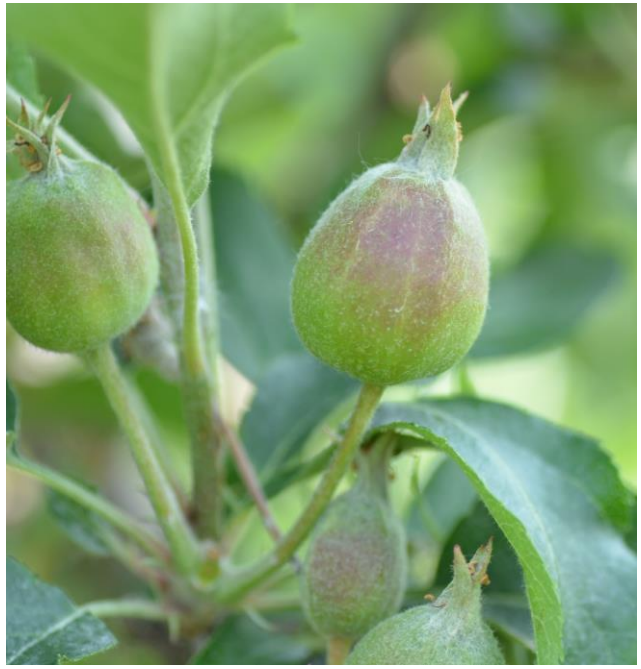

The Joys of Apple Thinning

2021

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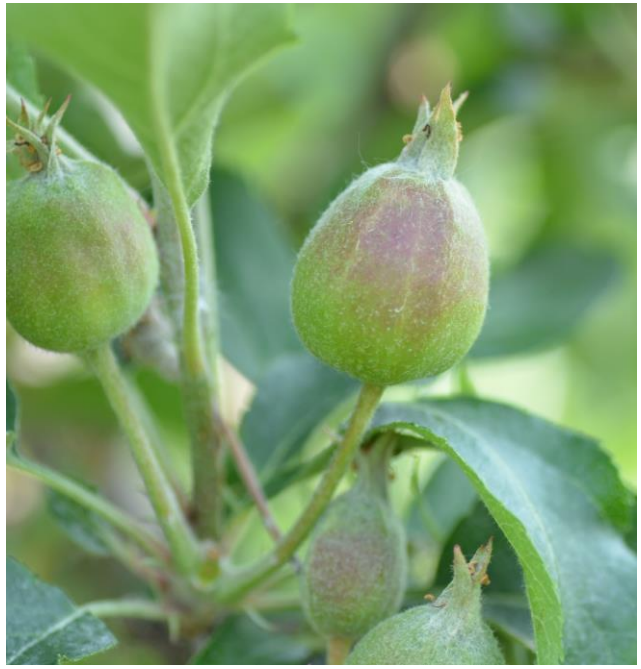

Frustration!

The ~~Joys~~ of Apple Thinning

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Bass Pro Shops

Introduction

- Thinning observations this spring
- Precision thinning
- Site of action of thinning compounds
- Simplified physiology leading to fruit drop (thinning)
- Factors that influence the thinning response
  - Temperature and solar radiation effects on natural fruit abscission
- Optimizing crop value
- Benefits of successful chemical fruit thinning

2021 Thinning Observations

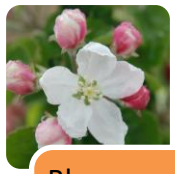
- Honeycrisp trees had very little bloom, despite a light crop in 2020. Trees were irrigated so it was not caused by drought stress
- Fruit set initially looked poor on Gala and Ambrosia at petal fall. I thought there would be no crop - but I was proven wrong.
- We had good thinning response with bloom sprays of lime sulphur + oil, and fruitlet thinners (Carbaryl, 6-BA)
- Experiments with metamitron (Brevis®) and 1-ACC (Accede™) have shown a thinning response
- To defruit 1-2 year old trees, and mature cider trees, I applied a combination of 2.1 L/ha Sevin XLR Plus in, 750 ppm Ethrel and 10 ppm NAA to defruit young trees 1000 L water on May 31st and then June 4th, and 1000 ppm Ethrel and 1-ACC on June 8th – very effective in defruiting most cultivars

Brookfield Gala – May 20 2021

Brookfield Gala – May 25 2021

Precision thinning

Pruning

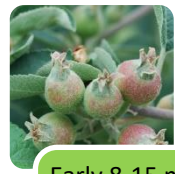


Blossom thinning

- Lime sulphur
- ATS
- String thinner

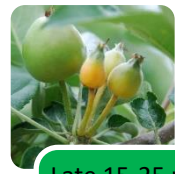
Petal Fall (5 mm ø

- NAA



Early 8-15 mm ø diameter

- 6-BA
- Carbaryl
- NAA
- (1-ACC)
- (Metamitron)



Late 15-25 mm fruitlet diameter

- (1-ACC)
- (Metamitron)
- (Ethephon)

Last Resort - Hand thinning

Target Fruit size

Precision thinning is the process of using multiple strategies to reach a target crop load with minimal need for hand-thinning

Sites of action of thinning compounds

Compound	Site	Reference
NAA	Leaf = fruit	Schneider and Lasheen, 1973
6-BA (thinning)	Leaf > fruit	Greene et al., 1992
6-BA (fruit size)	Leaf << fruit	Greene et al, 1992
Carbaryl	Leaf < fruit	Williams and Batjer, 1964

After Dennis, 2002

Underlying physiology of fruitlet abscission

Natural Fruit Abscission

- 'June drop' represents the period of natural abscission (shedding of fruits)
- Abscission is an internal mechanism regulated by the tree

Fruitlet thinners

Enhance and promote earlier fruit drop -> augment the natural process

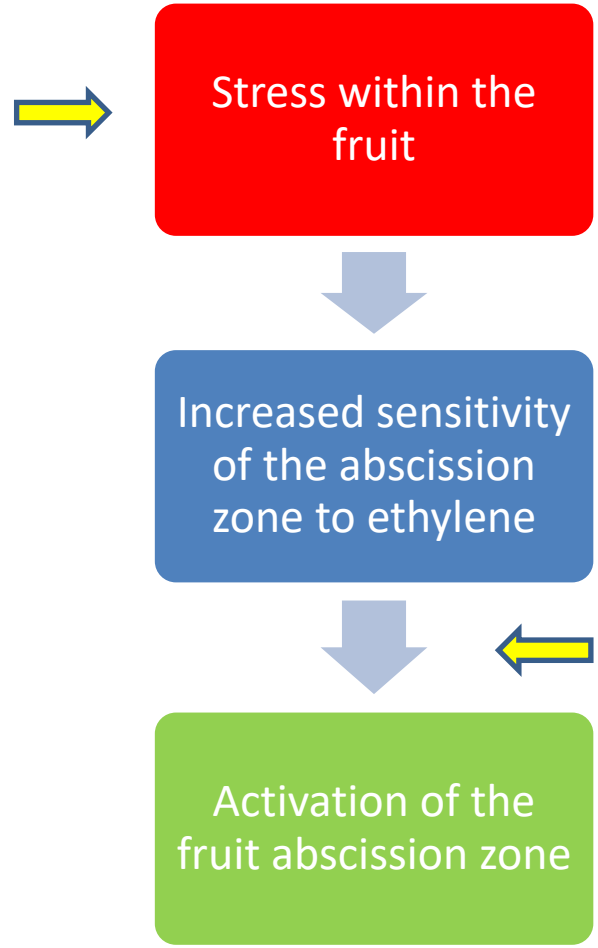
Physiology

Cloudy weather (shading)

High night temperature

Drought

Excessive crop load



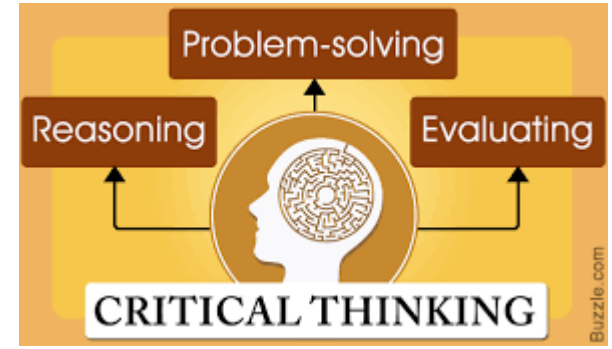
6-BA, NAA, Carbaryl, (Metamitron)

Promotion of ethylene

6-BA, NAA, Ethrel,(1-ACC)

Table 1. A summary of the key features of fruit trees that are either easy or difficult to thin (after Williams 1979; Williams and Edgerton 1981).

Trees are easy to thin when:	Trees are difficult to thin when:
1. Fruit spurs on the lower, shaded, inside branches are low in vigor.	1. Fruit set on spurs in well-lit areas of tree (tops and outer periphery).
2. Moisture and nitrogen supply are inadequate.	2. Trees are in good vigor with no mineral deficiencies.
3. Root systems are weakened by disease or physical damage.	3. Older trees in good vigor have a mature bearing habit.
4. Bloom is heavy, especially after previous heavy crops.	4. Light bloom or light fruit set occurs with the exception of young trees.
5. Young trees have many vigorous upright branches.	5. Trees have horizontal fruiting branches.
6. Thinners are applied to self-pollinated or poorly pollinated fruits.	6. Insects are active on cross-pollinated cultivars.
7. Fruit set is heavy on easily thinned cultivars such as 'Delicious'.	7. Limbs and spurs have been slightly girdled following moderate winter injury.
8. Cultivars tend to have a naturally heavy June drop.	8. Biennial bearing trees are in the off year.
9. Fruit sets in clusters rather than as singles.	9. Fruit sets in singles rather than in clusters.
10. Bloom period is short, and blossom-thinning sprays are used.	10. Cultivars such as 'Golden Delicious' and heavy-setting spur types are to be thinned.
11. High temperature is accompanied by high humidity before or after spraying.	11. When ideal fruit growth occurs before and after time of thinning.
12. Blossoms and young leaves are injured by frost before or soon after spray application.	12. Low humidity causes rapid drying, and decreased absorption occurs before and after spraying.
13. Foliage is conditioned for increased chemical absorption by prolonged cool periods.	13. Cool periods follow bloom without any tree stress.
14. Rain occurs before or after spray application.	14. Endogenous ethylene production is low.
15. Prolonged cloudy periods reduce photosynthesis before or after application of chemicals.	15. Bloom is light, and a high leaf-to-fruit ratio exists.



Weather is a key component (temperatures, rain, solar radiation)

Important factors that promote and supress the response to chemical thinners

Promoters

- Lower light conditions
- Heavy bloom
- Cuticles of leaves formed under cooler periods are lead to greater absorption of chemicals
- Higher night temperatures
- Fruit set in clusters rather than singles

Suppressors

- Lower temperatures reduced plant metabolism and activity
- Light bloom
- Highly tree vigour leading to maximal fruit growth before and after thinner application
- Biennial bearing trees in their ‘off’ year
- Less differentiation in size between the central fruit (king) and lateral fruit

Optimizing Crop Value

The number of fruit that remain on the tree directly affects:

- yield
- fruit size
- Colour
- Fruit quality
- Return bloom

Crop Value

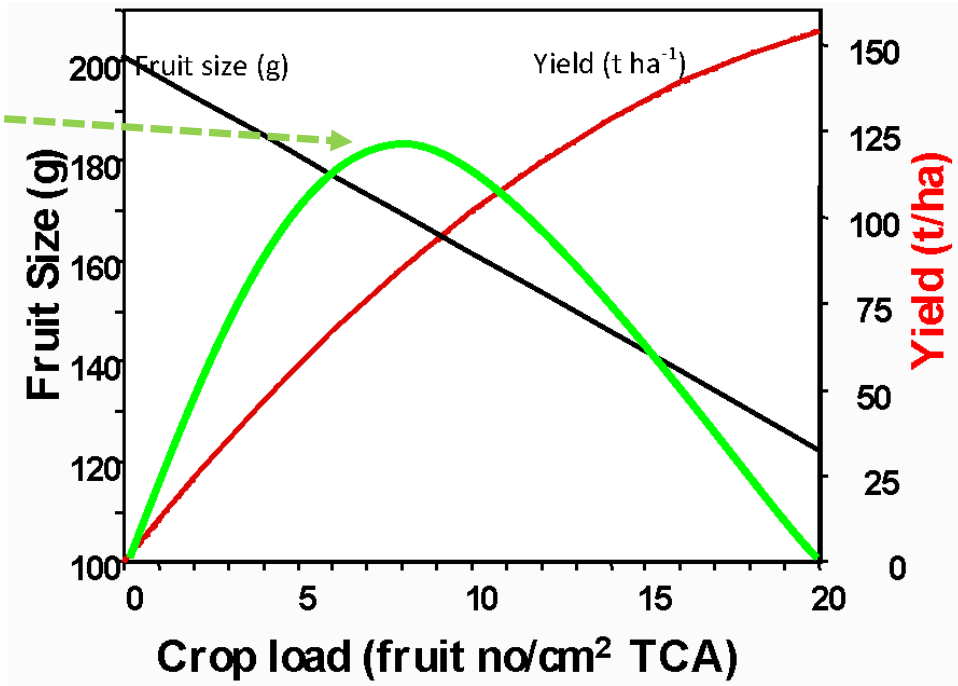
Calculations of crop value at various crop load levels have shown that at very high crop loads, yield is very high but fruit size and crop value are low (Robinson, 2013)

When crop load is reduced to more moderate levels through thinning, then crop value rises dramatically even though yield is lower because fruit size is larger and has greater value.

At some point crop value peaks when yield and fruit size are balanced and then with further reductions in crop load, crop value declines due to the lower yield not being fully compensated by larger fruit size

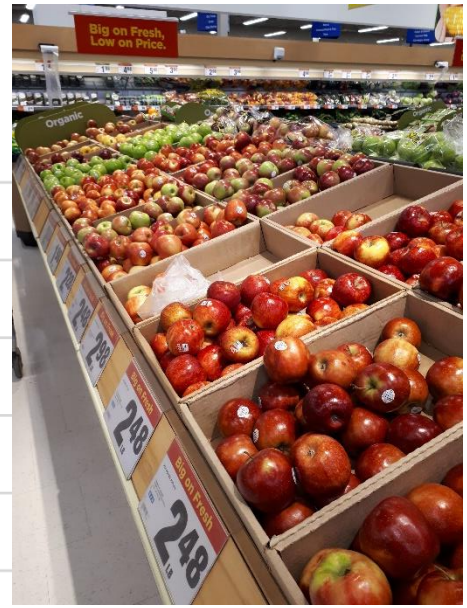
Managing crop load is a balancing act between reducing crop load (yield) sufficiently to achieve optimum fruit size and adequate return bloom without reducing yield excessively (Robinson et al., 2014).

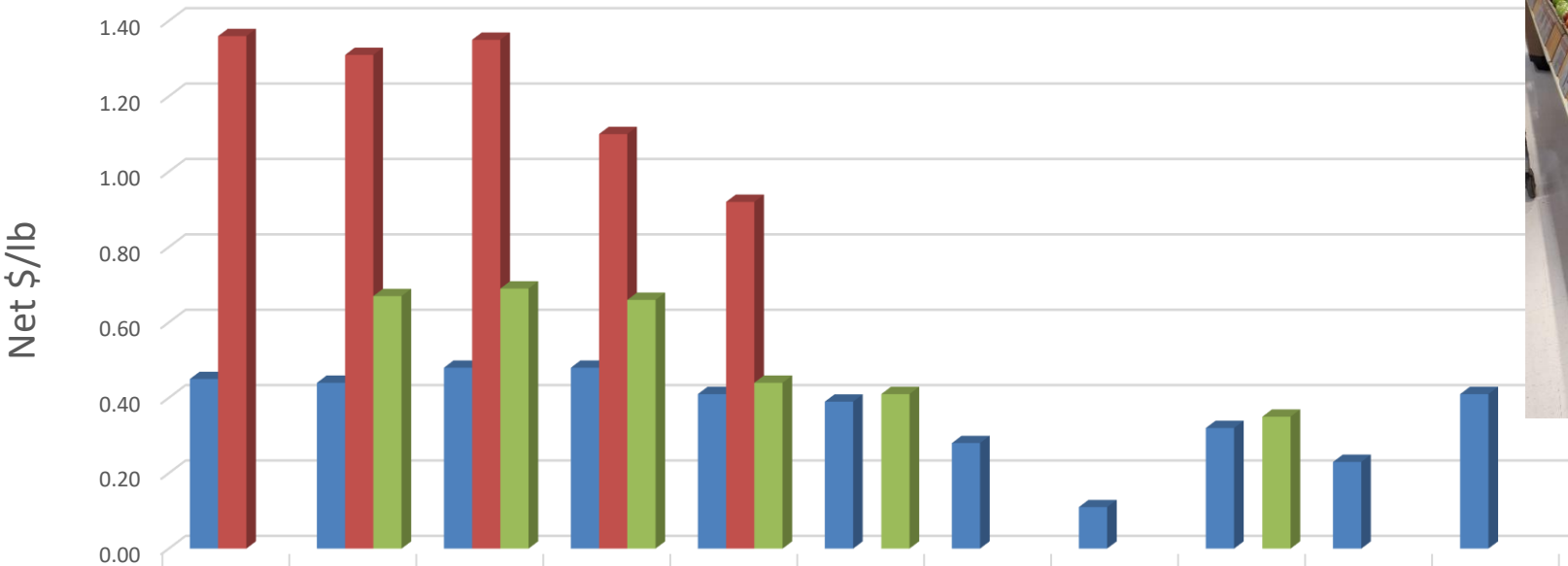
Gala



Robinson et al. 2016

Details of net returns are required to determine target fruit size





	64 Box	72 Box	80 Box	88 Box	100 Box	113 Box	163 Box	198 Count	12 x 3lb Bags	8 lb bag	10 lb bag
Gala	0.45	0.44	0.48	0.48	0.41	0.39	0.28	0.11	0.32	0.23	0.41
Honeycrisp	1.36	1.31	1.35	1.1	0.92						
Ambrosia		0.67	0.69	0.66	0.44	0.41			0.35		

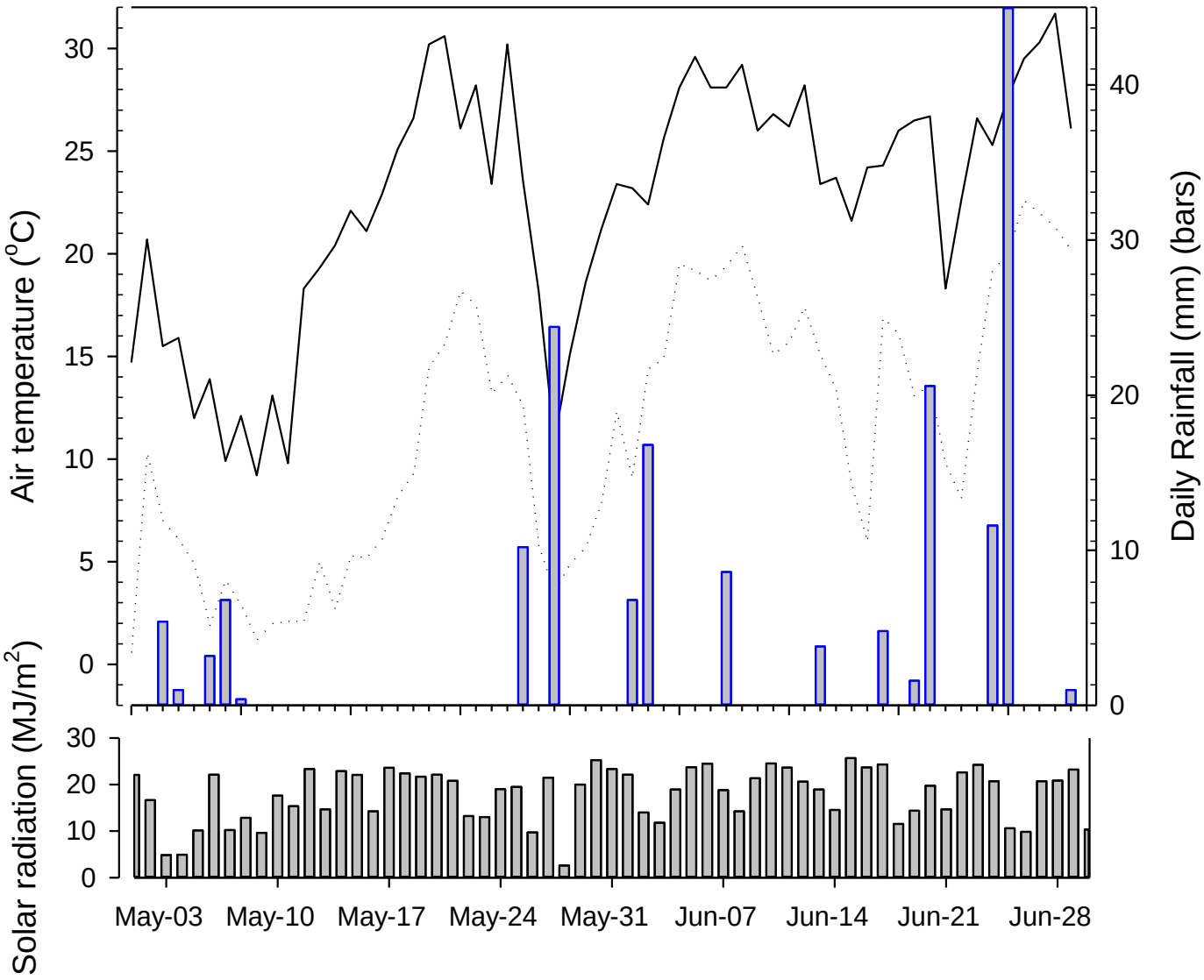
Example of $/lb in relation to fruit size

Benefits of a successful thinning program

Reduced labour costs

- Labour cost
- - hand thinning
- - harvest
- - handling and storing fruit
- Labour availability

Air temperature, rainfall, solar radiation, Simcoe (May 1 – June 30, 2021)



- Season advanced with warm temps in early April -> advanced bud developed
- Cool late April with temps dropping to -3.7 (April 22) and -2.9(April 26) -> resulted in frost and lost of many king flowers
- Bloom May 9-10th f(1 week earlier than 'normal'
- No significant rain for much of May
- Cool temperatures during May 27- May 30 - a key window for fruitlet thinning

Acknowledgements

Ontario Apple Growers

University of Guelph/OMAFRA Alliance Research fund

Cathy Bakker, Amanda Beneff - Technicians

Leticia Reis, PhD Candidate

Thinning Models/Tools

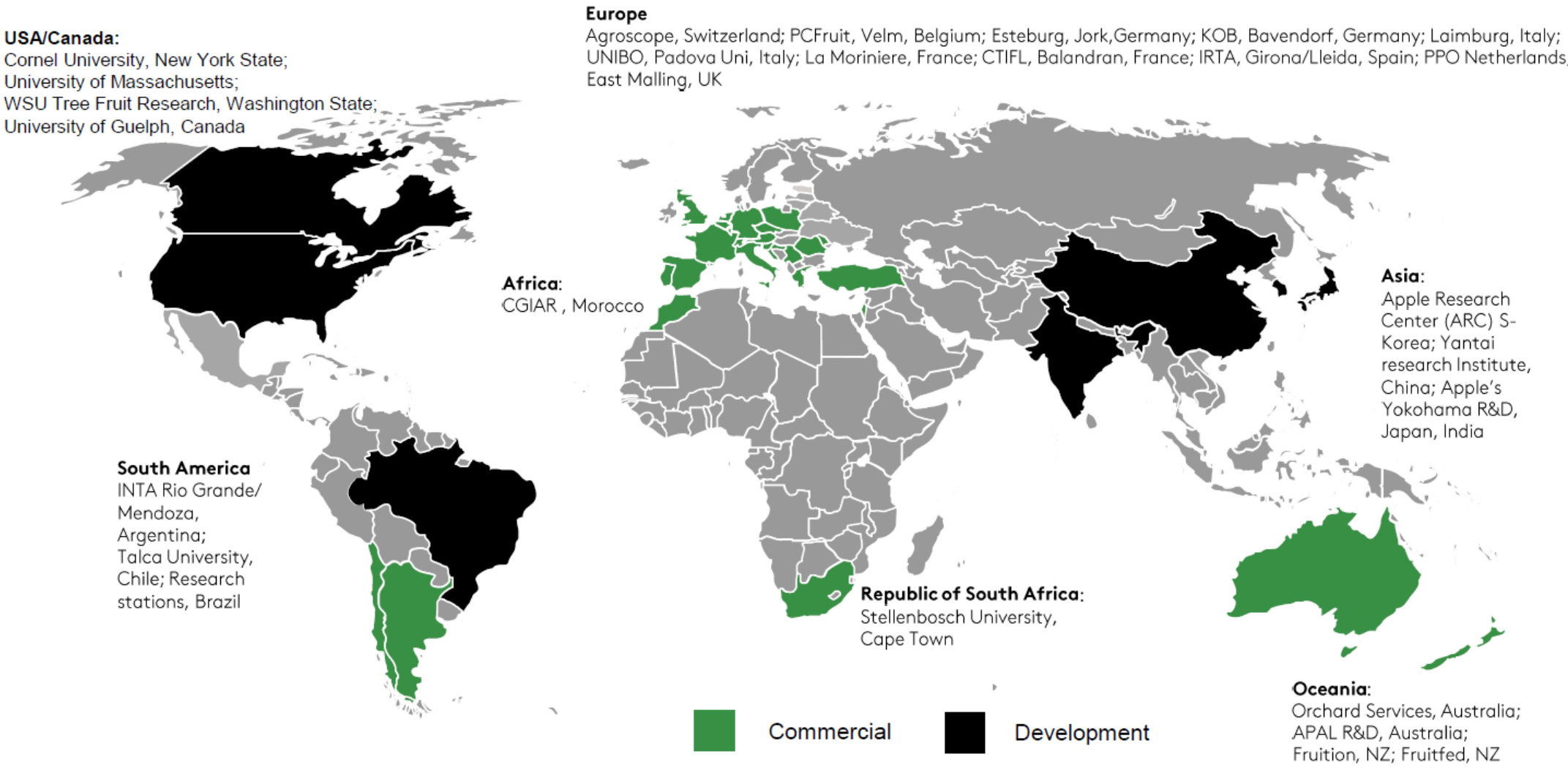
Model/Tool	Input	Output	Comments
Fruit Growth Model (Greene)	Fruit diameter	A predication of the final number of fruit that will remain after thinning	Very accurate Time consuming Difficult to implement with large acreage
Carbohydrate Model (Malusim) (Laskso and Robinson)	Amount of bloom, temperature, solar radiation	Timing and Efficacy of thinners – adjustment in the rate of chemical thinner	Requires local weather and weather forecasts Not available in Canada
Pollen Tube Growth Model (Yoder and Peck)	Style length, temperature	Best time to apply blossom thinners	Requires local weather Not available in Canada
BreviSmart (Adama)	Temperature, fruit diameter, cultivar, past and forecasted weather	Timing and efficacy of Brevis - adjustment in the rate of chemical thinner	Requires local weather and weather forecasts (which Not available in Canada

New Fruitlet Thinners for Canada

Product	Company	Mode	Ideal Timing	Status
Brevis (metamitron)	Adama Agricultural Solutions	Photosynthesis inhibitor	Petal fall – 20 or 25 mm	Registration is being prepared for submission Currently registered in other countries (Australia, New Zealand, Chile, Argentina, parts Europe, S. Africa)
1-ACC (Accede)	Valent BioSciences	Stimulates ethylene	Petal fall – 20 or 25 mm	Registration has been submitted in Canada 2022 – Valent will conduct larger grower trials in Ontario without crop destruct

Brevis status globally (2021)

Source: Ton Bresseling



OMAFRA Thinning Guidelines
http://www.omafra.gov.on.ca/english/crops/hort/thinning.htm

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Thinning of Tree Fruit

Table of Contents

1. Introduction
2. Peaches
3. Plums
4. Pears
5. Apples
6. Conclusion

Introduction

Thinning of tree fruit is a key step to annual cropping and increased fruit size. This is increasingly important to make your investment profitable in new plantings, especially trellised, high density apples and pears. In all orchards, proper thinning will: improve average fruit size, finish and colour; create more uniformity in the crop; avoid over cropping; encourage return bloom and annual bearing of apples and pears; reduce limb breakage; and reduce the probability of pest damage as some pests are more likely to damage clustered apples and pears.

Thinning can be achieved through pruning, chemical thinning and hand thinning. The first step to thinning is through pruning when many fruit buds or blossoms can be removed. At the fruitlet stage, chemical thinners can be used to remove fruitlets in apples and pears. Once June drop has occurred, which is the stage where trees will abort fruit naturally, hand thinning is done on all tree fruit.

Early thinning is important. For apples and pears, thinning near bloom or shortly afterward will increase average fruit size and maximize return bloom the next year. For peaches and plums, thinning at early fruit

Cultivar Specific Fruitlet Thinner Recommendations

Table 5. Suggested Rates for Chemical Thinning of Mature Apple Trees

Cultivar	Sevin XLR (L/1,000 L water)[2]	Fruitone (NAA) (ppm)[3]	Sevin XLR (L/1,000L water) + Fruitone (NAA) (ppm)[2,3]	MaxCel or Cilis Plus (g BA/ha)[4]	Sevin XLR (L/1,000 L water)[2,3] + MaxCel or Cilis Plus (g BA/ha)[4]
Ambrosia	1-1.5	-	-	50	-
Aurora Garden Gala™	1-1.5	-	-	75	1+50
Braeburn	-	1.2-7.3	-	-	-
Cameo	1	2.4-9.7	-	-	-
Cortland	-	1.2-7.3	1-2+2.5-5	-	-
Creston	0.5-1	-	-	-	-
Crispin/Mutsu	0.5-1.5	2.4-9.7	-	-	-
Empire	1-1.5	2.4-9.7	1+2.5-4	50-100	1+50
Enterprise	1-1.5	-	-	-	-
Fuji	-	-	1-1.5+10-12	100-150	1-2+50-75
Gala	-	2.4-9.7	1+5-10	75-100	1-2+50
Gingergold	1-1.5	2.4-9.7	1+2.5-5	75	1+50
Golden Delicious, Wealthy	1-2	3.6-9.7	1+5-10	75-100	1-2+50
Golden Supreme	1	2.4-9.7	-	-	-
Goldrush	-	-	1+10	-	-
Honeycrisp	1-1.5	2.4-9.7	1+2.5	-	-
Idared	-	1.2-7.3	-	50-75	-
Jerseymac	1-1.5	2.4-9.7	-	-	-
Jonagold	1-1.5	3.6-9.7	-	50-75	-
Jonamac	-	3.6-9.7	-	-	-
Lodi	-	3.6-9.7	1+10-15	-	-
Macoun	-	3.6-9.7	-	-	-
McIntosh,	-	3.6-9.7	1+5-105	50-75	-

Cultivar Sensitivity to Chemical Fruitlet Thinners

Easy	Moderate	Difficult
Ambrosia non-spur Red Delicious Idared Mutsu/Crispin Jonagold strains Jerseymac Honeycrisp Gingergold Silken Creston Cameo Golden Supreme	Empire McIntosh Northern Spy Cortland	Golden Delicious Paulared Gala strains Fuji Goldrush Spartan Wealthy spur-type McIntosh spur-type Red Delicious.

Source: http://www.omafra.gov.on.ca/english/crops/hort/thinning.htm#apples

Benefits of a successful thinning program

Reduced Biennial Bearing

For biennial bearing cultivar such as Fuji, Honeycrisp, and Northern Spy, it is important to reduce the crop sufficiently and early in the season to avoid reduced bloom the following year

How do thinners work?

- The mechanism involved in fruit abscission and thinning are very complex
- There remains uncertainty as to how thinners work within the tree and fruit
- They appear to have different mechanism that ultimately led to the same outcome

Table 1. Mechanisms proposed to explain how applied chemicals thin apple fruits.

1.	Abort seeds or inhibit their development
2.	Delay abscission, thereby increasing competition among fruits and stimulating fruit drop.
3.	Block transport of nutrients to fruit
4.	Reduce sink strength of fruit
5.	Reduce auxin synthesis by the seed
6.	Reduce auxin transport from fruit
7.	Stimulate ethylene biosynthesis
8.	Inhibit photosynthesis

Dennis, 2002