Horticulture Section, Cornell University
Geneva, NY

PGR Strategies for Improving Production Practices

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2016 Eastern NY Commercial Tree Fruit School

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PGRs – Their Roles and Uses

- Increasing fruit set (AVG/ReTain – cherries and pears; Promalin after frost damage)
- Fruit thinning (6BA, NAA, NAD, ACC, ABA)
- Growth control (Apogee, Kudos)
- Fruit russet control (GA4/7-ProVide)
- Fruit shape control, fruit finish (GA4/7 + 6BA – Promalin, ProGibb reduces blush in Golden and Granny)
- Fruit color improvement (MeJ-Blush, Stimplex)
- Fruit maturity and fruit drop control (Retain/NAA/Harvista, ProGibb - cherries)

Precision application of PGRs on Fruit crops

- Plant Growth Regulators (PGRs) are an investment
  - Unlike traditional crop protection products;
  - Increase value of crop.
- Plant response is often variable/inconsistent;
- Responses to PGRs are strongly influenced by:
  - Enviroment, application timing, rate, application volume, coverage, water quality, adjuvants

Cultivar, rootstock, tree age, tree vigor, crop load, training system, tree nutrition, aplication equipment

Precision application of PGRs on Fruit crops

- Effects of Environment

Temperatures before application

- CHO demand (cooler temps = less CHO demand = less stress)
- Plant physiology process (pollen tube growth, cell division rates)

Temperatures during application

- Absorption & uptake (warmer temps = greater uptake (>50F but <85F for thinning)
- Drying time

Precision application of PGRs on Fruit crops

- Effects of Environment

Temperatures after application

- Higher temperatures following application:

Increase response to post-blossom thinners

Increase ripening response to Ethephon and NAA

Decrease stop-drop response to Retain

- Humidity

- Increasing humidity increases absorption

Slow drying time

Increases absorption from deposit

Precision application of PGRs on Fruit crops

- *Rain*

  - *wash-off if too soon after application*

  - *re-wetting of deposits (NAA – 2 days after application)*

- Effects of coverage

  What is your target? Flowers, leaves or fruit?

  Many PGRs have limited movement

  (Retain, ProGibb, CPPU, Apogee)

- Surfactants

  - Reduce surface tension, increasing contact area

    - Do not apply surfactant when the purpose is to increase fruit set.

Summarizing…

High temperatures, slow drying conditions and healthy foliage will enhance absorption and increase plant response.

Cool temperatures, fast drying conditions, and damaged trees or foliage will decrease plant response.

If the weather is cool and humid, morning applications are best;
If it's been hot and dry, an evening application will be most effective.

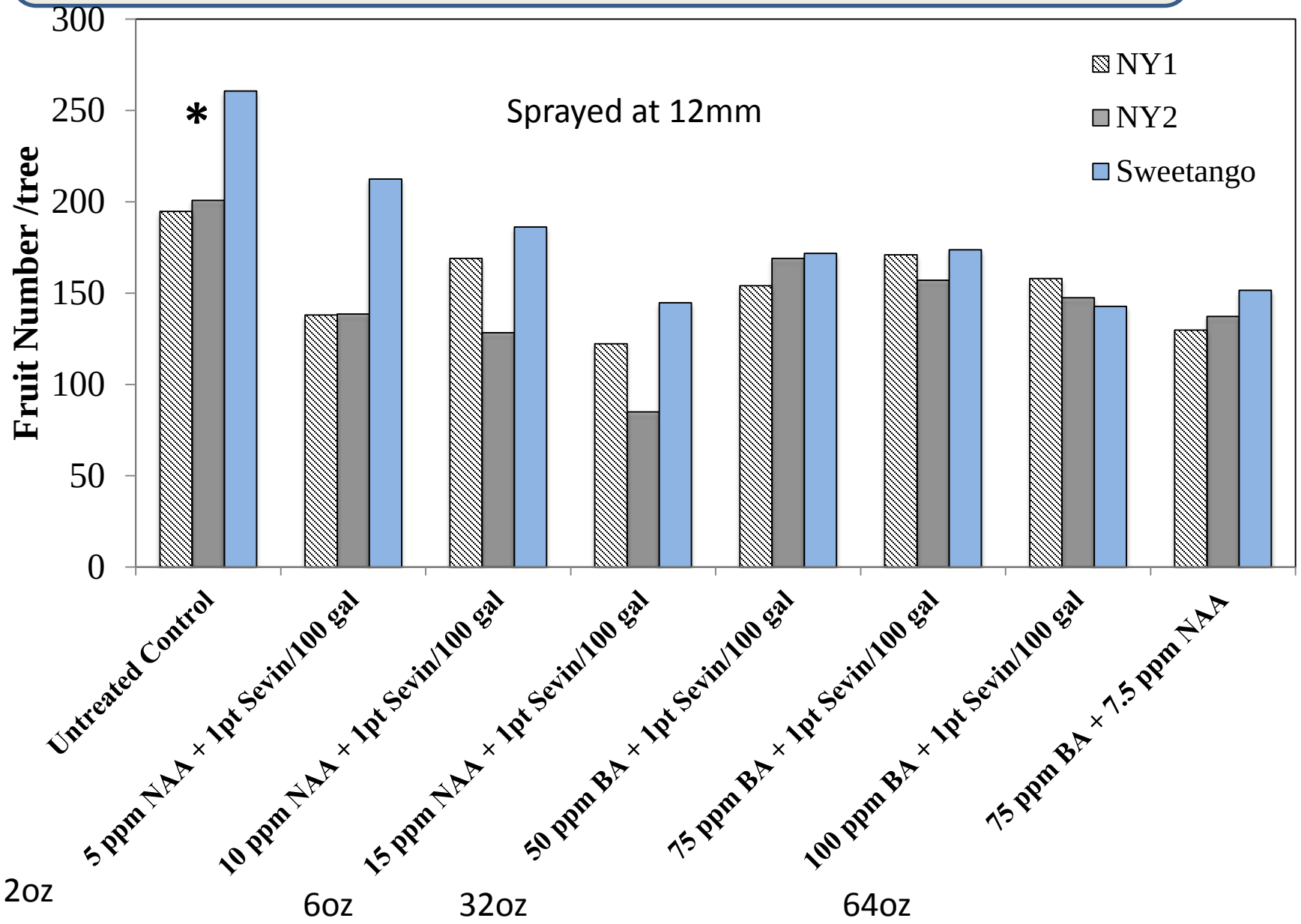
Ongoing PGRs Projects in Geneva

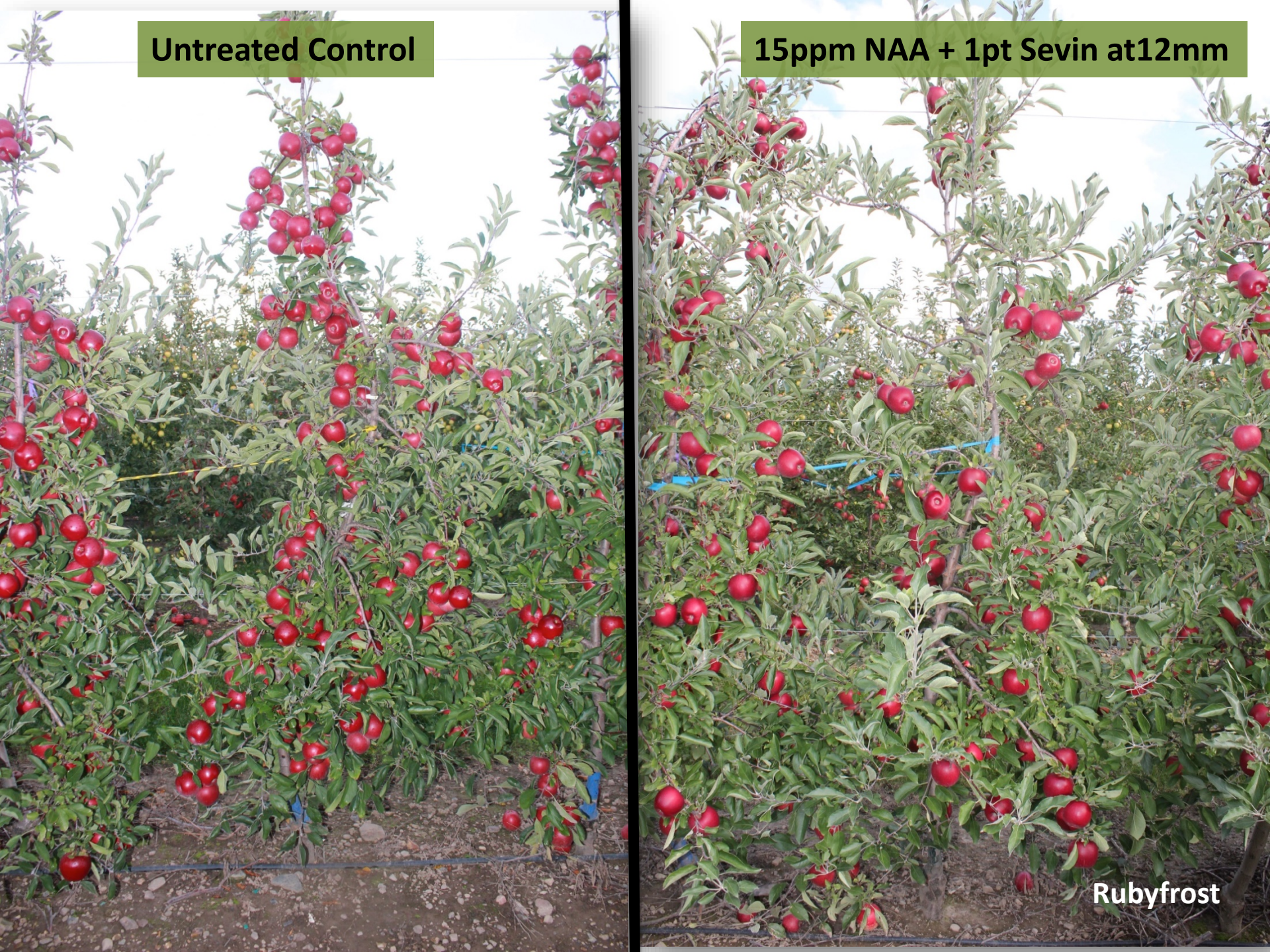
1) **Validate the accuracy of the Precision Thinning Protocol using the carb and FGR model;**
2) **Develop improved thinning treatments for existing and new varieties;**
3) **Testing new compounds for fruit thinning;**
4) **Develop return bloom treatments to overcome biennial bearing;**
5) **Investigate a new strategy to control bitter pit;**
6) **Develop improved pre-harvest drop control strategies;**

Ongoing PGRs Projects in Geneva

NY1 – SnapDragon, NY2 – Rubyfrost, Sweetango
(Planted in 2010 - M9/337)

NY1 – SnapDragon, NY2 – Rubyfrost, Sweetango
(Planted in 2010 - M9/337)




Untreated Control
15ppm NAA + 1pt Sevin at12mm
Rubyfrost

Testing Metamitron (Brevis) for fruit thinning

- Sugar beet herbicide – photosynthesis inhibitor
- Can cause phytotoxicity in very high rates (leaf damage)
- Applied at normal thinning window
- Works best in carbohydrate deficit
- Registered in EU, to be registered in the US in the near future

Efficacy of metamitron in Geneva –2015

Brevis® 15% - Sugar beet herbicide

Location: Experimental orchard at Cornell Station in Geneva, NY

Variety/age: Crimson Gala/M9 – 17 years old (1998)

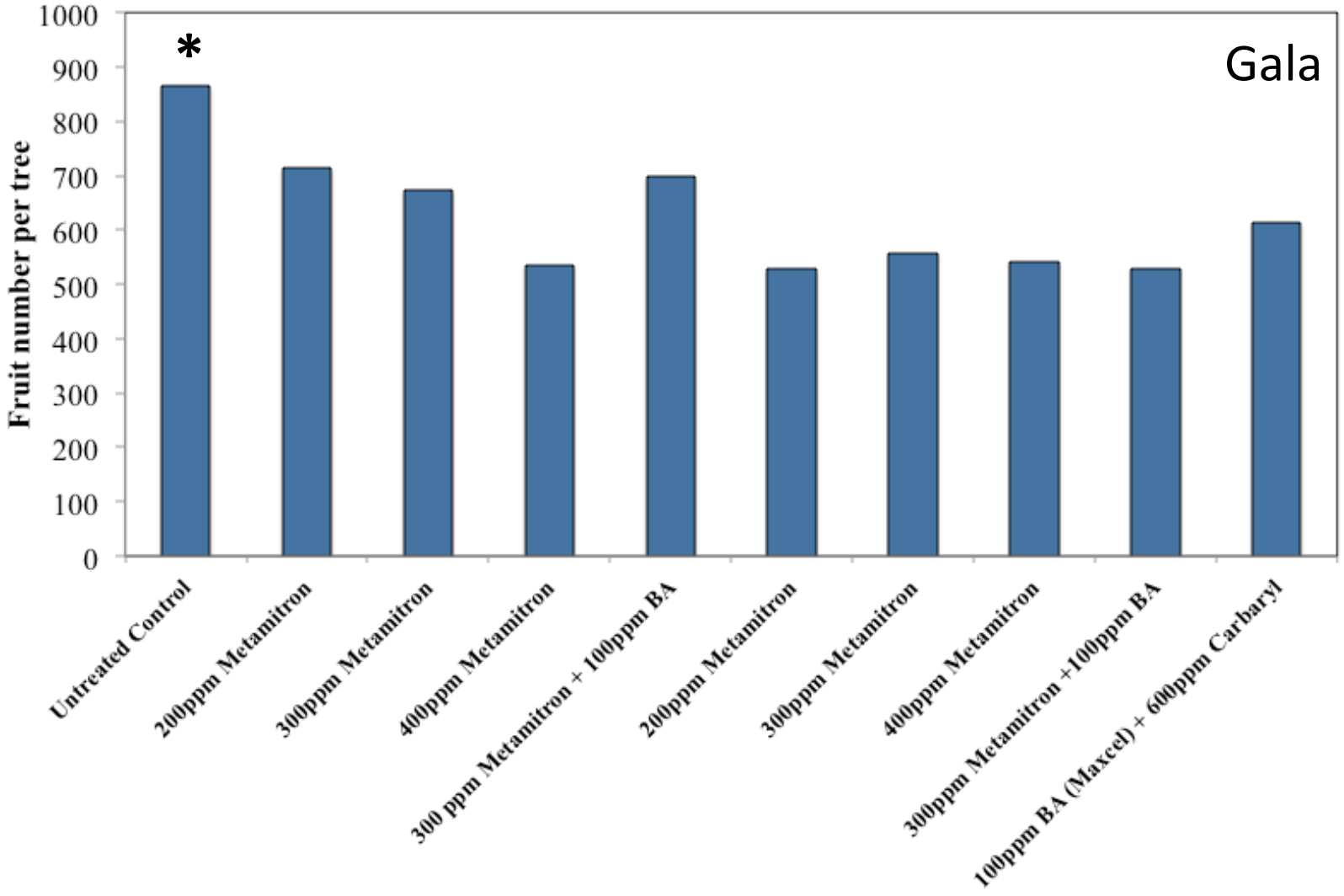
Tree density: **558** trees/acre

Petal Fall: 05/18/15 and 12mm: 05/21/15

Treatments:

Control
Metamitron 200 ppm PF
Metamitron 300 ppm PF
Metamitron 400 ppm PF
Metamitron 300 ppm+ 100ppm BA PF
Metamitron 200 ppm 12mm
Metamitron 300 ppm 12mm
Metamitron 400 ppm 12mm
Metamitron 300 ppm+ 100ppm BA 12mm
BA 100 ppm + 1pt Sevin 12mm

Efficacy of metamitron in Geneva –2015



Results from Brazil

Untreated trees

100 ppmMetamitron + BA 60 ppm at petall fall

Testing ACC for fruit thinning

- Precursor of ethylene
- Works well as pome and stone fruit thinner
- Applied up to 20 mm fruitlet size (after thinning window - RESCUE THINNER)
- Not registered, to be registered in 5-6 years from now
- “Works also as apple coloring agent (ethylene effect) – to counteract ReTain’s color depressing effect”

Testing new compounds for fruit thinning

Determine the effect of ACC on fruit thinning of Golden Delicious and Cameo.

Treatment	Date of Application
Untreated Control	
150 ppm ACC + Silwet	18mm
300 ppm ACC + Silwet	18mm
450 ppm ACC + Silwet	18mm
Ethephon 2pt/100gal + 1 pt oil/100gal	18mm
64oz Maxcel + 150 ppm ACC + Silwet	18mm
64oz Maxcel+ 1 pt Sevin/100 gal at 10mm then later 150 ppm ACC + Silwet at 18mm	10mm 18mm
64oz Maxcel + 1pt Sevin/100gal +1pt oil/100 gal	18mm

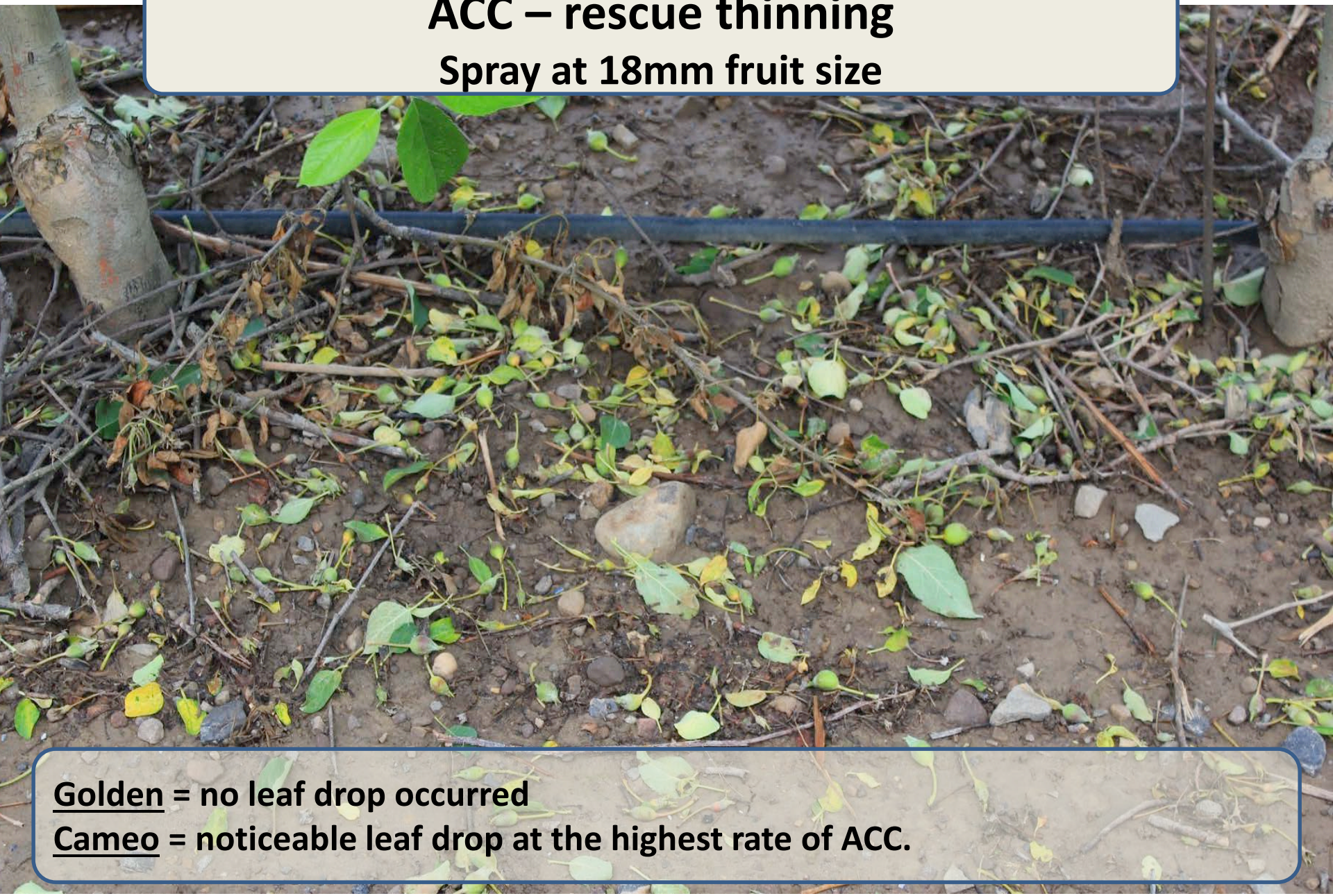
It seems the effect of ACC is cultivar-dependent.

Golden no leaf drop occurred

Cameo = noticeable, but not damaging, leaf drop at the highest rate of ACC

ACC – rescue thinning

Spray at 18mm fruit size



Golden = no leaf drop occurred

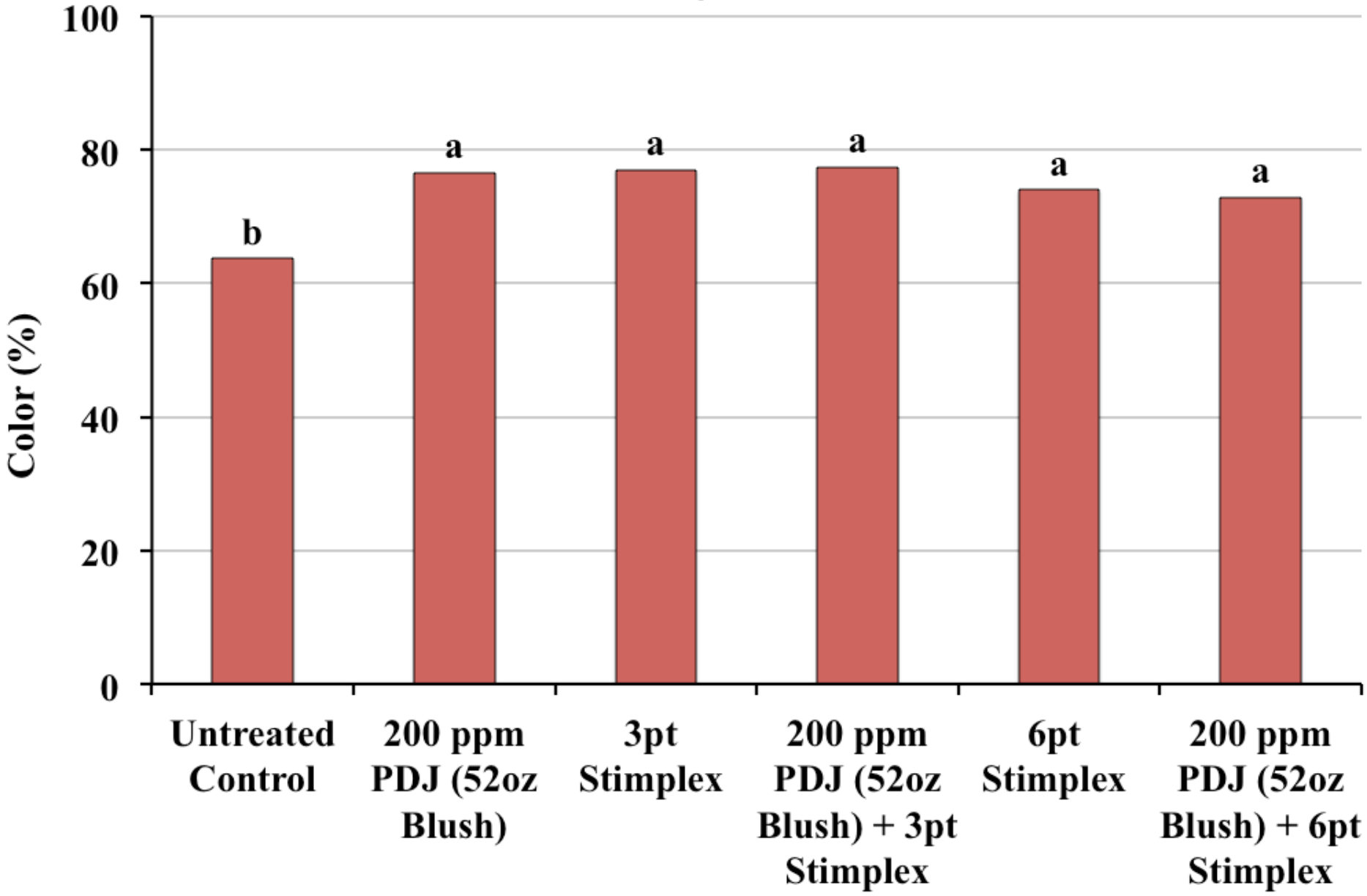
Cameo = noticeable leaf drop at the highest rate of ACC.


64oz Maxcel +Sevin at 10mm + 150ppm ACC + Silwet at 18mm

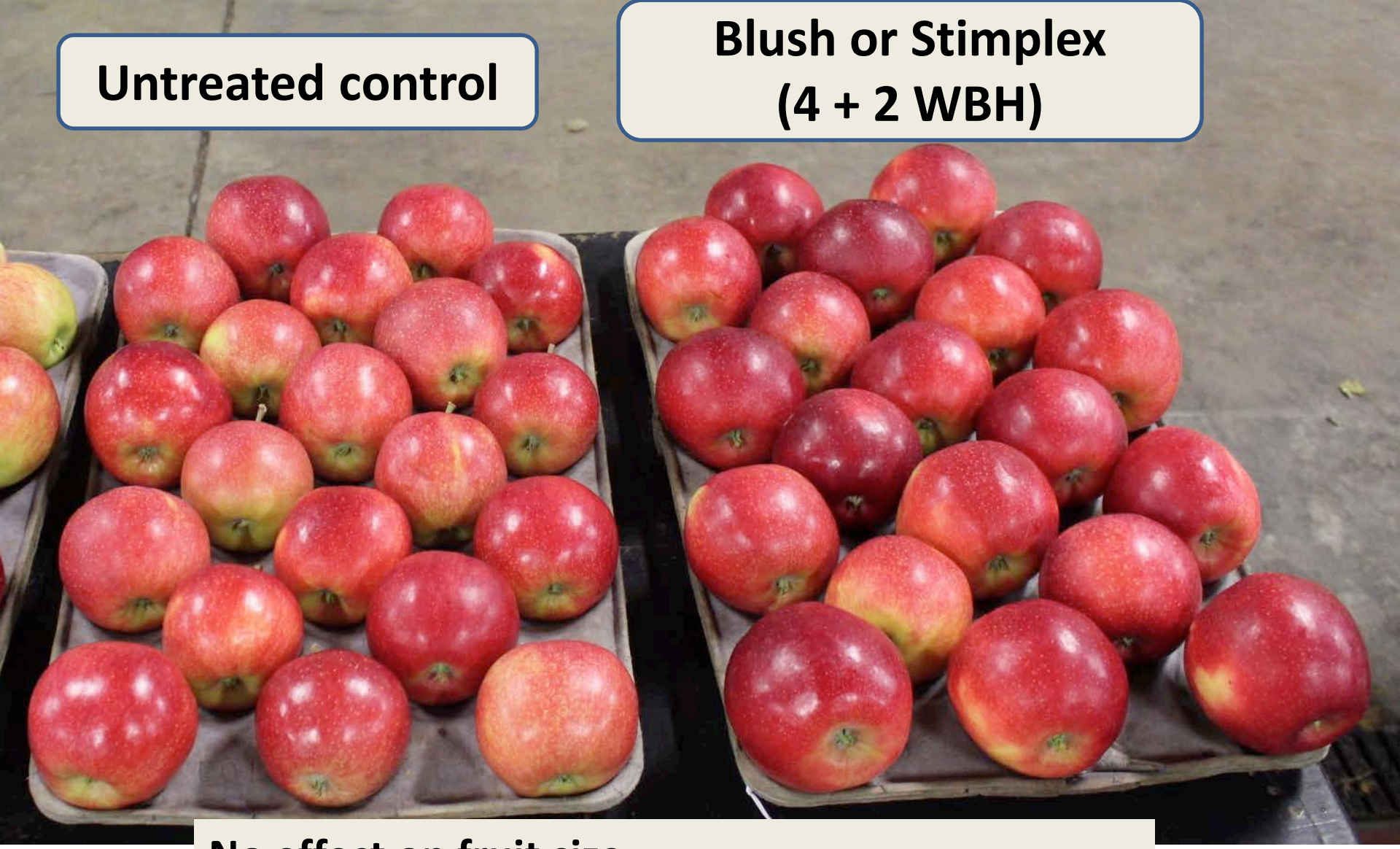
ABA

- ABA is a mild apple/pear thinner
- Good combination partner for other chemicals (6-BA)
- Works best in carbohydrate deficit
- Applied at 150-400 ppm
- Registered as grape coloring agent, under evaluation for apple and pear post-bloom thinning (and for ORGANIC production, as well!)

Improving Apple Color

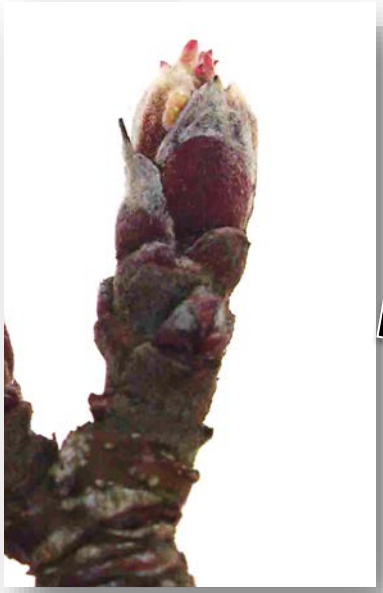


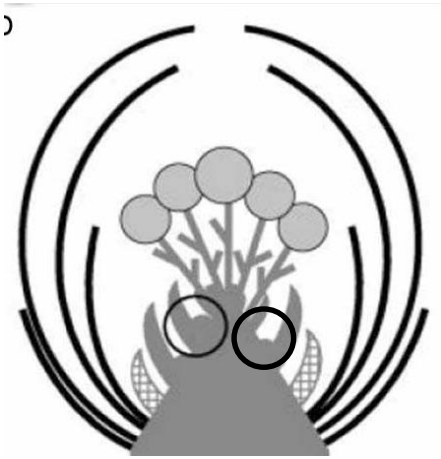
2 applications each treatment – 4 and 2 weeks before harvest



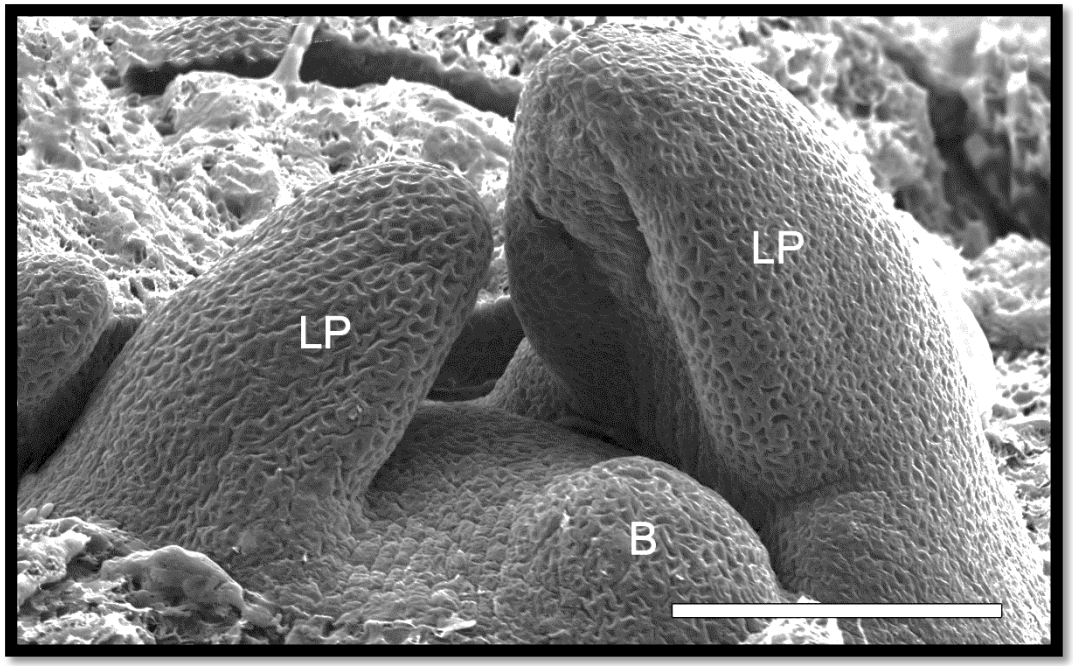
No effect on fruit size
No effect on fruit drop
No effect in fruit quality (SS and firmness)

Apple Flower Development



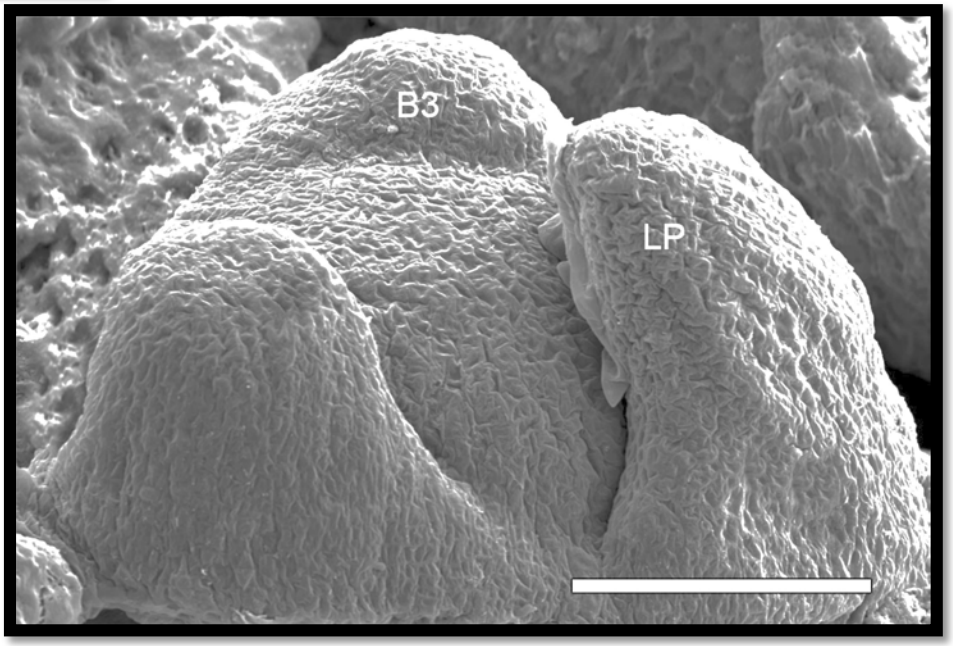


Foster et al., 2003



Stage 0

Vegetative stage
Flat meristem

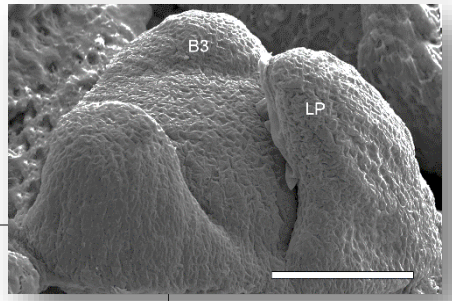


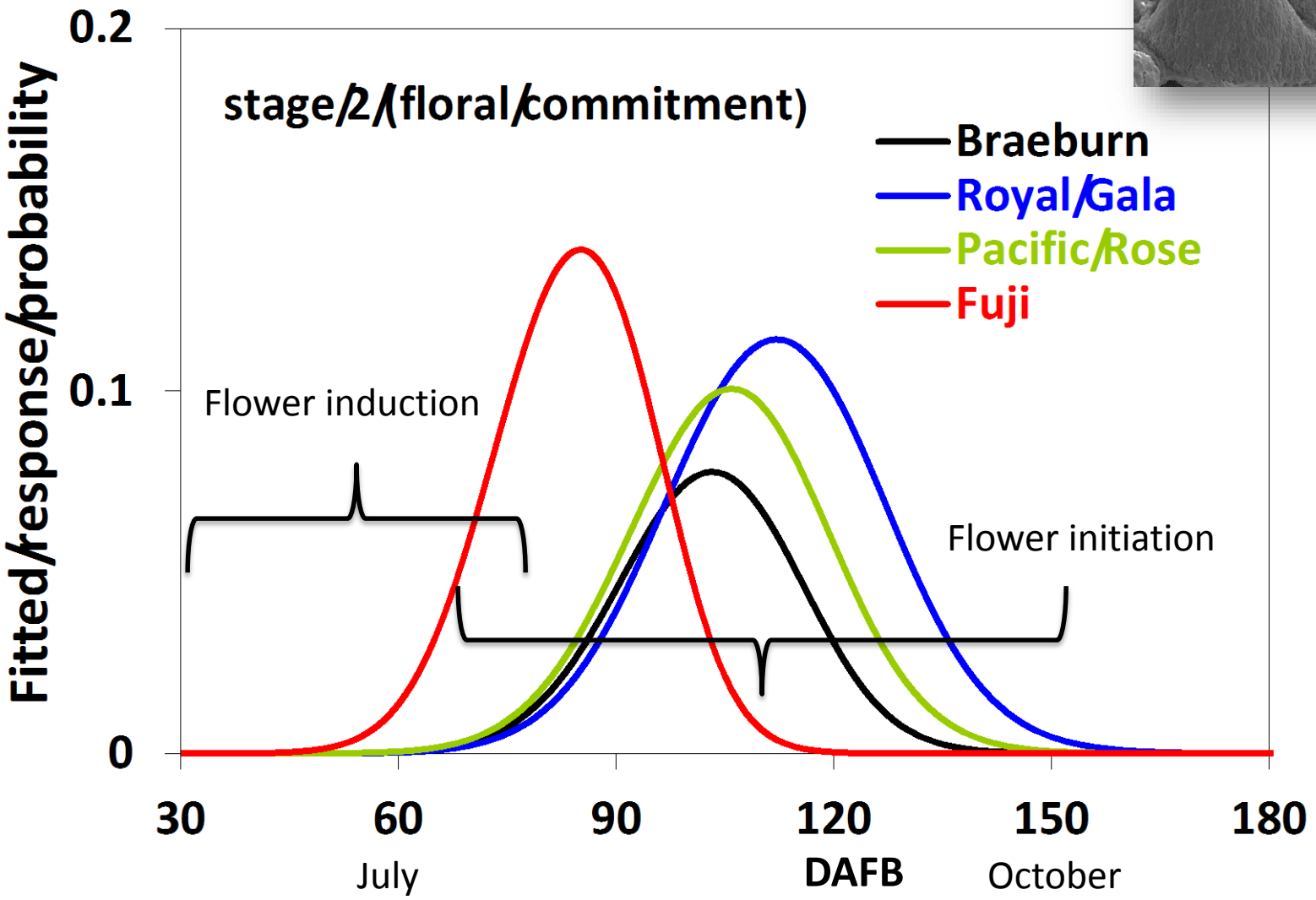
Stage 1

Domed apex (meristem)
Flower initiation

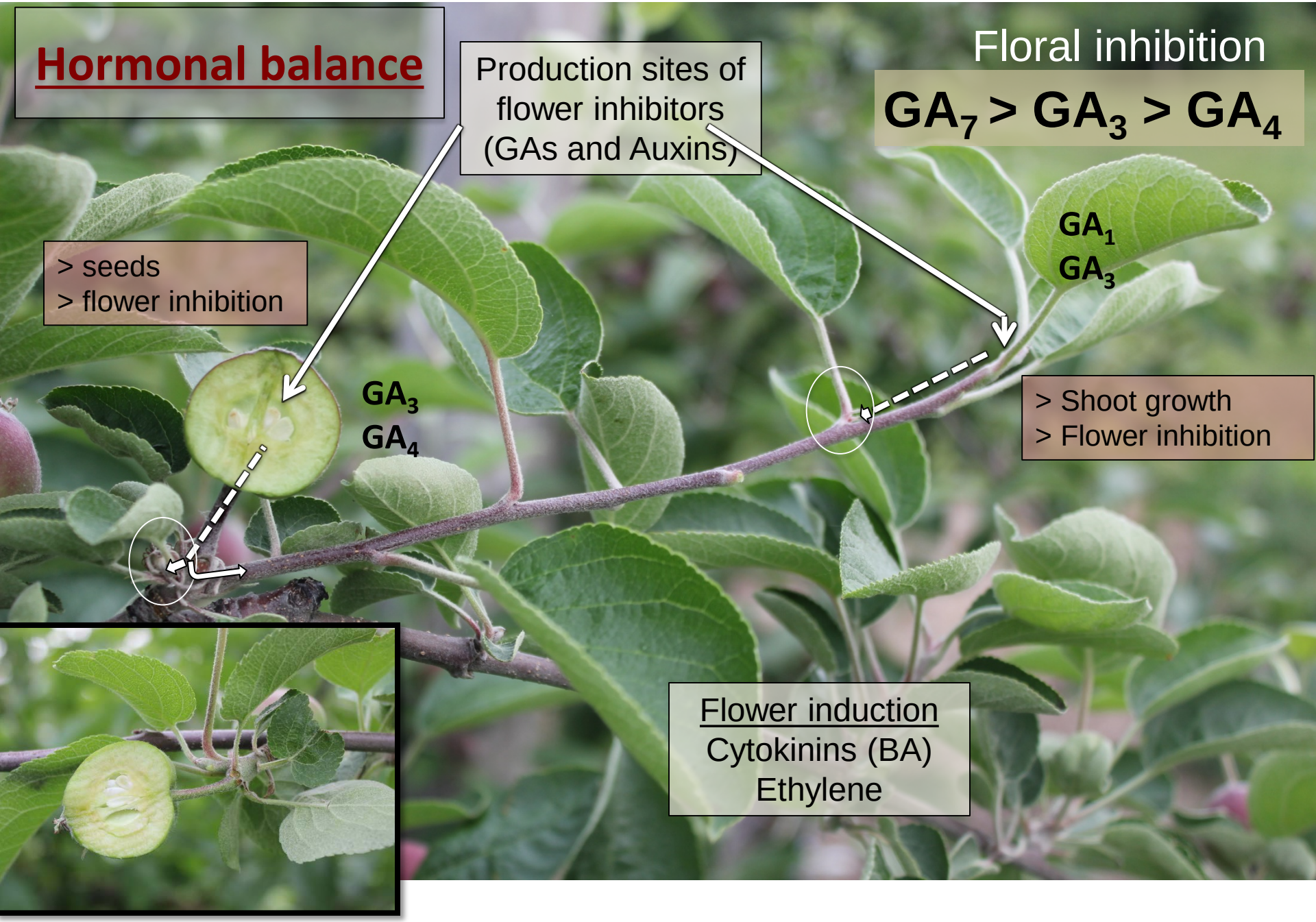
Fotos: MEV. Barra: 100µm
Source: Francescatto, P. 2014

Flower initiation in apples





Fonte: Hoover et al. (2004)


Hormonal balance
Production sites of flower inhibitors (GAs and Auxins)
Floral inhibition
$GA_7 > GA_3 > GA_4$
> seeds
> flower inhibition
GA_3
GA_4
GA_1
GA_3
> Shoot growth
> Flower inhibition
Flower induction
Cytokinins (BA)
Ethylene

Control of Biennal Bearing

To promote return bloom of apple trees cvs. Honeycrisp and Fuji – (and pears)

Trt No.	30 DAFB	37 DAFB missed	44 DAFB	51 DAFB	58 DAFB	65 DAFB
1.	Untreated control	Untreated control	Untreated control	Untreated control	Untreated control	Untreated control
2.	Ethephon	Ethephon	Ethephon	Ethephon	Ethephon	Ethephon
3.	NAA	NAA	NAA	NAA	NAA	NAA
4.	Ethephon +NAA	Ethephon +NAA	Ethephon +NAA	Ethephon +NAA	Ethephon +NAA	NAA
5.	Ethephon	Ethephon	Ethephon	NAA	NAA	NAA
6.	NAA	NAA	NAA	Ethephon	Ethephon	NAA
7.	Ethephon +NAA	Ethephon +NAA	Ethephon +NAA	NAA	NAA	NAA
8.	NAA	NAA	NAA	Ethephon +NAA	Ethephon +NAA	NAA

Results – to be analyzed in 2016

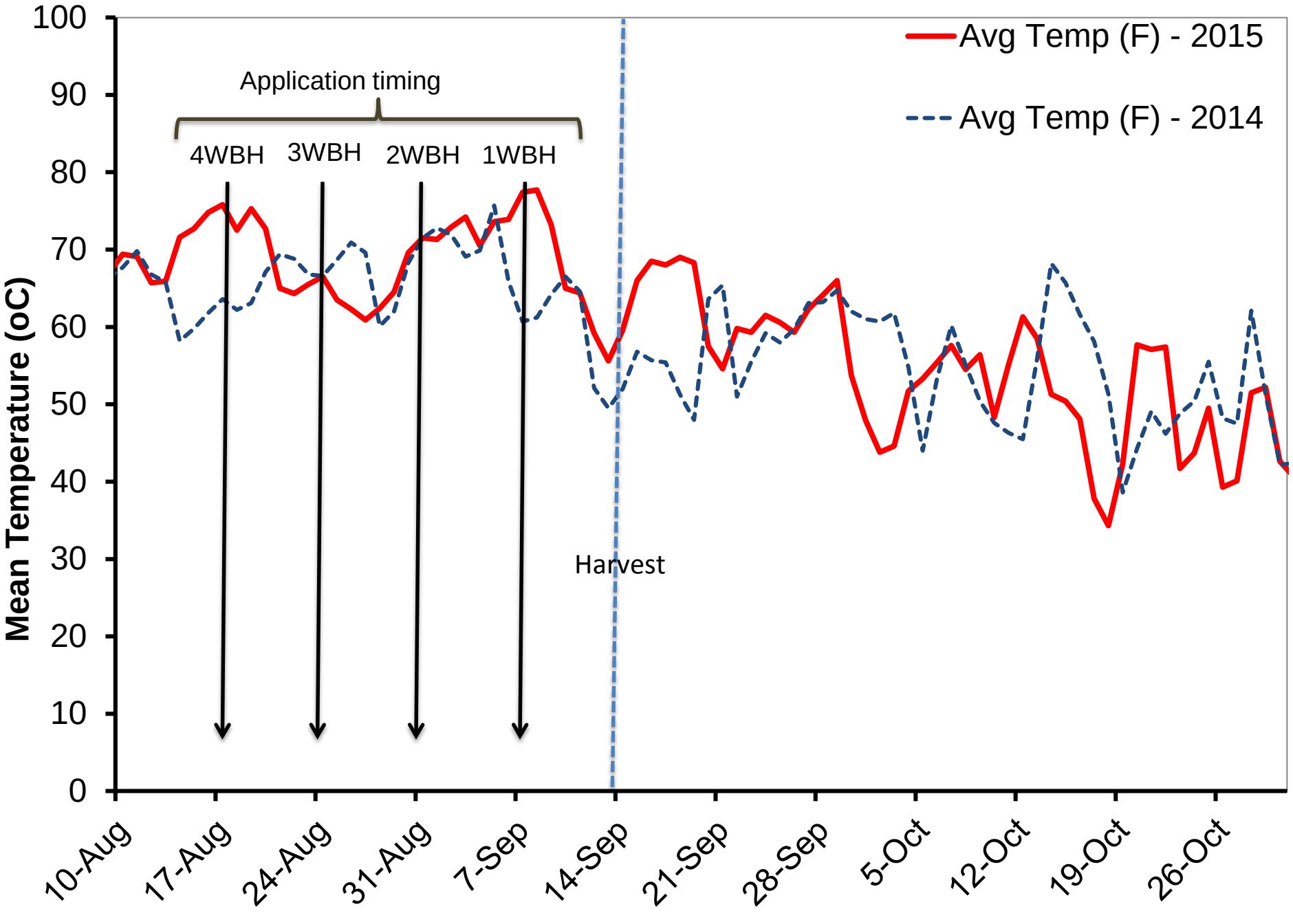
Small doses

Pre-harvest drop control:

To study the effect of Retain and/or Harvista on fruit drop control and fruit quality;

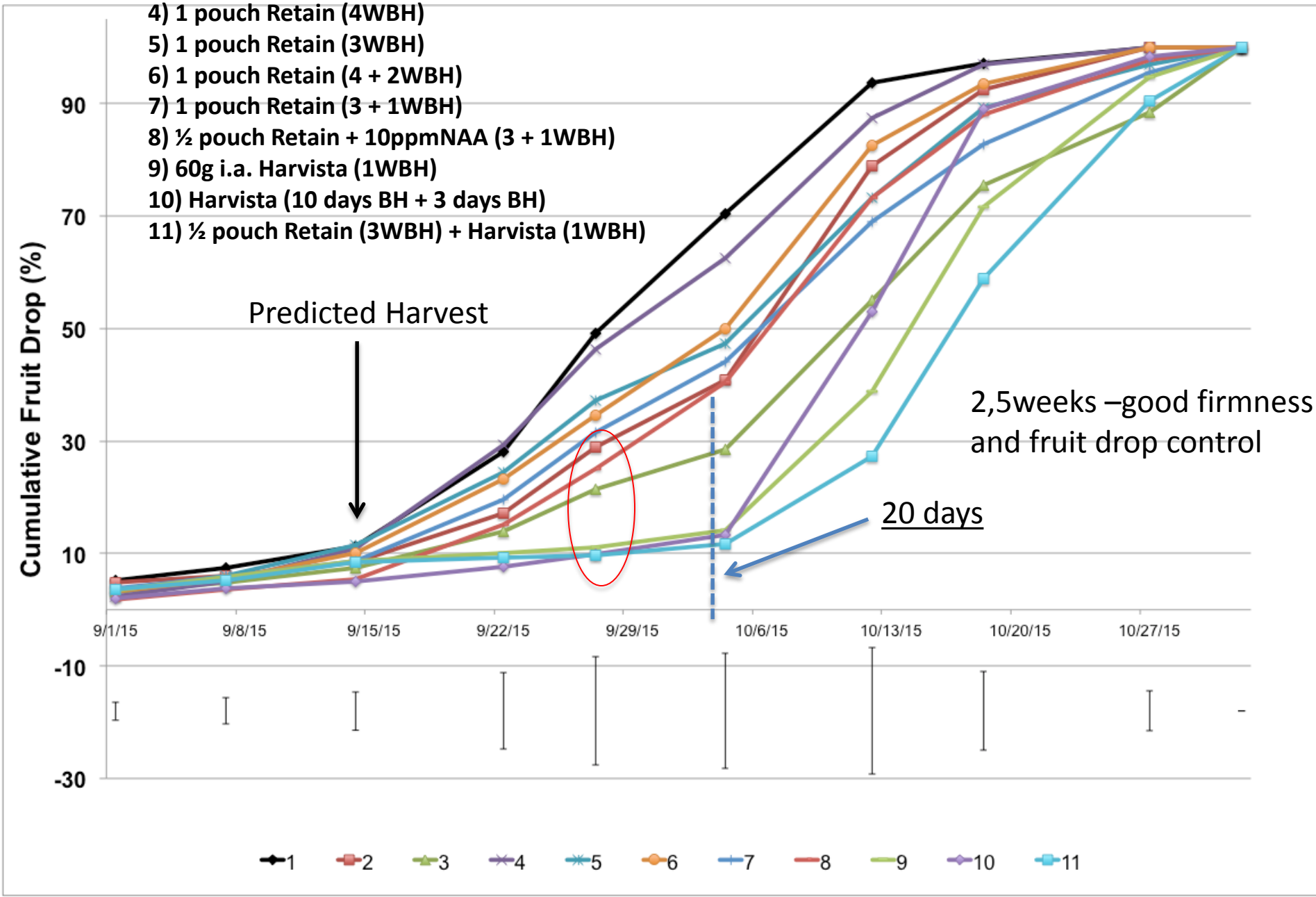
Variety: McIntosh Marshalls/M9
19 year old trees

- % Fruit drop (from 9/14 (2WBCH) to 10/27;
- Fruit quality at harvest (color, firmness, starch, sugar) – 5-6 weekly picks;
- Fruit quality after regular cold storage (firmness, sugar and disorders)


Avg Temp (F) - 2015
Avg Temp (F) - 2014
Application timing
4WBH
3WBH
2WBH
1WBH
Harvest
Mean Temperature (oC)
100
90
80
70
60
50
40
30
20
10
0
10-Aug
17-Aug
24-Aug
31-Aug
7-Sep
14-Sep
21-Sep
28-Sep
5-Oct
12-Oct
19-Oct
26-Oct

1) Untreated control
2) 2 pouch Retain (4WBH)
3) 2 pouch Retain (3WBH)
4) 1 pouch Retain (4WBH)
5) 1 pouch Retain (3WBH)
6) 1 pouch Retain (4 + 2WBH)
7) 1 pouch Retain (3 + 1WBH)
8) ½ pouch Retain + 10ppmNAA (3 + 1WBH)
9) 60g i.a. Harvista (1WBH)
10) Harvista (10 days BH + 3 days BH)
11) ½ pouch Retain (3WBH) + Harvista (1WBH)

Variety: McIntosh Marshalls



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Thank you!!

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