<thead>
<tr>
<th>Date</th>
<th>Max Temp (°F)</th>
<th>Min Temp (°F)</th>
<th>Solar Rad (MJ/m²)</th>
<th>Tree Carbohydrate Status (g/day)</th>
<th>Thinning Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Production</td>
<td>Demand</td>
</tr>
<tr>
<td>4/13</td>
<td>48</td>
<td>41</td>
<td>0.4</td>
<td>0.00</td>
<td>5.76</td>
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<tr>
<td>4/14</td>
<td>44</td>
<td>33</td>
<td>1.0</td>
<td>0.00</td>
<td>3.93</td>
</tr>
<tr>
<td>4/15</td>
<td>73</td>
<td>34</td>
<td>4.1</td>
<td>0.00</td>
<td>10.23</td>
</tr>
<tr>
<td>4/16</td>
<td>66</td>
<td>43</td>
<td>0.3</td>
<td>0.00</td>
<td>12.42</td>
</tr>
<tr>
<td>4/17</td>
<td>52</td>
<td>35</td>
<td>6.0</td>
<td>0.00</td>
<td>6.84</td>
</tr>
<tr>
<td>4/18</td>
<td>74</td>
<td>39</td>
<td>12.0</td>
<td>0.00</td>
<td>15.95</td>
</tr>
<tr>
<td>4/19</td>
<td>73</td>
<td>44</td>
<td>0.3</td>
<td>0.00</td>
<td>18.95</td>
</tr>
<tr>
<td>4/20</td>
<td>44</td>
<td>34</td>
<td>1.5</td>
<td>0.00</td>
<td>5.82</td>
</tr>
<tr>
<td>4/21</td>
<td>40</td>
<td>27</td>
<td>6.0</td>
<td>0.00</td>
<td>3.29</td>
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<tr>
<td>4/22</td>
<td>59</td>
<td>28</td>
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<tr>
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<td>62</td>
<td>40</td>
<td>13.9</td>
<td>0.39</td>
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<tr>
<td>4/24</td>
<td>67</td>
<td>41</td>
<td>2.6</td>
<td>0.00</td>
<td>20.18</td>
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</tbody>
</table>
Rules for using the carbohydrate model to adjust the rate of chemical thinners for ‘Delicious’

<table>
<thead>
<tr>
<th>4-Day Average Carb. balance</th>
<th>Thinning Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 g/day</td>
<td>Increase thinner rate by 30%</td>
</tr>
<tr>
<td>0 g/day to -20g/day</td>
<td>Apply standard thinner rate</td>
</tr>
<tr>
<td>-20g/day to -40g/day</td>
<td>Decrease thinner rate by 15%</td>
</tr>
<tr>
<td>-40g/day to -60g/day</td>
<td>Decrease thinner rate by 30%</td>
</tr>
<tr>
<td>-60g/day to -80g/day</td>
<td>Decrease thinner rate by 50%</td>
</tr>
<tr>
<td>Less than -80g/day</td>
<td>Do not apply thinner- fruit fall naturally</td>
</tr>
</tbody>
</table>
• The fee for an individual to join NEWA in a non-member state is $290 per year and includes nearby airport locations. The cost to bring an entire state into NEWA is $1,750 per year and includes all airport locations.

There are seven stations in Illinois, including Belleville, Grafton, and Millstadt
Advantages and Disadvantages of Chemical Thinners

**NAA**

- Best when applied from full bloom to 7 days after full bloom. It can be applied up to 21 days after FB, but may cause pigmy fruits.
- NAA promotes vegetative growth. May reduce red color.
- Not compatible with MaxCel and other Bezyladenine compounds, especially, especially when applied to larger fruits 15 to 20 mm

**Advantages**

- Good for early thinning

**Disadvantages**

- Tends to reduce seed number
- Weather dependent
- Can reduce fruit size at high conc.
- Can cause russeting
Carbaryl

A mild thinner and usually removed slow growing fruits. Some studies have combined it with Thiram for better thinning. Do not apply during bloom. Can be applied more than once.

Disadvantages

- Toxic to bees
- May cause russeting

MaxCel

Advantages

- Consistent thinning
- Non persistent and non toxic
- Increases fruit size

Disadvantage

- Temperature dependent
## Apple thinners

<table>
<thead>
<tr>
<th>Chemical</th>
<th>‘Red Delicious’</th>
<th>‘Golden Delicious’</th>
<th>‘Fuji’</th>
<th>‘Granny Smith’</th>
<th>‘Gala’</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAA (Primary thinner) At 3-7 days after FB</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Carbaryl (secondary thinner)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Benzyladenine (secondary thinner)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>-</td>
<td>x</td>
</tr>
<tr>
<td>ATS (Secondary thinner)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Ethephon</td>
<td>x</td>
<td>-</td>
<td>x</td>
<td>-</td>
<td>x</td>
</tr>
</tbody>
</table>

ATS = Ammonium thiosulfate
MaxCel or Cylex

- 20g/L (150 ppm) benzyladenin plus Regulaid (read label).
- Apply when temperature is above 65 °F.
- Recommended to apply after using a blossom thinner, like ammonium thiosulfate.
- Apply when king fruitlets are between 5 and 12mm in diameter.
- Works better when combined with NAA and Carbaryl.
- Will cause pigmy fruit without Carbaryl.
Thinning strategies for Gala

• Bloom
  – 2% ammonium thiosulfate
• Petal Fall (5-7 mm)
  – 7.5 ppm NAA + 1.0 pt Carbaryl in 100 gal water)
• 10 – 12 mm
  – 1,00 ppm MaxCel + 600 ppm Carbaryl (apply to top of tree)
• 15 – 20 mm
  – 125 ppm MaxCel + 600 ppm Carbaryl + 0.125% oil (Apply to top of tree)
# Factors Causing Variability in Thinning

<table>
<thead>
<tr>
<th>Factors that Reduces effectiveness of thinners</th>
<th>Factors that increases effectiveness of thinners</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Spur bearing cultivars</td>
<td>• Non spur bearing cultivars</td>
</tr>
<tr>
<td>• Moderate to low vegetative growth</td>
<td>• Vigorous vegetative growth</td>
</tr>
<tr>
<td>• Tree with good light exposure</td>
<td>• Poorly pruned tree with shaded spurs</td>
</tr>
<tr>
<td>• Tree with more horizontal branches</td>
<td>• Trees with upright branches</td>
</tr>
<tr>
<td>• Trees supplied with adequate nitrogen</td>
<td>• Trees supplied with high nitrogen</td>
</tr>
<tr>
<td>• Adequate soil moisture in the spring</td>
<td>• Drought tor overwaterring in spring</td>
</tr>
<tr>
<td>• Moderate bloom</td>
<td>• Heavy bloom</td>
</tr>
<tr>
<td>• Long bloom period</td>
<td>• Short bloom period</td>
</tr>
<tr>
<td>• Adequate pollination</td>
<td>• Poor pollination</td>
</tr>
<tr>
<td>• Good fruit set (one or more seeds per seed cavity (locule)</td>
<td>• Poor fruit set (no seed in most cavities</td>
</tr>
<tr>
<td>• Cold –poor response to most thinners</td>
<td>• Cloudy weather – high response to thinners</td>
</tr>
<tr>
<td>• Quick drying weather (Dry and windy). Poor response to NAA</td>
<td>• Warm and humid – Good absorption and good response to NAA</td>
</tr>
</tbody>
</table>