New Opportunities for Thinning Peaches and Plums with (ACC) Accede™

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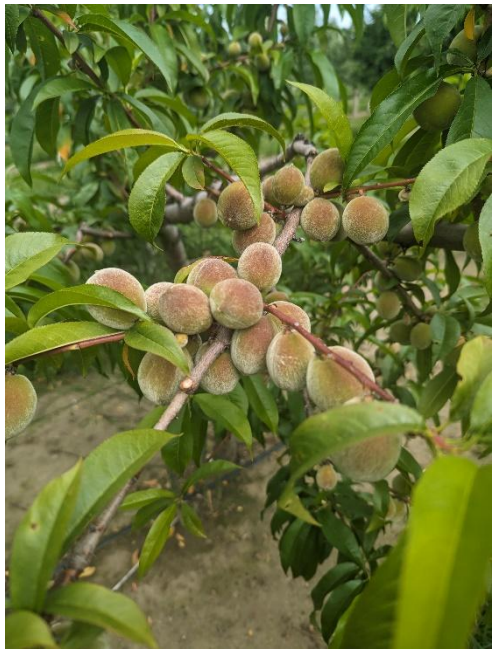
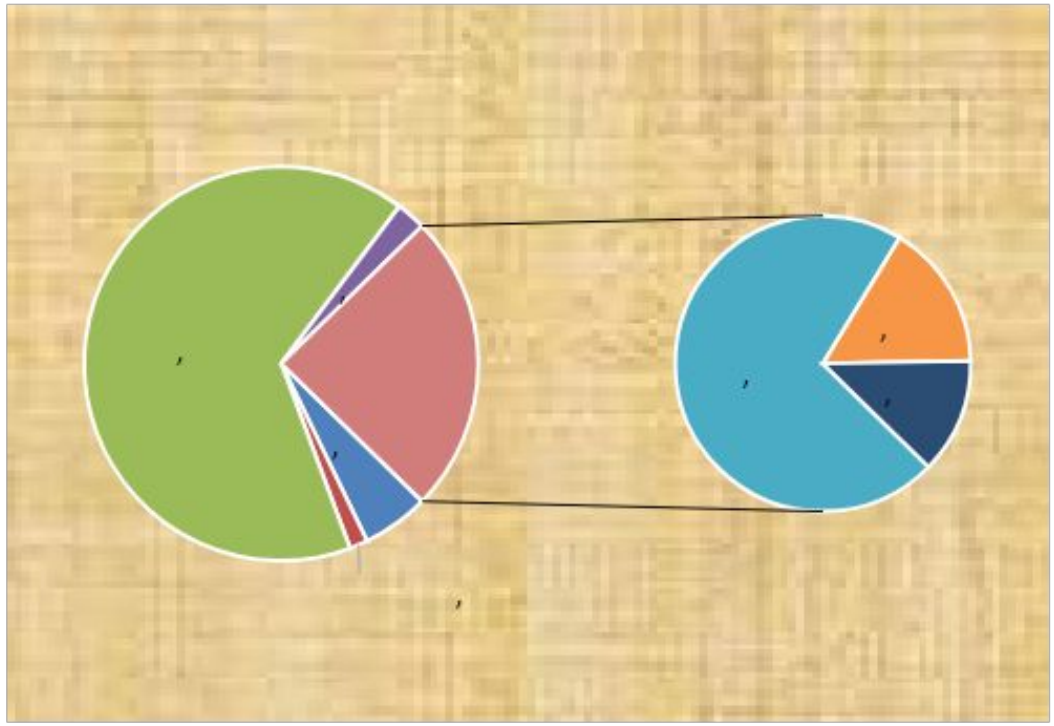


- Apples
- Sweet and Tart Cherries
- Peaches
- Plums
- Pears

Ontario Grape, Pear and Stone Fruit Production (acres) (2021)



- Ontario has ~4,300 acres of peaches and nectarines
- over 50% of Canadian tender fruit production
- 4% of location sold on-farm retail, 95% wholesale
- ~30% of market supply (70% of tender fruit are imported)

Source: Fruit and Vegetable Survey, Statistics Canada; Ontario Tender Fruit Producers' Marketing Board Annual Report, Grape Growers of Ontario Annual Report

The Niagara Peninsula is the primary tender fruit production in Canada

ONTARIO PEACHES

Variety/Availability Guide

ONTARIO TENDER FRUIT PRODUCERS

	% of Plantings	Variety Grouping	JULY		AUGUST					SEPTEMBER			
			20	27	3	10	17	24	31	7	14	21	28
Semi-Freestone The flesh clings to the pit. Excellent for eating fresh, baking and preserving	14	**GROUP 1** PF-1, Harrow Diamond, Springcrest	●	●									
	21	**GROUP 2** Harrow Dawn, Early Redhaven, Garnet Beauty, Risingstar		●	●								
	3	**GROUP 3** Brighton, Sunhaven, Sentinel			●	●							
Freestone Flesh separates easily from the pit when mature. Allow fruit to mature prior to use. A versatile peach, perfect for eating out of hand and for all your preserving needs.	25	**GROUP 4** Redhaven, PF-15A, Harbrite, Harson, Harken, Bellaire, Redstar				●	●	●					
	12	**GROUP 5** Harrow Fair, Starfire, Vivid, Blazingstar						●	●				
	20	**GROUP 6** Harrow Beauty, Loring, Allstar, Coralstar, PF-17, PF-23, PF-24-007							●	●	●		
	5	**GROUP 7** Cresthaven, Redskin, Glowingstar, Harcrest, PF-25, PF-27A									●	●	●

Ripening Tips: Select peaches on basis of ground color, not blush. Remove peaches from container. Sort according to ripeness. Consume or store ripe peaches uncovered in refrigerator up to five days. To ripen peaches quickly, store in paper bag at room temperature.

Learning Objectives

- Importance of thinning
- What is ACC and how does it work?
- ACC research data from Canada and elsewhere
- Review Valent USA Accede product label
  - Rates, species, guidelines, precautions key points
- Factors affecting the thinning response
- Grower recommendations for adopting Accede™ use

Importance of Peach Thinning

Other thinning methods have not largely been successful or not widely adopted

Grower's have relied on hand thinning

- the only current and widely practiced method to reduce the crop load of peaches
- completed at the end of phase I of fruit development (~50+ days after bloom)
- Costly
    - $20.26/hr and growing (2023 Ontario Tender Fruit Grower's)
    - Wage rates are continuing
- Labour scarcity and availability
- Lack of experienced labour

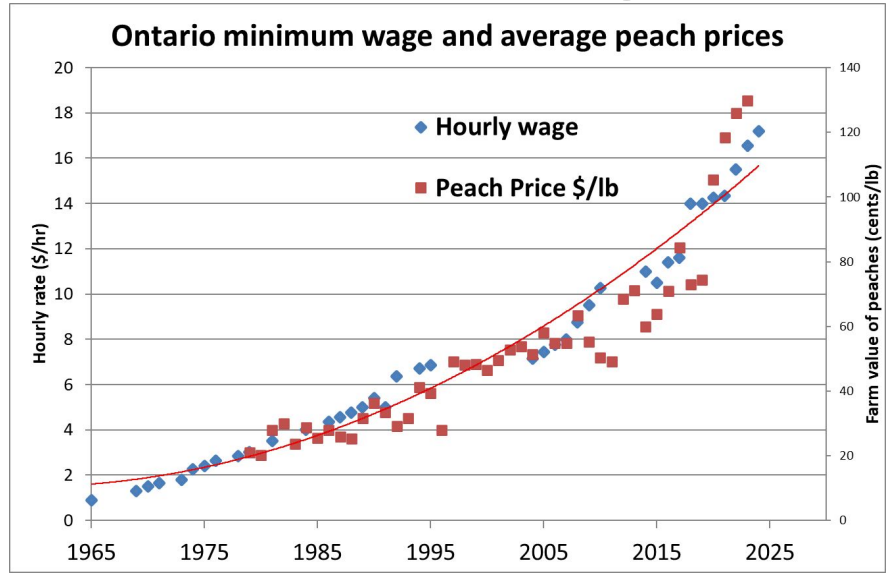


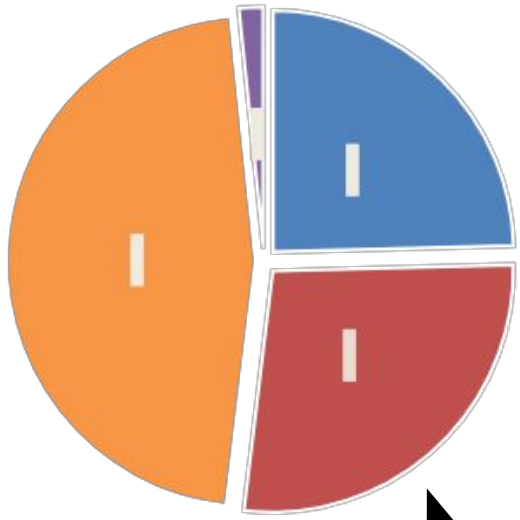
Photo credit: J. A. Cline

Importance of Plum Thinning

- Some growers hand thin, but many don’t
- Flowering on Japanese plums is earlier than peaches – greater risk of frost event affecting fruit set

Extremely high crop load on Early Golden, July 8, 2024

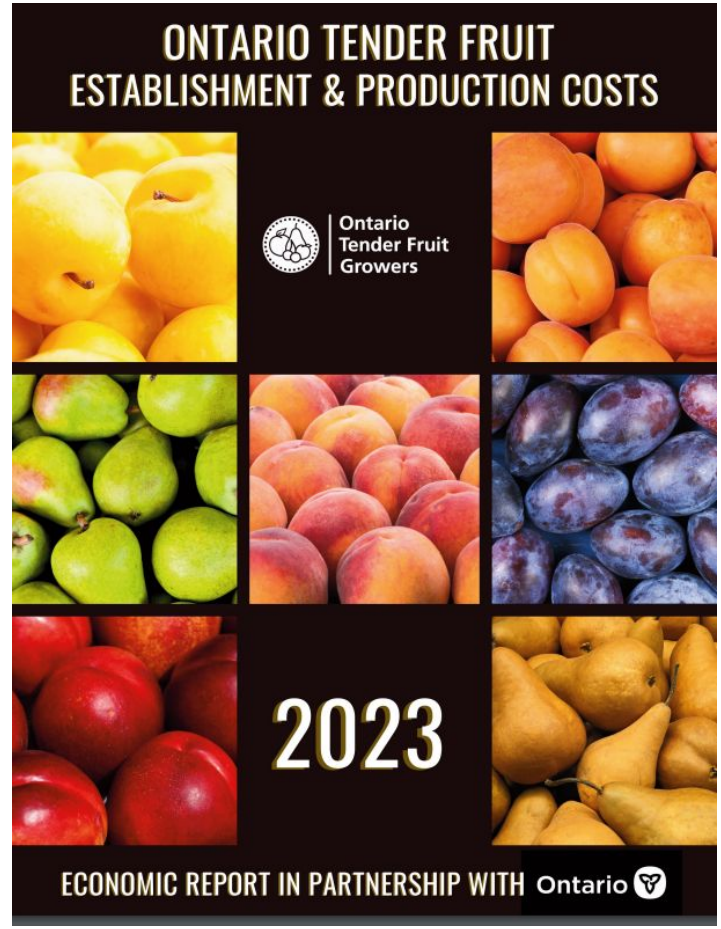
Estimated hand labour per acre for a mature peach/nectarine orchard in Ontario (2023)



Total Hand Labour=
$3,189/acre
189 hrs/acre

50 hours per acre for hand thinning

Ontario Tender Fruit, 2023

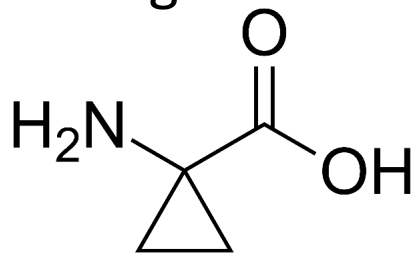


Hand Labour was charged at $20.25 per hour which is comprised of the 2023 Seasonal Agricultural Worker Program (SAWP) rate plus benefits (Worker's Compensation, Employment Insurance, Canada Pension Plan and an allowance for additional costs of air flight, housing, and local transportation). Employer Health Tax is not included based on a 80-acre orchard payroll model.

Harvest (Picking) Labour was charged at $22.30 per hour which is comprised of the 2023 SAWP wage rate plus benefits as above and includes vacation pay. Harvesting costs can be significantly affected by many variables from year to year such as fruit size, crop load and crop distribution.

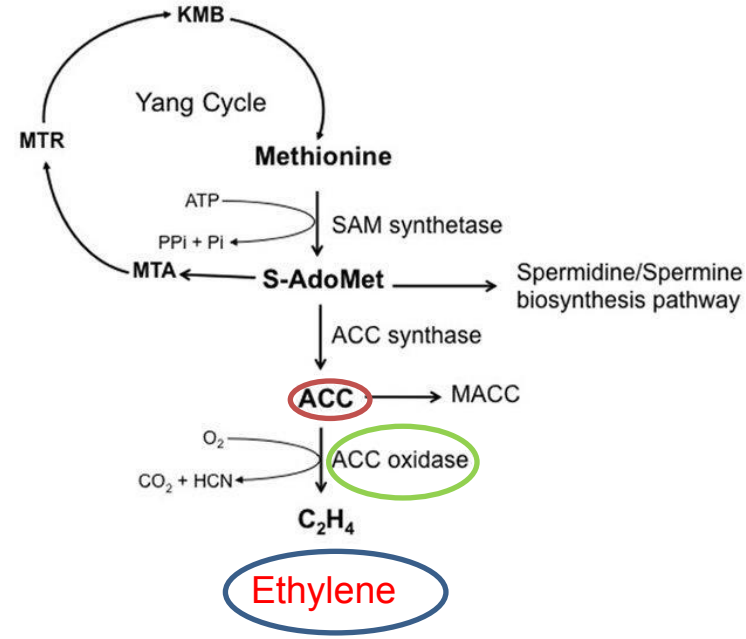
What is 1-ACC

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



- 1-ACC, discovered in 1979, is a precursor of ethylene in the ethylene biosynthesis pathway (Adams and Yang, 1979)
- In sufficient concentrations, ethylene accelerates flower and fruit drop, enhances fruit colour and ripening

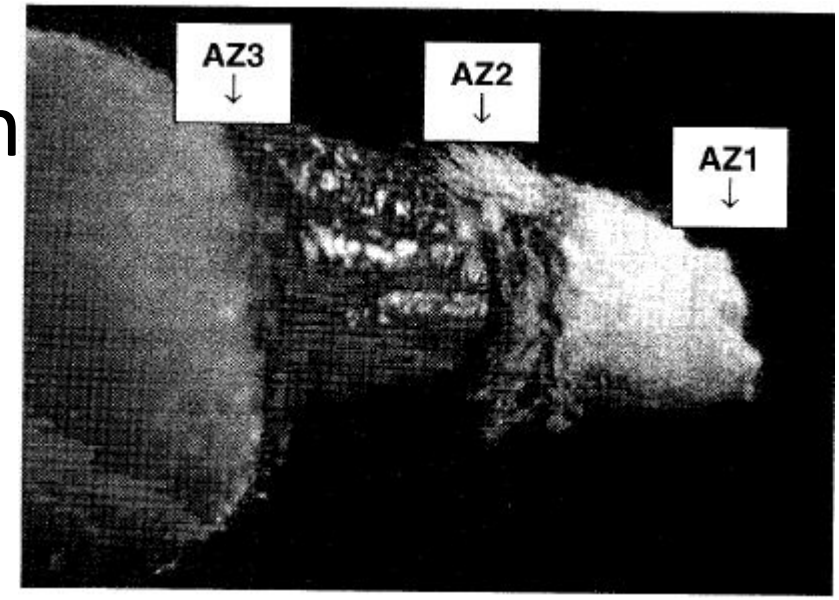
Ethylene Biosynthesis Pathway



Arc et al, 2013

ACC Physiology and Abscission

- ACC oxidase (ACO) in the plant cell converts ACC to ethylene in a temperature dependent biochemical reaction.
- The rate of ethylene release following an ACC application peaks 2-3 days after application, 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.
- Can cause leaf yellowing and leaf drop
- In peach, fruit drop is dependent on the activation of one of three abscission zones (AZ). AZ1 is responsible for the abscission of buds, flowers and young fruits (early June-drop) and AZ-2 and 3, in succession, are activated in mid and late June-drop (Rascio et al., 1985).



Byers, R.E., Costa, G. and Vizzotto, G. 2003. Flower and fruit thinning of peach and other Prunus. p.351-392. In: Horticultural Reviews 28 (Janick J. ed), Wiley J. & Sons Publishers, New Jersey, USA. https://doi.org/10.1002/9780470650851.ch7

Photo credit: J. Cline

ACC manufactured by Valent BioSciences.
Commercially formulated as Accede®

Accede® SG
PLANT GROWTH REGULATOR
SOLUBLE GRANULE

- First new chemical thinner for stone fruit
- Accede® applied during pink bud stage to petal fall will reduce fruit set and reduce, but is not intended to eliminate, the need for hand thinning.
- A second application of Accede® can further reduced fruit set.

Crops listed on label: apple, apricot, sweet and tart cherry, nectarine, peach, chicksaw plum, Japanese plum, plumcot, fresh prune plums

Accede® Benefits

Accede® SG
PLANT GROWTH REGULATOR
SOLUBLE GRANULE

- Reduces hand thinning
- Delivers early crop load management to improve fruit size (indirectly to improve colour and quality)
- Helps reduced tree and limb damage by heavy crop loads
- May improve harvest management by advancing and compressing fruit maturity

Accede® Rate and Timing Trials

Peach (*Prunus persica)*

- Redhaven: 2018, 2019, 2022
- Vivid: 2021, 2023, 2024
- Harrow Dawn: 2021, 2023, 2024

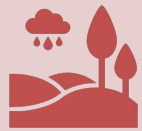
European Plum (*Prunus domestica*)

- Vibrant: 2023, 2024

Japanese Plum (*Prunus salicina*)

- Early Golden: 2023, 2024

Research Objectives



1. Determine the optimal rate and timing of foliar applications of 1-ACC to thin peach trees

2. Measure any negative effects of 1-ACC on tree health, including leaf yellowing and leaf drop

3. Measure the effects of 1-ACC on fruit quality – including fruit size, size distribution, and maturity

4. Conduct a cost-benefit analyses of 1-ACC

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^{-1})
1 ‘guard’ tree was left between sprayed trees

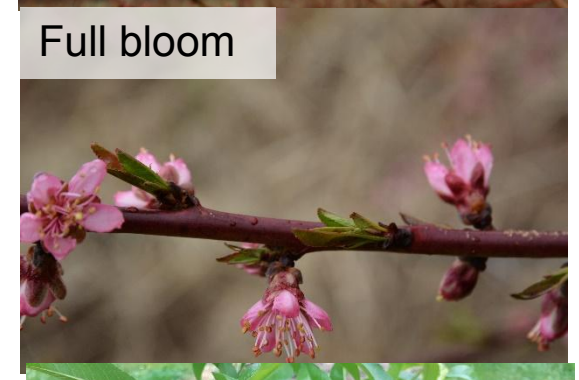
System: Open vase, free standing
Treatments: 8
Replications:5
Experiment design: RCBD

Tree were trickle irrigated

Thinning Treatments

Treatment (mg L^{-1} / ppm)	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)



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

Detailed data are required to access ACC performance. Fruit set and percent reduction in hand thinning is not sufficient to measure product performance.

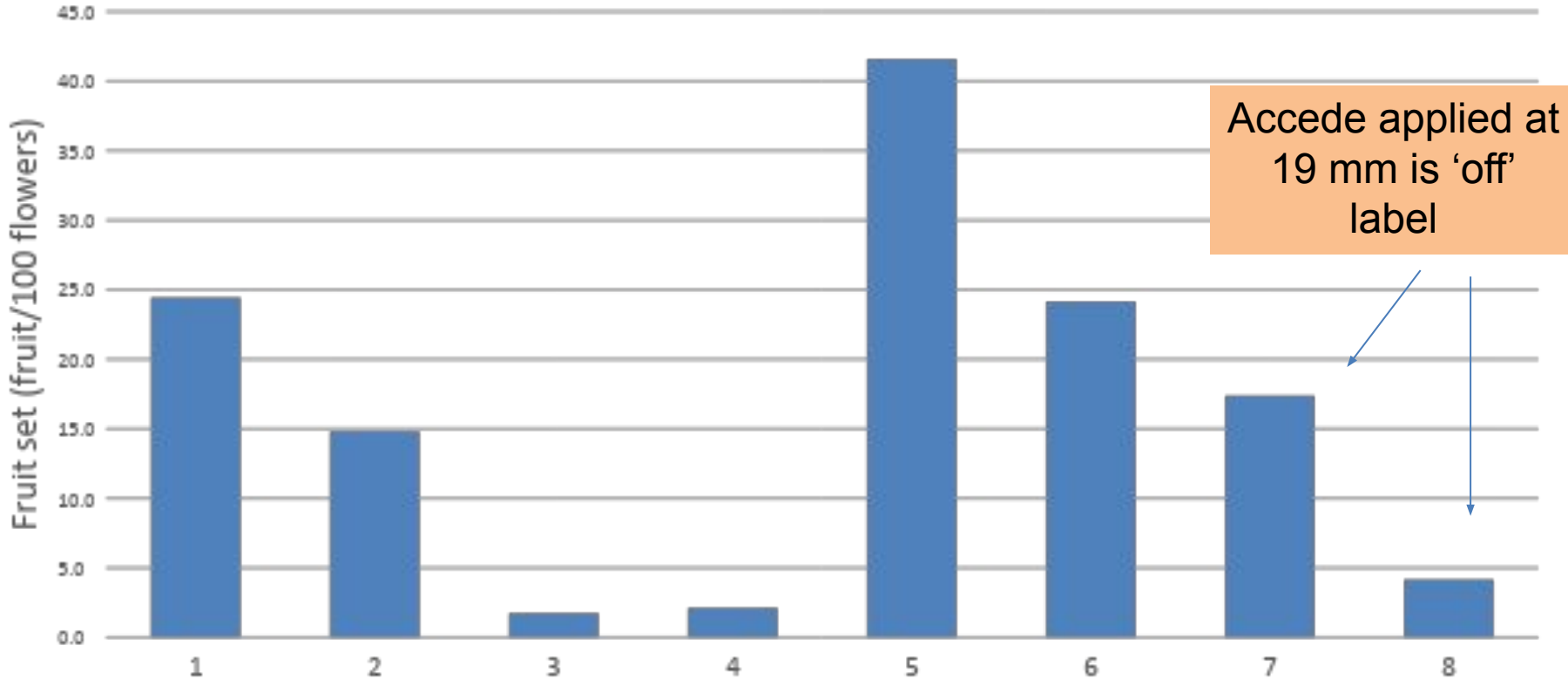
1-ACC effect on flowers (cv. Harrow Dawn)

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

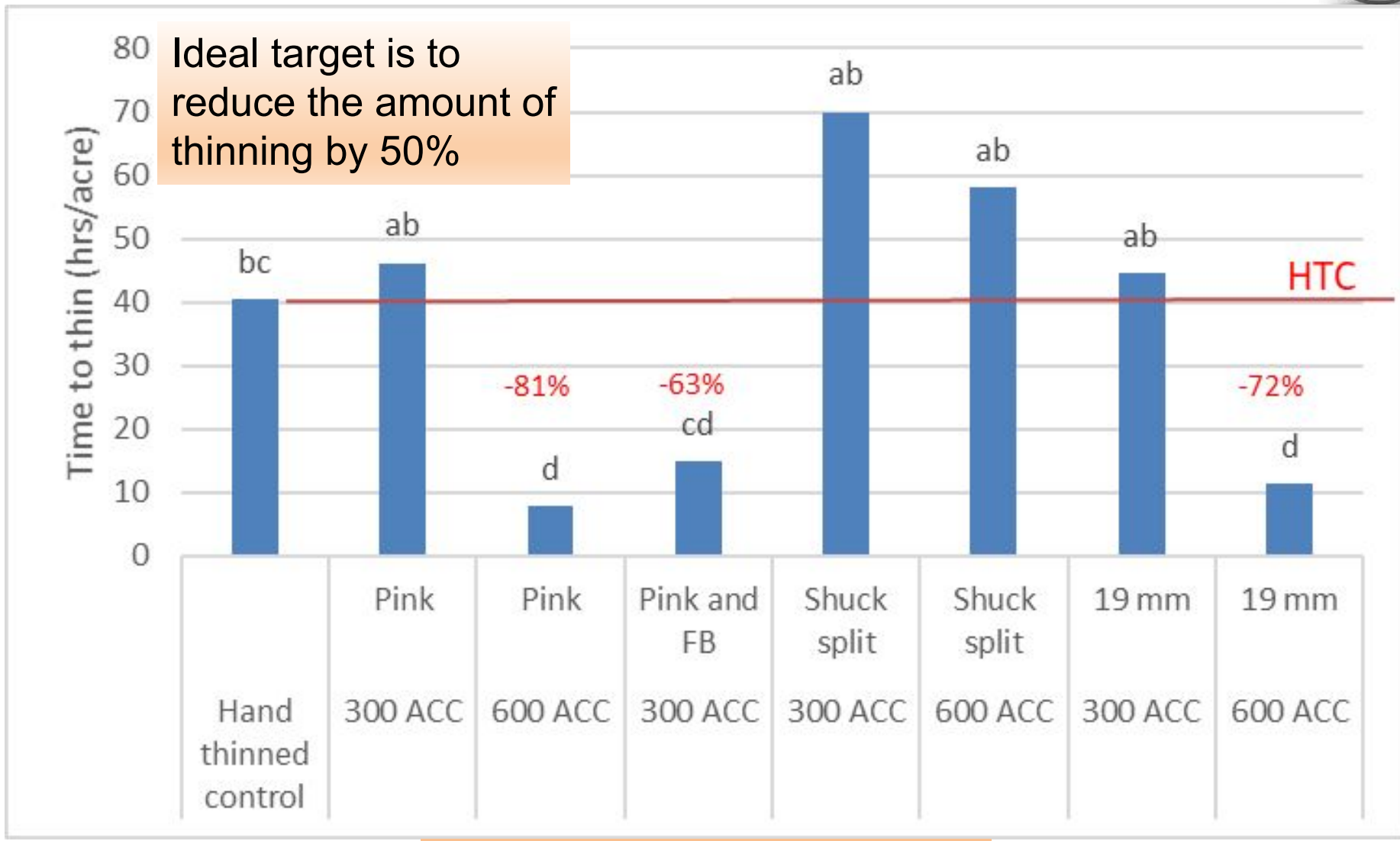
Atypical warm temperatures in late March advanced bud development predisposing the orchards to potential frost.

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

Harrow Dawn Results – Fruit set

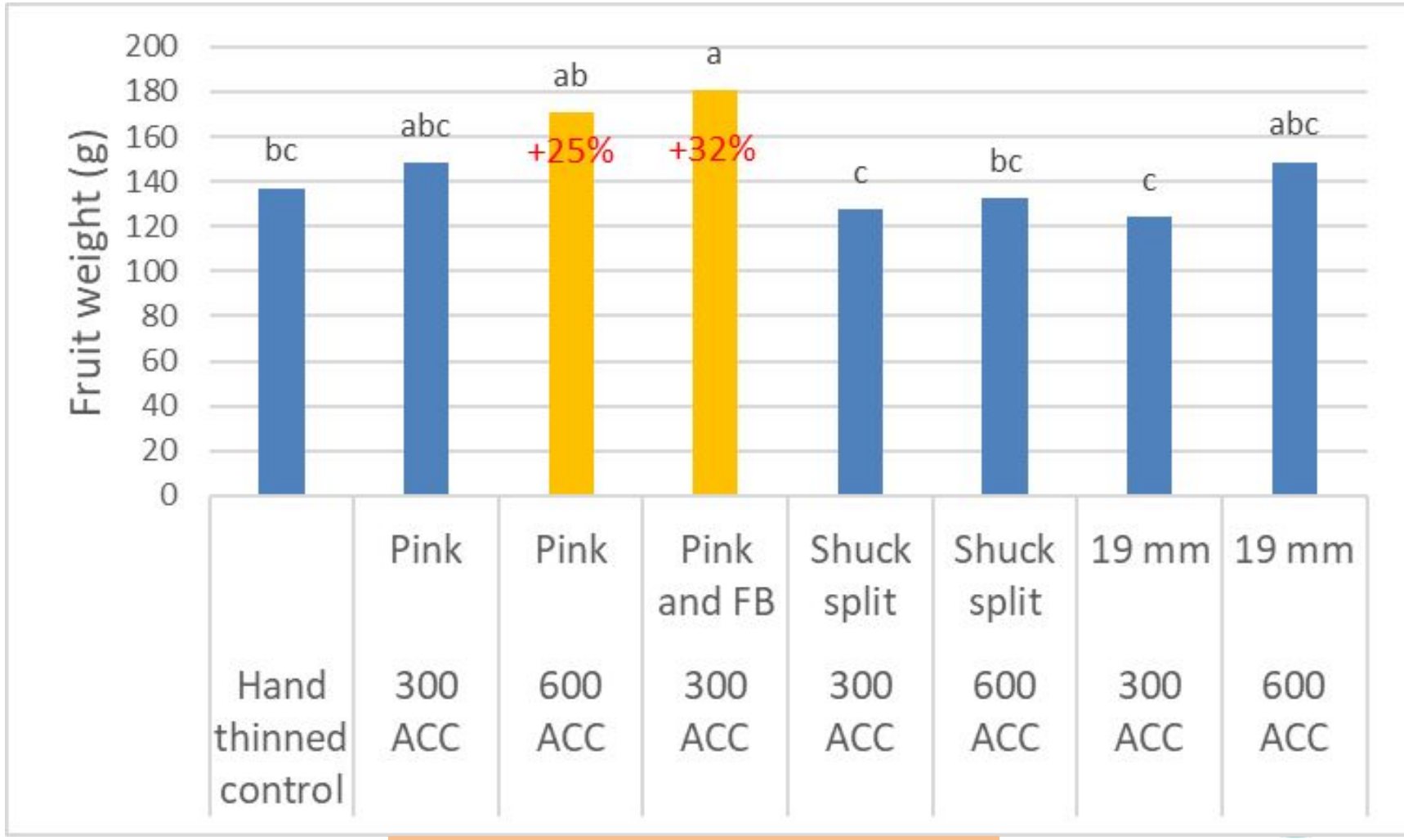


Harrow Dawn Results – Time to Thin



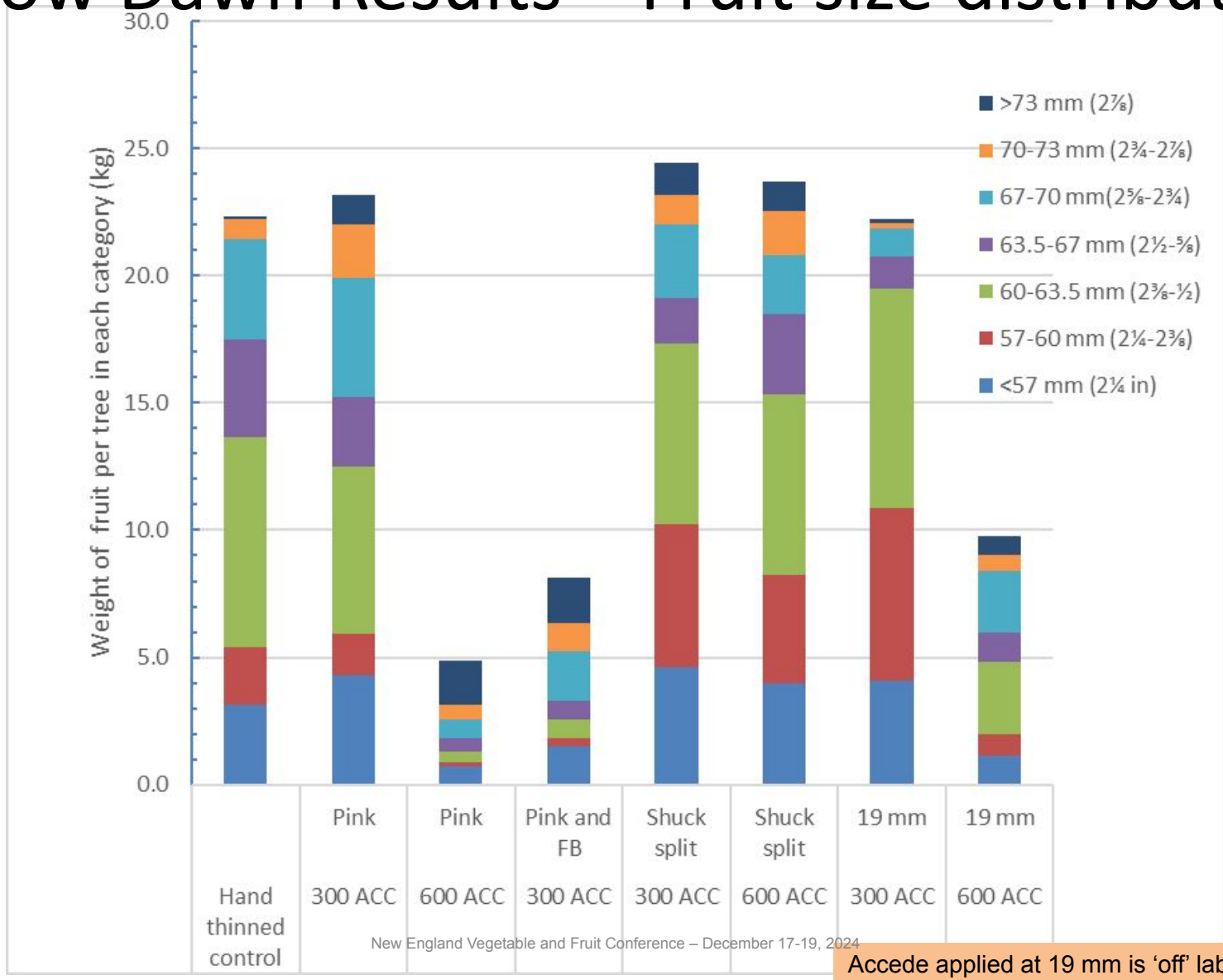
Accede applied at 19 mm is 'off' label

Harrow Dawn Results – Fruit size



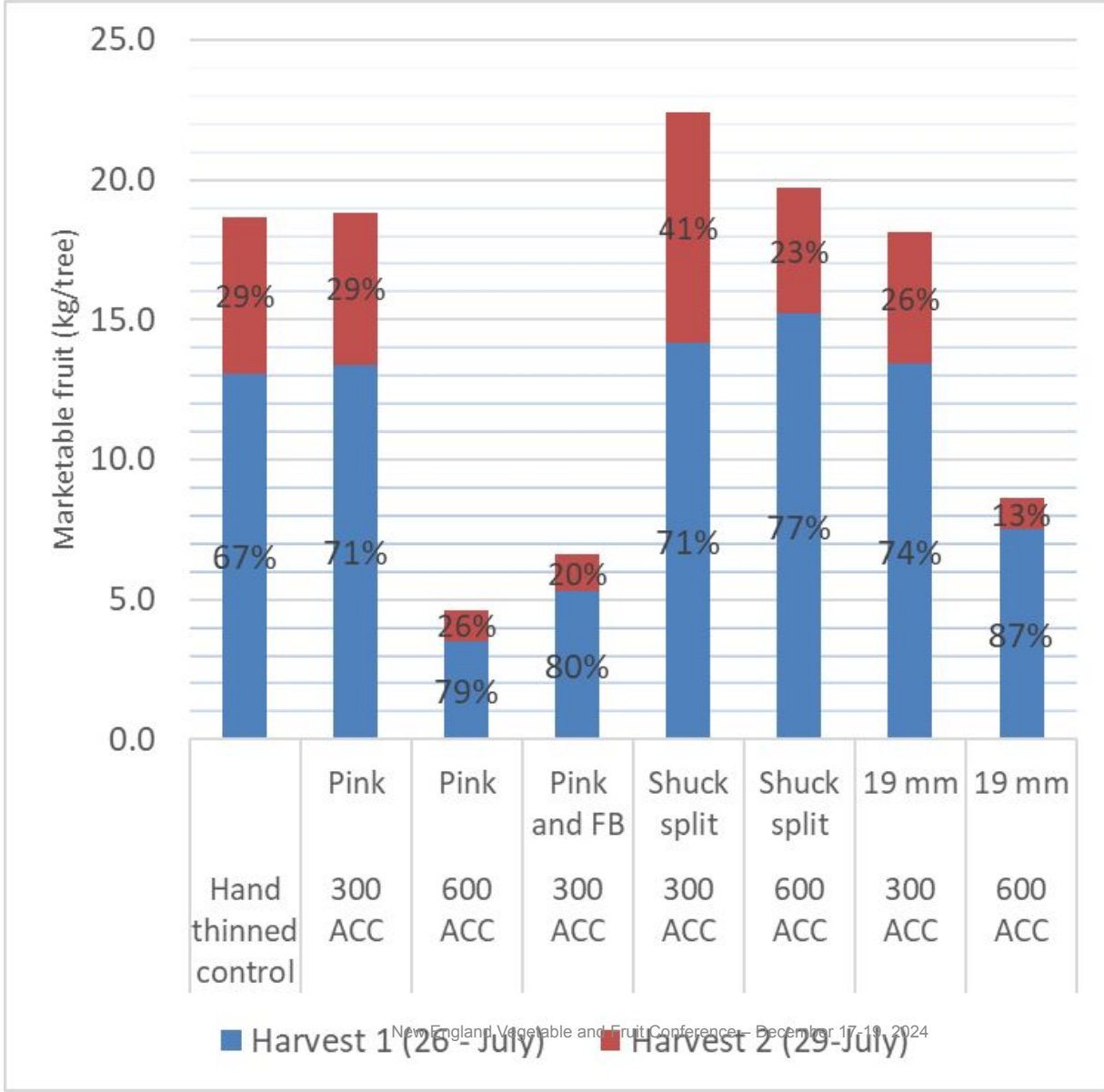
Accede applied at 19 mm is "off" label

Harrow Dawn Results – Fruit size distribution

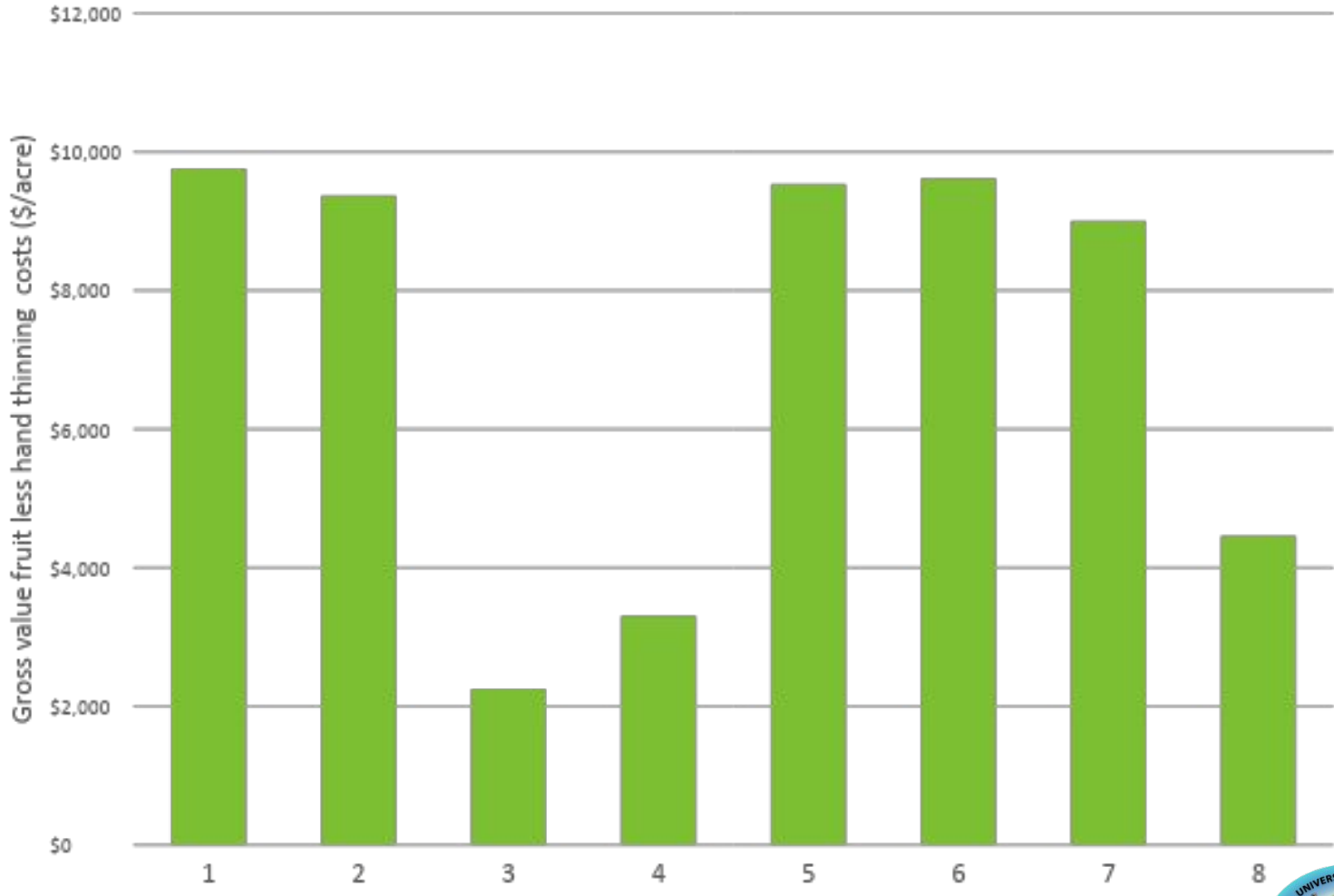


Accede applied at 19 mm is 'off' label

Harrow Dawn Results – Maturity



Harrow Dawn Results – Economics



Summary of Peach Results

How did the results answer the research objectives?

Determine the optimal rate and timing of foliar applications of 1-ACC to thin peach trees

- In most years, except 2022, ACC was effective at reducing the number of fruit per tree (crop load)
- <u>Rates</u>
  - Ideal rate appears to vary based on initial fruit set
  - 300 ppm generally provided inadequate thinning while 600 ppm caused overthinning
  - We have found 400-500 ppm to reduce hand thinning by approximate 50%
  - Thinning increases linearly with increasing rate of ACC
  - There appears to be no advantage using split application at pink bud and full bloom
- <u>Timing</u>
  - Pink bud and full bloom have provided more consistent thinning than fruitlet application at ~ 20 mm fruitlet diameter
  - 20 mm is off label, but offers more time to assess fruit set and need for thinning

How did the results answer the research objectives?

Measure any negative effects of 1-ACC on tree health, including leaf yellowing and leaf drop

- Full bloom applications cause less injury than fruitlet applications
- However, when applied after frost and in cold conditions, leaf phytotoxicity is increased
- Leaf drop (yellow and green leaves) is more common than leaf yellow
- Injury increases with rate of ACC used
- Effects do not appear long-lasting and trees appear to recover by harvest time

How did the results answer the research objectives?

Measure the effects of 1-ACC on fruit quality – including fruit size, size distribution, and maturity

- With effective thinning, ACC increased fruit weight, shifting fruit into larger size categories
- Generally, ACC has increased the amount of marketable fruit per tree by weight (because most fruit on hand-thinned trees are of acceptable marketable size)
- When hand-thinned trees have produced a ‘full crop’, ACC has advanced fruit maturity – resulting in more fruit to be harvested on this first pick
- ACC has not had any consistent direct effect on:
  - Fruit firmness
  - Fruit soluble solids
  - Fruit titratable acidity

How did the results answer the research objectives?

Conduct a cost-benefit analyses of 1-ACC

- Any reduction in crop load cause by ACC or hand thinning reduces total yield and marketable yield per tree
- Increases in fruit size have not offset reductions in yield, result in net gross value of fruit per tree
- In most - but not all instances, gross fruit value minus thinning costs have decreased using ACC

...But there are other economic factors to consider

- labour availability for thinning and harvest
- how quickly the crop can be timely thinned and harvested
- costs to store, grade fruit, and pack fruit

Summary of Plum Results

2023 Plum Results Summary (Franzluebber and Cline)

Objectives

- Rate treatments: Hand thin, 150, 300, 450, ppm ACC
- Timing: Full bloom, ~10 mm fruitlet diameter
- No fruit set on Early Golden, good fruit set on Vibrant (trees required hand thinning)

Effect	Early Golden (Japanese)	Vibrant (European)
1-ACC was effective in thinning (150, 300, 450 ppm)	No crop (no fruit set)	Yes, at full bloom and 10 mm fruitlet ∅
Fruit weight		Increased 11 to 63% compared with the HTC
Time to hand-thin		Up to 37% reduction
Advanced maturity (more fruit picked on first harvest date)		Yes, by up to 30% more fruit
Leaf injury, leaf drop (phytotoxicity)		Very little at FB, slight at 10 mm fruitlet ∅

2024 Plum Results Summary (Franzluebber and Cline)

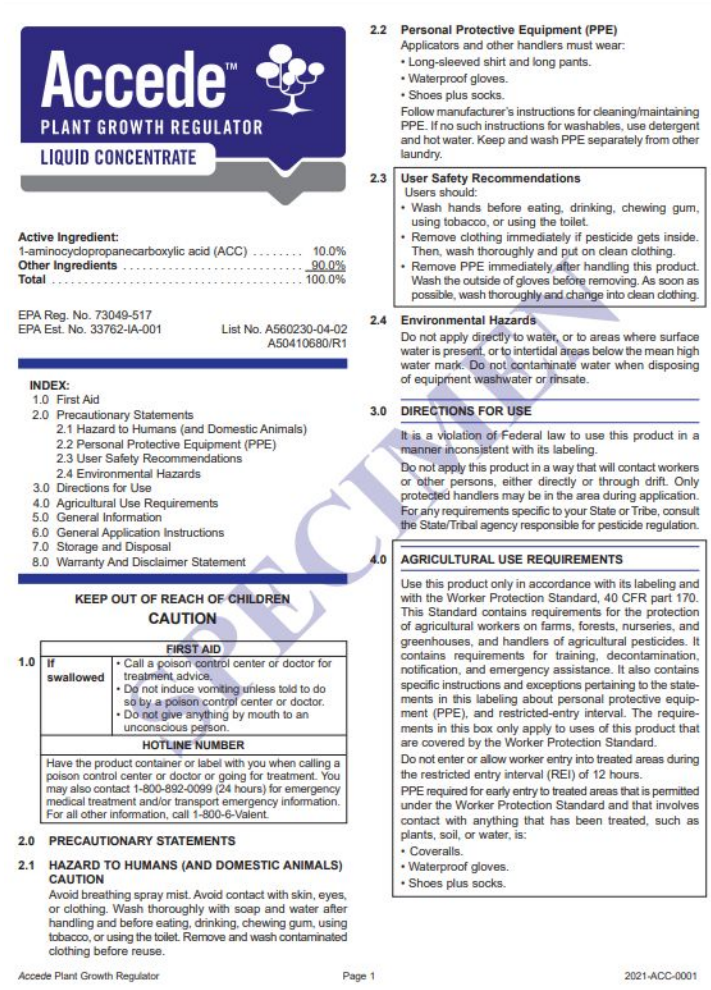
Objectives

- Rate treatments: Untreated control, 150, 300, 450, ppm ACC
- Timing: Full bloom, ~10 mm fruitlet diameter
- Fruit set was poor on Early Golden, fruit set was good on Vibrant, but premature fruit drop

Effect	Early Golden (Japanese) Very Light Fruit set and Crop	Vibrant (European) – No Hand Thinning Required
1-ACC was effective in thinning (150, 300, 450 ppm)	More effective at full bloom, only at 450 ppm at 10 mm fruitlet ∅	At full bloom only – not at 10 mm fruitlet ∅
Fruit weight	ACC increased fruit weight only slightly compared with the hand thinned controls	Increased 8-20% compared with the HTC
Time to hand-thin	No hand thinning required	No hand thinning required
Advanced maturity (more fruit picked on first harvest date)	Single pick	Single pick
Leaf injury, leaf drop (phytotoxicity)	None at full bloom, very slight at 10 mm fruitlet ∅	None at full bloom and at 10 mm fruitlet ∅
Marketable yield	ACC reduced by up to 80%	ACC reduced by up to 57%

Registration status, rates and timing of Accede™

- Registered in June 2021 in the USA by Valent USA
- 40% ACC (w/w) Granular formulation (liquid in California)
- Not approved for “organic” certification
- Label rates: 300 to 600 ppm
- Timing: pink bud to petal fall, no post-petal fall applications are recommended



Accede™
PLANT GROWTH REGULATOR
LIQUID CONCENTRATE

Active Ingredient:
1-aminocyclopropanecarboxylic acid (ACC) 10.0%
Other Ingredients 90.0%
Total 100.0%

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

INDEX:

KEEP OUT OF REACH OF CHILDREN
CAUTION

	FIRST AID
1.0 If swallowed	• Call a poison control center or doctor for treatment advice. • Do not induce vomiting unless told to do so by a poison control center or doctor. • Do not give anything by mouth to an unconscious person.
	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 emergency 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.

PREC

Peach phenology in relation to ACC spray timing

- There is relatively little leaf development at pink bud and full bloom.
- Post-bloom applications to peaches result in leaf yellowing and leaf drop. Phyto has been less on plum

Pink bud

Bloom

20 mm fruitlet diameter

Leaf Phytotoxicity with Post-bloom ACC Applications

500 ppm ACC applied 30 DAFB. Photo taken 10d after spraying (Vivid peach)

450 ppm ACC European Plum

1-yr-old shoot dieback- mid June (2024)

Dieback recovery (by late July, 2024)

Accede™ product Label

Precautions/Considerations

- Cultivars differ in sensitivity
- Use 300 – 600 ppm assuming 100 gallons/acre spray volume
- Spray with sufficient volume for complete tree coverage
- Do not apply when frost is expected
- Do not apply injured or stressed plants or fruits (e.g., drought stress, freeze injury, etc.)
- Application above 90°F (32°C) may increase result in over thinning and leaf yellowing and leaf drop
- Reduce rates when applied after or during a period of cold temperatures (< 40°F)
- Adjuvants: Use of a non-ionic surfactant with Accede will improve performance and response.
- Direct 80% of spray to the upper 2/3^{rds} of the tree canopy

STONE FRUIT CROP GROUP 12 – FOR FRUIT THINNING

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 SG • Fruit thinning	Apply 10 to 20 oz of Accede SG 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 SG 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 SG can be applied from the pink bud stage to petal fall. Do not apply Accede SG 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 SG from pink bud to full bloom. Make a second application 3-10 days later if necessary. Do not exceed a total of 8.0 oz a.i. per acre (20 oz Accede SG per acre, equivalent to 600 ppm ACC assuming a spray volume of 100 gallons per acre) in a single application Do not apply Accede SG after petal fall. Do not apply when frost is expected.

Accede® PGR How To Use — Peaches/Nectarines

Rate	300–600 ppm
Product Amount	**Accede LC**

Conc. (PPM)	fl oz/A (100 GPA)
300	34
450	51.5
600	69

California Only

Accede SG	
Conc. (PPM)	**oz/A (100 GPA)**
300	10
450	15
600	20

Spray Volume	100 gallons per acre (GPA)
Adjuvant	For optimal response, use a high-quality non-ionic surfactant at a standard rate of 6 fl oz per 100 gallons of spray solution (0.05% v/v)
Timing	• Accede can be applied from the pink bud stage to petal fall • Make the first application of Accede from early to full bloom – Not recommended, but the label allows for a second application 7–10 days later (up to petal fall)

Credit: Jozsef Racsko, Valent USA

Cultivar Response to Accede®

Expect cultivars to differ in response to ACC.

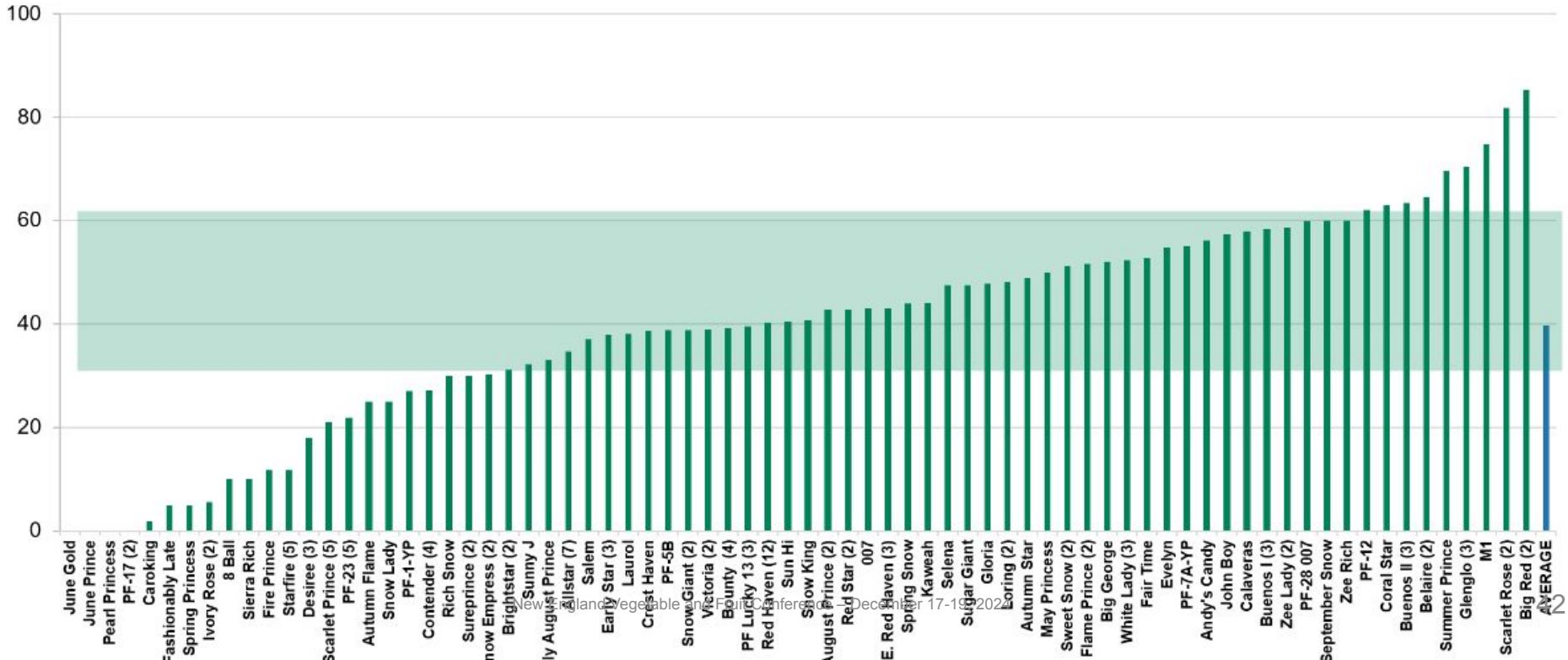
The results below could be related to genetics as well as application timing, and tree and environmental factors

Accede® PGR Peaches Thinning

2021–2022 Commercial Trials: % Reduction in Fruit Set by Variety

VALENT®

Source: Todd Burkdall, Valent



Considerations for using Accede® for the first time

- Start with lower rates (300-500 ppm)
- Leave and flag untreated rows for comparison purposes
- Record pollination conditions and the weather before and after application
- Compare performance with neighbours
- Take detailed spray records of:
  - Cultivar differences
  - Leaf yellowing and leaf drop
  - When and where on the shoot do the flowers drop
  - Impact on hand thinning
  - Effect on harvest maturity and number of harvest
  - Fruit size (weight) and yield at harvest

<u>Encouraging Observations</u>

- When fruit set is light and bloom is reduced, ACC did not cause excessive thinning
- ACC is effective at temperatures below 50^{o}F (which is unusual for a PGR)

Decision support tree for 1-Amino-cyclopropane -1- carboxylic acid (ACC[1]) for new users (2024)

Are trees mature, have adequate bloom to set a full crop, and is there a low risk of frost in the forecast, and is there good fruit set potential?

Are air temperatures forecasted to be above 90°F the day of application or is rain forecasted within 8 hours after application?

Yes

Delay application (no later than petal fall)

Apply 300-500 ppm ACC[1,2,3] for first time use. Increase rates based on experience, cultivar response, degree of desired thinning and past product performance.

Accede® SG mixing rates for 100 GPA(1000L/ha)[3]
300 ppm – 10 oz/acre (750 g/ha)
450 ppm – 15 oz/acre (1125 g/ha)
600 ppm – 20 oz/acre (1500 g/ha)

Accede SG PLANT GROWTH REGULATOR SOLUBLE GRANULE

Will ACC be used on young trees, trees that have light bloom, or is there evidence of frost injury or high risk of frost after bloom?

Is bloom earlier than usual?

Yes

Do trees have lower flower density than usual?

Are trees or flowers under stress?

Yes

Were air temperatures < 40°F[4] within one week prior to application of ACC or forecasted to be < 40°F[4] 2-3 days after application?

Is there evidence of frost injury to flowers or developing fruit?

Yes

Consider reducing ACC rates or do not apply ACC

Do not apply ACC

[1]ACC is formulated as Accede®, Valent Biosciences. The Accede SG formulation contains 40% ACC (w/w). Apply ACC between pink bud and petal fall.
[2]Accede® Apply enough water to ensure that flowers and foliage receive thorough spray coverage using calibrated spray equipment. Adjust water volumes based on plant size and spacing. Excessive spray application volumes resulting in spray runoff will reduce product efficacy.
[3]Consider using a non-ionic surfactant, such as Regulaid® at 0.05% (v/v).
[4]There is evidence that cool temperatures increase ACC efficacy, but the relationship between temperature and ACC performance is not fully known

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Funding Partners

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- Tom Platts and Doug Darling, Sunnydale Farms, Jordan, ON
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- Mike Culp, Greenlane Farms, Vineland

Your questions and comments.

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Supplementary Slides

Various Strategies of Thinning Peaches

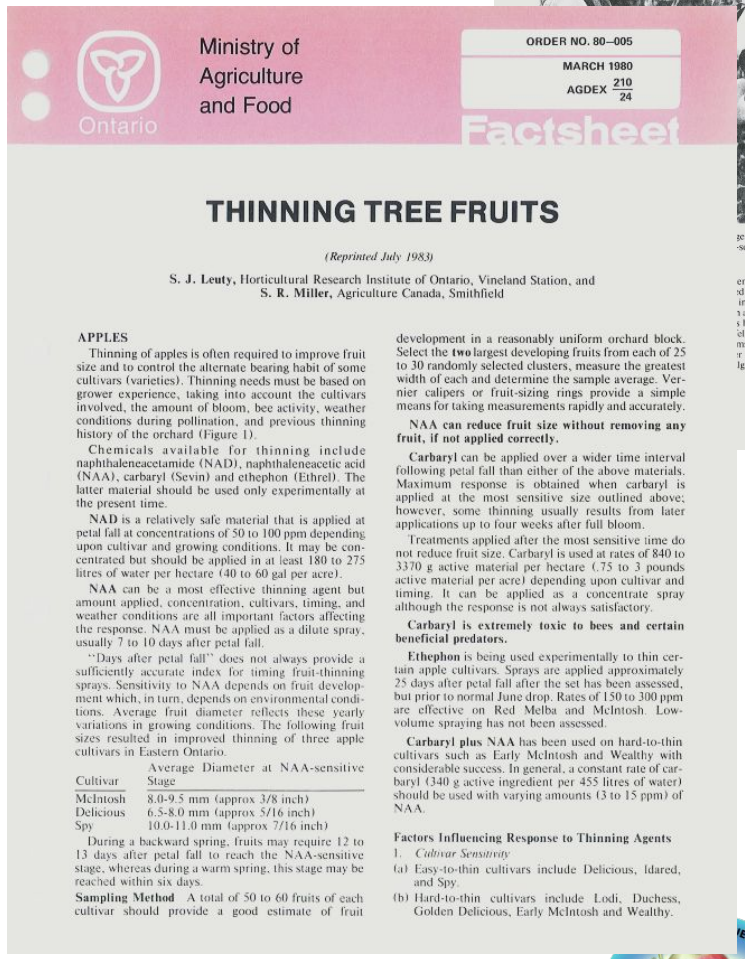
A. Pruning (Marini, 2002. HortScience 37:642)

B. Fruitlet Thinning

- Elgetol (Dinitro-ortho-cresol)
- Ethrel (Cline, Taheri, Coneva and others)
- Tree shaking (Leuty & Miller)
- Rope Thinning (Byers)
- Blossom desiccant thinners (eg, Tergitol) (Coneva and Cline, 2006)
- High pressure water (Cline, 2017)

C. Flower Inhibition

- Gibberellic Acid (Coneva & Cline, 2006 HortScience 41:1596)



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Factsheet

THINNING TREE FRUITS

(Reprinted July 1983)

S. J. Leuty, Horticultural Research Institute of Ontario, Vineland Station, and
S. R. Miller, Agriculture Canada, Smithfield

APPLES

Thinning of apples is often required to improve fruit size and to control the alternate bearing habit of some cultivars (varieties). Thinning needs must be based on grower experience, taking into account the cultivars involved, the amount of bloom, bee activity, weather conditions during pollination, and previous thinning history of the orchard (Figure 1).

Chemicals available for thinning include naphthaleneacetamide (NAD), naphthaleneacetic acid (NAA), carbaryl (Sevin) and ethephon (Ethrel). The latter material should be used only experimentally at the present time.

NAD is a relatively safe material that is applied at petal fall at concentrations of 50 to 100 ppm depending upon cultivar and growing conditions. It may be concentrated but should be applied in at least 180 to 275 litres of water per hectare (40 to 60 gal per acre).

NAA can be a most effective thinning agent but amount applied, concentration, cultivars, timing, and weather conditions are all important factors affecting the response. NAA must be applied as a dilute spray, usually 7 to 10 days after petal fall.

"Days after petal fall" does not always provide a sufficiently accurate index for timing fruit-thinning sprays. Sensitivity to NAA depends on fruit development which, in turn, depends on environmental conditions. Average fruit diameter reflects these yearly variations in growing conditions. The following fruit sizes resulted in improved thinning of three apple cultivars in Eastern Ontario.

Cultivar	Average Diameter at NAA-sensitive Stage
McIntosh	8.0-9.5 mm (approx 3/8 inch)
Delicious	6.5-8.0 mm (approx 5/16 inch)
Spy	10.0-11.0 mm (approx 7/16 inch)

During a backward spring, fruits may require 12 to 13 days after petal fall to reach the NAA-sensitive stage, whereas during a warm spring, this stage may be reached within six days.

Sampling Method A total of 50 to 60 fruits of each cultivar should provide a good estimate of fruit development in a reasonably uniform orchard block. Select the **two** largest developing fruits from each of 25 to 30 randomly selected clusters, measure the greatest width of each and determine the sample average. Vernier calipers or fruit-sizing rings provide a simple means for taking measurements rapidly and accurately.

NAA can reduce fruit size without removing any fruit, if not applied correctly.

Carbaryl can be applied over a wider time interval following petal fall than either of the above materials. Maximum response is obtained when carbaryl is applied at the most sensitive size outlined above; however, some thinning usually results from later applications up to four weeks after full bloom.

Treatments applied after the most sensitive time do not reduce fruit size. Carbaryl is used at rates of 840 to 3370 g active material per hectare (.75 to 3 pounds active material per acre) depending upon cultivar and timing. It can be applied as a concentrate spray although the response is not always satisfactory.

Carbaryl is extremely toxic to bees and certain beneficial predators.

Ethephon is being used experimentally to thin certain apple cultivars. Sprays are applied approximately 25 days after petal fall after the set has been assessed, but prior to normal June drop. Rates of 150 to 300 ppm are effective on Red Melba and McIntosh. Low-volume spraying has not been assessed.

Carbaryl plus NAA has been used on hard-to-thin cultivars such as Early McIntosh and Wealthy with considerable success. In general, a constant rate of carbaryl (340 g active ingredient per 455 litres of water) should be used with varying amounts (3 to 15 ppm) of NAA.

Factors Influencing Response to Thinning Agents

1. *Cultivar Sensitivity*

(a) Easy-to-thin cultivars include Delicious, Idared, and Spy.

(b) Hard-to-thin cultivars include Lodi, Duchess, Golden Delicious, Early McIntosh and Wealthy.

thinning such cultivars until many of the split-pit fruits can be identified and selectively removed.

Late-maturing cultivars are thinned according to their individual requirements. Heavy-setting, hard-to-size cultivars such as Redhaven and Madison require heavier thinning than easier-to-size types like Vivid and Loring. As a rule of thumb, however, late-maturing cultivars with a good, uniform set are usually thinned 10 to 13 cm apart. Distance between fruits is not too critical as long as clusters are broken up and fruits separated (Figure 2). If the set is spotty on the tree, more fruits may be left on heavy-set branches.

for example, may be used at 0.5 to 1.7 litres per 455 litres of water (1 to 3 pints per 100 gal) depending on cultivar. Trees under 5 years of age should not be chemically thinned.

Mechanical The trunk-shaker method supplemented by touch-up hand thinning is being employed by a few growers (Figure 3). Major drawbacks of this method are erratic thinning and the very real danger of overthinning. Stiff branches are easily overthinned, while willowy or hanging branches are generally underthinned. Recent experiments at Vineland clearly demonstrated that while a mechanical trunk shaker reduced thinning costs, the savings were often more than obliterated by losses in yield due to overthinning.

Figure 3. Mechanical thinning of peaches. Care must be taken to avoid overthinning.

If mechanical thinning must be practised, it is strongly recommended that an observer accompany the machine operator to help avoid overthinning. It will be necessary to leave more fruit than normal on some of the underthinned branches to compensate for excessive thinning on others.

PLUMS

The dinitros will thin plums more easily than peaches. Where biennial bearing is occurring or where size is difficult to obtain, bloom thinning can be helpful. Elegtol at 0.5 litres per 455 litres of water is a suggested strength to try.

Metric to Imperial Conversions

Sevin	113 g = ¼ lb
	340 g = ¾ lb
	454 g = 1 lb
Water	455 litres = 100 Imperial gallons
Elgetol	0.5 litres = 1 pint (approximately)
	1.7 litres = 3 pints (approximately)

This Factsheet has been reviewed and is endorsed by the Ontario Pesticides Advisory Committee.

Darwin Mechanical String Thinning

Designed by Fruit-Tec, Germany
Sold in North America by N.M. Bartlett Inc. https://www.provideag.ca/
Has front mount 3PH, fixed, or fork-lift mounts
Model evaluated Darwin 300

Allstar

Tall spindle training system

Trees thinned at bloom

Goal was to evaluate: speed of rotation (RPM), string configuration and to compare with hand thinning

5-yr old, 6 ft (1.8 m) x 16 ft (4.8 m) (468 trees/acre)

Mechanical Thinning Study

Conducted for two years

Cultivars: Allstar, Catherina

High density spindle orchard system

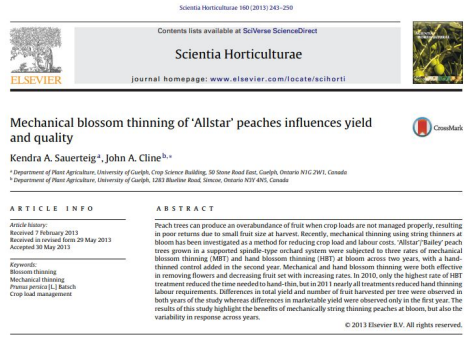
Ground speed: 2.1 miles/hr

Timing: Full Bloom

Treatments

- Hand thinned control
- 180 RPM, 18 strings
- 180 RPM, 9 strings
- 240 RPM, 18 strings
- 240 RPM, 9 strings

Mechanical Thinning Peaches Results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Mechanical blossom thinning of 'Allstar' peaches influences yield and quality

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ABSTRACT

Peach trees can produce an overabundance of fruit when crop loads are not managed properly, resulting in poor returns due to small fruit size at harvest. Recently, mechanical thinning using string thinners at bloom has been investigated as a method for reducing crop load and labour costs. 'Allstar'/'Bailey' peach trees grown in a supported spindle-type orchard system were subjected to three rates of mechanical blossom thinning (MBT) and hand blossom thinning (HBT) at bloom across two years, with a hand-thinned control added in the second year. Mechanical and hand blossom thinning were both effective in removing flowers and decreasing fruit set with increasing rates. In 2010, only the highest rate of HBT treatment reduced the time needed to hand-thin, but in 2011 nearly all treatments reduced hand thinning labour requirements. Differences in total yield and number of fruit harvested per tree were observed in both years of the study whereas differences in marketable yield were observed only in the first year. The results of this study highlight the benefits of mechanically string thinning peaches at bloom, but also the variability in response across years.

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Aim for approx. 50% flower removal

- substantially reduces initial fruit load
- does not over thin

Reduction in hand thinning

- Allstar: 21-50%
- Catherina: 10-50%

Mechanical thinning increased fruit size by 8 – 15%

Major Limitations:

- May damage the blossoms and leaves
- May expose the tree to additional disease
- Not selective or uniform throughout the tree canopy
- Requires a 2-D hedgerow narrow, 'V' or quad 'V' tree canopy leaving fruiting shoots within 24" from scaffold
- Will not be effective on open vase systems

2021 Summary

Effect	Harrow Dawn	Vivid
1-ACC was effective in thinning	Yes	Yes
ACC spray timings	Pink to Full bloom	Pink and split application (Pink & Full Bloom)
Improvement in fruit size	Up to +32%	+29 to +83%
Time to hand-thin	63-81% reduction	21-74% reduction
Gross fruit value less thinning costs	Decreased	Increase
Improved fruit firmness	No	Yes
Advanced maturity (more fruit picked on first harvest date)	Small	Significant
Leaf injury, leaf drop (phytotoxicity)	Very little	Very little

2022 Summary

- There was widespread winter injury to peach and nectarine trees resulting in lower flower density, especially in the lower tree canopy (temps dropped to -4°F in Jan 2022)
- Trees would not normally be treated with 1-ACC in this situation
- Objective: to study performance of ACC in a light flowering year

Effect	Redhaven
1-ACC at 200, 300, 400, 500 ppm	No
ACC spray timings	Pink to Full bloom
Improvement in fruit size	No effect
Time to hand-thin	No effect
Gross fruit value less thinning costs	Decreased
Improved fruit firmness	No effect
Advanced maturity (more fruit picked on first harvest date)	No effect
Leaf injury, leaf drop (phytotoxicity)	Very little

- Orchard variability was high
- Thinning was required(380 fruit removed in HTC)
- Fruit set data did not reflect final crop loads
- ACC did not cause over-thinning in a year when likely not recommended

2023 Peach Results Summary (Franzluebber and Cline)

Objectives

- Rate treatments: Hand thin, 300, 400, 500 ppm ACC
- Timing: Full bloom, 20 mm fruitlet diameter
- Bloom period was unusually long (10+days) with cool weather
- Fruit set was good, trees required hand thinning

Effect	Harrow Dawn	Vivid
1-ACC was effective in thinning (300, 400, 500 ppm)	Effective at full bloom, not at 20 mm fruitlet ∅	Yes, at full bloom and 20 mm fruitlet ∅
Fruit weight	ACC increased fruit weight slightly compared with the hand thinned controls	Increased 11 to 63% compared with the HTC
Time to hand-thin	Up to 43% reduction	Up to 37% reduction
Advanced maturity (more fruit picked on first harvest date)	Yes, by up to 20% more fruit	Yes, by up to 30% more fruit
Leaf injury, leaf drop (phytotoxicity)	Very little at FB, moderate at 20 mm	Very little at FB, moderate to high at 20 mm fruitlet

2024 Peach Results Summary (Franzluebber and Cline)

Objectives

- Rate treatments: untreated control, 300, 400, 500 ppm ACC
- Timing: Full bloom, 20 mm fruitlet diameter
- Frost Injury caused light crop loads and cool temperatures at bloom
- Fruit set was light, no hand thinning required

Effect	Harrow Dawn	Vivid
1-ACC was effective in thinning (300, 400, 500 ppm)	Effective at full bloom, not at 20 mm fruitlet ∅	Yes, at full bloom and 20 mm fruitlet ∅
Fruit weight	ACC increased fruit weight slightly compared with the hand thinned controls	Increased 11 to 63% compared with the HTC
Time to hand-thin	Up to 43% reduction	Up to 37% reduction
Advanced maturity (more fruit picked on first harvest date)	Yes, by up to 20% more fruit	Yes, by up to 30% more fruit
Leaf injury, leaf drop (phytotoxicity)	Very little at FB, moderate at 20 mm	Very little at FB, moderate to high at 20 mm fruitlet