

Thinning with 6-BA (MaxCel®) & Enhancing Return Bloom using Ethephon and NAA

John A. Cline
Department of Plant Agriculture
University of Guelph



Outline

MaxCel ®

- Differences with Accel ®
- Suggested use patterns
- Research Results

Enhancing Return Bloom with PGRs

- Flowering
- Biennial bearing
- Strategies

Features

- Active ingredient in MaxCel® is 6-benzyadenine (6-BA).
- a cytokinin - promotes cell division.
- Does not contains gibberellic acid (GA_{4+7})

	MaxCel®	Accel®
Percent active ingredient: 6-BA, GA₄₊₇	6-BA: 1.9 % (w/w) ----	6-BA: 1.8 % (w/w) GA ₄₊₇ : 0.18 % (w/w)
Amount of 6-BA per L of product	19.9 g/L	19.0 g/L
Cost of product (per liter)	\$112 – 126 per Litre ^{[1],[2]}	\$112 per Litre ^[1]
Container size	5 L bottle	1 L bottle
Cost per gram of 6-BA	\$5.63- \$6.33 ^{[1],[2]}	\$5.89 ^[1]
Maximum number of sprays per season	2 for thinning, 4 for fruit size enhancement	2
Amount of product/hectare per season as stated on label	0.5 to 22.5 Liters (10- 446 grams 6-BA)	1.5 to 4 Liters (28.5 - 76 grams)
Range in application rates stated on product label	10-200 mg/L (ppm)	28-75 mg/L (ppm) (based on above at 1000 L/ha)
Pre-harvest interval	86 days	28 days
Compatibility with Sevin and other pesticides	Labels states “compatibility with Sevin and other pesticides”	Label indicates “No information is available on spray tank-mix compatibility with other control products”

MaxCel® - What's New

- **Rates and number of sprays:** MaxCel® is limited to two sprays if used for thinning, and four sprays if used for fruit size enhancement.
- The total amount of product applied per season cannot exceed 446 gram 6-BA/ha (22.5 Litres/ha), which is nearly six times more 6-BA than was permitted under the Accel® label.

MaxCel® - What's New

- **Using Maxcel® to size fruit:** The product label states that Maxcel® can be used to enhance fruit with mild or no thinning.
- Two to four applications, beginning at petal fall and repeating every 3-10 days, are required
- Rates of 10-50 mg/L 6-BA (ppm) are suggested

MaxCel® - What's New

- **Using Maxcel® to Thin:** The product label states that MaxCel® can be used at rates of 75 to 200 mg/L 6-BA.
- Our experience has shown that 6-BA at concentrations ranging from 50-75 mg/L 6-BA, is a mild thinner. However, if used alone at rates up to 200 mg/L or combined with Carbaryl for harder to thin cultivars, the spray becomes much more aggressive.

Suggested rates of MaxCel® to use with or without Sevin®.

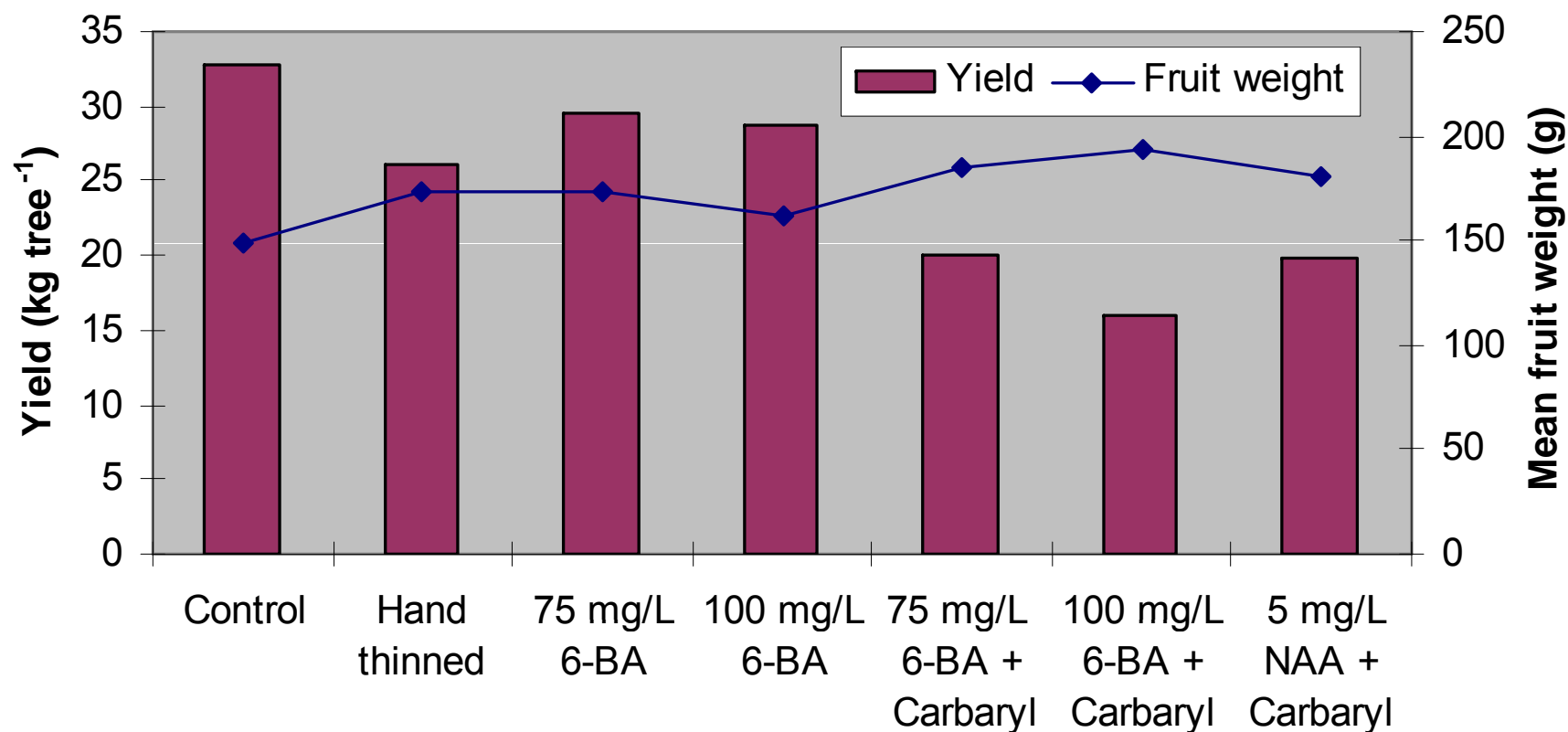
Desired Response ^[1]	Concentration of 6-BA (ppm) ^[2]	Concentration rate of Carbaryl (ppm) ^[2]	Number of Applications	Amount of MaxCel® per 1000 Litres water. Apply to 1 hectare	Amount of Sevin ® XLR Plus per 1000 Litres water. Apply to 1 hectare	Approximate cost of treatment per single application (\$/ha) ^[3]
Enhance size only ^{[4],[5]}	10 to 50	–	2 to 4	0.5-2.5 L	–	\$56 - \$280
Mild thinning and sizing	50-75	–	1 to 2	2.5-3.75 L	–	\$280 - \$420
Moderate thinning and sizing	75-100	–	1 to 2	3.75 - 5.0 L	–	\$420 - \$560
	50-75	500	1 to 2	2.5-3.75 L	1 Litre	\$296 - \$436
Aggressive thinning and sizing	100-150	–	1 to 2	5.0 - 7.5 L	–	\$560 - \$840
	75-100	500 - 1000	1 to 2	3.75 - 5.0 L	1 - 2 Litres	\$436 - \$593
Very Aggressive thinning and sizing	150 - 200	–	1 to 2	7.5 - 10 L	–	\$840 - \$1,120
	100 - 125	1000	1 to 2	3.75 - 5.0 L	2 Litres	\$453 - \$593

Effect of MaxCel and Carbaryl on yield, thinning and fruit size of 5-yr-old 'Royal Gala'/Bud.9 apple trees in 2008.

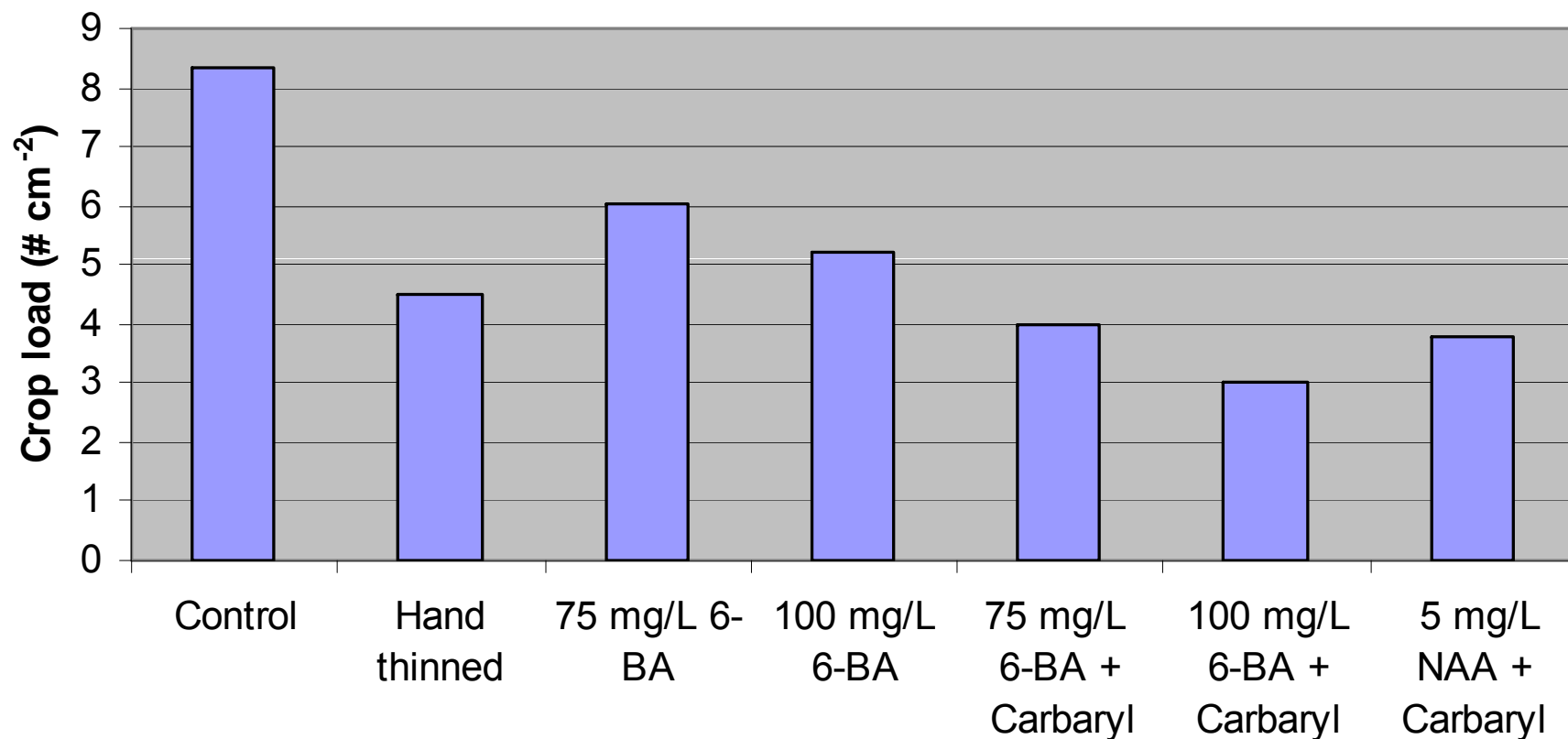
Treatment	Rate (mg/L)	Yield (kg.tree ⁻¹)	Number of fruitlets thinned	Total number fruit per tree	Mean fruit weight (g)	Crop density (#.cm ⁻²)
1. Hand thinned control		17.2	89	99	173	7.5
2. Maxcel	20 x4	15.8	79	90	177	6.3
3. Maxcel	40 x4	17.1	84	99	173	7.2
4. Maxcel + Carbaryl	80,750	12.0	43	70	173	5.2
5. Treatment 2+4		14.0	48	82	172	6.1
6. Treatment 3+4		14.2	42	78	182	5.1
significance ^z		ns	***	ns	ns	ns
LSD (P=0.05)		4.12	27.80	23.85	9.41	1.82
P value		0.1087	0.0009	0.0860	0.2466	0.0515

^z ns, ***, **, *, indicates non significance and statistical significance at P=0.001, P=0.01, and P=0.05, respectively

Effect of 6-BA and Carbaryl on Empire



Effect of 6-BA and Carbaryl on Empire



MaxCel® - Summary

- MaxCel has worked well on Empire, McIntosh, Idared, and Gala and many other varieties.
- MaxCel® thins as well as can increase fruit size
- The thinning response to 6-BA is concentration dependant
- MaxCel® at 100 to 150 ppm 6-BA will provide a stronger thinning response than what might be expected from Accel at an equivalent rate

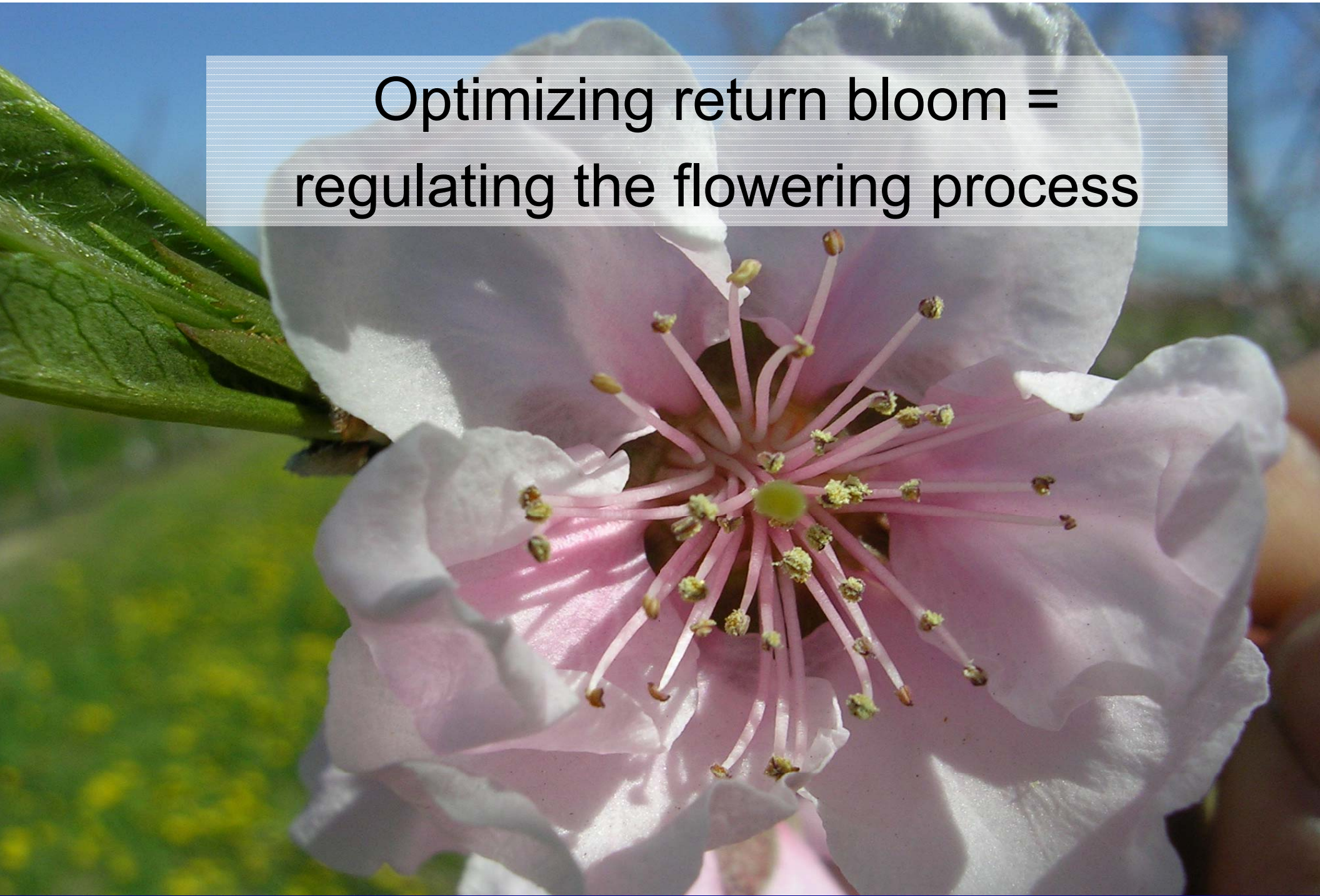
MaxCel® - Summary

- The MaxCel® label will permit a range of rate options from mild through aggressive thinning
- If mild thinning is desired, similar to the results obtained with Accel®, then 75 ppm MaxCel® is a good starting point.
- For moderate thinning with easy to moderately difficult cultivars, 75-100 ppm is acceptable, while 100-150 ppm might be used for more difficult to thin cultivars.

MaxCel® - Summary

- Apply for thinning between 5 and 15 mm fruit size.
- Apply dilute (do not concentrate more than 2X)
- Uniform and thorough coverage is essential.
- Concentrations below 50 ppm 6-BA are ineffective for thinning and single applications of at least 50 ppm are necessary for improving fruit size.
- Do not apply MaxCel® in combination with NAA or NAD (either tank mix or separate sprays) during the same growing season to Delicious or to Fuji, as this combination may result in the formation of minature fruit.

Optimizing return bloom =
regulating the flowering process



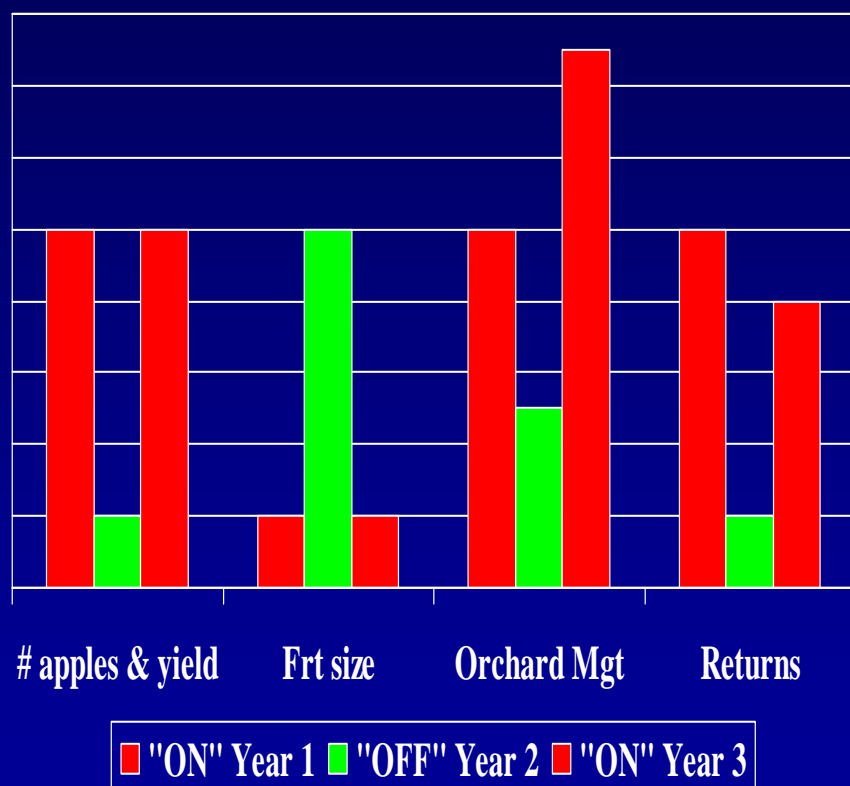
Why regulate flowering ?

1. Trees with low precocity (slow to bear fruit)
2. Production becomes biennial
3. Thinning -trees required only 5-10% of fruit to set a commercial crop

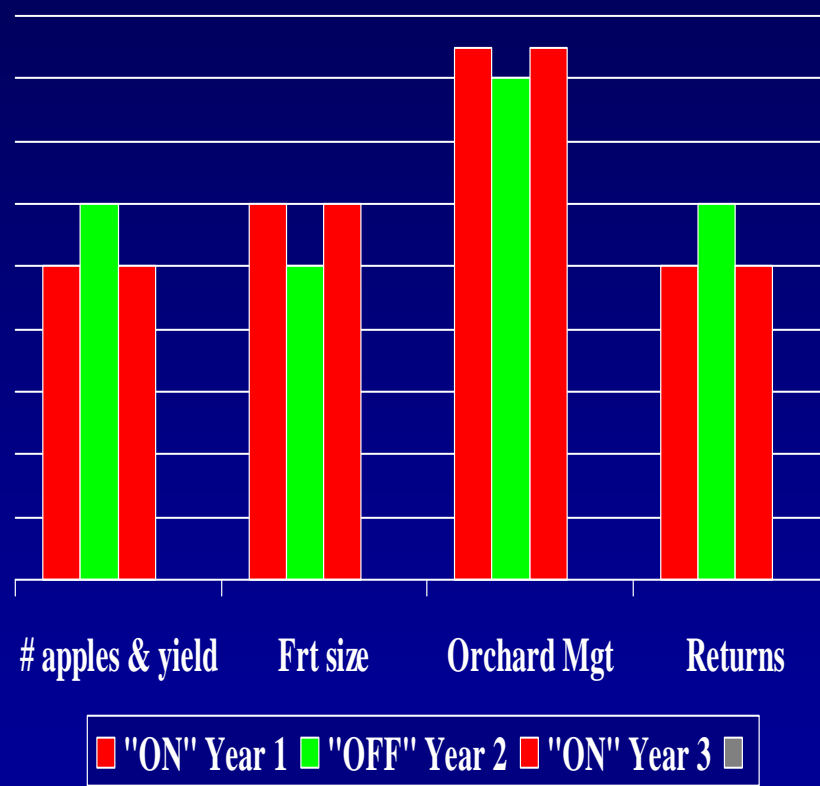


Schematic of production, management, profit production cycle over 3 years

Biennial Bearing



Annual Bearing



Biennial Bearing in Apples



Possible causes

- Nutrient diversion (Kraus and Kraybill)
- Floral inhibition produced by seeds (Chan and Cain, 1967)
- Bourse shoot length x seed no (Nelson and Dennis, 1999)

Hypotheses

- Seeds produce GA's
- Seeds compete for floral promoter

Factors influencing flowering

Decrease

- excessive nitrogen
- excessive pruning
- vigorous rootstocks
- gibberellins sprays



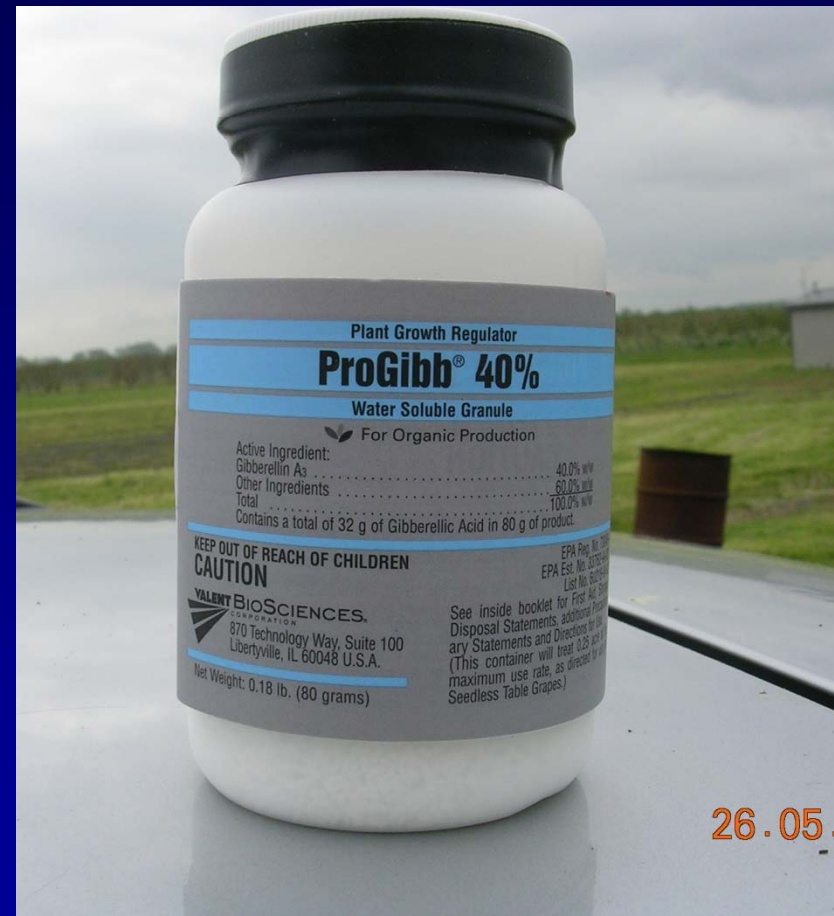
Increase

- branch bending
- branch ringing
- dwarf rootstocks
- fruit thinning
- Plant bioregulators (NAA, Ethephon)

Gibberellic Acid can be used to Selectively Inhibit Flowering

- GA₃ - stone fruit
- GA₄₊₇ - pome fruit

Concept: reduce or prevent flower initiation, thereby minimizing the requirement for chemical and hand thinning



26.05.

Flower Initiation

Definition: the first discernable change from a vegetative bud to a floral primordium

Flower Development – occurs from initiation to flowering the following season. Many floral parts are developed by harvest

Trigger: hormones, biochemical processes, environment (light, temperature, day length)

Period of Initiation

Apple	Early Summer (June, July)
Peach	Mid Summer
Sweet Cherry	July (after harvest)

Plant Bioregulators

Plant hormones that increase flowering in temperate tree fruit

- Ethephon
- NAA
- others



Application Details – Bearing Details

NAA:

Rate: 4 ppm

3-4 sprays starting in early
July, 7 day intervals

Ethrel:

Rate: 150 ppm

Timing: as above



Ethrel responses by cultivar

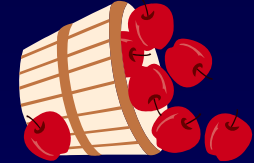
	<u>Non Bearing</u>			<u>Bearing</u>			
	N. Spy 1	N. Spy 2	J.Gold	Fuji 1	Fuji 2	Empire	J.Gold
Tree							
Return bloom	↑	↑	↑	X	↑	↑	X
Crop Load (year applied)	-	-	X	↓	X	↓	X
Yield (year applied)	-	-	X	X	-	↓	-
Shoot Growth (yr applied)	-	X	↓	X	X	X	X
Fruit Quality							
Fruit size	-	-	-	↑	-	↑	X
Firmness	-	-	-	↓	-	X	X
Soluble Solids	-	-	-	↑	-	X	X
Starch Index	-	-	-	?	-	X	?
Percent Red	-	-	-	↑	-	X	X
Colour by Instrument	-	-	-	↑	-	X	X

X – no sign. effect ↑ Sign. Increase ↓ Sign. - Not measured

Summary of Treatment Responses

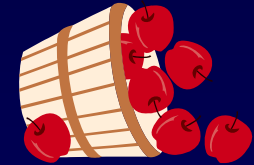
<u>Cultivar</u>	<u>Bearing</u>	<u>Non Bearing</u>
Northern Spy	? needs further testing	✓ 1 x 1500 ppm
Empire	✓ 2 x 150 ppm	? needs further testing
Fuji	✓ 3 x 300 ppm	✓ (1 x 1500 ppm)
Jonagold	✗ (3 x 150 ppm)	✗ (1 x 1000 ppm)

Summary



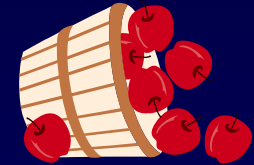
- Ethrel sprays can effectively increase return bloom

Summary



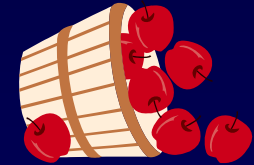
- Ethrel sprays can increase return bloom
- Higher rates can be used on non-bearing trees with a single application

Summary



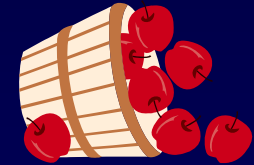
- Ethrel sprays can increase return bloom
- Higher rates can be used on non-bearing trees with a single application
- Ethrel can reduce tree (shoot) growth

Summary



- Ethrel sprays can increase return bloom
- Higher rates can be used on non-bearing trees with a single application
- Ethrel can reduce tree (shoot) growth
- 'Jonagold' did not respond to Ethrel

Summary



- Ethrel sprays can increase return bloom
- Higher rates can be used on non-bearing trees with a single application
- Ethrel can reduce tree (shoot) growth
- 'Jonagold' did not respond to Ethrel
- Sprays of 4 x 4 ppm NAA improved the bloom of 'Empire'

Precautions

Non Bearing Trees

- Do not use on weak trees
- Excessive fruiting could stunt the tree and cause alternate bearing

Bearing Trees

- Can cause fruit thinning if applied very close to bloom (before June Drop)
- Use at lower concentration (< 500 mg per litre)
- Apply Ethrel in “ON” year of biennial cycle. Applications in “OFF” year may contribute towards biennial bearing

What does it cost?

Based on 1000 litres per hectare
(100 US Gallons/acre) & excluding
machinery costs



Ethrel: \$12 (150 ppm), \$80 (1000 ppm)

NAA : \$27/ha (4 ppm)

Based on: Fruitone N: \$118/567 grams, Ethrel: \$189/10 Litres

Further Reading and Future Research

Further Research

- Honeycrisp, bearing trees (ongoing)
- Northern Spy (working on a proposal to initiate work in 2009)



www.plant.uoguelph.ca/treefruit
Search “return bloom”

