

# Preliminary results on a new compound, 1-ACC, for thinning peaches

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# Statement of the Problem

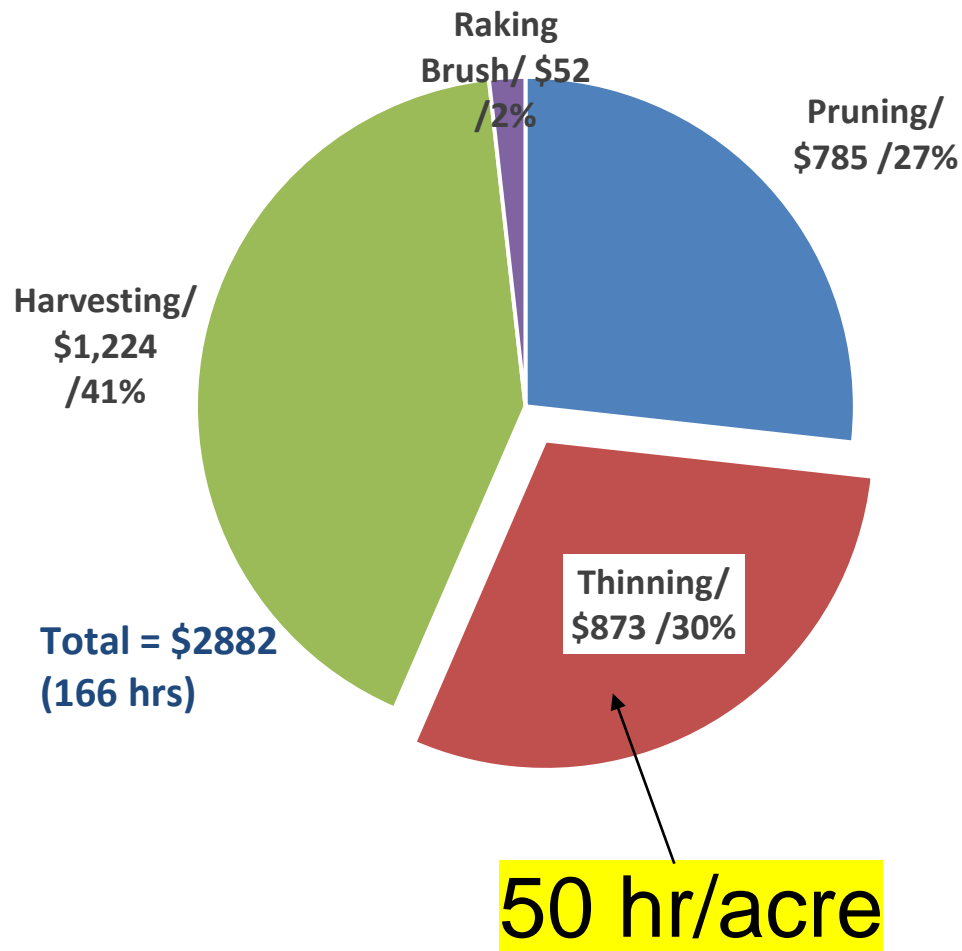
Hand thinning is:

- the only current method to reduce the crop load of peaches
- It is completed at the end of phase I (50+ days after bloom)
- Is labour intensive
  - \$17.45/hr and growing (2018 Ontario Tender Fruit Grower's)
  - Annual increases in minimum will increase
- Labour scarcity/availability
- Other thinning methods have not largely been successful or widely adopted



# Estimated hand labour per acre

## – Mature peach/nectarine orchard



Crop	Trees per Acre	Establishment Period
Peach – Fresh Market	242	4 ½ years
Nectarines	242	4 ½ years
Sour Cherries	145	6 ½ years
Plum - European	201	6 ½ years
Plum - Japanese	201	8 ½ years
Apricot	201	8 ½ years
Pear – Standard Fresh	201	8 ½ years
Pear – High Density Fresh	1117	7 ½ years

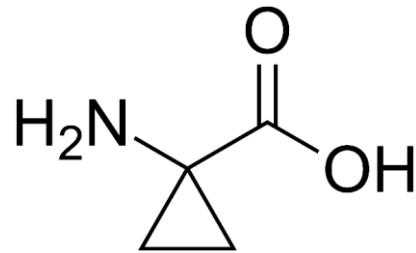
Hired Labour, which is usually offshore labour, was charged at \$17.45 per hour which is comprised of minimum wage plus benefits (worker's compensation, employment insurance, Canada pension plan and an allowance for additional costs of air flight, housing and local transportation). Minimum wage in Ontario is now tied to Ontario's Consumer Price Index (CPI). Minimum wage increases are announced by April 1 each year, and are in effect on October 1 of the same year. Employer Health Tax is not included based on an 80-acre tender fruit orchard payroll model.

Harvest Labour was charged at \$18.00 per hour which is comprised of minimum wage plus benefits as above and includes vacation pay.

# What is 1-ACC

## What is 1- ACC

- Chemical Name: 1-Aminocyclopropane -1- carboxylic acid
- Naturally occurring amino acid found in plants

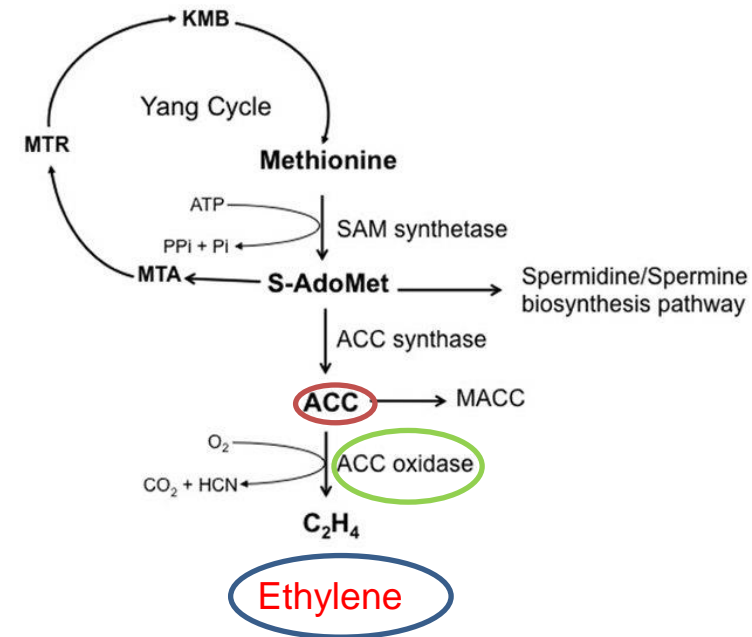


- 1-ACC is a precursor of ethylene in the ethylene biosynthesis pathway
- In sufficient concentrations, ethylene accelerates flower and fruit drop.

## Manufacturer

- Valent BioSciences, a division of Sumitomo Chemicals,
- Developed for thinning apple, peach/nectarine and other stone fruit crops (pear is excluded)
- Commercial formulation is called Accede™

## Ethylene Biosynthesis Pathway



Arc et al, 2013

# Study Objectives

- Determine the optimal rate and timing of foliar applications of 1-ACC to thin peach trees
- Measure any negative effects of 1-ACC on tree health, including leaf yellowing and leaf drop
- Measure the effects of 1-ACC on fruit quality – including fruit size, size distribution, and maturity
- Conduct a cost-benefit analyses
  - Costs: product cost, potential negative effects on the tree
  - Benefits: reduced hand thinning, improvement in fruit size



# Experimental Plan – Harrow Dawn/Bailey

Harrow Dawn: early season cultivar (Aug 5)  
Trees planted: 2018 (4-yr-old)  
Spacing: 10' x 18 ft (242 trees/acre)  
Treatments applied to single trees using a commercial air blast sprayer to tree row volume dilute (761 L ha<sup>-1</sup>)  
1 'guard' tree was left between sprayed trees

System: Open vase, free standing  
Treatments: 8  
Replications:5  
Experiment design: RCBD

Tree were trickle irrigated



# Thinning Treatments

Treatment L <sup>-1</sup> / ppm)	(mg)	Application timings/fruitlet diameter	Date of application	Days before/after full bloom
Hand thinned control			Jun 22	47.0
300 ACC		Pink	Apr 27	-10
600 ACC		Pink	Apr 27	-10
300 ACC		Pink and FB	Apr 27, May 6	-10, 0
300 ACC		Shuck split	May 27	21
600 ACC		Shuck split	May 27	21
300 ACC		19 mm	Jun 07	32
600 ACC		19 mm	Jun 07	32

All 1-ACC sprays included 0.05% (v/v) Agral 90 non-ionic spray adjuvant (Syngenta Canada Inc., Guelph, Canada)



Pink bud



Full bloom



Shuck split



19 mm

# Measurements

## Thinning

Fruit set

Crop load

Number of fruit per tree

Number of fruit removed during hand thinning

Time to thin trees

## Leaf Phytotoxicity

Leaf yellowing

Leaf drop



## Fruit

Number of fruit per tree

Yield per tree

Average fruit weight

Fruit size distribution

Proportion of fruit harvested on each harvest date



## Fruit Quality

Firmness, soluble solids, juice pH, titratable acidity

## Economics

Value of fruit per tree

Cost of thinning

## Vegetative growth

Trunk cross section area

Shoot growth



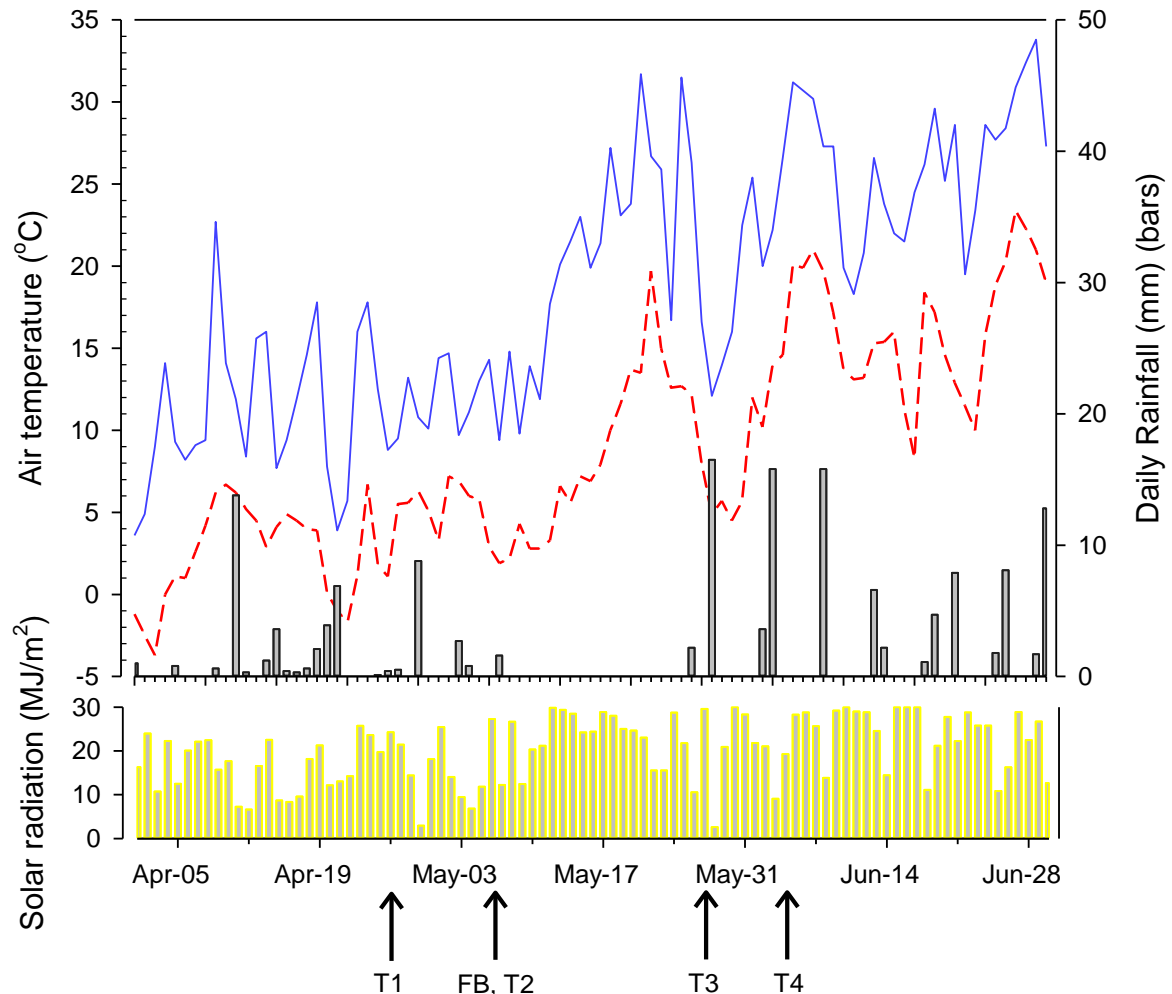


# 1-ACC effect on flowers



Flowers on distal portion of branch appeared more affected  
10-14 days to observed a response after spraying  
There was very little leaf drop or leaf yellowing

# Air temperature, rainfall, solar radiation, Vineland Station (April 1 – June 30, 2021)



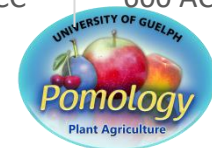
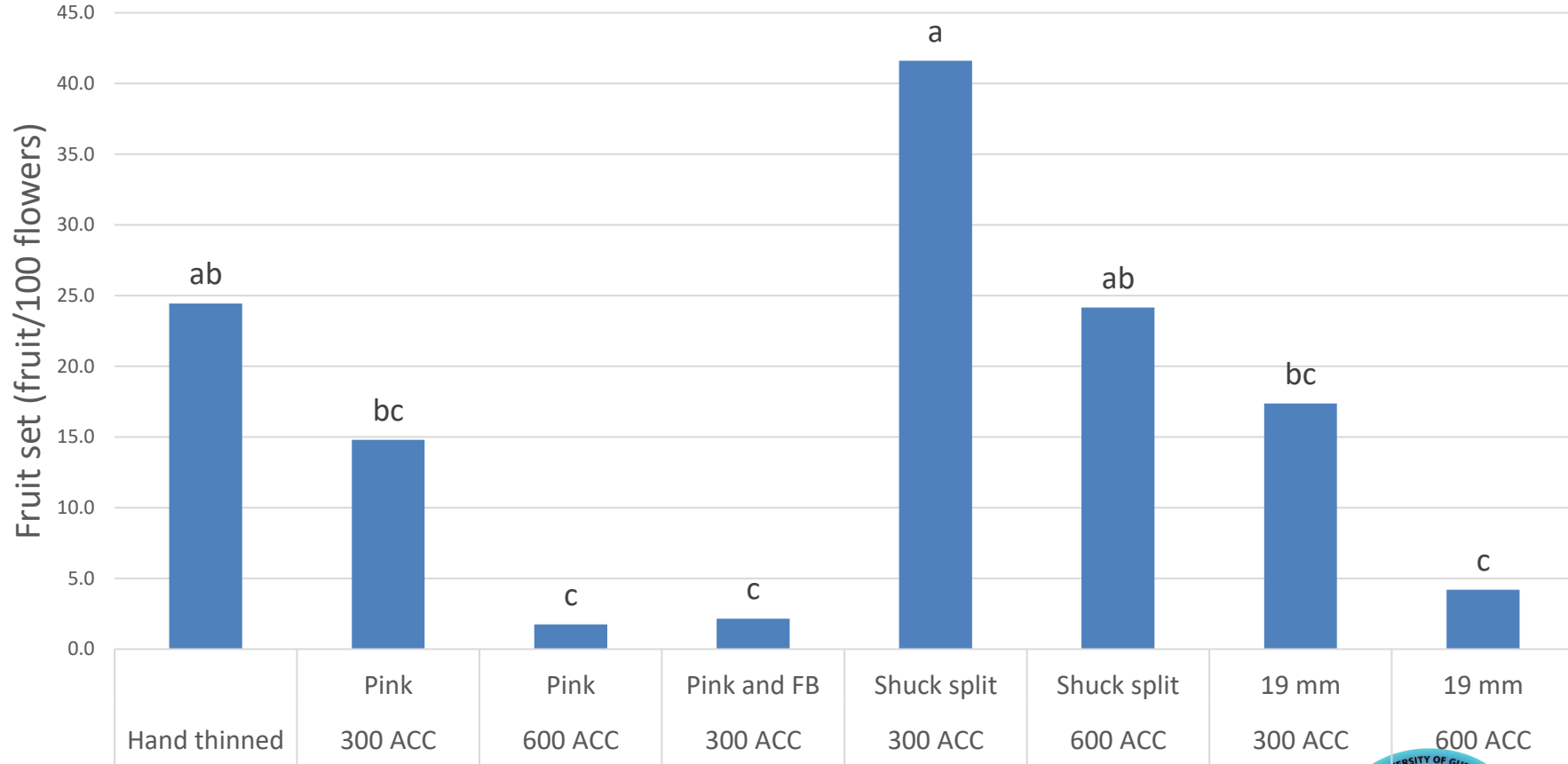
Atypical warm temperatures in late March advanced bud development predisposing the orchards to potential frost.

This was followed by a period cool weather around 20-Apr with minimum temperatures reaching as low as -1.7°C on 22-Apr.

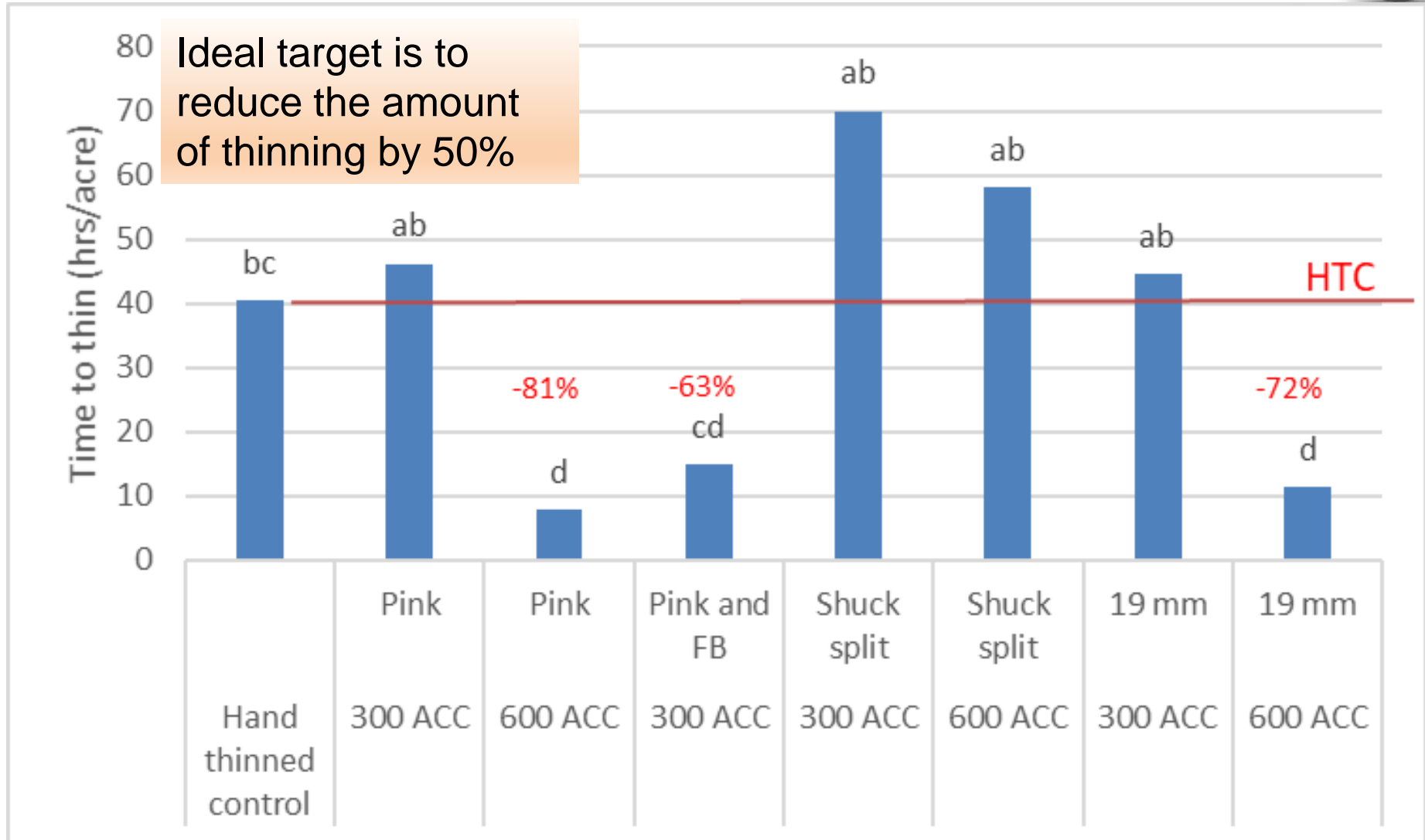
Figure 1. 2021 minimum (dashed line) and maximum (solid line) air temperature, precipitation and solar radiation at the Vineland, ON (1 Apr - 30 June). Arrows indicate the dates of full bloom 6-May (FB) and application of treatments on 27-Apr (T1), 6-May (T2), 27-May (T3) and 7-June (T4).



# Harrow Dawn Results – Fruit set

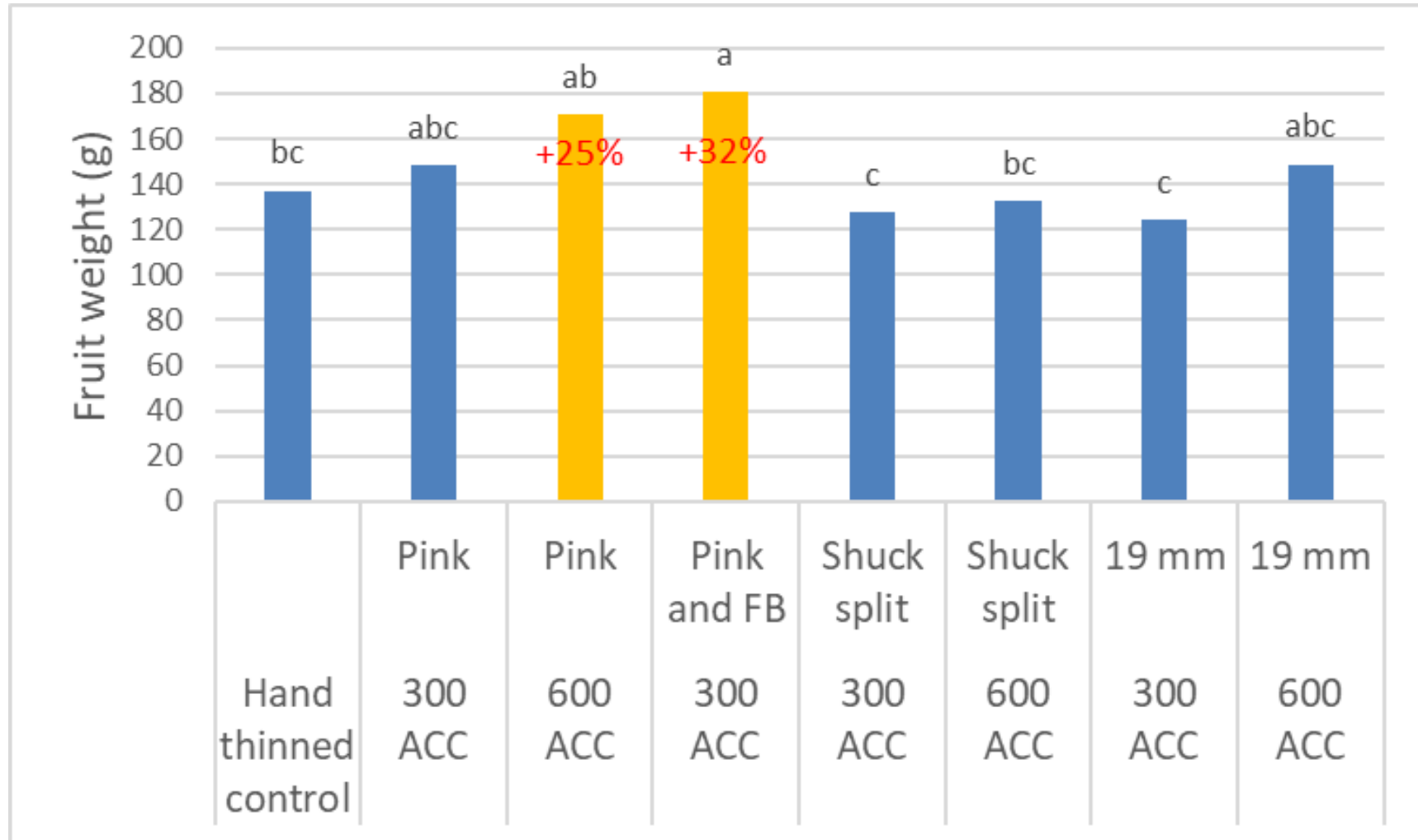


# Harrow Dawn Results – Time to Thin

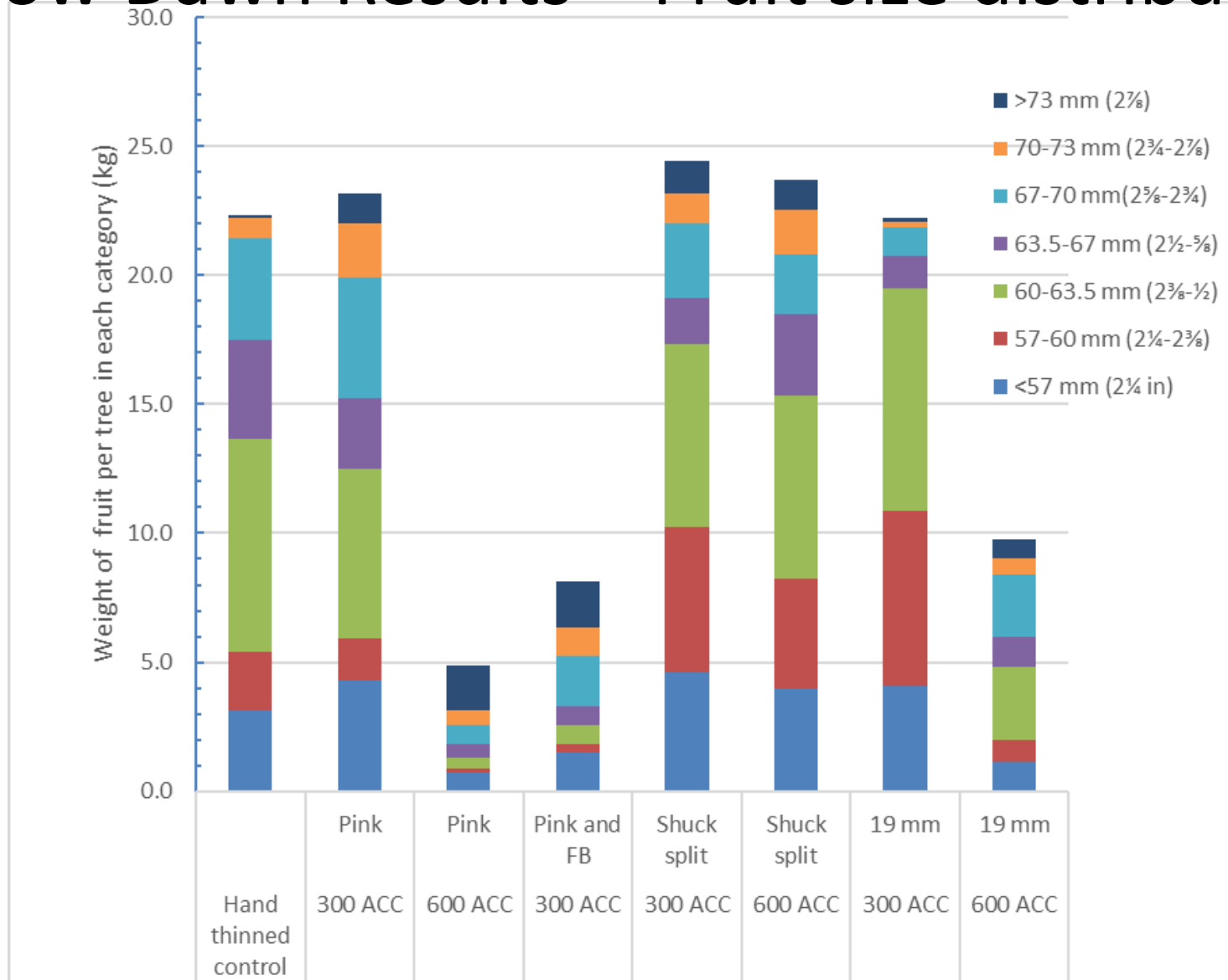




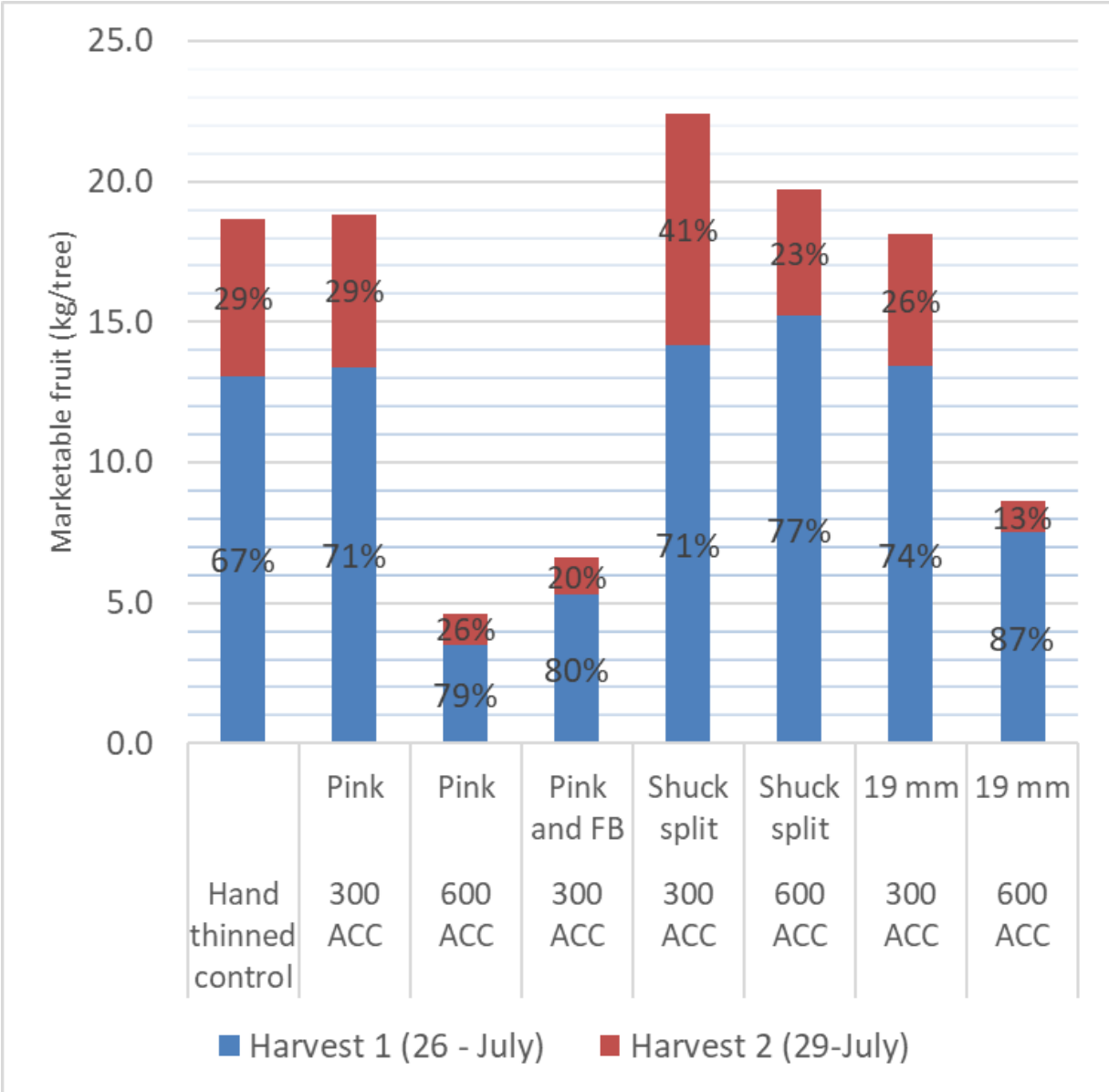
# Harrow Dawn Results – Fruit size



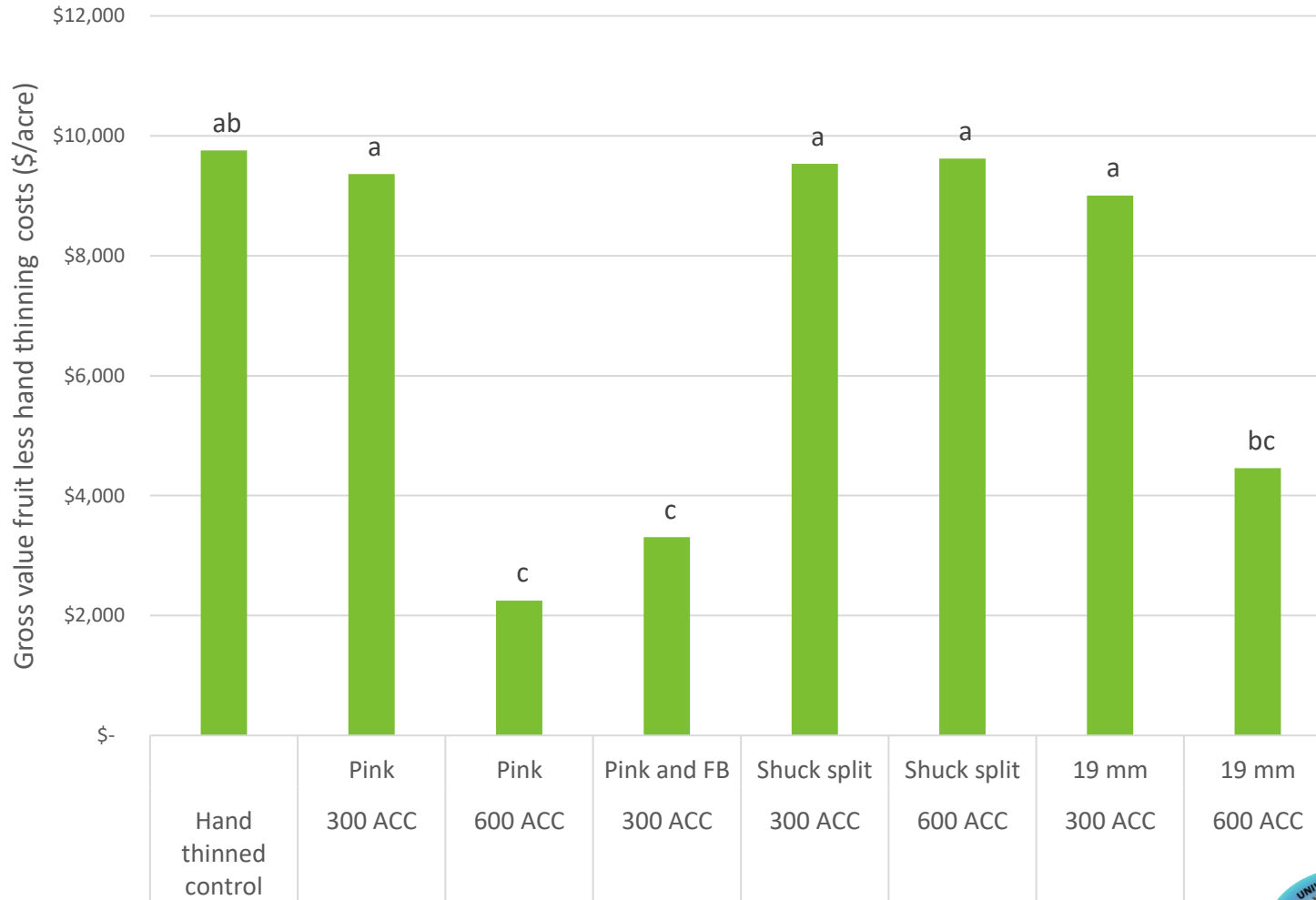
# Harrow Dawn Results – Fruit size distribution



# Harrow Dawn Results – Maturity



# Harrow Dawn Results – Economics





# Experimental Plan – Vivid/Bailey

Vivid: early season cultivar (Aug 20)  
Trees planted: 2017 (5-yr-old)  
Spacing: 10' x 18 ft (242 trees/acre)  
Treatments applied to single trees using a commercial air blast sprayer to tree row volume dilute (761 L ha<sup>-1</sup>)  
1 'guard' tree was left between sprayed trees



System: Central Leader, free standing  
Treatments: 4  
Replications:4  
Experiment design: RCBD

Trees were not trickle irrigated



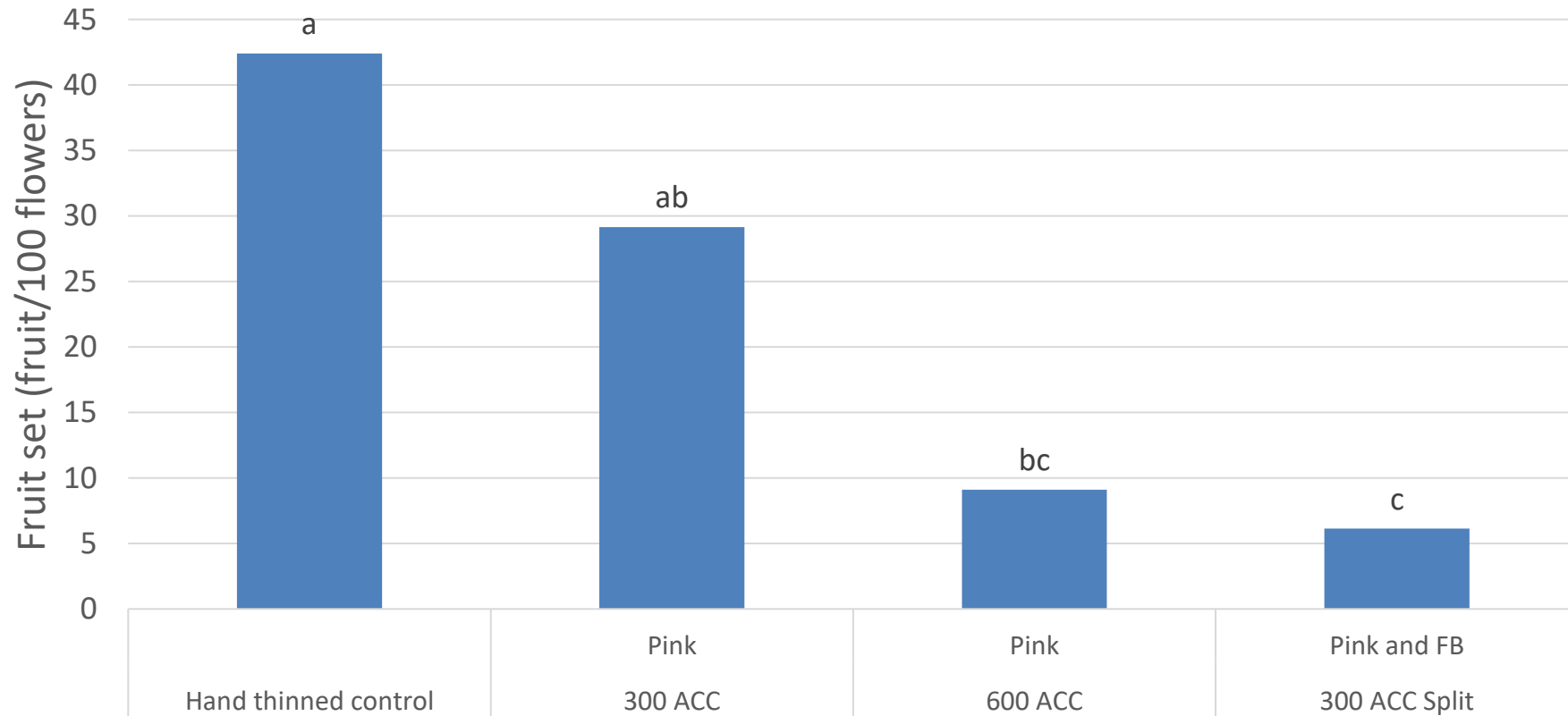
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300 ACC	Pink	Apr 27	-10
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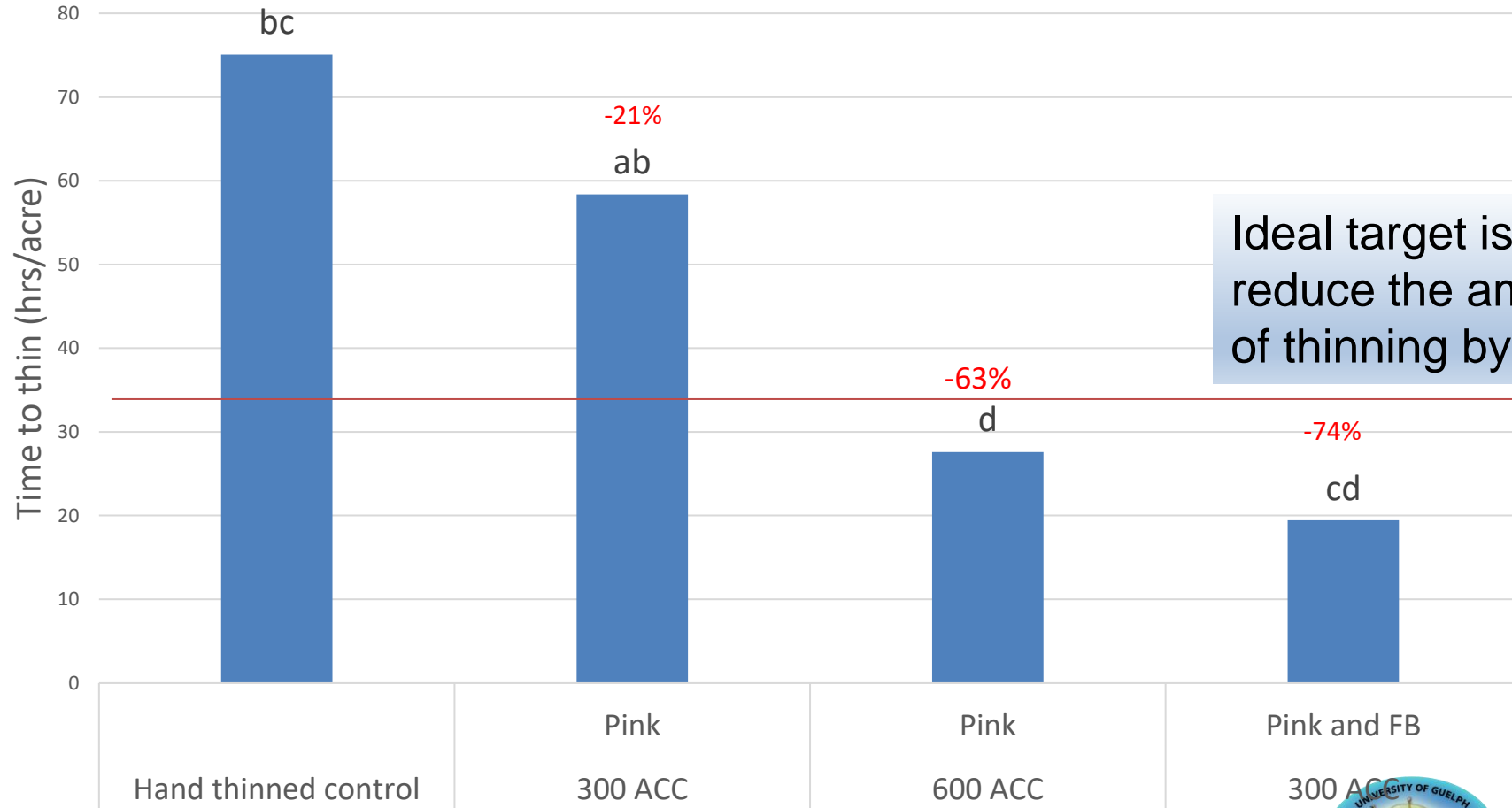
All 1-ACC sprays included 0.05% (v/v) Agral 90 non-ionic spray adjuvant (Syngenta Canada Inc., Guelph, Canada)



# Vivid Results – Fruit set



# Vivid Results – Time to Thin

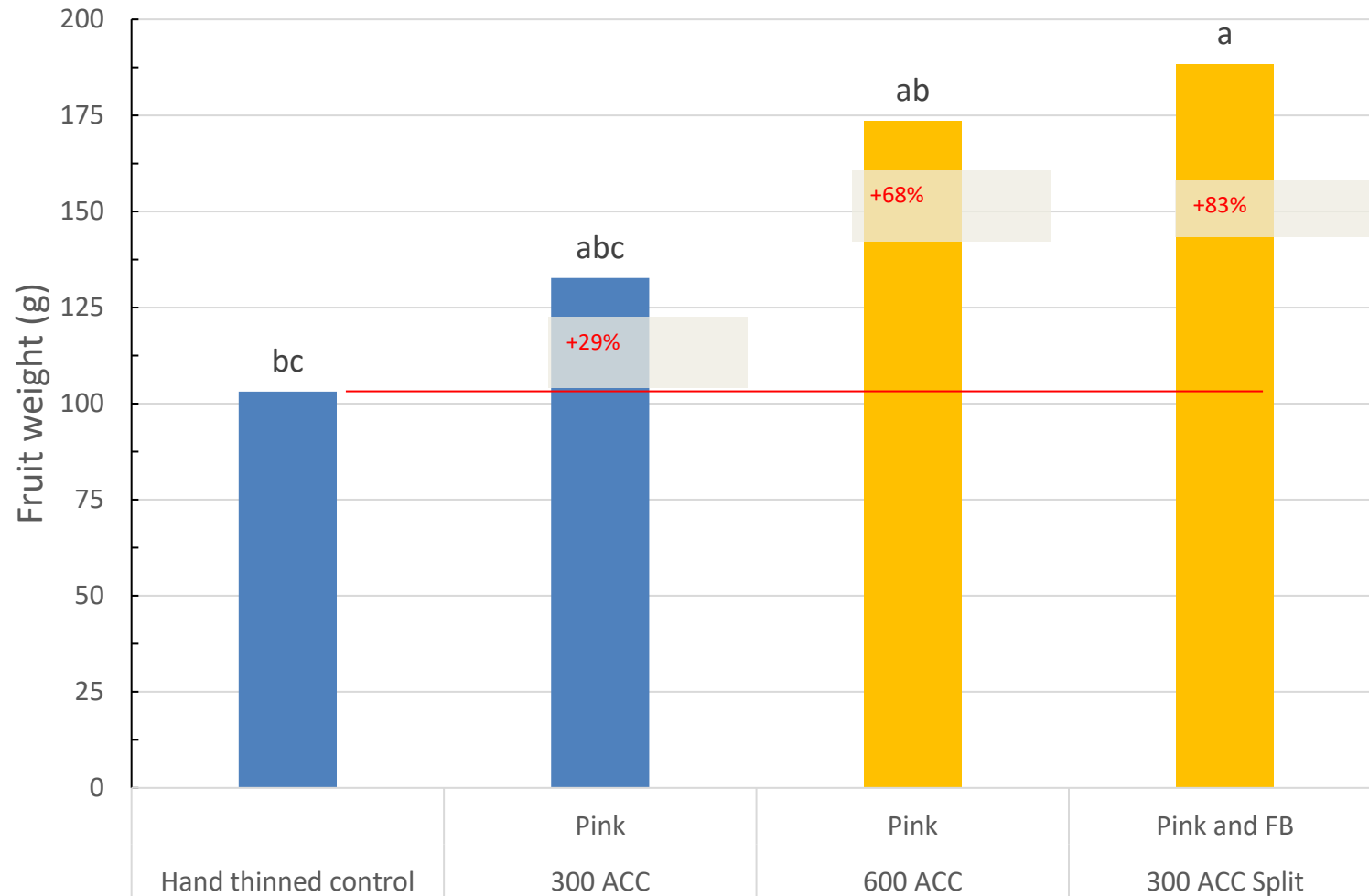


Ideal target is to reduce the amount of thinning by 50%

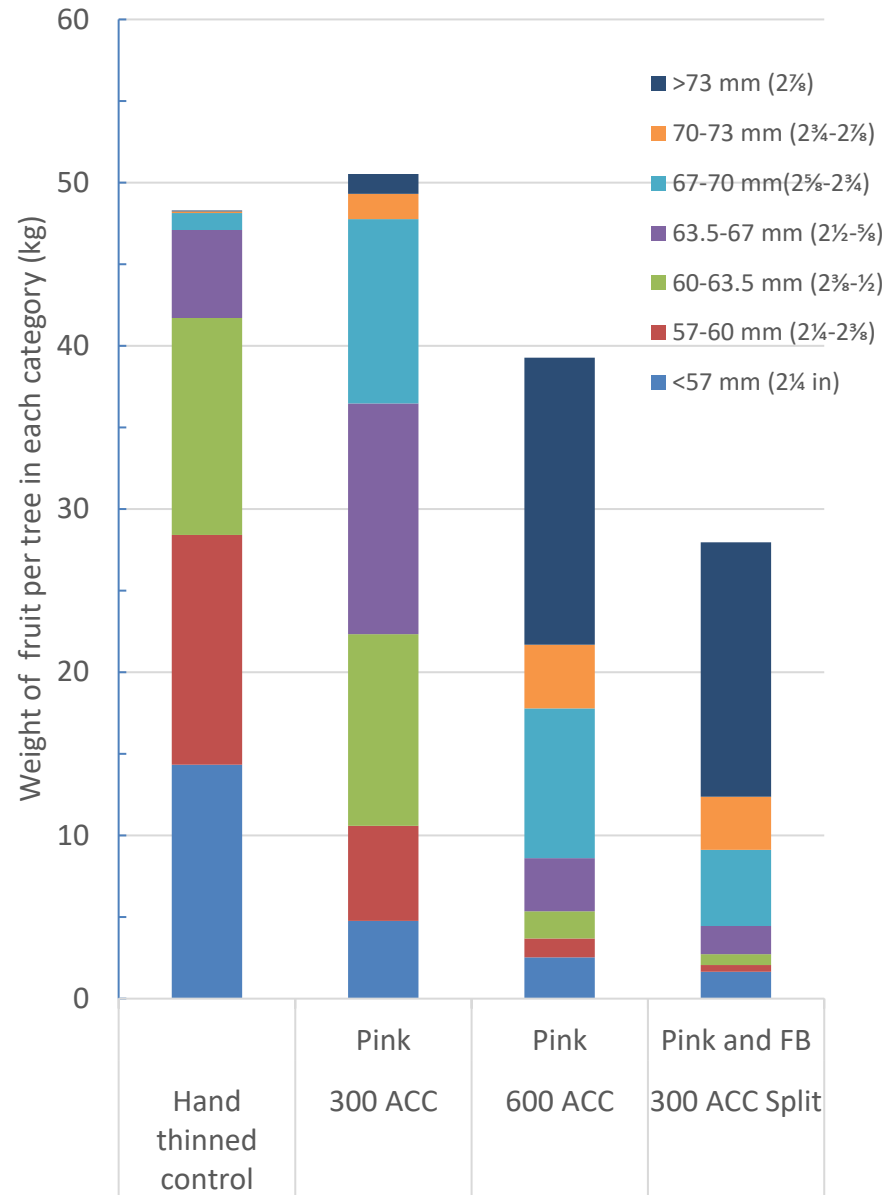




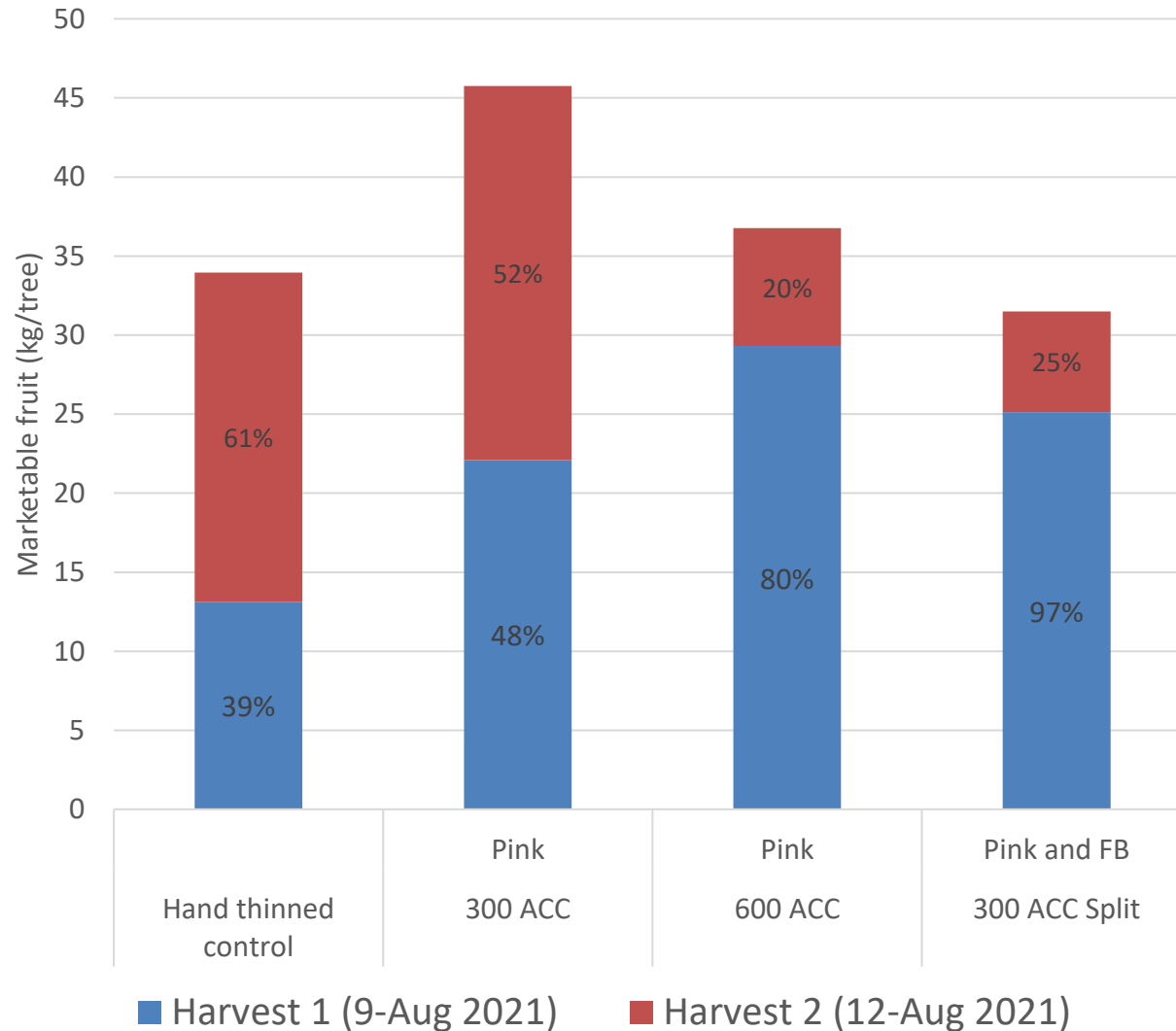
# Vivid Results – Fruit size



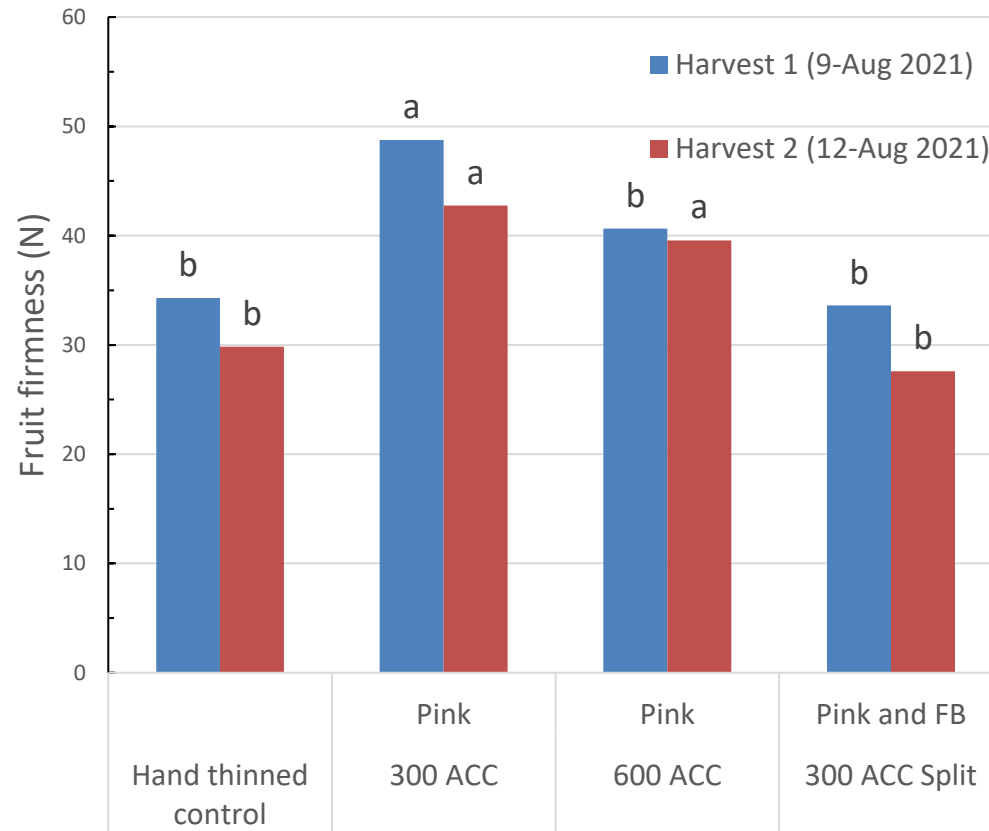
# Vivid Results – Fruit size distribution



# Vivid Results – Maturity



# Vivid Results – Fruit quality (firmness)

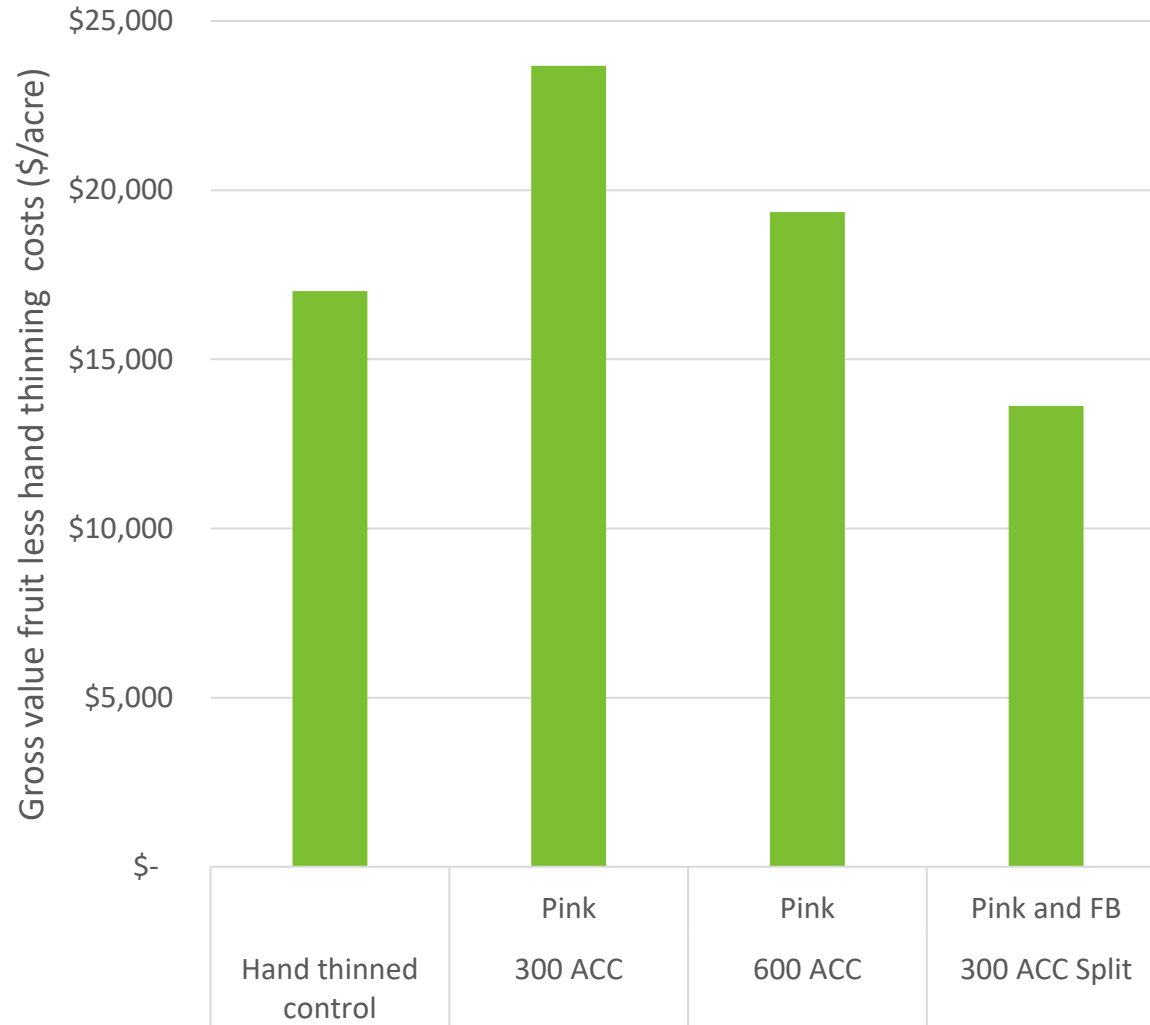


Measurements  
made on similar  
size fruit  
2 3/8" – 2 5/8"  
1<sup>st</sup> harvest 153 g  
2<sup>nd</sup> harvest 142 g





# Vivid Results – Economics



# Summary of Tree Response

Effect	Harrow Dawn	Vivid
1-ACC Effect on thinning	Yes	Yes
Timing	Pink to Full bloom	Not tested
Improvement in fruit size	Small	Very significant
Time to hand -thin	63-81% reduction	21-74%
Gross fruit value less thinning costs	Decreased	Increase
Improved fruit firmness	No	Yes
Advance maturity (more fruit picked on first harvest date)	Small	Significant
Leaf injury, leaf drop (phytotoxicity)	Very little	Very little



# Why was 1-ACC so effective?

- Product was applied at the recommended rates
- The cold weather prior to and following early applications of 1-ACC may have contributed to increased ethylene production and sensitivity of the tree to 1-ACC.
- Our results indicate growers should lower rates when cold temperatures exist prior or during 1-ACC applications. This is indicated by the manufacturer



# Why the different cultivar response

- Drought stress on Vivid trees
  - Resulted in reduced fruit size
- Genetics and size potential
- Unlikely due to environmental factors or bloom dates



# Registration status of 1-ACC

- Product registered in June 2021 in the USA
- It is a liquid formulation

What does it cost? \$US 168/litre

- 300 ppm spray = \$US169/acre
- 600 ppm spray = \$US 338/acre

This is equivalent to ~12.5 -25 hrs labour

(adjusted for Canadian exchange rate and based on \$17.45/hr labour rate)

Note: a granular formulation will be registered in Canada



<b>Active Ingredient:</b>	
1-aminocyclopropanecarboxylic acid (ACC) .....	10.0%
<b>Other Ingredients</b> .....	90.0%
<b>Total</b> .....	100.0%

EPA Reg. No. 73049-517  
EPA Est. No. 33762-IA-001  
List No. A560230-04-02  
A50410680/R1

#### INDEX:

- 1.0 First Aid
- 2.0 Precautionary Statements
  - 2.1 Hazard to Humans (and Domestic Animals)
  - 2.2 Personal Protective Equipment (PPE)
  - 2.3 User Safety Recommendations
  - 2.4 Environmental Hazards
- 3.0 Directions for Use
- 4.0 Agricultural Use Requirements
- 5.0 General Information
- 6.0 General Application Instructions
- 7.0 Storage and Disposal
- 8.0 Warranty And Disclaimer Statement

#### KEEP OUT OF REACH OF CHILDREN CAUTION

FIRST AID	
1.0 If swallowed	<ul style="list-style-type: none"> <li>• Call a poison control center or doctor for treatment advice.</li> <li>• Do not induce vomiting unless told to do so by a poison control center or doctor.</li> <li>• Do not give anything by mouth to an unconscious person.</li> </ul>
HOTLINE NUMBER	
Have the product container or label with you when calling a poison control center or doctor or going for treatment. You may also contact 1-800-892-0099 (24 hours) for emergency medical treatment and/or transport information. For all other information, call 1-800-6-Valent.	

#### 2.0 PRECAUTIONARY STATEMENTS

##### 2.1 HAZARD TO HUMANS (AND DOMESTIC ANIMALS) CAUTION

Avoid breathing spray mist. Avoid contact with skin, eyes, or clothing. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, using tobacco, or using the toilet. Remove and wash contaminated clothing before reuse.

#### 2.2 Personal Protective Equipment (PPE)

- Applicators and other handlers must wear:
- Long-sleeved shirt and long pants.
  - Waterproof gloves.
  - Shoes plus socks.

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

#### 2.3 User Safety Recommendations

- Users should:
- Wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet.
  - Remove clothing immediately if pesticide gets inside. Then, wash thoroughly and put on clean clothing.
  - Remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

#### 2.4 Environmental Hazards

Do not apply directly to water, or to areas where surface water is present, or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwater or rinsate.

#### 3.0 DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

Do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application. For any requirements specific to your State or Tribe, consult the State/Tribal agency responsible for pesticide regulation.

#### 4.0 AGRICULTURAL USE REQUIREMENTS

Use this product only in accordance with its labeling and with the Worker Protection Standard, 40 CFR part 170. This Standard contains requirements for the protection of agricultural workers on farms, forests, nurseries, and greenhouses, and handlers of agricultural pesticides. It contains requirements for training, decontamination, notification, and emergency assistance. It also contains specific instructions and exceptions pertaining to the statements in this labeling about personal protective equipment (PPE), and restricted-entry interval. The requirements in this box only apply to uses of this product that are covered by the Worker Protection Standard.

Do not enter or allow worker entry into treated areas during the restricted entry interval (REI) of 12 hours.

PPE required for early entry to treated areas that is permitted under the Worker Protection Standard and that involves contact with anything that has been treated, such as plants, soil, or water, is:

- Coveralls.
- Waterproof gloves.
- Shoes plus socks.

# Future Research

- Timing: focus on pink-bud to petal fall
- Conduct a rate study to determine more optimal thinning rates
- Investigate further benefits of split applications
- Investigate the physiology involved in the how 1-ACC causes flower and fruitlet abscission
- Reduced crop loads are associated with higher vegetative shoot growth, and therefore may be associated with the requirement for dormant (or summer) pruning. The additional time and costs, if any, have not been measured
- Evaluation on European and Japanese plums (subject of funding)

Accede™ use will be optimized through wider grower use and experience



# Accede™ product Label

Rates: 300-600 ppm

Timing: pink bud – petal fall

(there are concerns of leaf injury when applied after full bloom)

## Precautions/Considerations

- Cultivar sensitivity
- Spray with sufficient volume for complete tree coverage
- Do not apply when frost is expected
- Do not apply when temperatures are above 32°C
- Reduce rates when applied after *a period of cold* weather

Crop	Objective/ Benefit	Application Timing/ Use Instructions
Nectarine, Peach	Depending on cultivar, orchard conditions, application timing, and grower objectives, the following benefits will be associated with Accede: • Fruit thinning	Apply 34.5 to 69 fl oz Accede per acre (equivalent to 4.0 to 8.0 oz a.i. per acre or 300 to 600 ppm ACC assuming a spray volume of 100 gallons per acre) using sufficient spray volume to ensure complete tree coverage (refer to the dilution table for assistance).  Accede rate will depend on the amount of fruit thinning required. Product performance can be impacted by factors such as cultivar, prevailing and anticipated climactic conditions, tree vigor, fruit set potential and orchard history.  Accede can be applied from the pink bud stage to petal fall.  Do not apply ACC prior to pink bud stage. In order to achieve the proper timing, targeting sprays between the upper and lower tree canopy may be necessary.  Make the first application of Accede from pink bud to full bloom. Make a second application 7-10 days later if necessary. Do not exceed a total of 8.0 oz a.i. per acre (69 fl oz Accede per acre, equivalent to 600 ppm ACC assuming a spray volume of 100 gallons per acre) in a single application.  Do not apply Accede after petal fall.  Do not apply when frost is expected.



# What is Valent reporting on Accede™ ?

- ACC oxidase (ACO) in the plant cell converts ACC to ethylene in a temperature dependent biochemical reaction.
- The rate of ethylene release following an Accede application reaches a maximum after two to three days, and ethylene declines to background levels around 10 days after application.
- No residues at harvest.
- No gummosis in peaches/nectarines, in contrast to other ethylene releasing compounds such as ethephon.





## Funding Partners

Ontario Tender Fruit Growers  
BC Fruit Growers' Association  
UoG/OMAFRA Alliance Research fund  
Valent BioSciences



## Technical Assistance

Amanda Benefff  
Cathy Bakker  
Summer students

## Grower Cooperators

David Hipple, Hipple Farms, Beamsville, ON  
Tom Platts, Doug Darling, Sunnydale Farms,  
Jordan ON



We welcome your questions and comments.

- John Cline – [jcline@uoguelph.ca](mailto:jcline@uoguelph.ca)
- Kathryn Carter - [Kathryn.Carter@ontario.ca](mailto:Kathryn.Carter@ontario.ca)

