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Enhancing Flowering in Apple Trees

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Ways to Enhance Flowering

- Variety Selection
- Rootstock Selection
- Maximum exposure to sunlight
- Tree manipulation training
- Nutrient management
- Vigor control
- Crop load management
- Chemical enhancement

Enhancing Flowering

1. Initial flowering – Improving the precocity of young trees
   - Produce early income to pay off investment
   - Use fruiting to help control excess tree growth and vigor.

2. Preventing biennial bearing by stabilizing flowering from year to year.

Overcoming Juvenility
"Reaching Ripeness to Flower"

- Rootstock selection
  - M.9 vs. Seedling
    - NC140.org
- Variety Selection
  - Gala vs. Northern Spy
    - General information from test data, nursery catalogues and grower experience


16-E Sweetheart Mazzard


16-B Swthrt. Gle

Maximum interception of Solar radiation – good exposure to the sun – Smaller Trees, Open Canopies

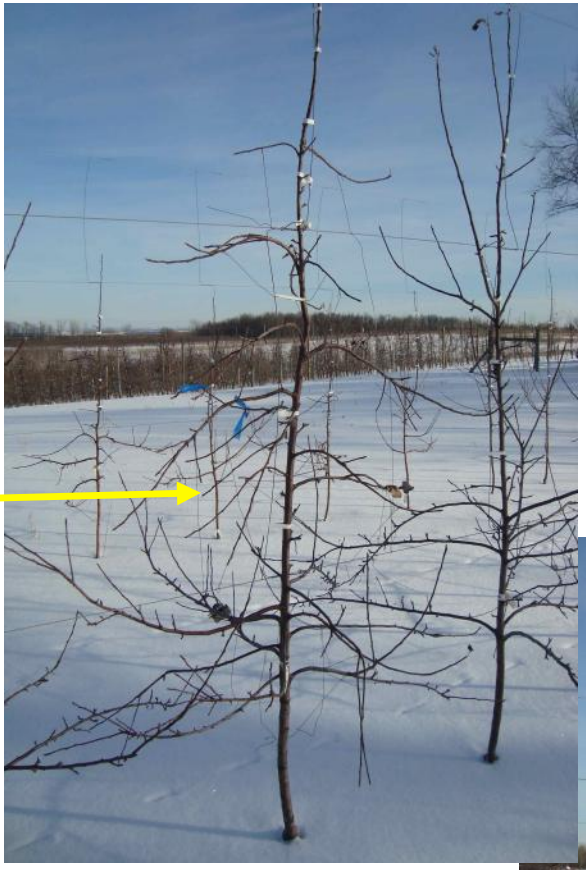
- Geographic regions with higher solar radiation have heavier bloom
- Sections of the tree better exposed to sunlight have a heavier bloom.
  - Plant trees north/south for maximum exposure to sunlight.
  - Keep tree canopies as thin as possible for maximum exposure to sunlight
  - Tall Spindle, Vertical Axe, Palmette leader

Using Cultural Practices to induce early flowering

- Training vs. Pruning
  - Training
    - Branch spreading
    - Branch tying
  - Pruning
    - Refrain from extensive pruning. Remove only 2 or 3 of the largest limbs.
    - No heading cuts!

End of First Year
All Feathers tied down at planting

Dominguez and Robinson, 2011



Tree at end of second year Feathers tied down in year 1

Tree at end of second year Feathers left erect in year 1

Nutrient Management

- Manage nitrogen in young trees to maximize growth and flowering.
  - NH_4 – N has been shown to increase flowering in young trees

- Manage nitrogen in mature trees to minimize (optimize) growth and maximize flowering and fruit quality.

- **Phosphorous has been shown in the west coast to improve early flowering :**

"Flowering of Apple Trees in the Second Year Is Increased by First year P Fertilization" (1990) GH Neilsen, EJ Hogue, and P Parchomchuk

Table 3. Effect of P fertilization of apple trees in 1st year on number of flower clusters, flower intensity, and fruit set in 2nd-year and 1st-year leaf N and P concentration (expt. 3).

Variable	Flower clusters (no./tree)	Flower intensity (no./cm²)	Fruit set (no./tree)	Leaf	
				N	P
P rate (g/tree)				(% *dry wt*)	
0	42.0	15.8	13.7	2.83	0.19
17.5	83.8	31.7	23.1	2.77	0.23
35.0	89.3	33.6	26.6	2.96	0.28
SE	5.4	1.9	1.8	0.04	0.01
P contrasts					
Linear	***	**	***	*	****
Quadratic	*	*	NS	*	NS
N x P	NS	NS	NS	NS	NS

NS,*,**,***,****Nonsignificant or significant at $P = 0.05$, 0.01, 0.001, or 0.0001, respectively.

APP applied to McIntosh/M.26 in 4 early irrigations

"Flowering of Apple Trees in the Second Year Is Increased by First year P Fertilization" (1990) GH Neilsen, EJ Hogue, and P Parchomchuk

Table 1. Effect of P fertilization of young apple trees on number of flower clusters, flower intensity, and fruit set in 2nd-year and 1st-year leaf N and P concentration for planting hole P treatments (expt. 1).

P applied (g/tree)	Flower clusters (no./tree)	Flower intensity (no./cm^2)	Fruit set (no./tree)	Leaf	
				N	P
				(% *dry wt*)	
0	14.3	6.6	1.9	2.23	0.20
36	61.9	29.2	6.8	2.19	0.26
SE	10.0	3.8	1.2	0.02	0.02
Significance	***	***	*	NS	NS

NS,*,***Nonsignificant or significant at $P = 0.05$ or 0.001, respectively.

Planting hole amendment using MAP to McIntosh/M.26

"Flowering of Apple Trees in the Second Year Is Increased by First year P Fertilization" (1990) GH Neilsen, EJ Hogue, and P Parchomchuk

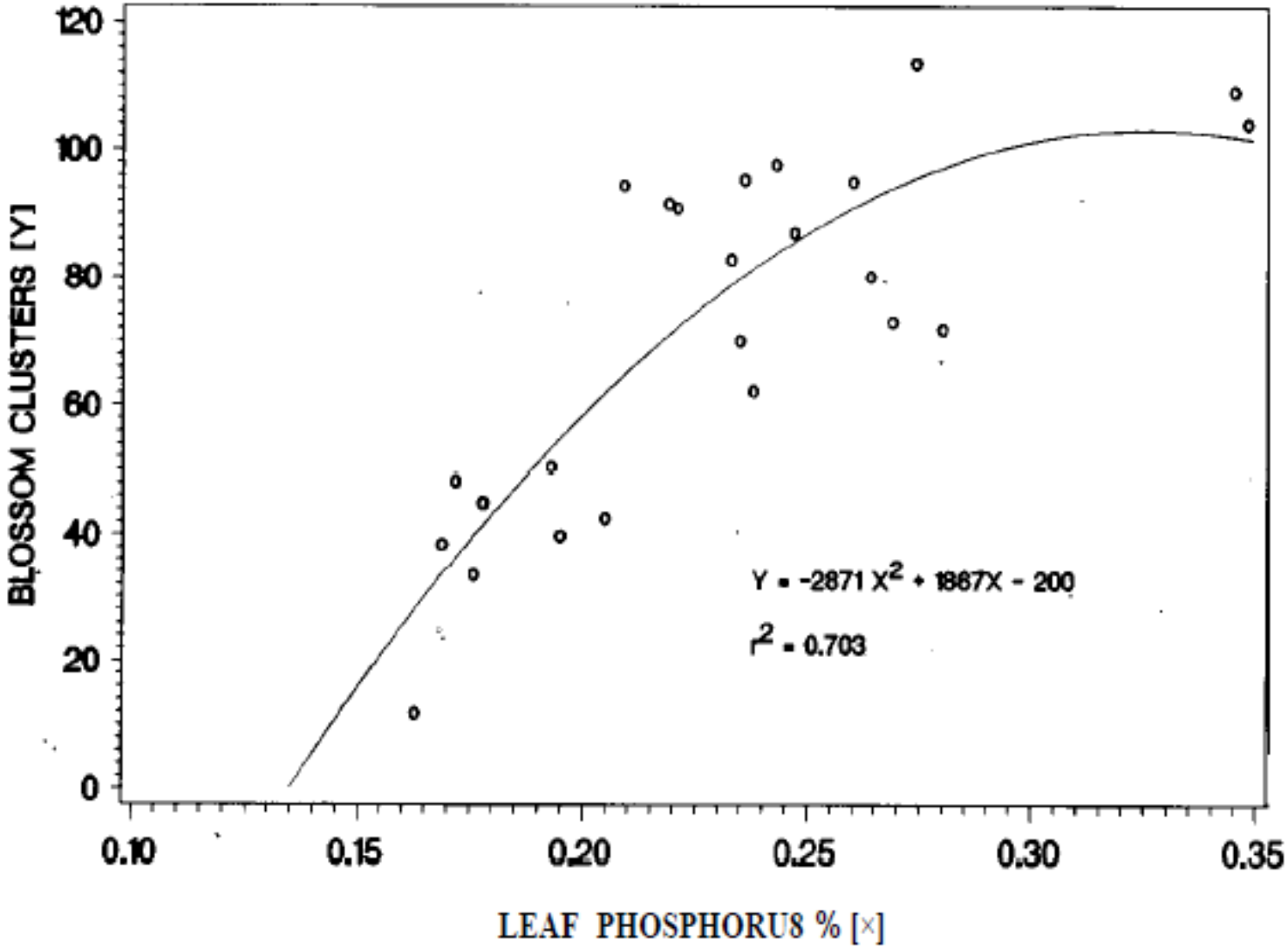


Fig. 1. Relationship between 1st-year midterminal leaf P concentration and number of flower clusters in the 2nd year for fertigated 'Summerland McIntosh' apple on M.9 rootstock (expt. 3).

Mature Trees That Fail to Flower

Vigor Control or lack of it

- Planting the wrong rootstock for the soil or planting system – excess vigor – reduces flowering
- Over fertilization with Nitrogen stimulates excess growth - reduces flowering
- Over pruning stimulates vigorous growth which reduces flowering
- Early crop loss results in excess vigor and reduced flowering

Managing Vigor

- Rootpruning
  - 30-50% of root must be removed
  - Reduces photosynthesis and transpiration
  - Dormant timing results in 53% reduction in vegetative growth, 76% increase in light penetration and a 40% reduction in pruning time.
  - Increased fruit bud differentiation and flowering the following year.

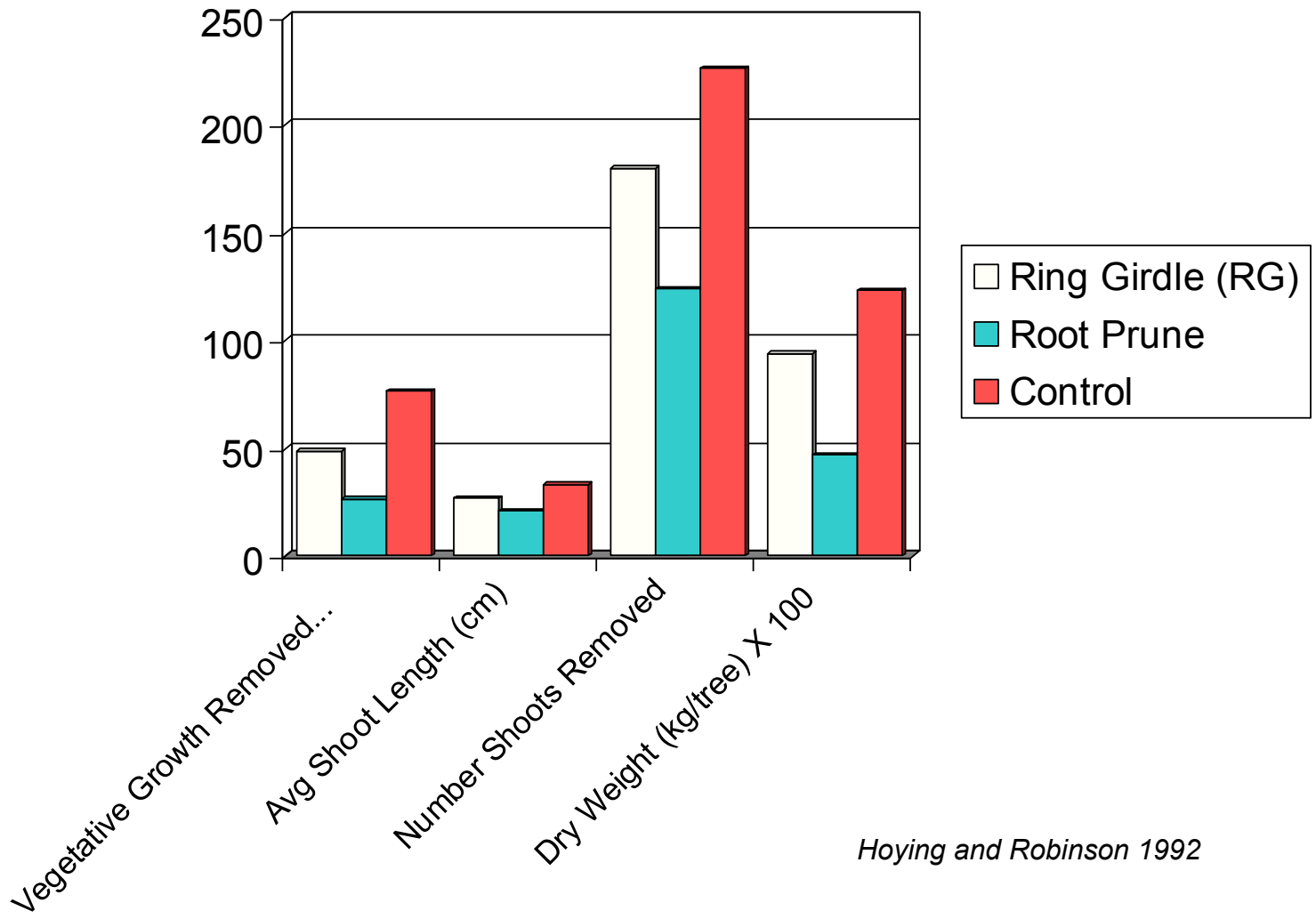
Girdling

Knife or narrow saw blade can be used to girdle completely around the tree at bloom increasing floral abundance and reducing shoot growth.

Chainsaw Girdling

- Timing
  - Late Dormant – 2 weeks after bloom
- ½ Circle cuts on the trunk, 6 inches apart, overlapping 1-2 inches
- Cut through the bark and cambium layer
- Followup the following season in same cuts on very vigorous trees
- DO NOT APPLY HERBICIDES to Fresh cuts!

Managing Vigor - Girdling



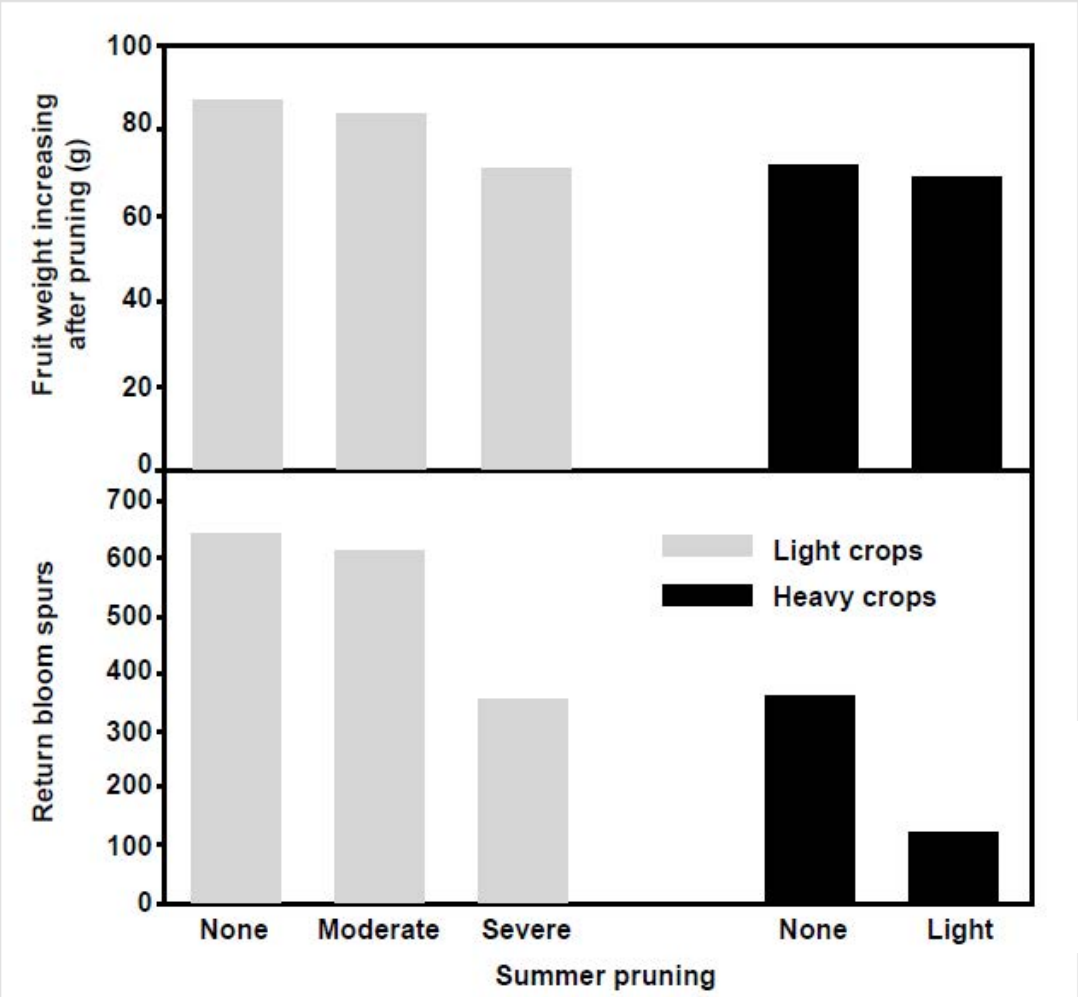
Hoying and Robinson 1992

Chemical Vigor Control

- Apogee has significant effect reducing tree vigor
- Has no direct effect increasing flower bud formation
- In fact, because of increased difficulty in thinning the use of Apogee may result in decreased bloom the following year if thinning is not successful

Foliage Health

Interaction of summer pruning intensity and cropping level on fruit weight and return bloom on Empire apples.



- Leaf damage or early defoliation caused by leaf feeding pests such as mites, leafhoppers or aphids or severe summer pruning can reduce return bloom

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Crop Load Management to Enhance Flowering

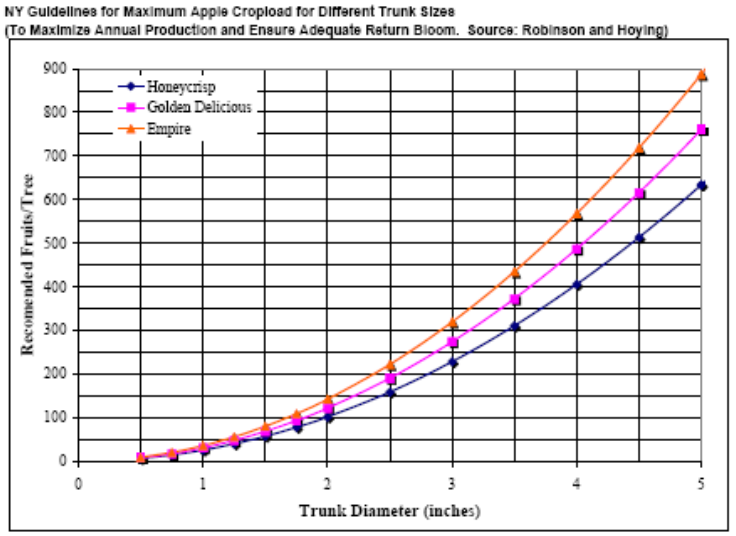
Biennial bearing is largely a thinning problem

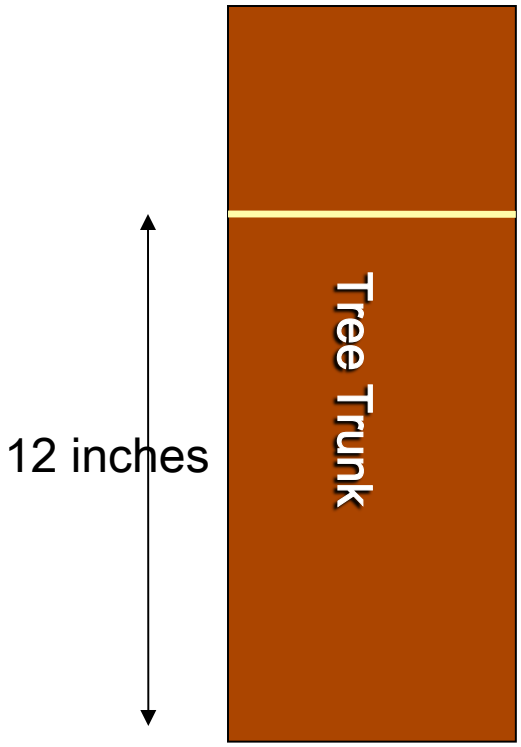
- Thinning
  - Hand
  - Chemical

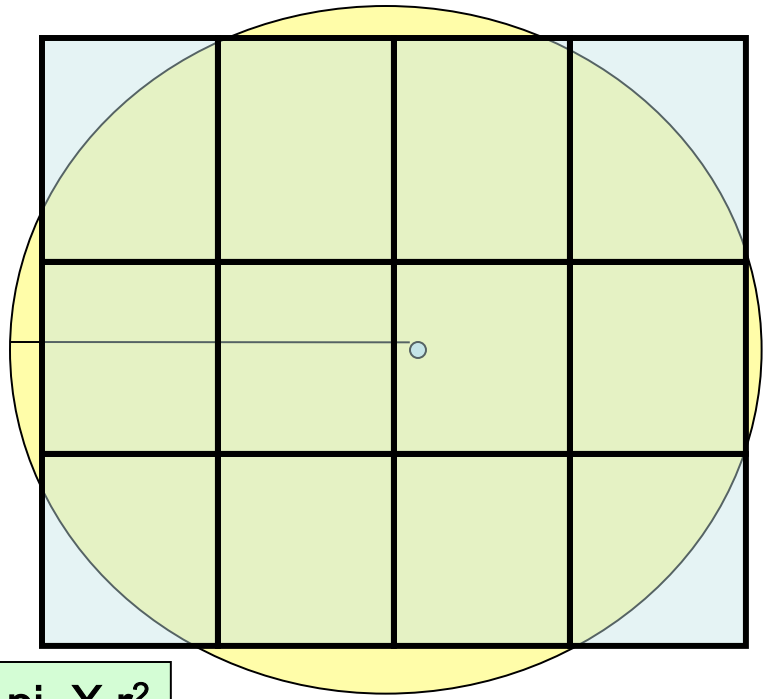
Acceptable Crop Loads for Return Bloom on Young Trees

Empire = 8-10 fruit/sq cm TCA

Honeycrisp = 4-5 fruit/sq cm TCA







TCA= pi X r^2

Cornell University
Young Apple Thinning Gauge
Optimum fruit number per tree
To use, see instructions on back.
H11/G17
H20/G30
H32/G48
H46/G68
H182/G274
H153/G230
VALENT

This relationship breaks down when containment pruning begins but holds for un-pruned branches!

Return Bloom
Chemical Thinning

- A successful chemical thinning program will reduce apple crop to levels between 4-8 fruit per sq cm of TSA (branch cross-sectional area) is the most important method for annualizing crop load.

- This ensures there are enough resting spurs to provide enough flowers to set a full crop for the following year.

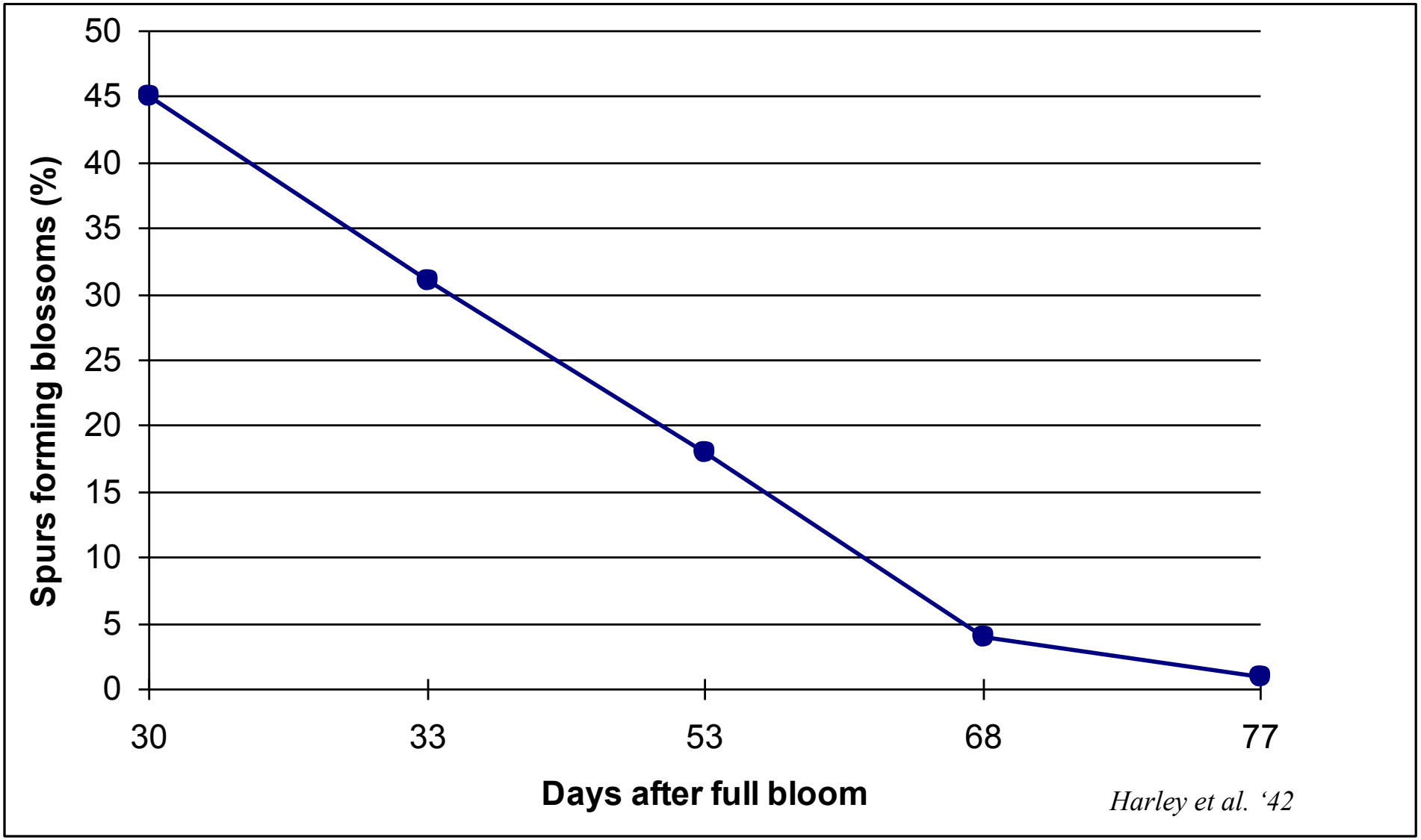
Fruit Bud Initiation and Return Bloom

Fruit buds intiate or form a flower primordia typically by the end of June in NY. This process determines whether there will be flowers on that spur the following year.

# of free spurs without fruit at initiation (end of June) determine the number of spurs available to set the following year.

Typically 50% or more of spurs on a tree should be free of fruit at initiation to insure the best chance of fruit set.

Effect of time of thinning on Return Bloom



Harley et al. '42

Return Bloom
Hand Thinning

- Hand thinning is an option for encouraging return bloom even when chemical thinning is not completely effective (not enough fruit has been removed and fruit have sized beyond when chemical thinning will remove any more fruit)

- This must be done before 45 days after full bloom to ensure fruit bud initiation

Other Chemical Treatments to Enhance Return Bloom

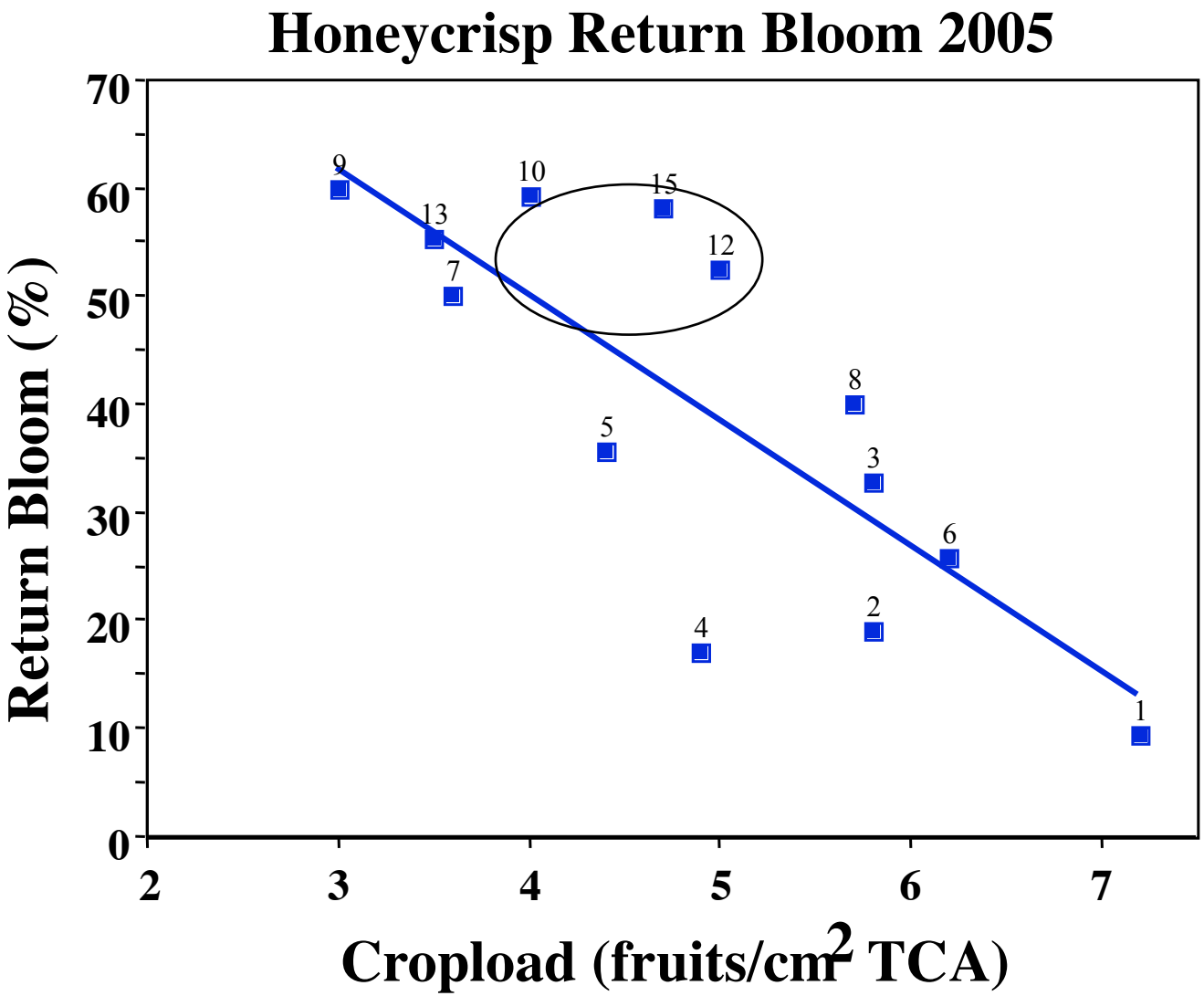
- NAA
- Ethephon

Return Bloom
Summer PGRs

- Ethephon (0.5 pts/100 gallons) have been shown to promote flowering when applied starting 4-6 weeks after full bloom in a 4 spray weekly program (Buyers, '93)
- NAA is recommended in NY to encourage return bloom (7.5 ppm in 4 weekly applications, starting 30-45 days after full bloom.

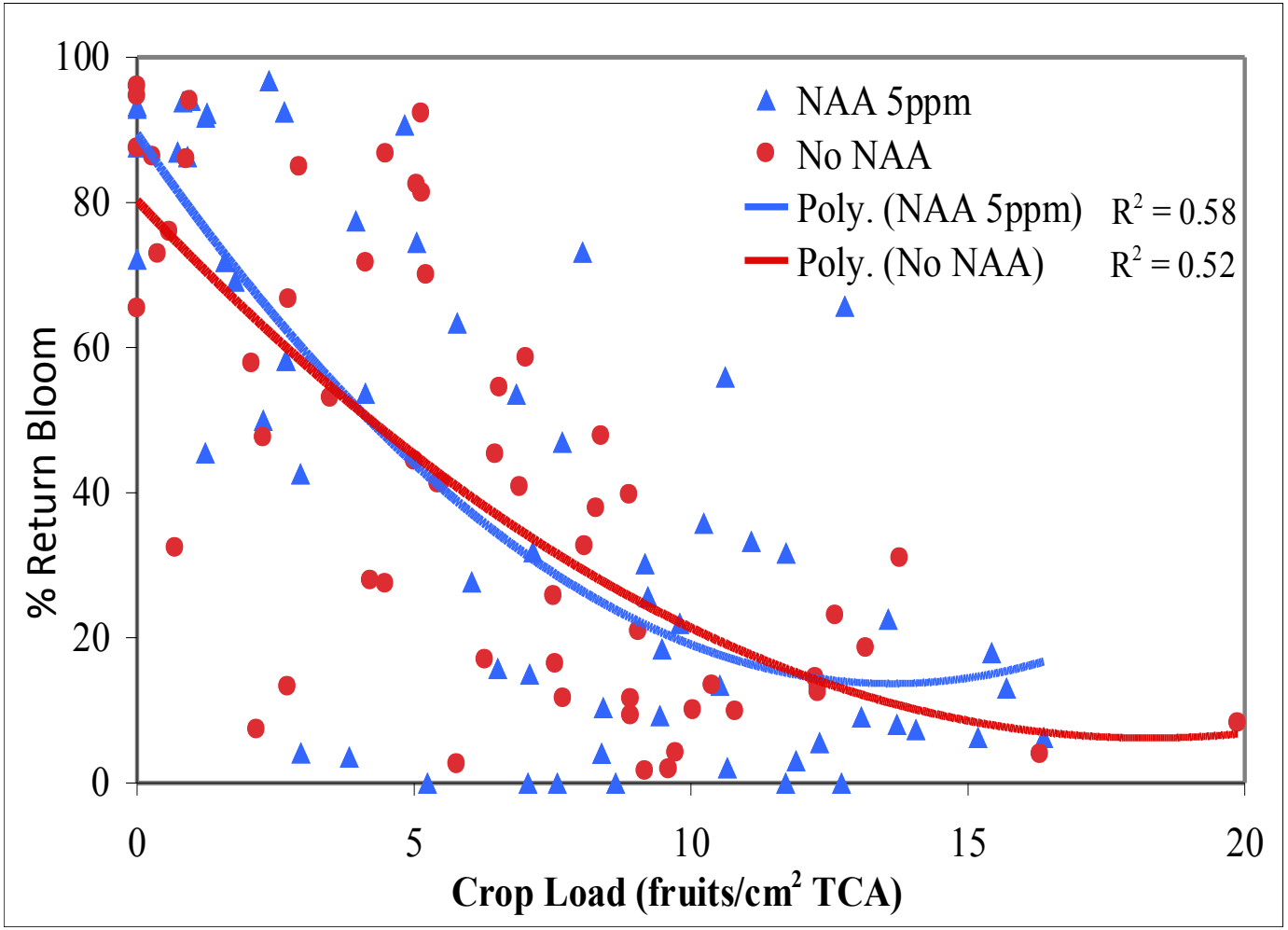
However, the results have not been consistent.

Honeycrisp Return Bloom was Improved with NAA/Sevin at PF plus Maxcel/Sevin at 10mm stage plus Summer NAA or Summer Ethrel in 2005



Robinson

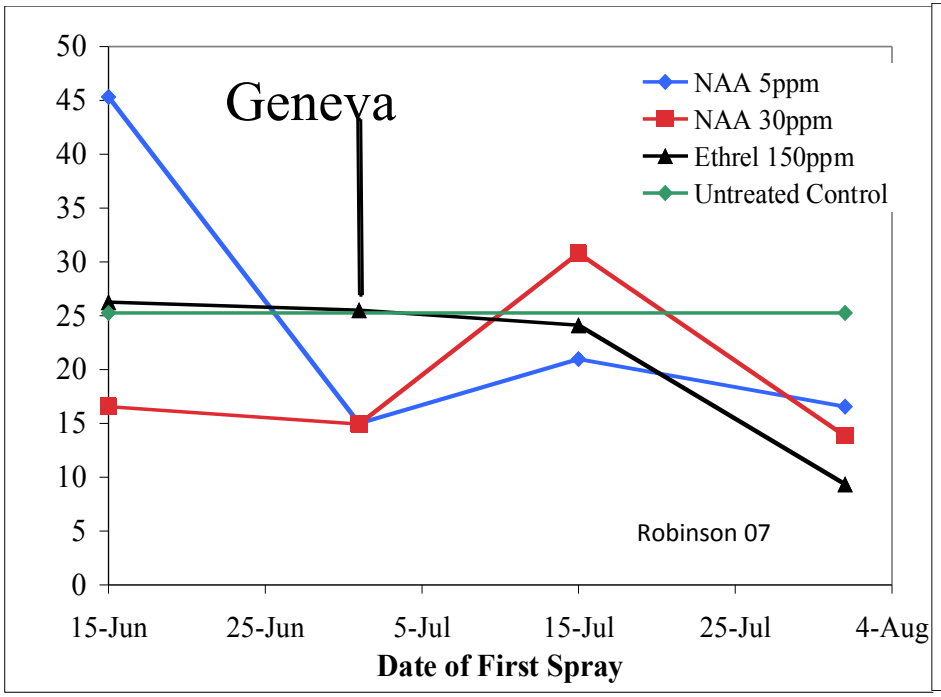
Summer NAA Sprays in 2007 Did Not Change the Effect of Cropload on Return Bloom

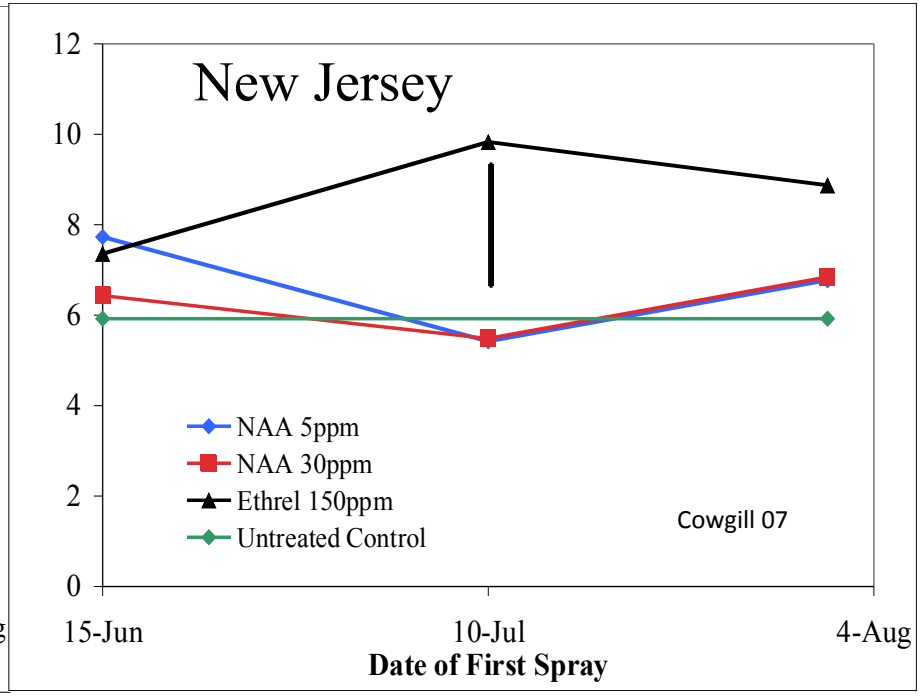


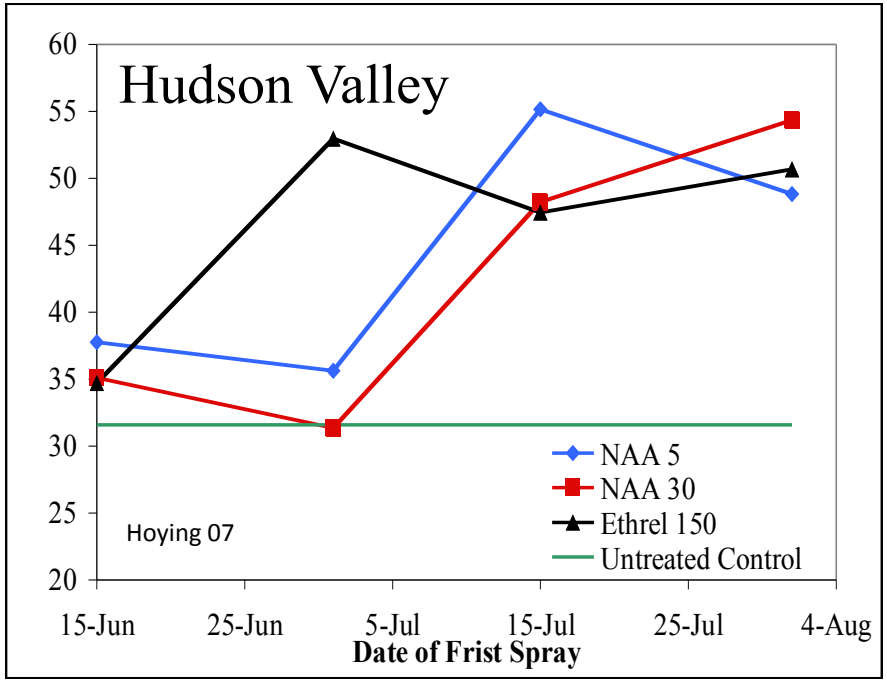
Return BloomTreatments

2008

	Untreated control		
6/15	4 weekly sprays	5ppm NAA	25 mm
	4 weekly sprays	30ppm NAA	25 mm
	4 weekly sprays	150ppm Ethrel	25 mm
7/1	4 weekly sprays	5ppm NAA	35 mm
	4 weekly sprays	30ppm NAA	35 mm
	4 weekly sprays	150ppm Ethrel	35 mm
	Trunk Ringing		35 mm
7/15	4 weekly sprays	5ppm NAA	45 mm
	4 weekly sprays	30ppm NAA	45 mm
	4 weekly sprays	150ppm Ethrel	45 mm
8/1	4 weekly sprays	5ppm NAA	55 mm
	4 weekly sprays	30ppm NAA	55 mm
	4 weekly sprays	150ppm Ethrel	55 mm







The Effect of Timing and rate of Summer NAA and Ethephon Sprays on return bloom.

Results

3 Ethrel treatments ripened early

- 35mm (7/1), 45mm (7/15), 55mm (8/1)
- 45 and 55 Harvested 8/31/07
- 35 Harvested 9/5/07
- 25 Harvested with rest of NAA treatments

Obvious early color improvement

Early and significant fruit drop

Firmness not affected


45 mm application
Ethrel
July 15,22,29, Aug 5


Untreated Control

Return Bloom
PGR's

- Summer NAA and Ethrel will enhance return bloom in some years in some locations.
- Ethrel should not be used on early varieties for return bloom.
- It is not predictable.
- We are still recommending NAA because of it's value when it does work, especially on high value Honeycrisp as part of a complete crop management program!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