

# **PGRs 101: Tools for Modern Fruit Production**

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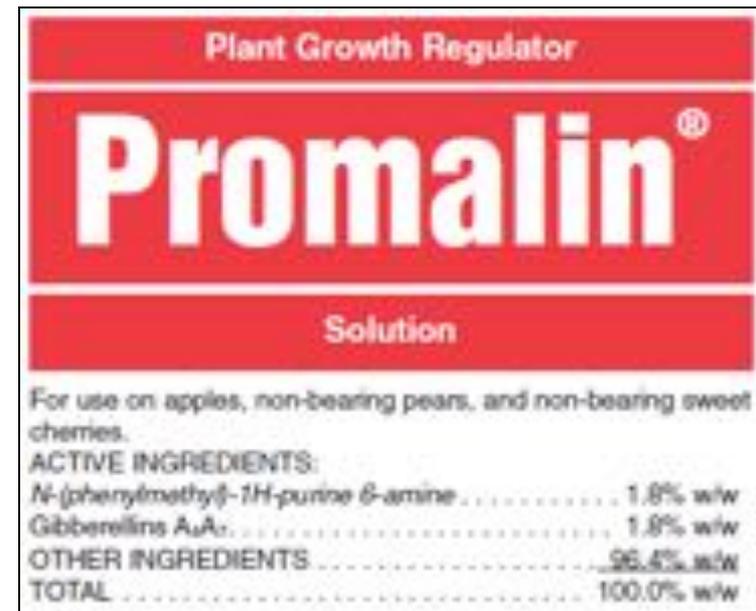
***Gregory Clarke • Field Scientist***

*February 24, 2016*

*Products That Work, From People Who Care®*

## Plant Growth Regulator

- A compound synthesized in one part of a plant and translocated to another part where, at very low concentrations, it produces a physiological response
- Naturally occurring or synthetic; +/- organic
- Traditional classes:
  - Auxins
  - Gibberellins
  - Cytokinins
  - Abscisic acid
  - Ethylene



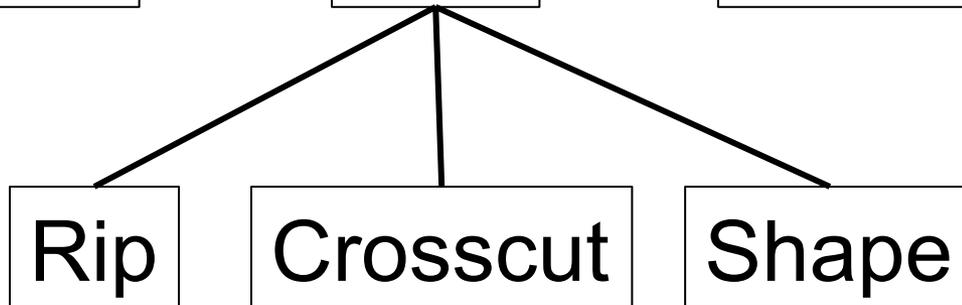
The image shows a label for Promalin Plant Growth Regulator Solution. The label is red and white. At the top, it says "Plant Growth Regulator". Below that, "Promalin" is written in large white letters on a red background. Underneath, it says "Solution". At the bottom, there is a table of ingredients and their percentages.

Plant Growth Regulator	
<b>Promalin<sup>®</sup></b>	
Solution	
For use on apples, non-bearing pears, and non-bearing sweet cherries.	
ACTIVE INGREDIENTS:	
<i>N</i> -(phenylmethyl)-1H-purine 6-amine	1.8% w/w
Gibberellins A <sub>6</sub> A <sub>7</sub>	1.8% w/w
OTHER INGREDIENTS	96.4% w/w
TOTAL	100.0% w/w

# “THE GREAT TOOL ANALOGY”



Class

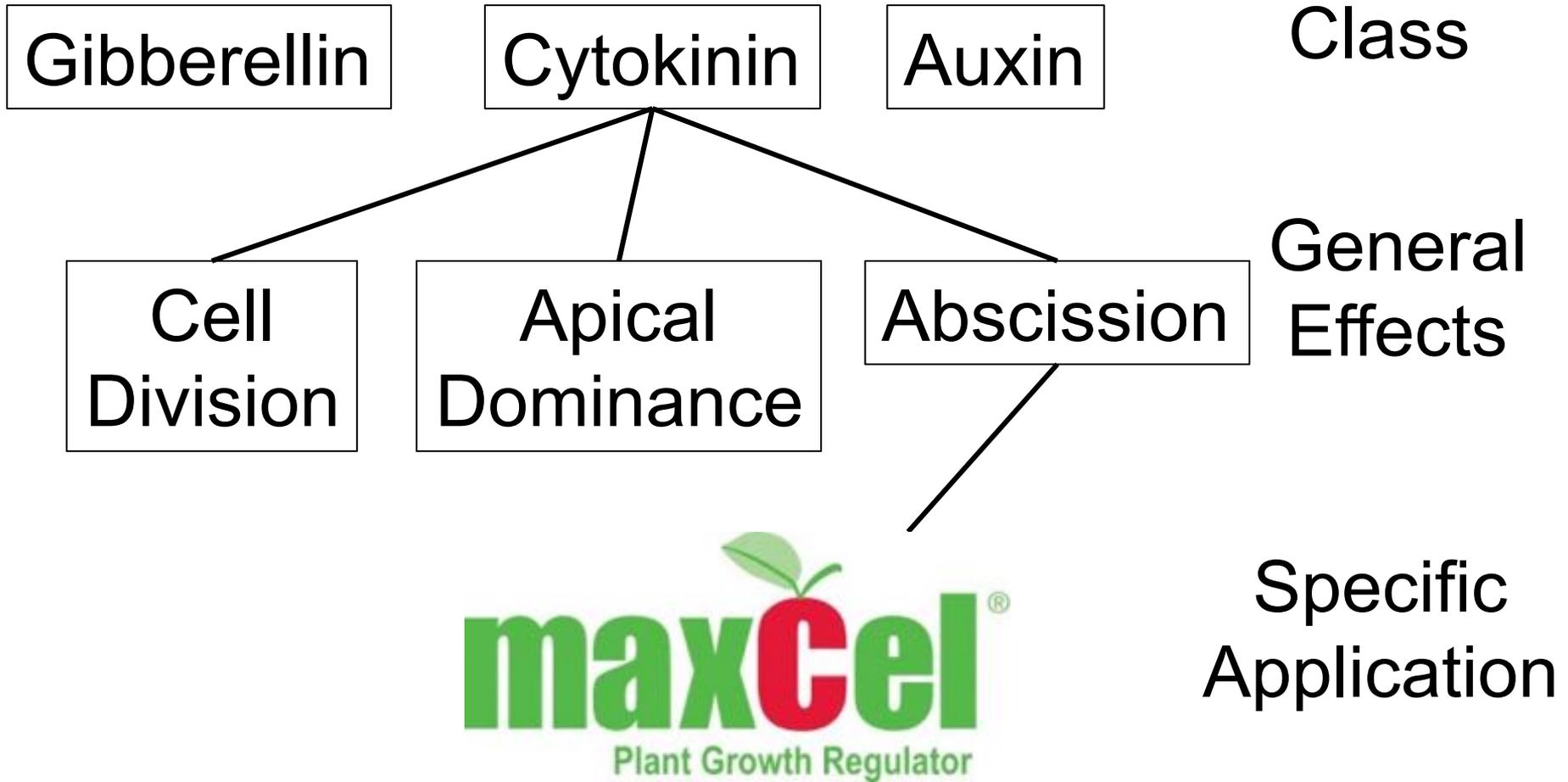


General Effects



Specific Application

# “THE GREAT TOOL ANALOGY”



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Often more than one tool for the job:



Combination of tools gives better results:



# “THE GREAT TOOL ANALOGY”



Often more than one tool for the job:

- Improve fruit set:
  - Promalin (6BA, GA4,7)
  - ReTain (AVG)

Combination of tools gives better results:

- Harvest Management:
  - ReTain + PoMaxa (AVG + NAA)
- Thinning:
  - MaxCel + PoMaxa (6BA + NAA)



## **Crop Protection**

- Expenditures that are necessary & unavoidable to produce crops at expected quality & yield

## **Plant Growth Regulators**

- Investments to maximize the genetic potential of a crop and to optimize yield & quality
- One part of an integrated program to achieve horticultural and financial objectives

## **“Not your grandfather’s toolbox”**

- New registrations, new use patterns for old materials, new basic understanding of how and where PGRs fit in production systems.

# PGRs in Tree Fruit Production



- Branching in the nursery or orchard
- Fruit set
- Thinning
- Fruit sizing / shape
- Return bloom
- Vegetative growth control
- Russet / cracking control
- Harvest aids
- Drop control
- Regulators of fruit maturity



# PGRs in Tree Fruit Production



- Problem solving matrix

	Auxin	ABA	AVG	ACC	Cytok.	Ethyl.	Gibb.	1-MCP	Pro Hex-Ca.
■ Branching					X		X		
■ Fruit set			X				X		
■ Thinning	X	X		X	X	X			
■ Fruit sizing / shape					X		X		
■ Return bloom	X					X	X		
■ Veg. growth control									X
■ Russet / cracking control							X		X
■ Harvest aids				X		X			
■ Drop control	X		X					X	
■ Reg. of fruit maturity		X	X	X		X	X	X	

Note: Not all uses registered

# Auxins



- Cell enlargement
- Apical dominance
- Rooting promotion
- ➔ Fruit thinning
- ➔ Fruit drop prevention



- Products:
  - Fruitone, PoMaxa, Fruit Fix, refine, etc. (NAA)
  - Amid Thin (NAD)
- New Developments:
  - NAD in “precision crop load management”
  - NAA + AVG harvest management.

# Abscisic Acid



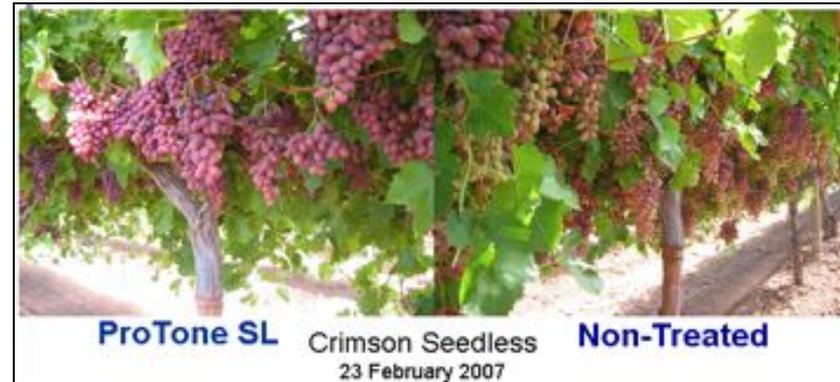
- Promotes leaf & fruit abscission
- Regulates dormancy in perennials
- Controls hydraulic status through stomata opening control
- Promotes color development in grapes

- **Products:**

- ProTone (ABA)

- **New developments:**

- Grape thinning agent
  - Apple and Pear thinning agent
  - Nursery defoliation



# Gibberellins

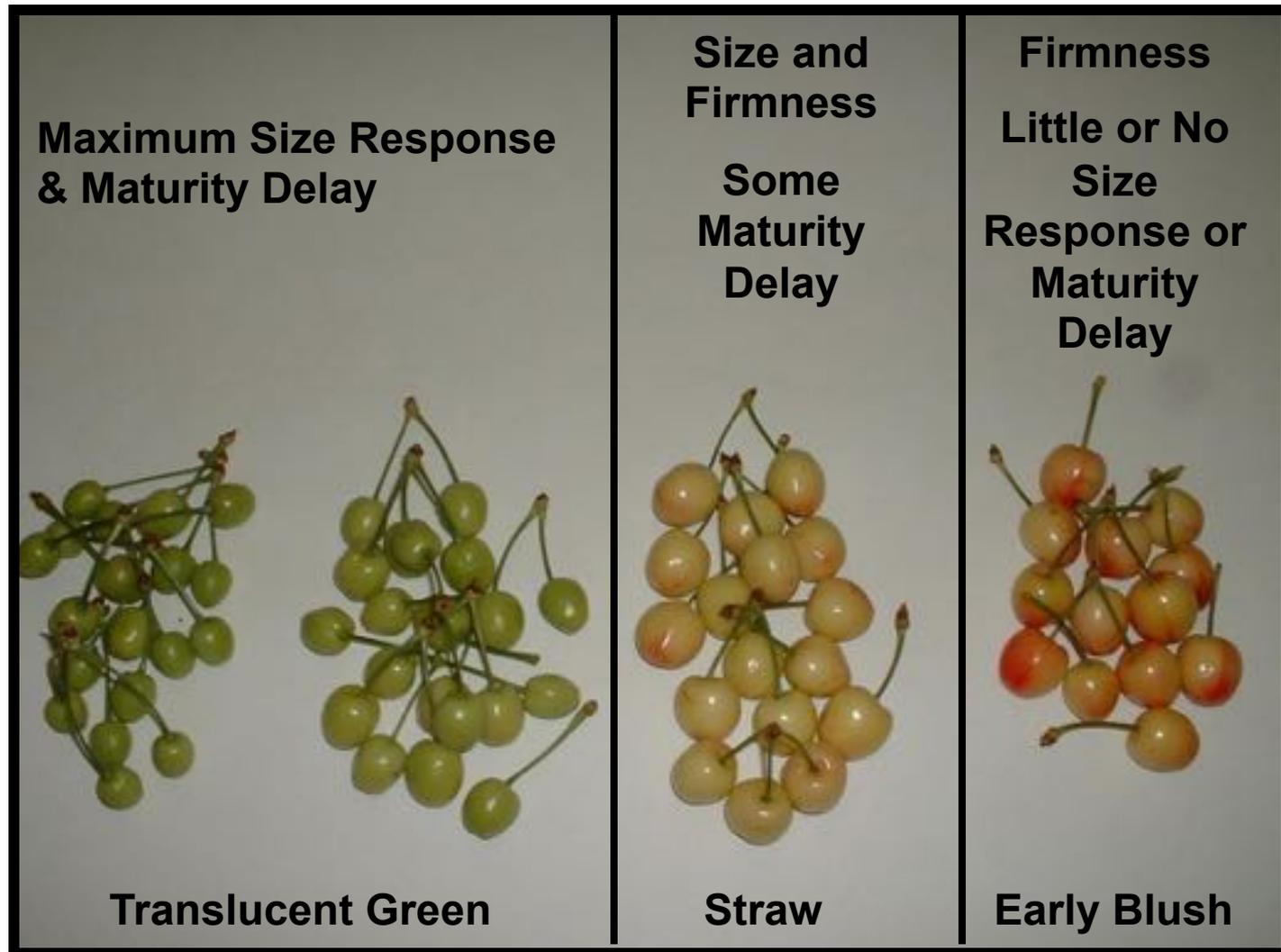
- There are 126 GAs, only a few are bioactive
- Cell enlargement
- Promotes fruit set (parthenocarpy)
- Flower induction, sex expression
- Flower reduction (thinning)
- Break of dormancy
- Increase seed germination
- Delay of senescence
- Russet reduction
- Products:
  - ProGibb (GA3), ProVide (GA4,7), Promalin (GA4,7+6BA)
- New Developments:
  - Promalin for apple fruit set after frost event



# *ProGibb – Timing determines response*



- *ProGibb* (GA<sub>3</sub>) Timing on Sweet Cherry



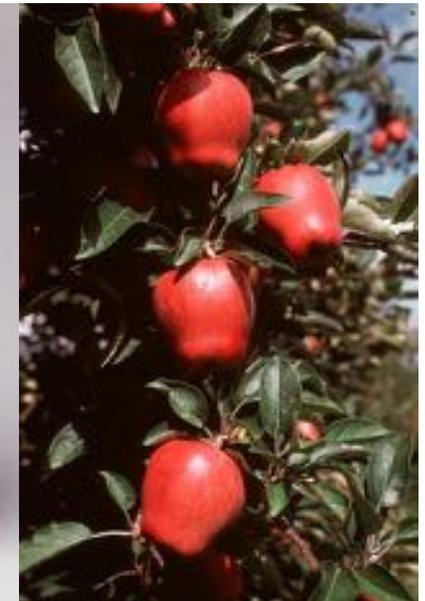
# Increasing fruit set with PGR's



- *GA 4+7, 6-BA (Promalin®)*

**Promalin®**  
Plant Growth Regulator

- Traditional use – increase fruit size and typiness
- Applied from early bloom to petal fall



- Increase Fruit Set in Apple & Pear
  - Used commercially in Europe
  - Gibberellins and other hormones critical for fruit set
  - Gibberellins promote parthenocarpic Fruit Set
    - Increase set after killing frost
    - poor pollination conditions
    - low performing (yielding) blocks



# Improved Set – Frost Rescue



- *Promalin* for Frost Recovery

Treatment	Total Yield (lbs / tree)	Bushels / acre	No. Fruit / tree
Untreated Control	25.8 a	94	58 a
Promalin (1 pt/acre)	81.0 b	296	195 b
Promalin (2 pts/acre)	74.7 b	273	185 b
<b>Significance</b>	<b>&lt;0.0001</b>		<b>&lt;0.0001</b>

Effects of *Promalin* application after two freeze events in 2012 on total yield and fruit number per tree of 'Taylor Spur Rome' apple at harvest. Means followed by different letters are significantly different at  $P < 0.05$  using Duncan's Multiple Range test. Steve McArtney • NCSU



# Cytokinins



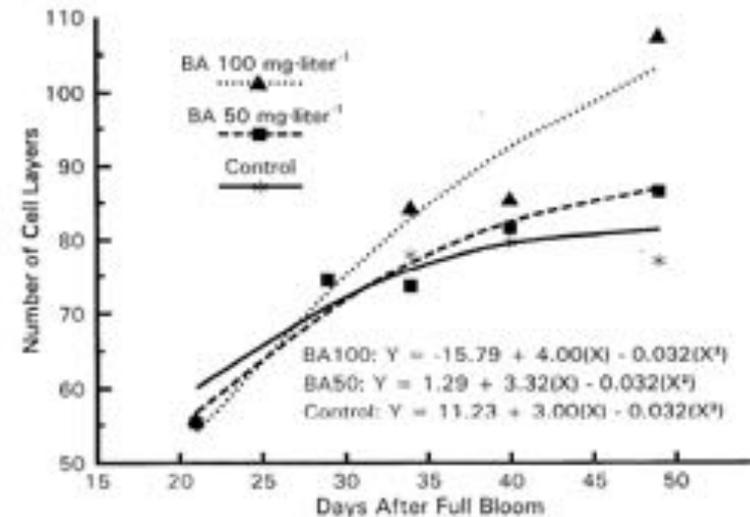
- Cell division
- Counteract apical dominance
- Branching agent
- Delay of senescence
- Cause fruit abscission

- Products:

- MaxCel (6BA), Promalin (GA4,7 + 6BA)

- New Developments:

- MaxCel branching label
- Work differentiating MaxCel and Promalin branching uses



Wismer et al., 1995



# Use of Multiple Applications of Maxcel and Promalin to Produce Feathered Trees

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Keywords: apple varieties, nursery trees, PGR



### INTRODUCTION

Feathered nursery trees are a critical component of most high-density apple planting systems including the Tall Spindle. As the benefits of highly feathered trees were discovered, it became necessary to develop nursery management techniques to stimulate lateral branch development.

of Fuji apple nursery trees. The trial used a randomized complete-block design with 4 replications distributed down a row. Each experimental unit was a section of row consisting of 5 trees. Proprietary formulations of cyclanilide (Tiberon) and benzyl adenine (Maxcel) and Promalin (a mixture of 50% benzyl adenine and 50% GA4+7) were used in the trials. All plant



### Apple Nursery Stock, Northeast



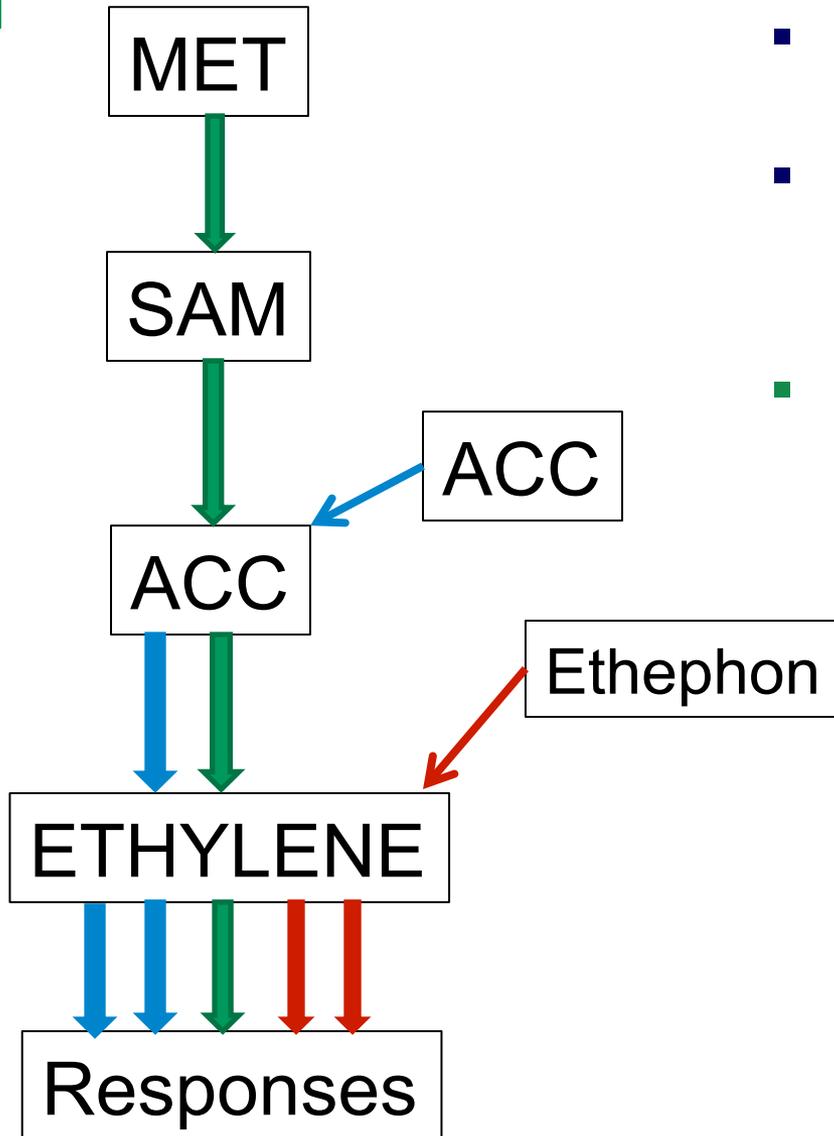
Feathering achieved using three applications of MaxCel at 500 ppm with a backpack sprayer.



WA: MaxCel at 1500 ppm applied at bud swell by hand with foam gloves.

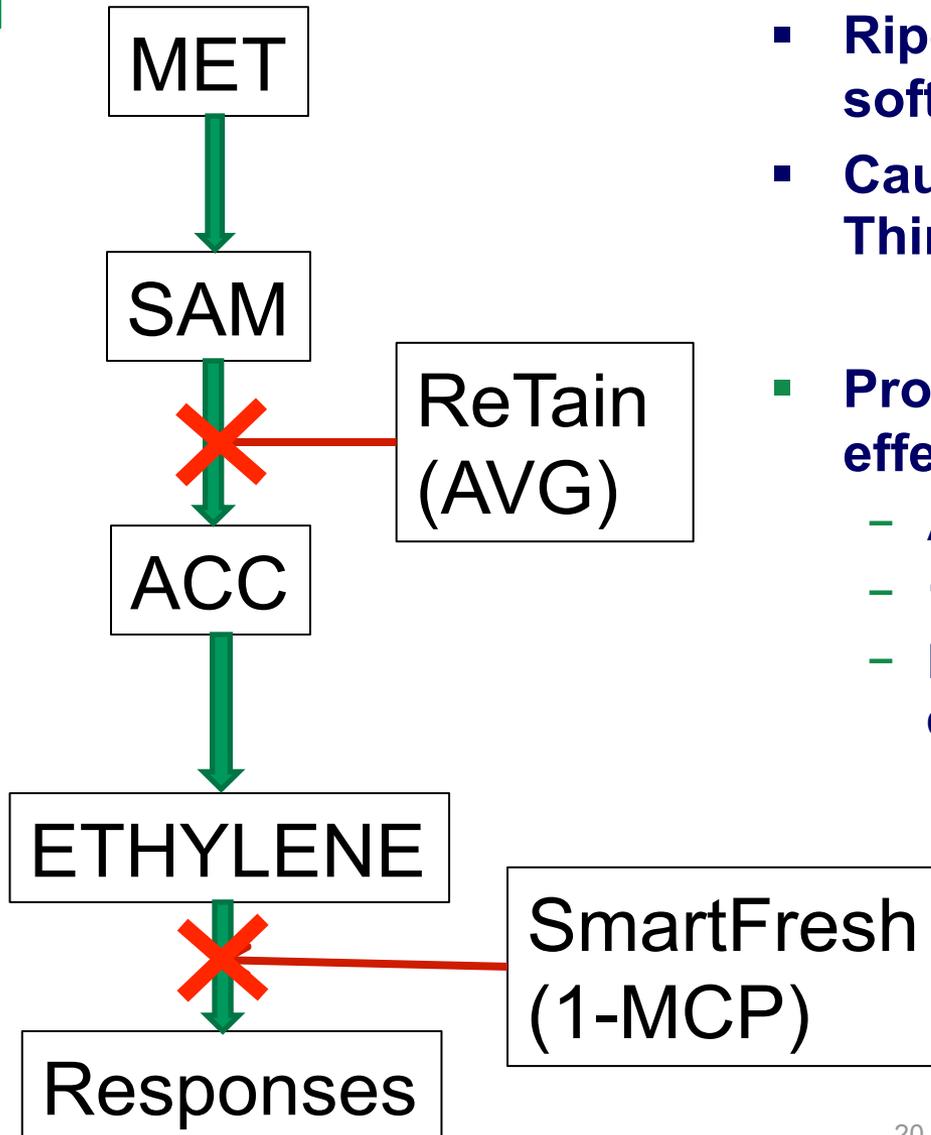


# Ethylene and Ethylene Management...



- Ripening agent → color development, softening
- Causes leaf & fruit abscission → Thinning, harvest aid
- Products to **INCREASE** ethylene and its effects:
  - Ethrel / Ethephon
  - In development: ACC
    - Thinning
    - Color development
    - Defoliation

# Ethylene and Ethylene Management...



- Ripening agent → color development, softening
- Causes leaf & fruit abscission → Thinning, harvest aid
- Products to **REDUCE** ethylene and its effects:
  - AVG: ACC biosynthesis inhibitor
  - 1-MCP: Ethylene action inhibitor
  - Drop control, delay ripening, maintain quality, etc.

## New Developments:

- Fruit set uses of ReTain
- Higher ReTain label rates for enhanced effects

# ReTain Fruit Set - Cherry



- Longevity of Cherry Flowering



## Stage 0

Popcorn



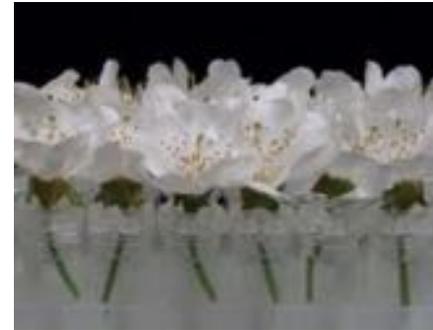
## Stage 1

Freshly opened flowers; Stigmatic surface green & wet; Pollen shedding started.



## Stage 2

Petals sound; stigmatic color yellowish-green; Pollen shedding.



## Stage 3

Petals sound; Sepal brown; stigmatic activity decreased.



## Stage 4

Petals started to dry; No stigmatic activity; Stigma dried.



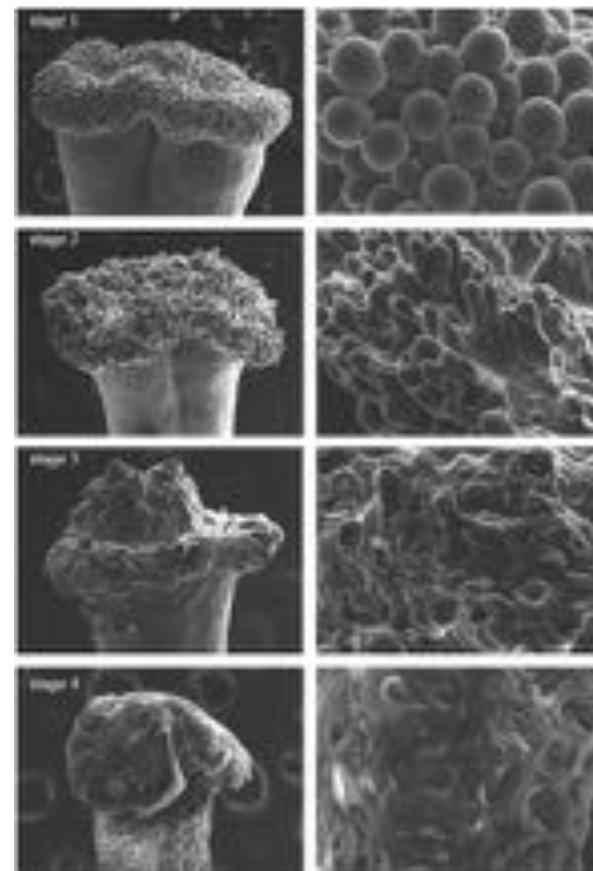
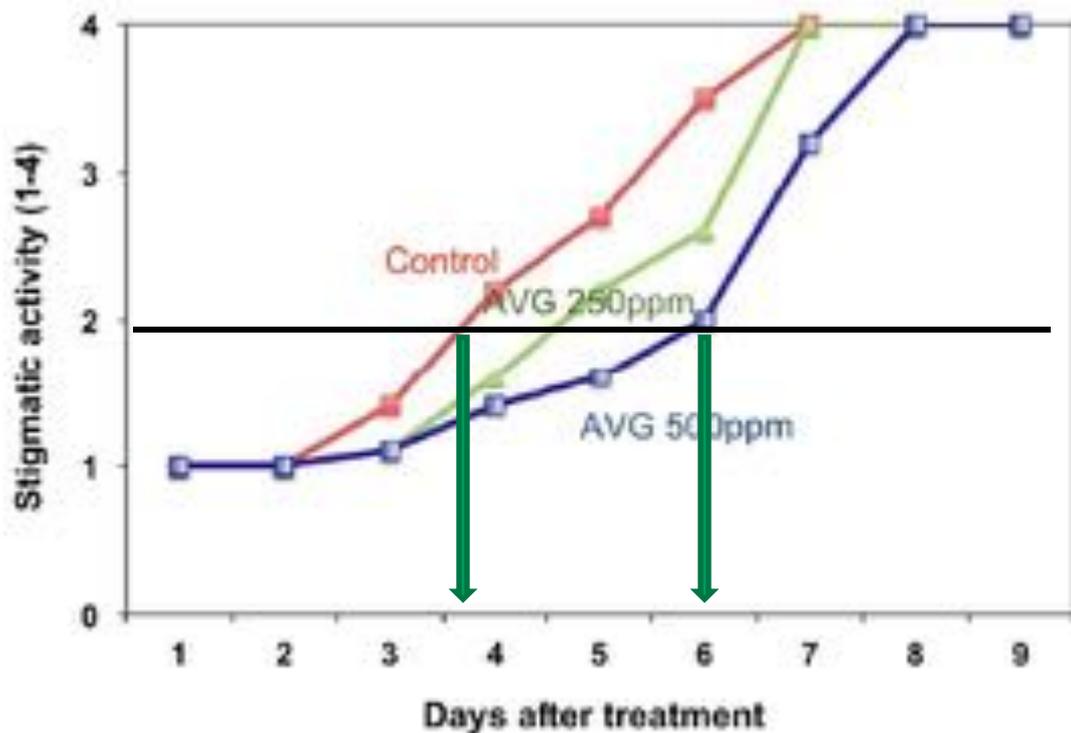
## Stage 5

Flowering is over. All flower parts turned brown and dried.

# ReTain Fruit Set - Cherry



- *ReTain* to Increase Fruit Set
  - Extends Blossom Viability



Field Rep: Clarke  
Investigator: Racsko  
ExSum#: 2011gclar042

Crop: Cherry  
Cultivar: Regina  
Application Date: Popcorn/  
Full bloom

Harvest Date:  
Site: Berlin Heights,  
OH  
Country: US



- **New Use Pattern:**
  - **2 pouch maximum**
  - **One or two applications**
    - **28 DBH**
    - **28 DBH + 7 DBH**
  - **Extended drop control**
  - **Extended delay in maturity**
  - **More time for color, size**
  - **Reduction in watercore, cracking**

**Supplemental Label**





EPA Reg. No. 73049-45

(For Use In: AK, AL, AR, CO, CT, DC, DE, FL, GA, HI, IA, ID, IL, IN, KS, KY, LA, MA, MD, ME, MI, MN, MO, MS, MT, NC, ND, NE, NH, NJ, NM, NV, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VA, VT, WA, WI, WV and WY Only)

**RETAIN<sup>®</sup> PLANT GROWTH REGULATOR SOLUBLE POWDER  
FOR USE ON APPLE AND PEAR  
FOR HARVEST MANAGEMENT AND IMPROVED FRUIT QUALITY**

This supplemental labeling expired on March 15, 2018 and must not be used or distributed after this date.

**DIRECTIONS FOR USE**

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

THIS LABELING MUST BE IN THE POSSESSION OF THE USER AT THE TIME OF APPLICATION. READ THE LABEL AFFIXED TO THE CONTAINER FOR RETAIN<sup>®</sup> PLANT GROWTH REGULATOR SOLUBLE POWDER BEFORE APPLYING. USE OF RETAIN<sup>®</sup> PLANT GROWTH REGULATOR SOLUBLE POWDER ACCORDING TO THIS LABELING IS SUBJECT TO THE USE PRECAUTIONS AND LIMITATIONS IMPOSED BY THE LABEL AFFIXED TO THE CONTAINER FOR RETAIN<sup>®</sup> PLANT GROWTH REGULATOR SOLUBLE POWDER.

**APPLE AND PEAR – FOR HARVEST MANAGEMENT AND IMPROVEMENT OF FRUIT QUALITY**

CROP	OBJECTIVE / BENEFIT:	APPLICATION TIMING/ USE INSTRUCTIONS
Apple	Single Application: Depending on cultivar, orchard conditions, application timing, and grower objectives, one or more of the following benefits will be associated with ReTain <ul style="list-style-type: none"> <li>• Delayed fruit maturity</li> <li>• Improved harvest management</li> <li>• Reduced preharvest fruit drop</li> <li>• Additional time for increase in fruit size</li> </ul>	Single Pick Harvest: Apply one to two pouches of ReTain per acre 21 to 28 days prior to the anticipated beginning of the normal harvest period of untreated fruit. ReTain applied 21 to 28 days before harvest will delay the harvest period up to 7 to 10 days. Applications made either too early or too late will significantly reduce the efficacy of the product.

# Bisbee Red Delicious, 2015



1 Pouch



2 Pouches



**Effect of ReTain rate on drop of Bisbee Red Delicious, Ortanna, PA. One pouch (left), Two pouches (right). Application on 8/28; photo on 10/12 (45 DAA).**

# ReTain: 2 Pouches on Honeycrisp



**Phil Schwallier / MSU:**

- 1 Pouch @ 30 DBH
- 2 Pouches: 1 @ 30 DBH + 1 @ 7 DBH
- Photo 10/15: 33 days after normal harvest

**New Options:**

- PYO
- New Markets

**UTC      1 Pouch      2 Pouches**

**Green  
Side**



**Red  
Side**

# *Precision Application of PGRs*



- Responses to PGR Applications are Strongly Influenced by:
  - Environment
  - Application Timing
  - Rate
  - Application Volume
  - Coverage
  - Water Quality
  - Adjuvants
- Cultivar, Rootstock, Tree Age, Tree Vigor, Crop Load, Training System, Tree Nutrition, Application Equipment



## Plant Growth Regulators

- Powerful tools for maximizing the potential of your crop
- Several general classes of PGRs exist with unique and overlapping affects on plants
- New products and registered uses are expanding the options for fruit growers

Thank You!

