

Response of Gala apples to blossom thinning with ammonium thiosulphate (ATS) and lime sulphur

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Blossom Thinning

Why ?:

Early thinning enhancing fruit size and flower bud initiation

What ?:

Common products and methods to blossom thin

Compound	Mode of Action
Lime sulphur (LS) combined with minerals oil (oil)	<ol style="list-style-type: none">1. Direct effect on the pollen tube growth (has some kick-back activity)2. Reduces plant photosynthesis and carbon balance
Ammonium thiosulphate (ATS)	<ol style="list-style-type: none">1. Desiccant (prevents pollen from growing on the flower stigma)

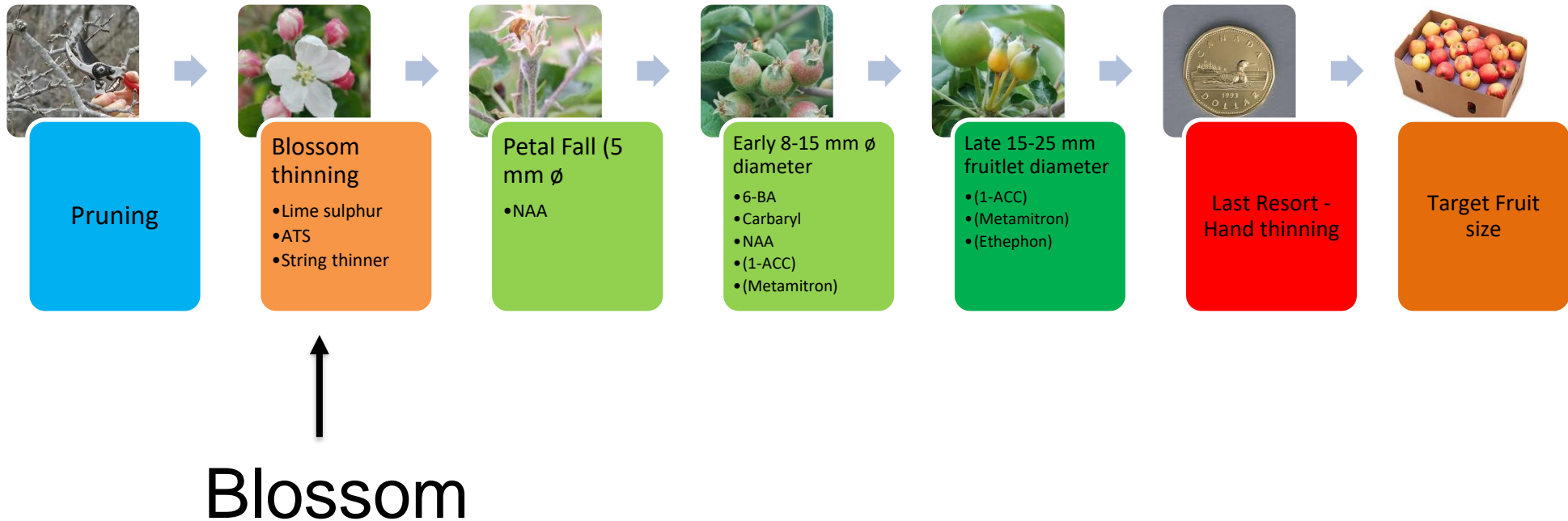
How to use:

Alone or in combination with fruitlet thinner is a crop load management program



Precision thinning

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



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 Model is 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)

Experimental Plan

- Cultivar: Brookfield Gala
- System: super spindle
- Trees planted: 2017
- Spacing: 3.5 x 0.9 m (3' x 12') (1285 trees/acre)
- Tree height: 2.8 m (11.5 ft)
- Canopy width: 2.3 m (7 ft) Super Spindle
- Treatments applied to two-tree plots using a commercial air blast sprayer to TRV dilute
- 1 'guard' tree was left between sprayed trees

Experimental Design

- Treatments: 7
- Replications: 5
- Experiment design: RCBD
- Trees were trickle irrigated



Treatment list

2020

Bloom Spray Description	8-12 mm Timing	Bloom dates of Application(s)	Post-Bloom date of application
Untreated Control			
Hand Thinned Control			
---	Tank mix 1500 mg Carbaryl + 75 mg/L -BA		
2% ATS (one or two applications depending on PTGM)		26 May, 27 May	
2.5% Lime sulphur with 2% (v/v) Purespray Green 13E Oil (two applications)		26 May, 27 May	
2% ATS (two applications)	Tank mix 1500 mg Carbaryl + 75 mg/L -BA	26 May, 27 May	9-Jun
2.5% Lime sulphur with 2% (v/v) Purespray Green 13E Oil (two applications)	Tank mix 1500 mg Carbaryl + 75 mg/L -BA	26 May, 27 May	9-Jun

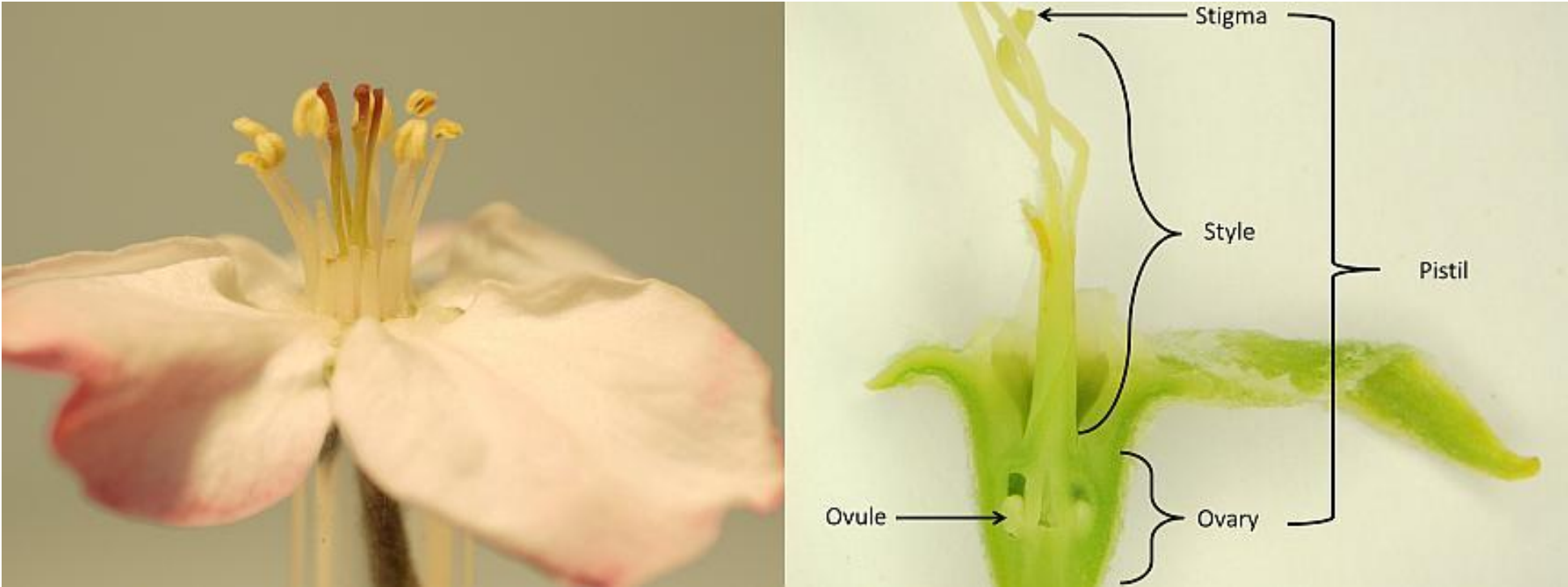
2021

# Bloom Spray Description	8-12 mm Timing	Bloom dates of Application(s)	Post-Bloom date of application
1 Untreated Control			
2 Hand Thinned Control			
3 ---	Tank mix 1500 mg Carbaryl + 75 mg/L -BA		
4 2% ATS (one or two applications depending on PTGM)		13 May, 17 May	
5 2.5% Lime sulphur with 2% (v/v) Purespray Green 13E Oil (two applications)		13 May, 17 May	
6 2% ATS (two applications)	Tank mix 1500 mg Carbaryl + 75 mg/L -BA	13 May, 17 May	30 May (10 mm)
7 2.5% Lime sulphur with 2% (v/v) Purespray Green 13E Oil (two applications)	Tank mix 1500 mg Carbaryl + 75 mg/L -BA	13 May, 17 May	30 May (10 mm)

0.05% (v/v) Agral 90 included in all sprays



Can blossom thinner applications be timed with flower phenology?



Implementing the Pollen Tube Growth Model on NEWA

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²NYS IPM Program, Cornell AgriTech, Geneva, NY

Keywords: apple, crop load management, crop modelling, thinning, *Malus xdomestica* (Borkh.)

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New York Quarterly Winter 2018



How to use the Pollen Tube Growth Model (PTGM)

- The first blossom thinners are applied at ~ 30% full bloom when most of the king flowers were open but prior to lateral flowers opening.
- Style length is measured on 25-50 flowers at this time
- The pollen tube growth model is used to time when to apply the blossom spray
- Using cultivar specific pollen tube length, pollen growth rate, and air temperature, the model predicts the time required for the flowers to be fertilized after the pollen reaches the stigma.
- In addition, the predicted time to apply blossom thinners is based on the desired number of flowers to be fertilized per tree, which is approximate 25% higher than the desired number of fruit per tree.



Measurements

Thinning

Fruit set

No. fruit per spur

Number of fruit per tree

Crop load

Leaf Phytotoxicity

Leaf necrosis

Leaf Necrosis severity

Fruit

Number of fruit per tree

Yield per tree

Marketable yield

Average fruit weight

Fruit size distribution

Economics

Value of fruit per tree

Cost of thinning

Vegetative growth

Trunk cross section area



2020 Results

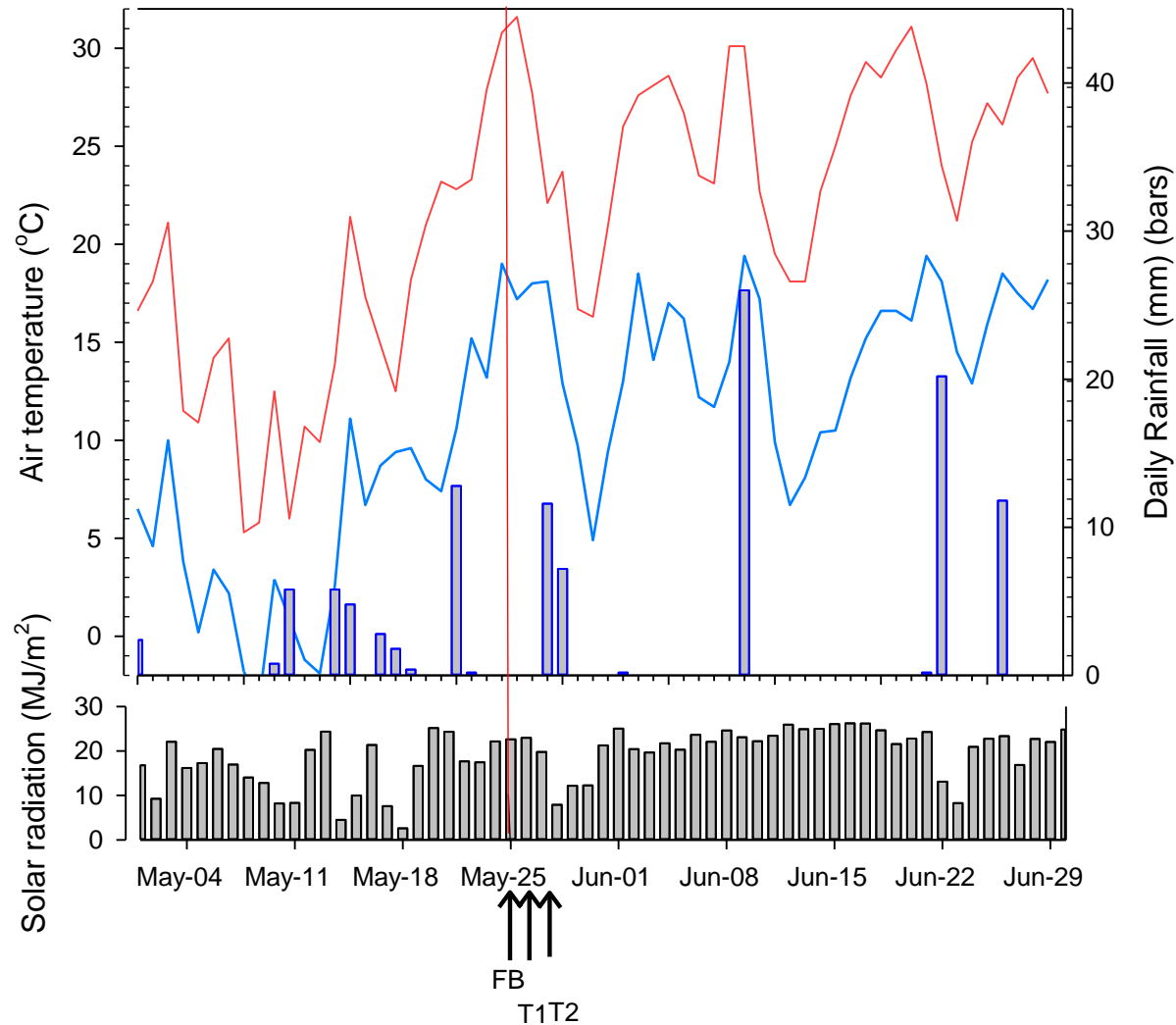
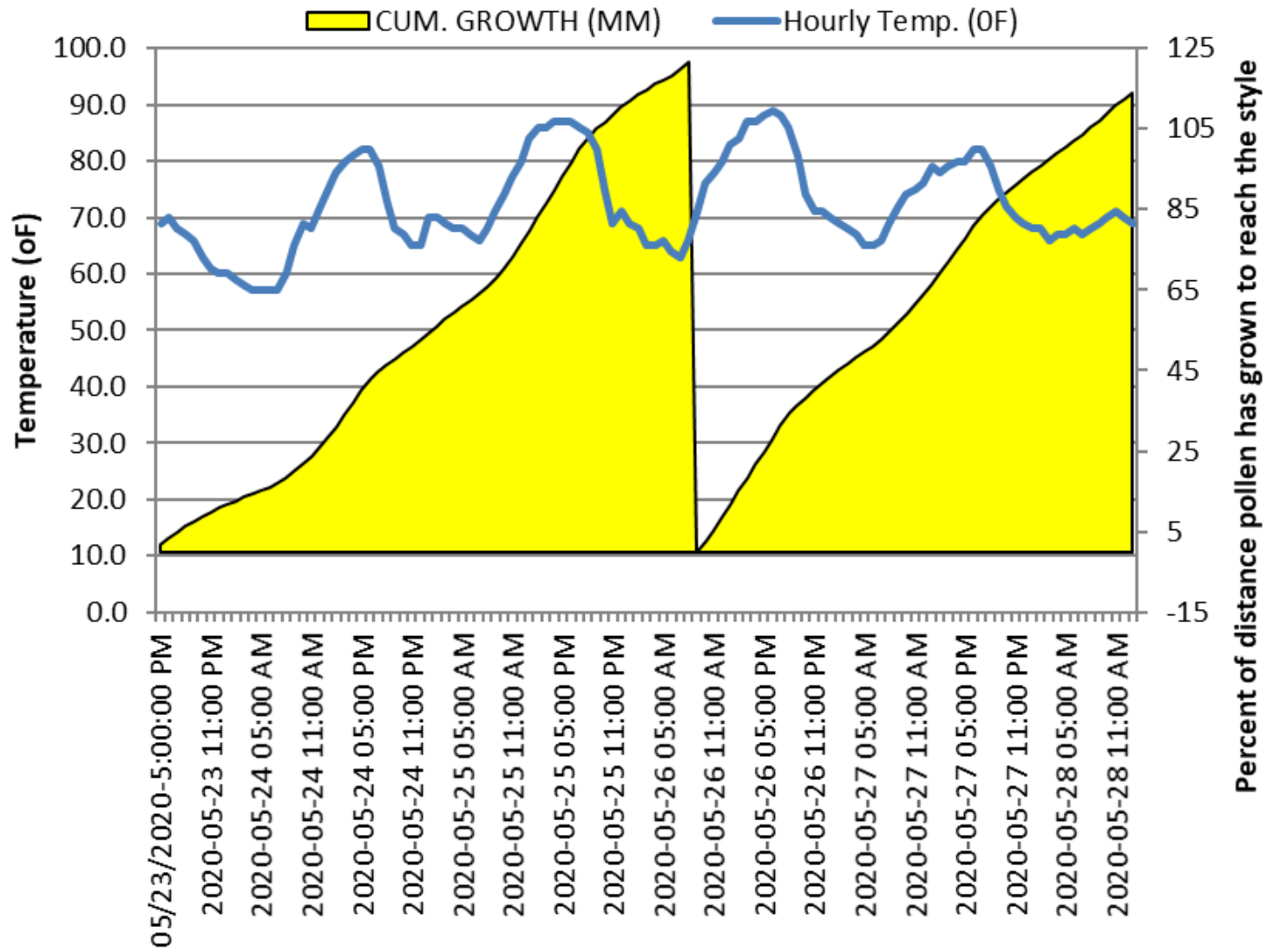
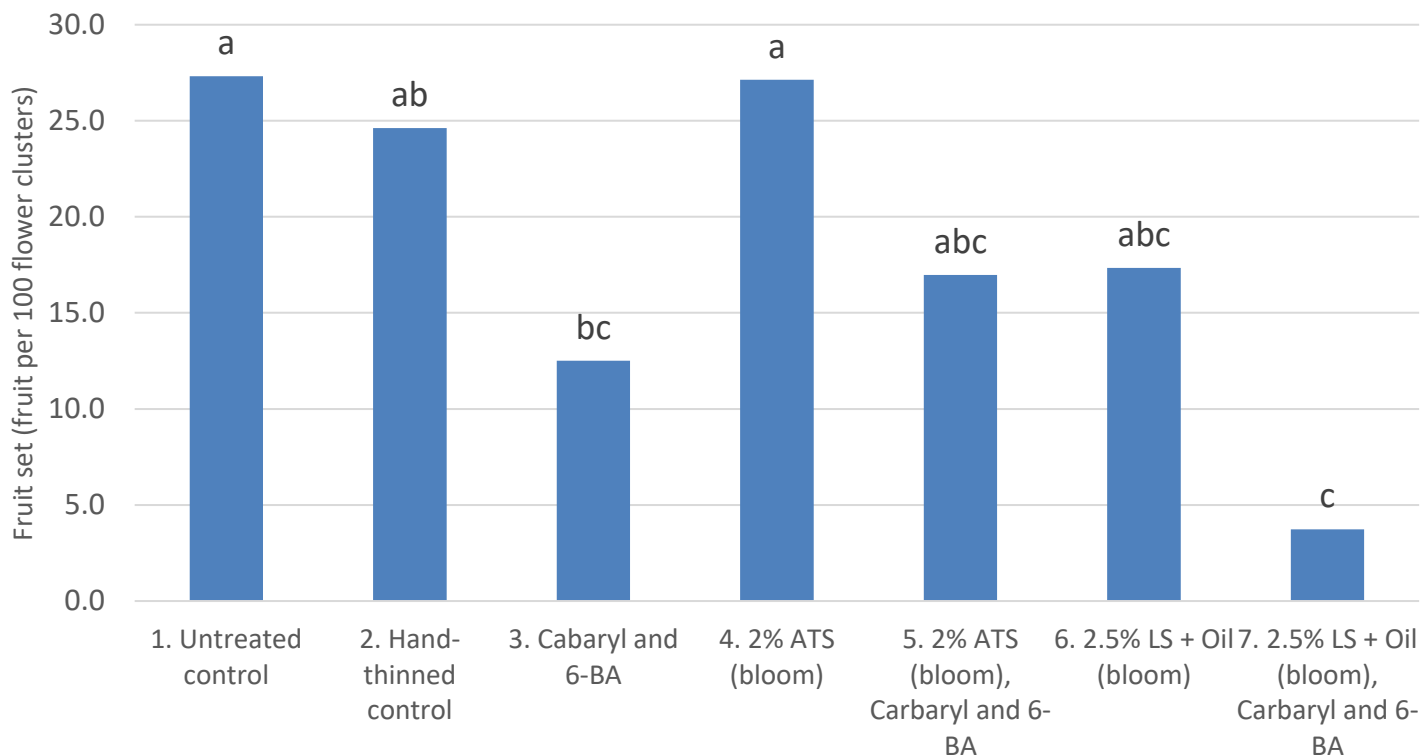


Figure 1. 2020 minimum and maximum air temperature, precipitation and solar radiation at the University of Guelph, Simcoe (1 May - 30 June). Arrows indicate the dates of full bloom (FB) and application of treatments of 26-May (T1) and 27-May (T2).





Gala fruit set -2020



There was a significant treatment effect on fruit set ($P < 0.0001$)

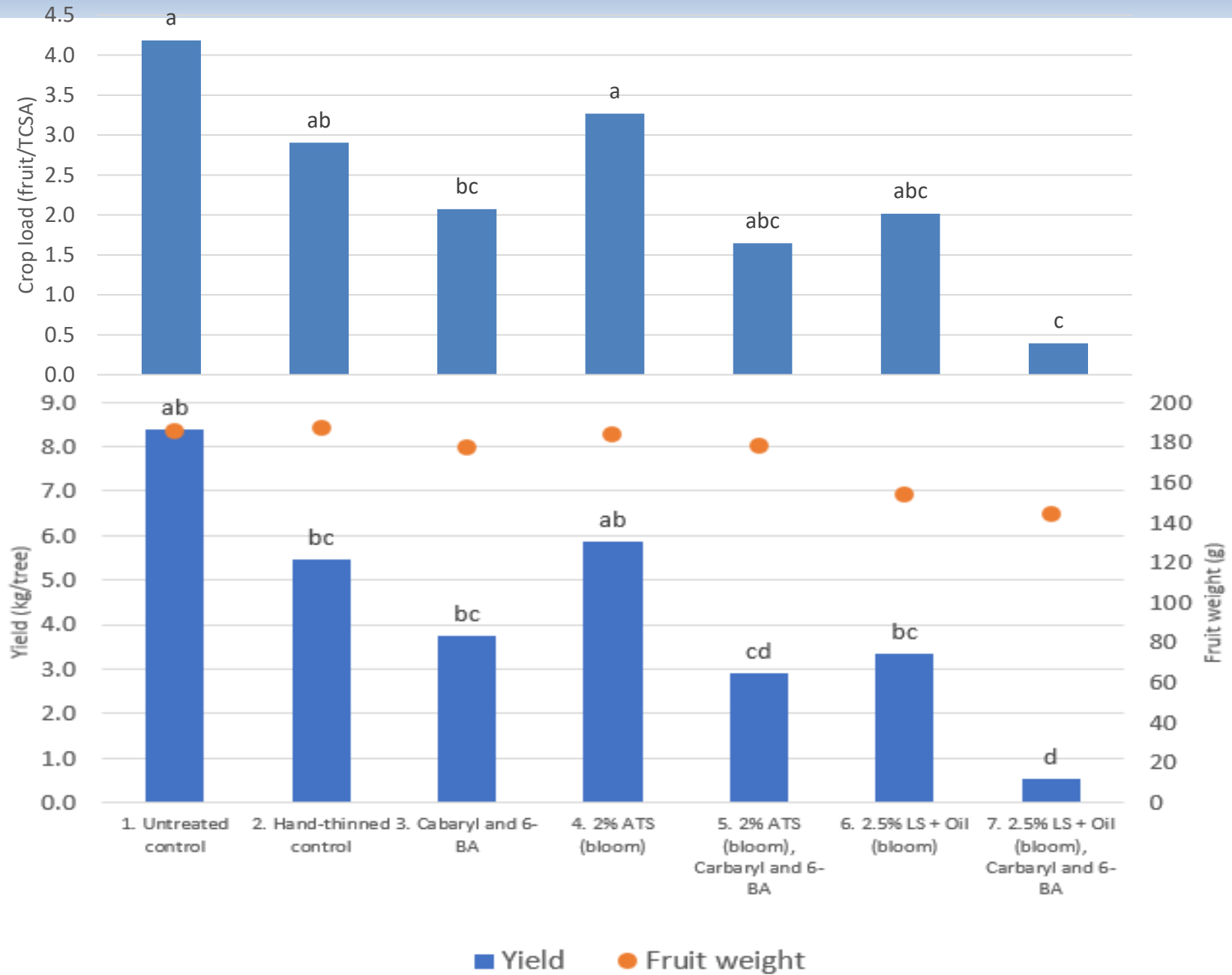
The untreated control and ATS blossom thinning treatments had the highest fruit set, whilst the LS blossom thinning followed by the CB and 6-BA fruitlet thinning treatment had the lowest fruit set.

Thinning increased when bloom sprays were followed by CB and 6-BA

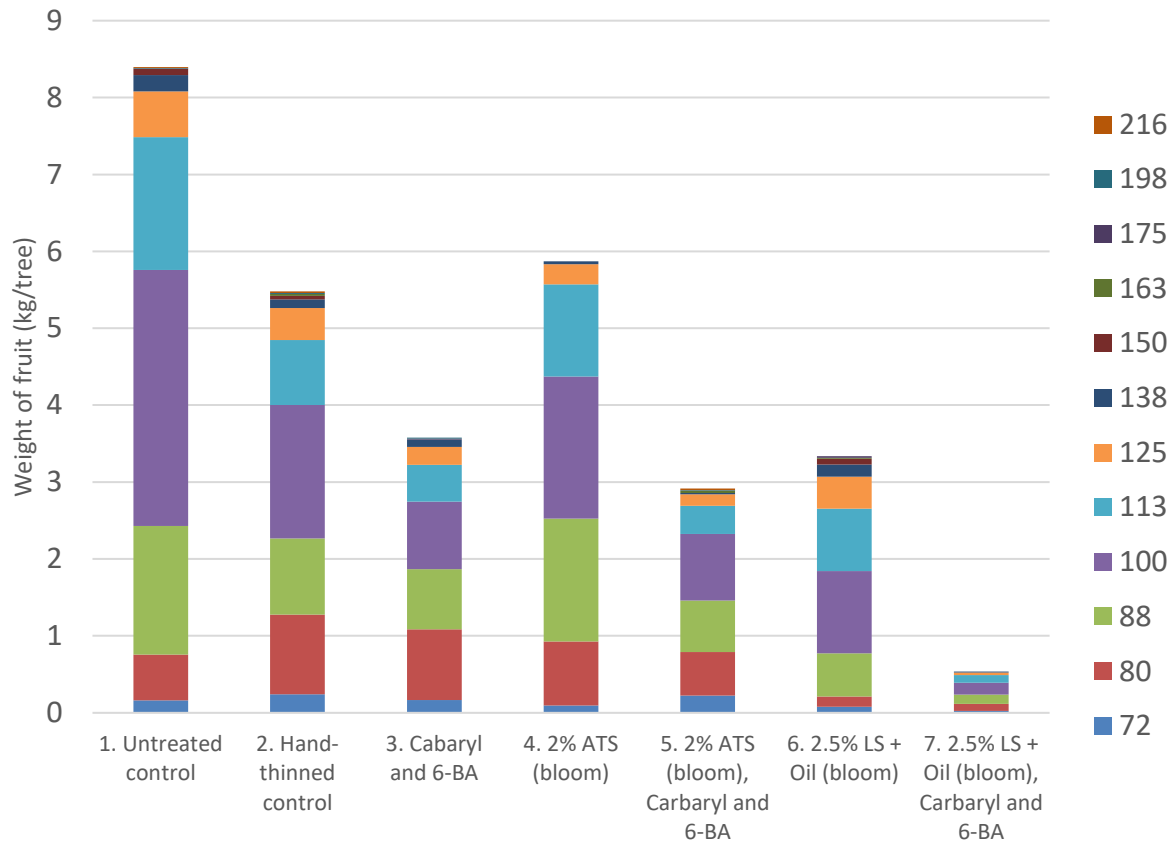
nibble approach



Gala yield and crop load - 2020

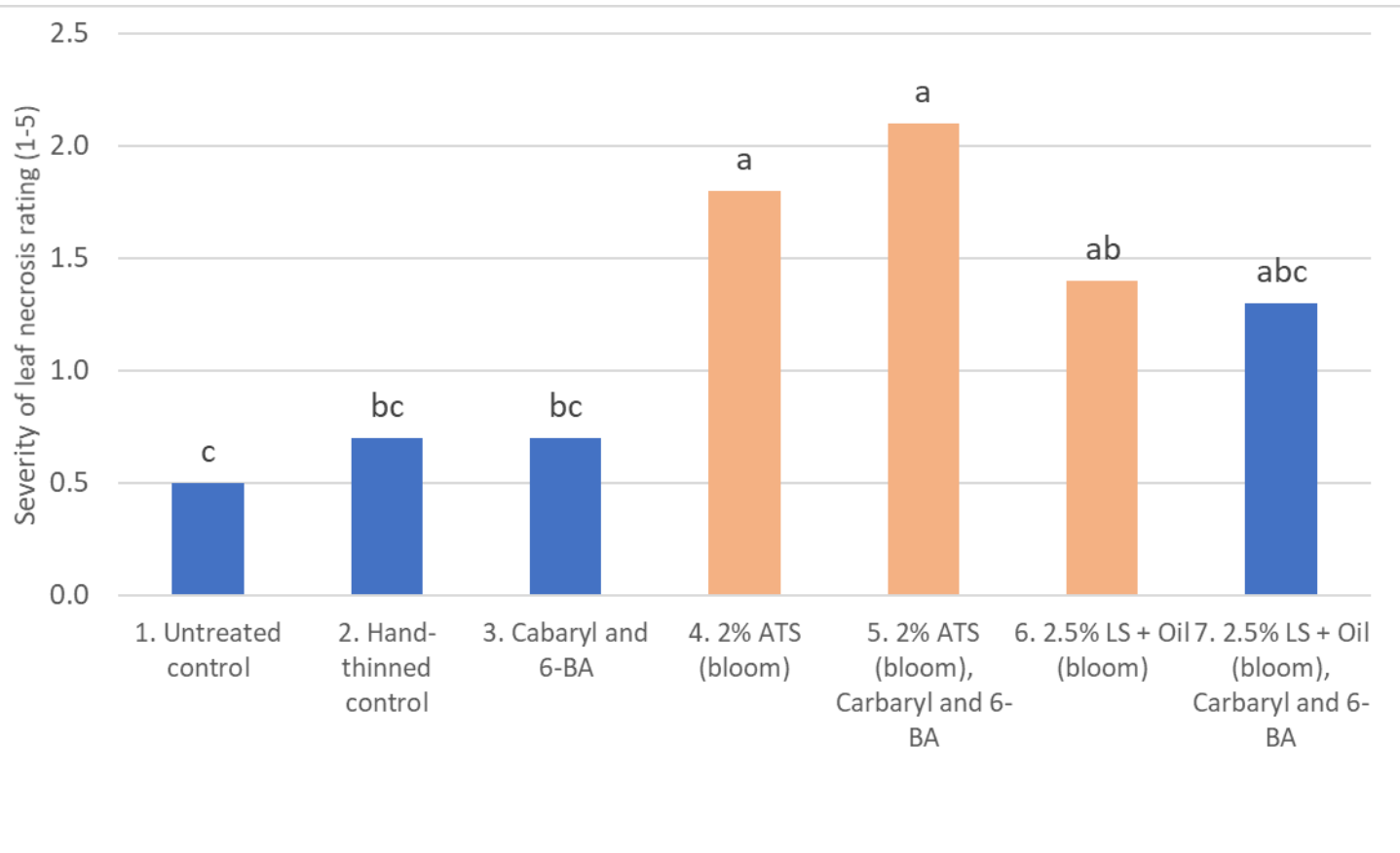


Gala size distribution - 2020



- Fruit size for the untreated control treatment peaked at size 100
- All other treatments reduced yield with little effect on size distribution

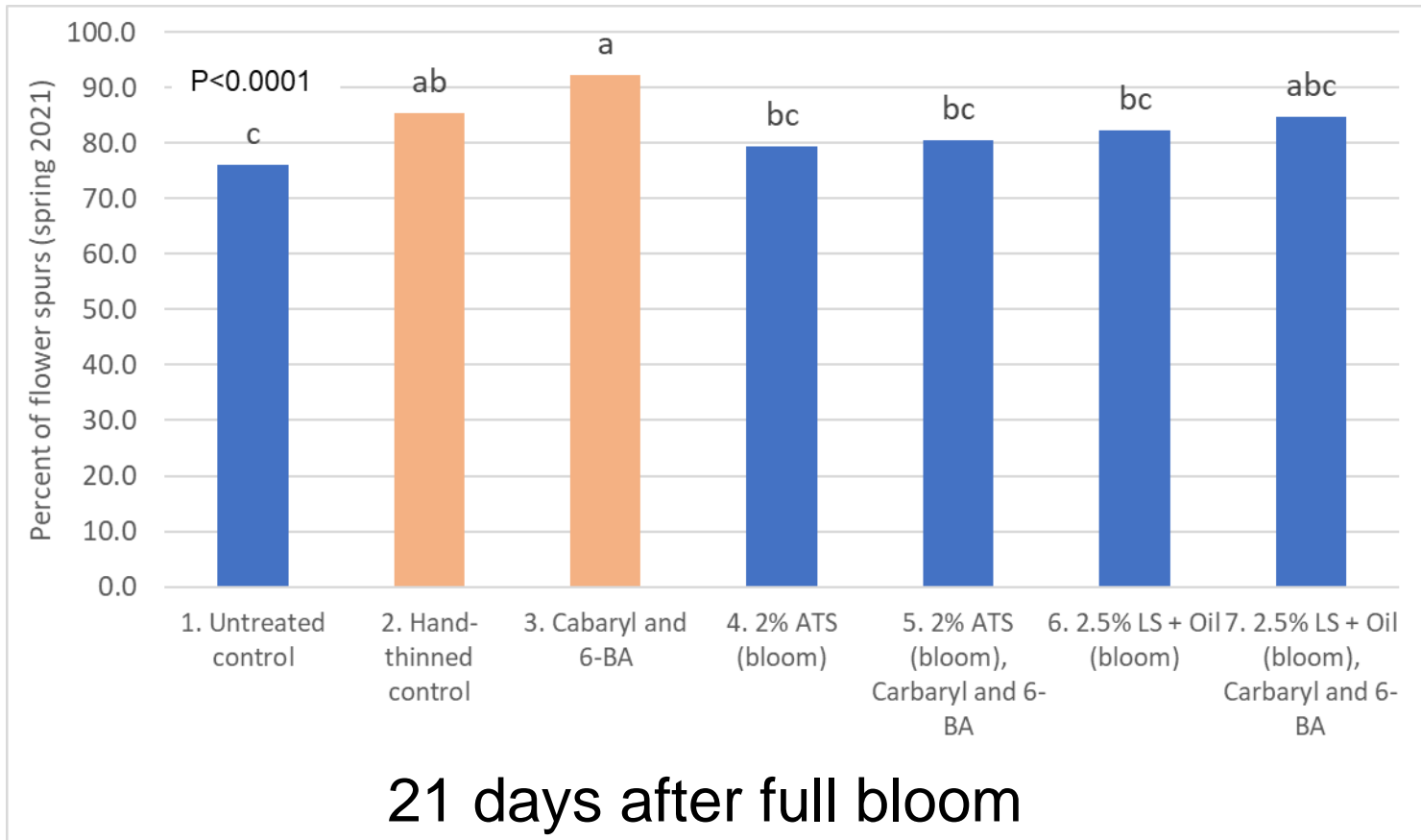
Gala leaf phytotoxicity - 2020



Both ATS (2%) and Lime Sulphur plus oil caused moderate leaf necrosis.



Gala Return Bloom - 2020



- Return bloom was high
- Fruitlet thinners of Carbaryl and 6-BA and HTC had slightly higher return bloom than the untreated control.



2021 Results

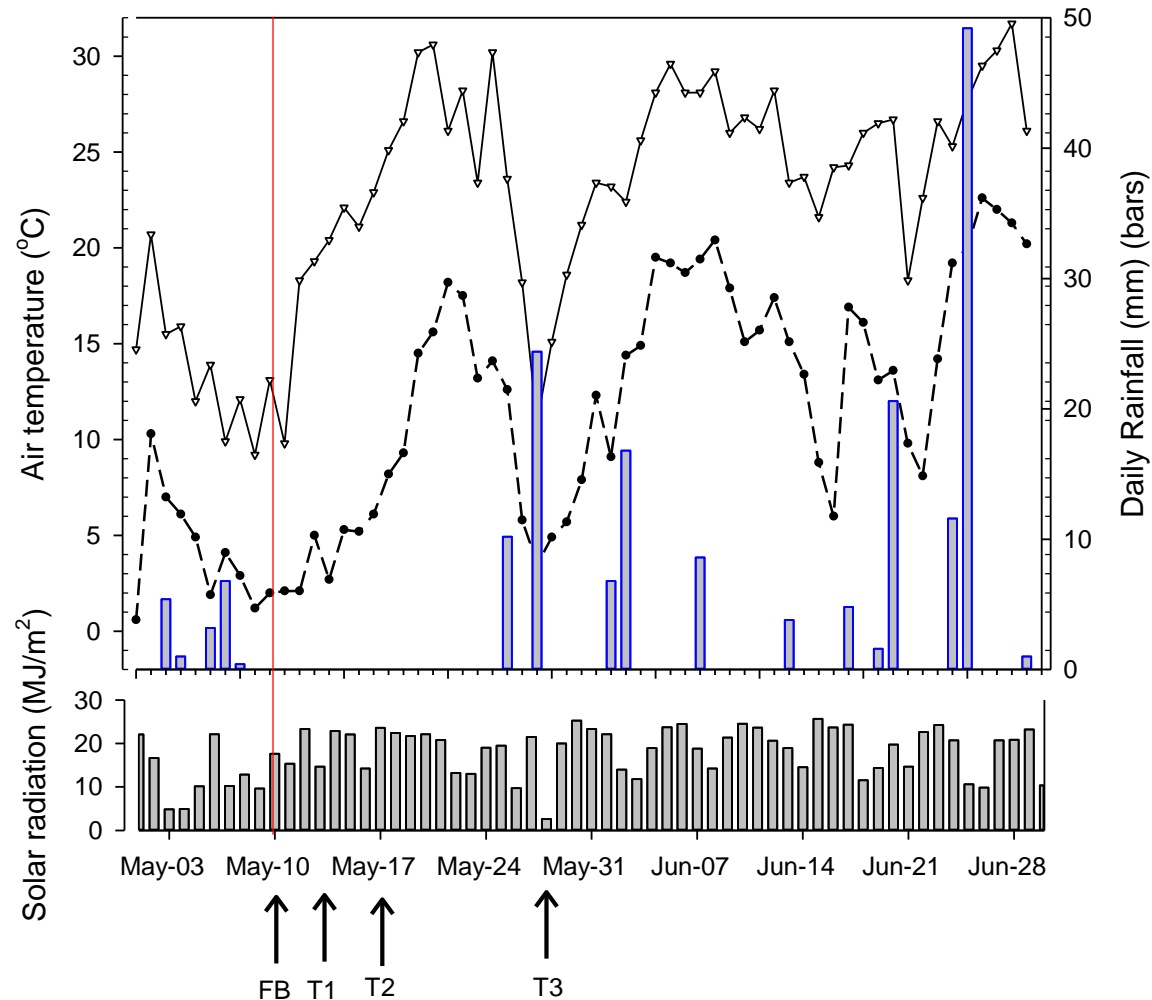
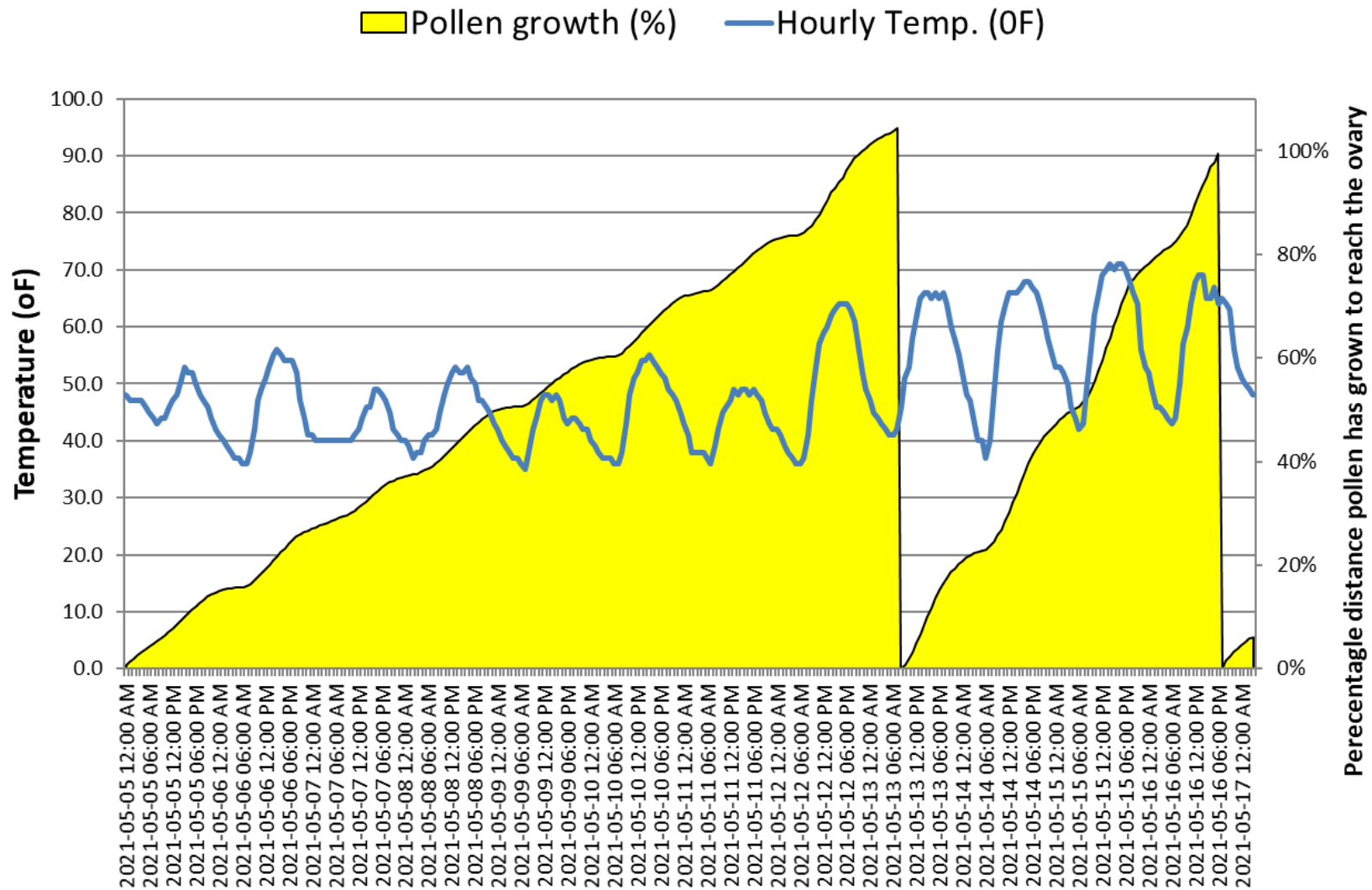


Figure 1. 2021 minimum (dashed line) and maximum (solid line) air temperature, precipitation and solar radiation at the University of Guelph, Simcoe (1 May - 30 June). Arrows indicate the dates of full bloom 10-May (FB) and application of treatments on 13-May (T1), 17-May (T2) and 3--May (T3).

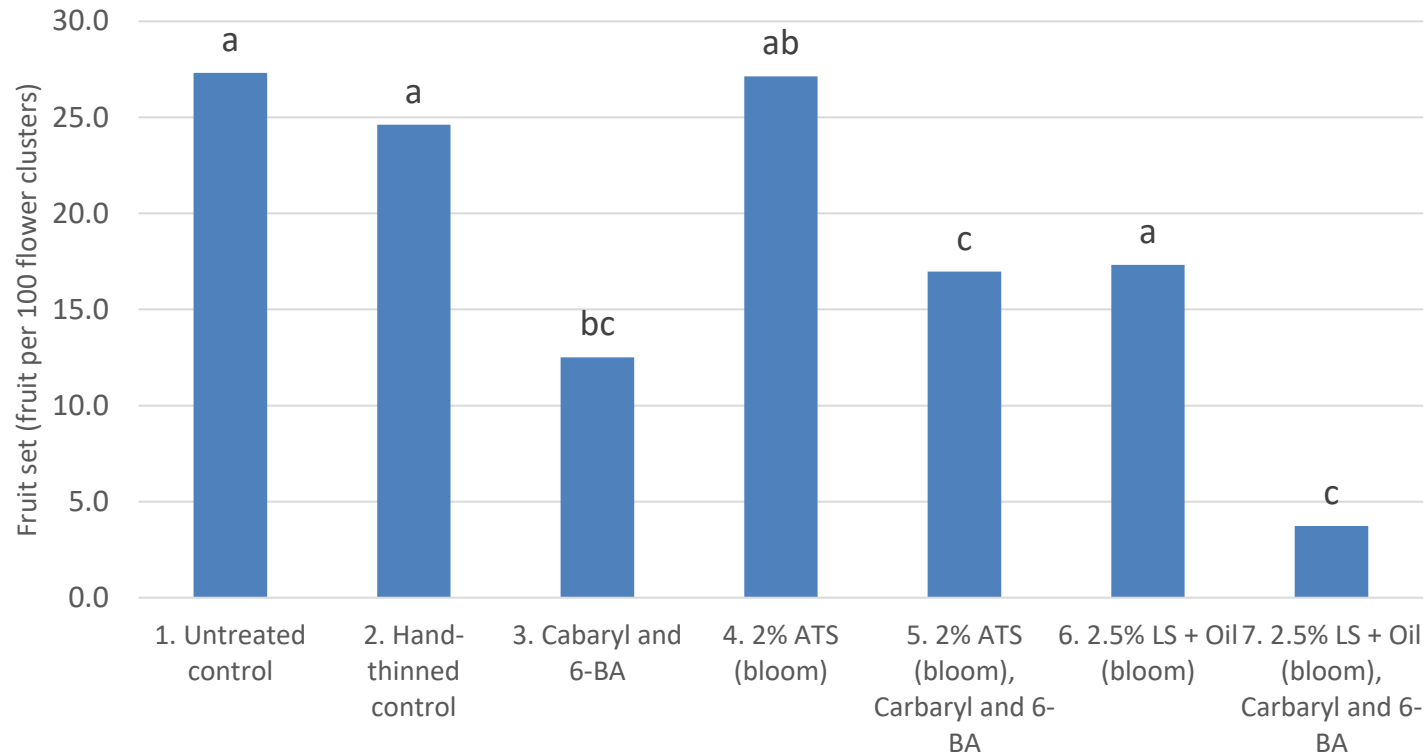




↑ ————— 82h ————— ↑



Gala fruit set -2021



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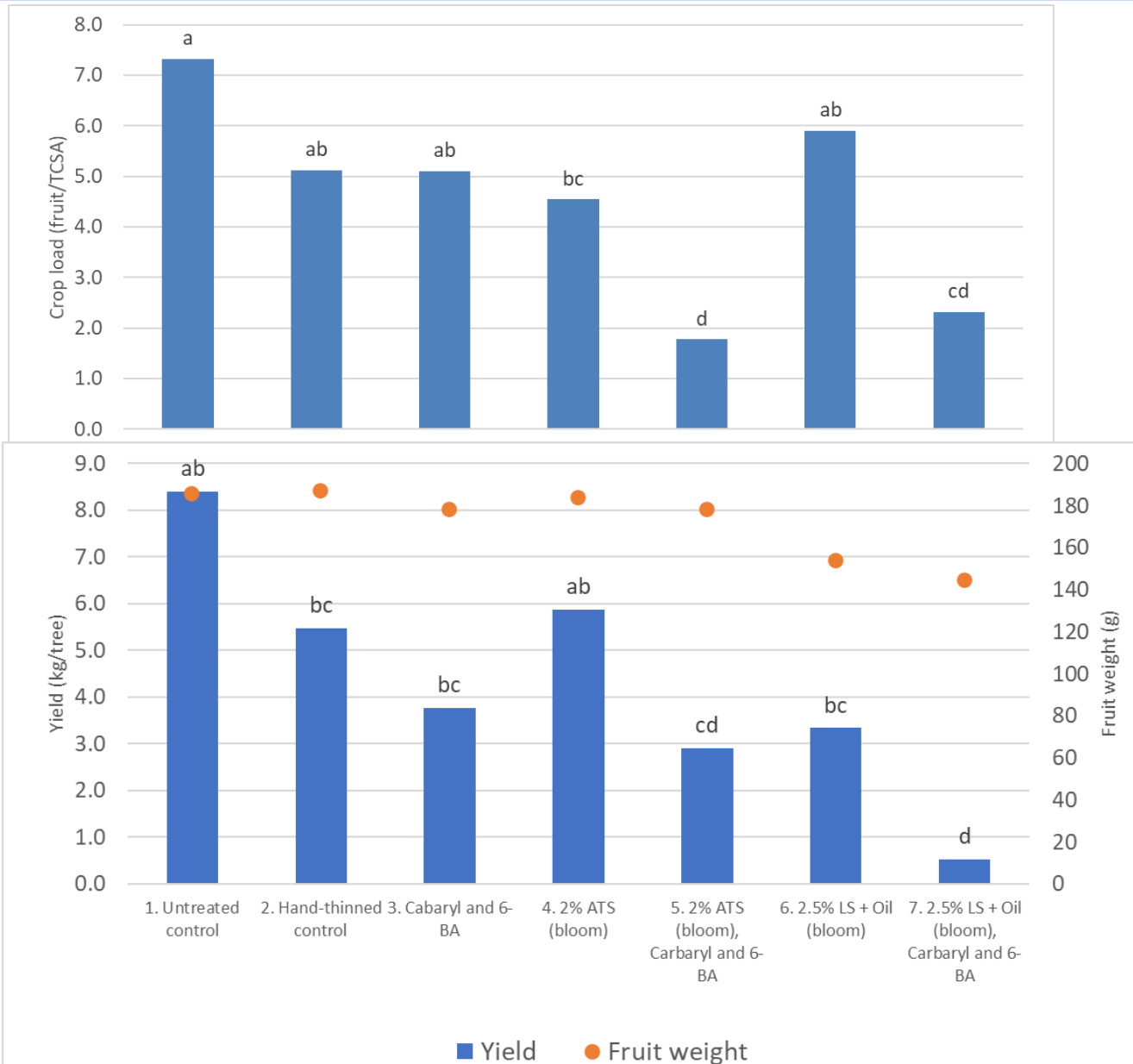
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Thinning increased when bloom sprays were followed by CB and 6-BA

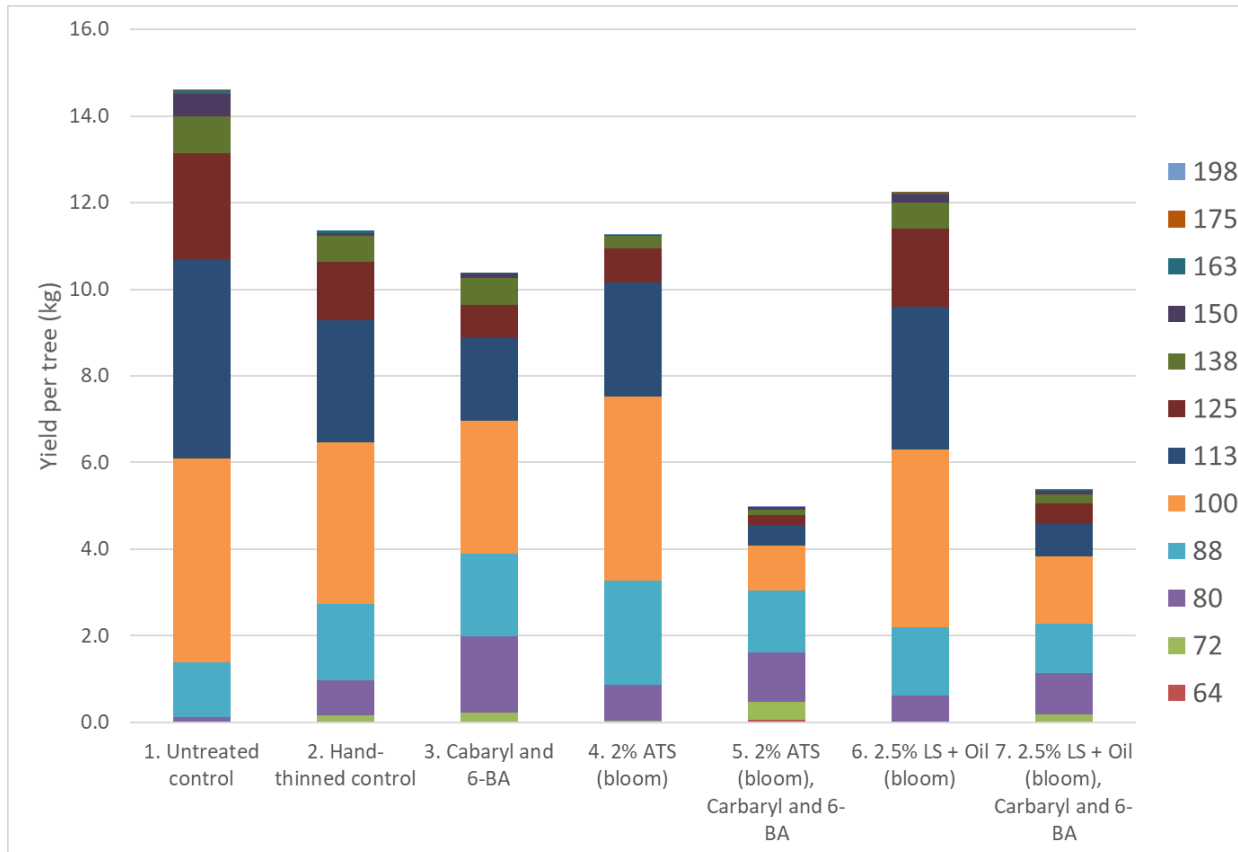
nibble approach



Gala yield and crop load - 2021



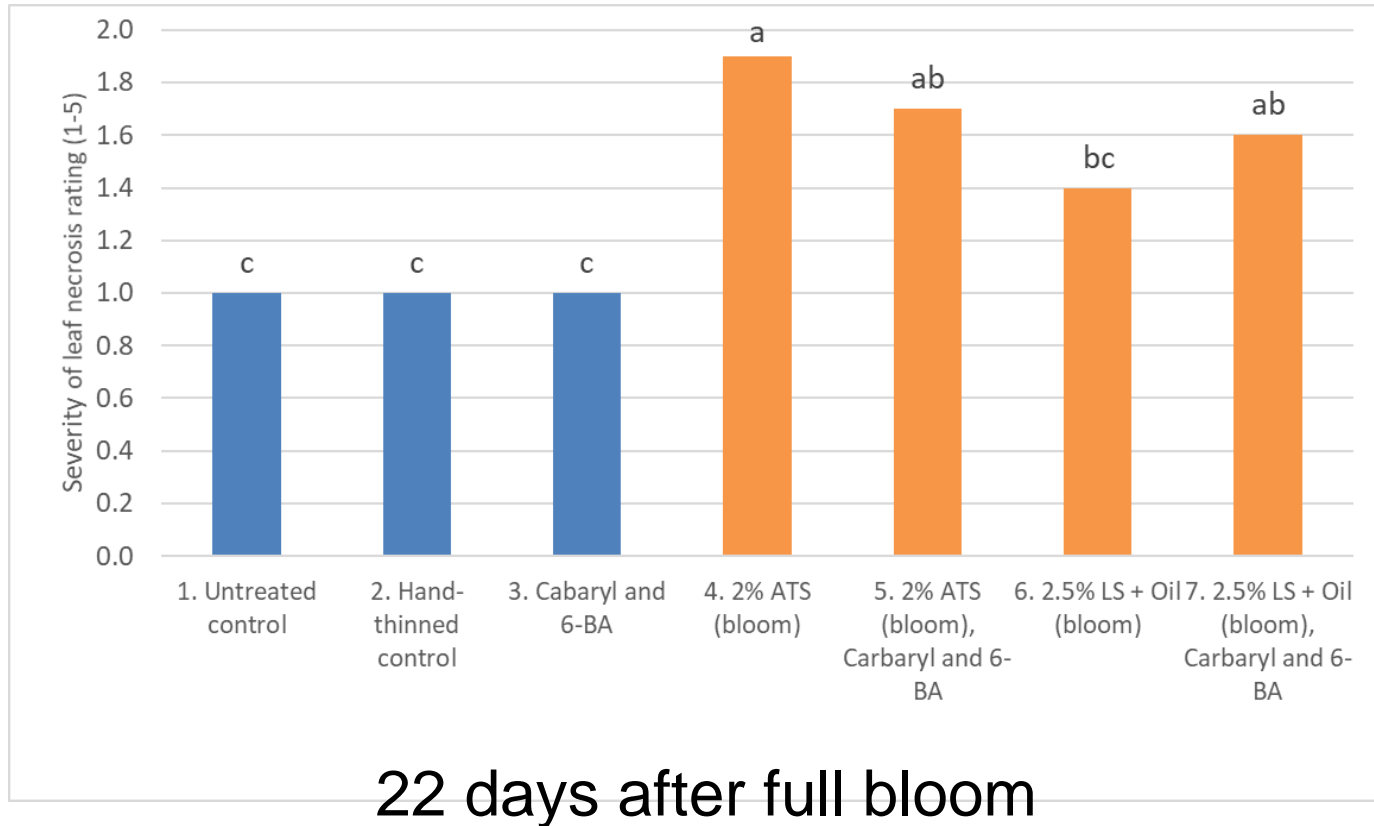
Gala size distribution - 2021



- Fruit size for the untreated control treatment peaked at size 100
- All other treatments reduced yield with little effect on size distribution
- ATS and LS+Oil followed by Carbaryl and 6-BA overthinned



Gala leaf phytotoxicity – 2021



- Both ATS and Lime sulphur + oil caused moderate leaf necrosis.

Limitations of PTGM

- It does not account for pollinator activity (bees)
- Blossom thinning can't always be applied at the time the model indicates b/c inclement weather
- Does not account for flower competence (e.g. frost damage)
- See Allen et al, 2021 “Evaluation of Blossom Thinning Spray Timing Strategies in Apple” for further limitations
<https://www.mdpi.com/2311-7524/7/9/308>



Thinning without the PTGM

Gala (Winchester, Virginia, and Mills River, North Carolina)

- 2019 growing season

What was tested:

1. model-guided sprays with the pollen tube growth model (PTGM)
2. fixed spray intervals with the first spray applied at a specified percentage of open bloom (20% vs. 80%), and the second spray applied at a reapplication interval (48 h vs. 72 h).

What the study revealed

- Model-guided and 20% open bloom + 48-h treatments reduced fruit set and increased fruit weight at both sites.
- Treatments with a delayed first spray at 80% open bloom or a more extended second reapplication of 72 h were generally ineffective.

What this means

- There was no conclusive evidence that lime sulfur + oil blossom thinning spray timing influenced russet incidence/severity or leaf phytotoxicity.
- This study demonstrated that effective and safe blossom thinning can be obtained from applying two sprays at 20% open bloom and 48 h thereafter or using the PTGM



Article

Evaluation of Blossom Thinning Spray Timing Strategies in Apple

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Abstract: In the eastern USA and several other apple-growing regions, apple blossom thinning using lime sulfur is a relatively new crop load management strategy. This study sought to evaluate how application timing of lime sulfur + stilet oil blossom thinning sprays would influence thinning efficacy and crop safety of 'Gala' apples. This project occurred at two locations in the USA, Winchester, Virginia, and Mills River, North Carolina, during the 2019 growing season. Two main timing strategies were assessed: (1) model-guided sprays with the pollen tube growth model (PTGM), (2) fixed spray intervals with the first spray applied at a specified percentage of open bloom (20% vs. 80%), and the second spray applied at a reapplication interval (48 h vs. 72 h). Model-guided and 20% open bloom + 48-h treatments reduced fruit set and increased fruit weight, diameter, and length at both sites. Treatments with a delayed first spray at 80% open bloom or a more extended second reapplication of 72 h were generally ineffective. There was no conclusive evidence that lime sulfur + stilet oil blossom thinning spray timing influenced russet incidence/severity or leaf phytotoxicity. This study demonstrated that effective and safe blossom thinning can be obtained from applying two sprays at 20% open bloom and 48 h thereafter or using the PTGM.

Keywords: apple; blossom thinning; lime sulfur; pollen tube growth model; crop load management



Citation: Allen, W.C.; Kon, T.; Sherif, S.M. Evaluation of Blossom Thinning Spray Timing Strategies in Apple. *Horticulturae* 2021, 7, 308. <https://doi.org/10.3390/horticulturae7090308>

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Cost per hectare (\$/1000 L)

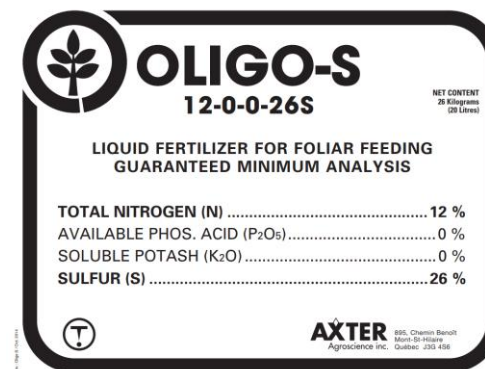
2.5 % Lime Sulphur + 2% Oil (\$436 total)

- 25 L Lime Sulphur @ \$10.53/L = \$263.25
- 20 L Purespray green (13E) @ \$8.19/L = \$163.8
- 0.5 L Agral 90 @ 18.25/L = \$9.12



2 % ATS (12-0-0-26S) (\$152 total)

- 20 L Oligo-S ATS @ \$7.15/L = \$143
- 0.5 L Agral 90 @ 18.25/L = \$9.12



Summary

- Lime sulphur plus oil effectively reduced fruit set and number of fruit per tree.
- 2% ATS was only effect in one of two years.
- When the blossom thinner ATS and LS were combined with the fruitlet thinners (carbaryl and 6-BA) applied at 12 mm, fruit set and number of fruit per tree were reduced further
- Leaf phytotoxicity was slight to moderate on trees treated with ATS and lime sulphur plus oil. There was no difference in the amount of leaf necrosis on trees treated with 2% ATS and those treated with 2.5% lime sulphur plus 2% oil.
- The PTGM model may be helpful, but not necessary



Recommendations

- Consider using LS+Oil or ATS alone or in a thinning program, especially for biennially bearing cultivars such as Honeycrisp.
- No not use if there has been spring frost damage earlier in the season
- LS+Oil appears more effective than ATS in reducing crop load.
- Consider single applications or lower rates if less thinning is desired
- Product costs need to be considered
- Fruit size was not improved to a comparable level as ATS or fruitlet thinners. This is concerning.
- Do not apply during slow drying times
- In the absence of the PTGM, apply the first blossom thinner at 20% open bloom followed by a second application 48-72 hr later
- Overall, the benefits of early crop load reduction using blossom thinners need to be balanced with the potential risk of frost, leaf phytotoxicity or fruit russetting.



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