The Biology of Letting Go:
How Chemical Thinners Work

***Erika DeBrouwer**, OMAFA Tree Fruit Specialist*

Plant growth regulators are used for many purposes within the apple orchard, but its most pronounced use is for chemical thinning. The nuances of chemical thinning are involved and vary substantially based on environmental factors, but why? In this article I will go over how each current product works to take off fruitlets, giving you a better understanding and hopefully more confidence in utilizing various products to reach your goal.

Competition in the Canopy

Before delving into the nitty gritty of plant growth regulators (PGRs) there are a few physiological aspects that should be understood. Apple trees have a dynamic that is essential for growth of vegetative and reproductive tissue, termed **sources** and **sinks**.

- **Source Organs:** produce and export carbohydrates, Source organs convert light, water and CO_2 into sugars (photosynthesis).
  - Example: Fully expanded, mature, sunlit leaves are a primary example.
  - Strength: depends on how much sugar is produced.
- **Sink Organs:** consume and store carbohydrates. Sink organs unload sugars from the phloem to drive cell division and growth.
  - Examples: Developing fruitlets, roots, buds and young expanding leaves are examples.
  - Strength: depends on how strongly an organ demands sugar.

The relationship between sources and sinks is a driver in chemical thinner efficacy for many PGRs. These localized sink ratios aid chemical thinners as the ratios generate differences in growth that chemical thinners can exploit.

These include differences in:

Seed Development

Seeds produce auxin, where the more viable the seed is, the stronger auxin signal it sends. This means that fruitlets with higher seed viability will be more difficult to thin. If seeds are damaged (less viable) auxin production is reduced, and these fruitlets would be easier to thin.

Fruit Position

King blooms flower first, being the first to access carbohydrates and become the dominant sink in comparison to laterals. Chemical thinners take advantage of this difference by decreasing resources to weaker fruitlets.

Laterals always have a disadvantage because they are typically behind in staging compared to the king, but if the king has been damaged – perhaps due to frost – then one (or more) of the laterals would become the dominant sink(s). This is why waiting until size differences are obvious between laterals after a significant frost event is suggested before applying chemical thinners.

Leaf-to-Fruit Ratio

The number of functional leaves supplying a single fruitlet. This ratio focuses on the spur leaves, as they typically provide almost all the energy for fruitlet growth and development.

Generally, 20 to 40 leaves per fruit allow most cultivars to reach premium size targets. This number changes as cultivars have variable leaf sizes, thickness, and photosynthetic capacity.

Spur leaves are small and not fully photosynthetically active early in the season. During this time the tree will rely on stored carbohydrates to sustain fruitlet needs until the leaves mature. This is the period in which chemical thinners are typically applied and why a carbohydrate deficit is needed to increase chemical thinner efficacy.

Remember that:
Not all fruitlets are treated equally on the tree, which is why chemical thinners work.

Label is law. Be sure to follow the label.

Products & Their Performance

Accede™ (40%)
1-aminocyclopropane-1-carboxylic acid (ACC)

What: ACC is a new plant growth regulator for apples in Ontario. It has been researched by Dr. John Cline at the University of Guelph and continues to be studied.

How: ACC works by enhancing ethylene production, as ACC is a direct precursor to ethylene. ACC drives the fruit drop process by initiating the ethylene pathway. It is suggested that ACC has a more localized effect compared to NAA and 6-BA.

When: The product can be applied anytime between full bloom to 25mm, although it is intended to be used as a 'rescue' thinner and is more efficacious between 15 – 20 mm.

Mixing: Research is ongoing about tank mixing and use is season with other products. Initial studies in Ontario have shown that carbaryl use with ACC has been successful.

For more information on ACC, please refer to the following articles:

- Thinning Response of Ambrosia and Gala Apple Trees to Petal Fall and Late Application of Accede®, with and without Sevin XLR. ONcore Vol.30 Issue 1 – Winter 2026.
- Response of Gala Apple Trees to ACC and Metamitron Applied at Different Fruitlet Diameters. ONNL Vol. 26 Issue 4 – December 2022.
- Is there a Rescue Thinner for 14 to 25 mm Diameter Apple Fruitlets? ONNL Vol. 21 Issue 2 – April 2017.

Brevis 150 SC (150 g/L)
Metamitron

What: Another recent addition to the Ontario apple thinning toolbox and originally registered as a herbicide in sugar beets, metamitron shows promise as a chemical thinner. Dr. John Cline continues to study this product.

How: Generates carbon stress, as it inhibits photosynthesis. It directly reduces carbohydrate supply to fruitlets due to the inhibition of photosystem II, this stress causes fruitlets to abort.

When: Product can be applied from petal fall to 20 mm fruitlet size. This product comes with a model to aid in application timing of the product.

Mixing: It is recommended to apply alone. Research is ongoing into tank mixing and use in season with other products. Initial trials by Dr. John Cline show that efficacy mixing with carbaryl or 6-BA increases efficacy, while multiple applications caused over-thinning.

For more information on metamitron, please refer to the following articles:

- Apple Fruitlet Thinning Gala with Metamitron Applied in Sequence, Tank-mixed, and at Different Timings. ONcore Vol.30 Issue 1 – Winter 2026.
- Response of Gala Apple Trees to ACC and Metamitron Applied at Different Fruitlet Diameters. ONNL Vol. 26 Issue 4 – December 2022.

Fruitone® L (3.1%) or Maintain™ 3.5 L (3.1%)
Naphthalene acetic acid (NAA)

What: NAA is an auxin-type thinner that interferes with auxin signaling from the seeds. NAA has also shown to affect the ethylene pathway, and research has also shown that NAA impairs photosynthesis.

How: A reduction in supply and auxin flow results in the loss of fruit, while impairing photosynthesis contributes to carbon stress as it is limiting source carbohydrate generation and mobility. NAA has multiple pathways of affecting fruitlet abscission, which is why can be variable in its response.

When: NAA products can be applied from full bloom to 30 days after full bloom. Application between 5 to 10 mm fruitlet size has shown to be more effective.

Mixing: Efficacy has been improved with use of a non-ionic surfactant (NIS), rates should be adjusted when using NISs.

Cilis Plus® (2.0%) or Maxcel (1.9%)
6-benzyladenine (6-BA)

What: 6-BA contains a cytokinin that promotes cell division. This alters carbohydrate distribution, meaning the sink strength of the larger fruitlets increases.

How: The change in sink competition drives the large fruitlet to gain more carbohydrates while reducing the auxin flow in weaker fruitlets. The reduction in auxin causes fruit to abscise.

When: 6-BA products are most effective between 5 to 15 mm diameter and can be applied from 7 to 21 days after full bloom.

Mixing: Research has shown that mixing with carbaryl surfactant improves thinning efficacy. Do not apply NAA product in same tank or separate sprays in same season, as it can result in pygmy fruit (Delicious and Fuji).

Sevin® XLR (99.5%)
Carbaryl

What: A previously registered insecticide in apples that also causes fruitlet thinning is absorbed through the fruit, not the leaves.

How: Fruitlet biochemical processes are interfered when using carbaryl, as the product ceases growth, causing fruitlets to drop.

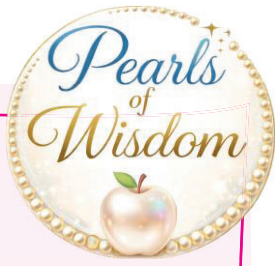
When: Carbaryl can be applied between late petal fall (bees need to be removed or are not active in orchard) to 25 days after full bloom.

Mixing: Carbaryl has been studied with success for use with NAA and 6-BA products.

PGRs influence hormones **locally**, meaning spray coverage plays a significant role in efficacy.

For more information on apple thinning PGRs, check out the links below:

- Thinning of Tree Fruit: Apples
- Plant Growth Regulators: Apples
- Crop Protection Hub: Apple Fruitlet Thinning Products



Back to the Thinning Future

Volume 9 Issue 2
June 2005

Written by John Gardner, Apple Specialist, OMAF & Dr. John Cline, Tree Fruit Physiologist, University of Guelph.

10 Common Misconceptions about Thinning Apple Chemically

1. Thinning will have a significant impact on the total crop volume a grower can expect from an orchard.
2. Thinners applied during the daylight hours work better than at other times during the day.
3. Thinners must be applied at a specific king fruitlet diameter.
4. Low water volumes that distribute the thinner through the tree canopy work really will if properly timed.
5. If a given rate of thinner works well on one farm then that's the rate that works on all farms in Ontario.
6. I've got a pretty good crop of a hot paying newer cultivar on trees in their 3rd year after planting – I'm going to thin them with a good rate to make sure I get the size I want.
7. Thinning treatments should be cut back drastically with frost damage evident in the orchard.
8. It's easy to tell the thinning response of any treatment without a set of control trees.
9. Thinning treatments always produce a very uniform fruit size.
10. Doing no thinning is a good option.

Do you agree with these misconceptions? Have things changed since 2005 in the thinning world of apples?