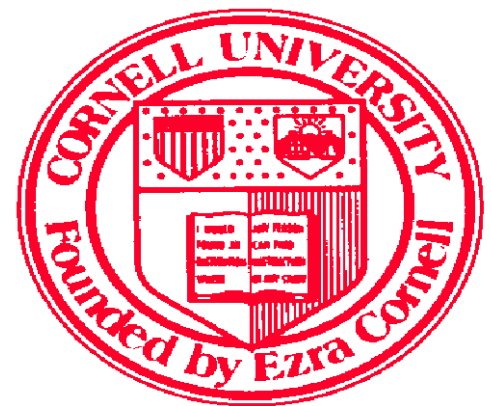


Precision Chemical Thinning - 2014

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Leo Dominguez, Mike Biltonen
Dept. of Horticulture, Cornell University
Geneva, NY 14456



Precision Crop Load Management

PCLM is a strategy to manage the number of fruit per tree to a specific pre-determined target:

1. Prune to a specific flower bud number
2. Chemically thin to a specific fruit number
3. Hand thin to a specific fruit number

Precision Thinning is a strategy to manage the chemical thinning process better by:

1. Identifying a target number of fruit per tree
2. Using the carbohydrate model to predict thinning response
3. Using multiple applications of chemical thinners
4. Assessing results using the fruit growth rate model
5. Re-applying chemical thinners if needed.



Calculation of Desired Fruit Number (Tall Spindle Examples)

Determine desired yield/acre

Determine the desired fruit size acre

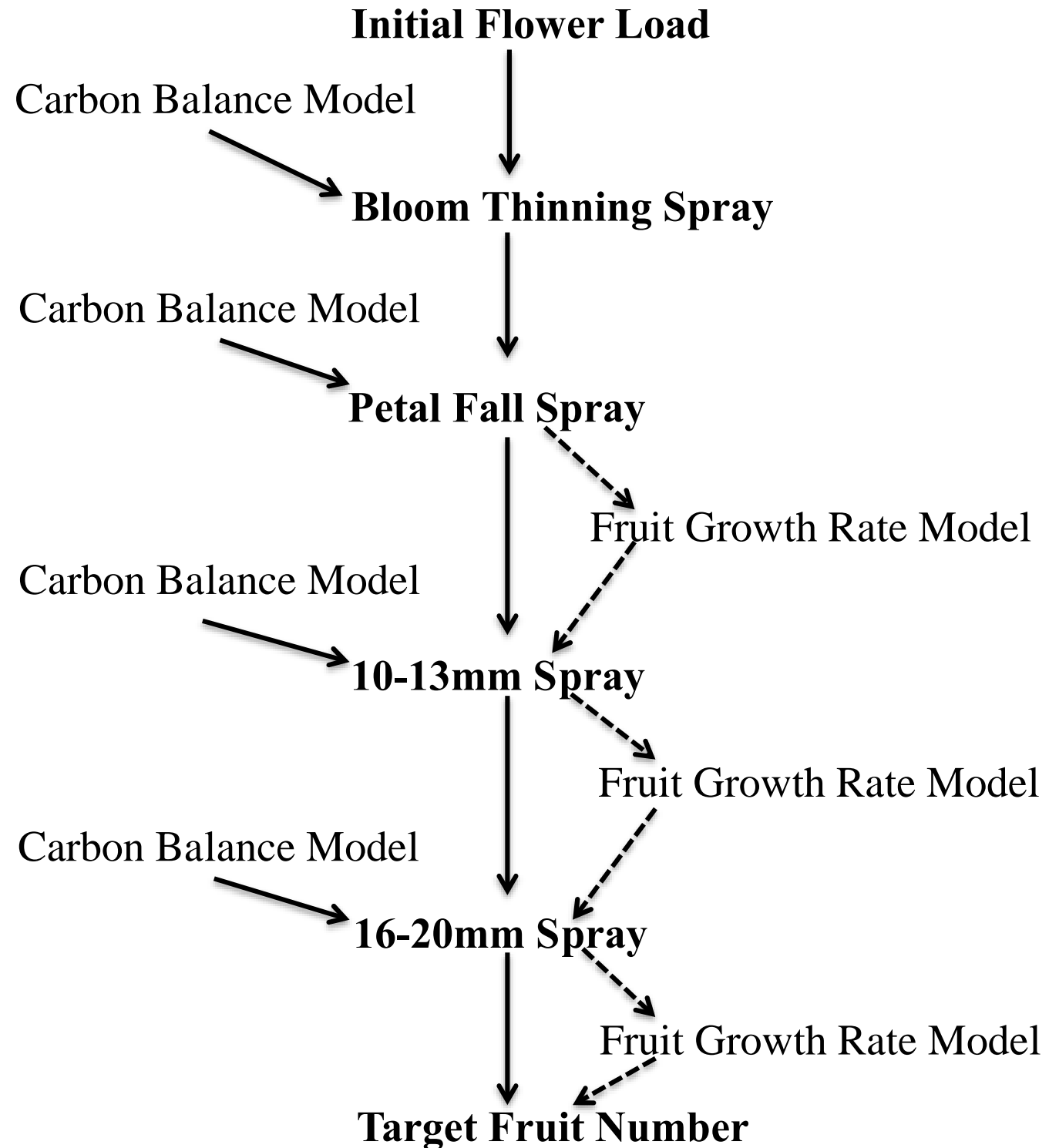
$1500 \text{ bu/acre} * 100 \text{ fruits/bu} = 150,000$
 $\text{fruits/acre} / 1210 \text{ trees/acre} = 124$
fruits/tree

If target yield is 1000 bu/acre then
target fruit number = **83 fruits/tree**

If target yield is 2000 bu/acre then
target fruit number = **165 fruits/tree**



Steps in Precision Thinning



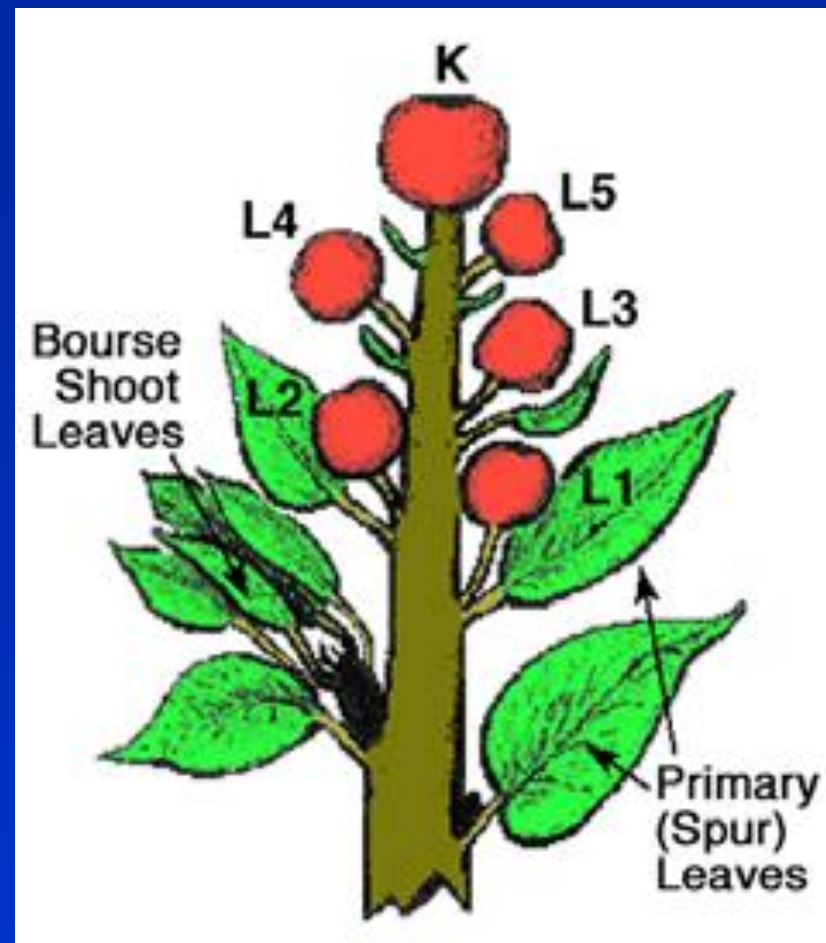
Thinning Windows

- Bloom
 - Ammonium Thiosulfate (ATS) (2-2.5%)
 - Lime Sulfur (2-2.5%) and Fish Oil or Damoil (2%) or Soybean oil (2%)
 - Promalin (2pt/acre)
 - Maxcel (64-128oz/acre)
 - NAA (4-8oz/acre)
- Petal Fall (fruits at 5-6mm)
 - Sevin (2pt/acre)
 - Maxcel (64-128oz/acre) + Sevin (2pt/acre)
 - NAA (4-8oz/acre) + Sevin (2pt/acre)
 - Maxcel + NAA
- Fruits at 10-13 mm
 - NAA (4-8oz/acre) + Sevin (2pt/acre)
 - Maxcel (64-128oz/acre)+ Sevin (2pt/acre)
 - Maxcel (64-128oz/acre) + NAA (3oz/acre)
- Fruits at 16-18 mm
 - NAA (4-8oz/acre) + Sevin (2pt/acre)+Regulaid (1pt/100gal)
 - Maxcel (64-128oz/acre)+ Sevin (2pt/acre) + Oil (1qt/100gal)
 - Ethrel (2-3pt/acre) + Oil (1qt/100gal)

Using the Carbohydrate Model

The Carbohydrate Theory of Thinning:

1. Fruitlets need carbohydrates to grow.
2. The tree allocates carbohydrates first to the shoot then to the fruits.
3. Weather conditions that result in low carbohydrate production often create a shortage of carbohydrates to support the growth of the fruits.
4. The weakest fruits do not receive enough carbohydrates and stop growing and begin to abscise.
5. Chemical thinners magnify the carbohydrate deficit and thus are more effective when applied during periods of natural shortage and are less effective when applied during periods of ample carbohydrate supply.



Web version of Carbohydrate Model

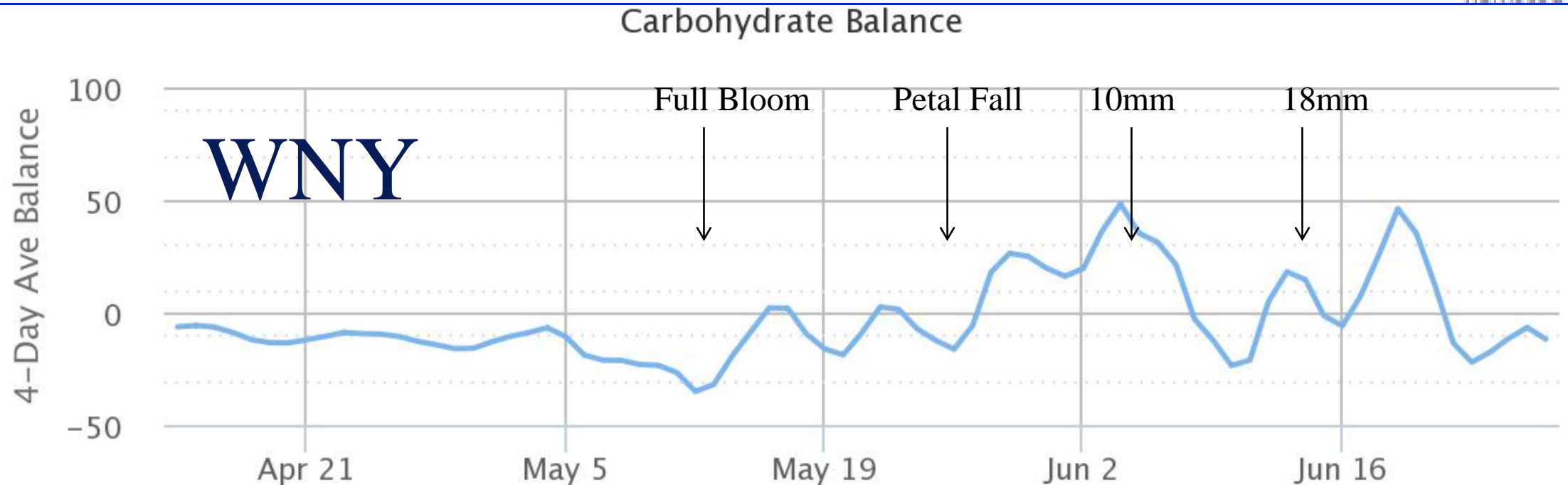
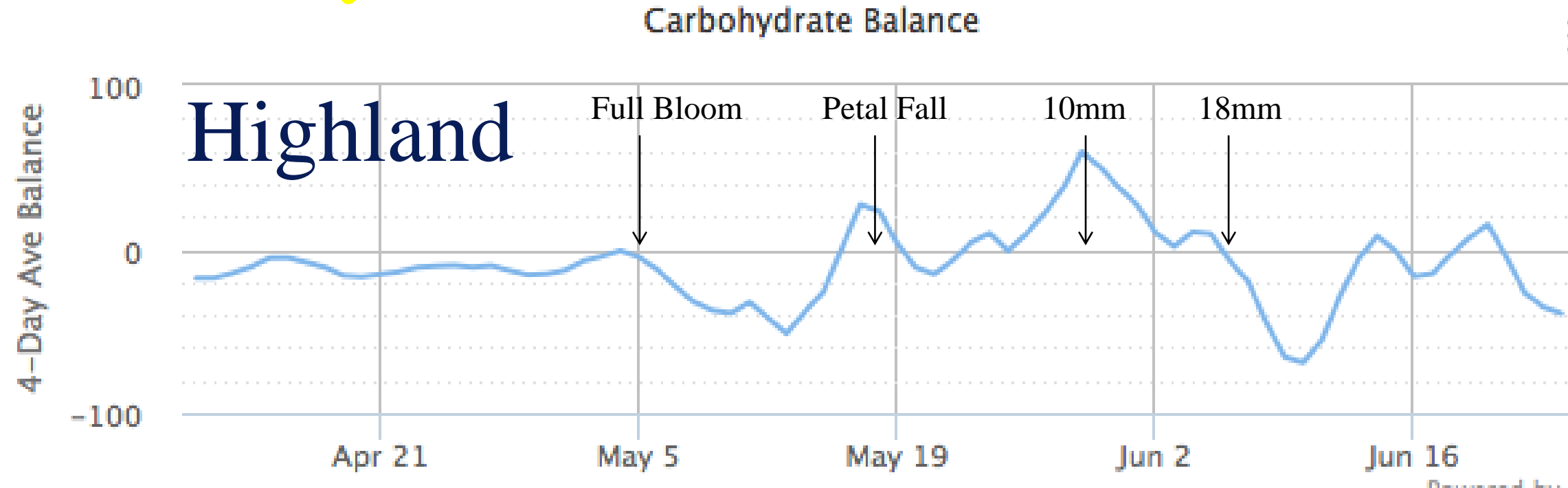
<http://newa.cornell.edu>

5/22	84	54	19.2	61.49	93.99	-32.50	4.37	Increase chemical thinner rate by 30%
5/23	75	49	12.9	54.73	70.94	-16.21	27.3	Increase chemical thinner rate by 30%
5/24	50	40	7.7	39.36	27.10	12.26	42.15	Increase chemical thinner rate by 30%
5/25	56	44	25.1	93.50	39.57	53.93	34.88	Increase chemical thinner rate by 30%
5/26	61	41	27.5	102.02	42.80	59.22	10.59	Increase chemical thinner rate by 30%
5/27	69	45	27.4	103.73	60.54	43.20	-19.91	Apply standard chemical thinner rate
5/28	62	44	6.6	33.54	50.37	-16.83	-45.19	Decrease chemical thinner rate by 30%
5/29	80	59	14.5	58.79	102.04	-43.25	-51.49	Decrease chemical thinner rate by 30%
5/30	90	67	23.9	71.26	134.04	-62.78	-36.33	Decrease chemical thinner rate by 15%
5/31	93	65	23.2	68.42	126.34	-57.92	-4	Apply standard chemical thinner rate
6/1	88	67	20.2	65.97	108.00	-42.02	28.36	Increase chemical thinner rate by 30%
6/2	77	57	20.7	89.22	71.82	17.41	50.57	Increase chemical thinner rate by 30%
6/3	62	51	26.5	114.18	47.65	66.53	34.17	Increase chemical thinner rate by 30%
6/4	67	46	27.2	119.36	47.84	71.52	6.75	Increase chemical thinner rate by 30%
6/5	67	52	22.1	102.98	56.18	46.80		
6/6	58	54	2.3	0.59	48.77	-48.18		
6/7	60	55	3.8	12.10	55.24	-43.15		

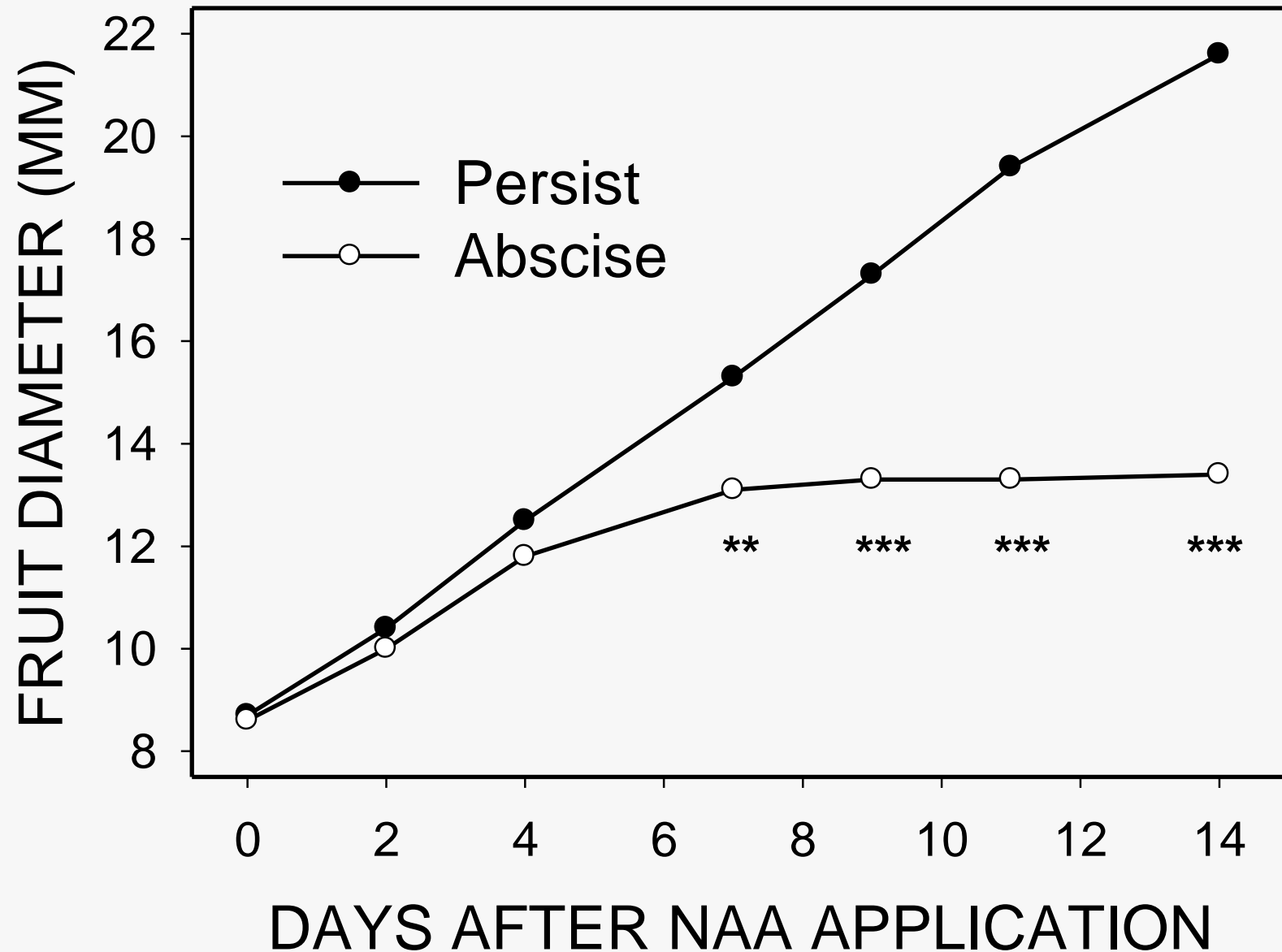
Decision Rules We Use to Make Recommendations with the Carbohydrate Model

4-Day Av. Carb. Balance	Thinning Recommendation
+20g/day to +40g/day	Increase Chemical Thinning Rate by 30%
+20g/day to 0g/day	Increase Chemical Thinning Rate by 15%
0g/day to -20g/day	Apply Standard Chemical Thinning Rate
-20g/day to -40g/day	Decrease Chemical Thinning Rate by 10%
-40g/day to -60 g/day	Decrease Chemical Thinning Rate by 20%
-60g/day to -80 g/day	Decrease Chemical Thinning Rate by 30%
< than -80g/day	Do not thin (many fruits will fall off naturally)

Carbohydrate Balance 2014



Use The Fruit Growth Model to Accurately Assess the Effect of a Thinning Spray



Tagging Spurs and Measuring Fruit Diameter

1. At pink, select and tag 15 representative spurs per tree
 - Location of spurs must represent where the fruit is (top, middle and bottom of tree)
 - Do not tag flowering clusters on 1 year wood
 - Use a strip of orange ribbon and label for easy identification later (spur 1-15)
2. At exactly 3 days after each spray, label each fruit in each cluster with a number (1-5) using a permanent marker.
3. Measure and record diameter of each fruitlet with a digital caliper on day 3 after application
4. Re-Measure diameter of each fruitlet 5 days later on day 8 after application



NY Participants in Precision Thinning Group Effort 2014

Abbott

Buhr

Cahoon

Coene

Dominguez

Farrow

Furber

Hance

Oaks

Reisinger

Russell

Smith

Vandewalle

Chazy

Sullivan

Indian Ladder

Crist

Minard

HVL

Two Options in 2014 for Precision Thinning of Gala

Option 1

1. Apply a Bloom Spray
 - NAA (8oz/acre)
2. Apply a Petal Fall Spray (6mm)
 - NAA (6oz/acre) + Sevin (2pt/acre)
3. Apply a 12 mm Spray
 - Maxcel (96oz/acre) + Sevin (2pt/acre)
4. Apply an 18 mm spray (if needed)
 - Maxcel (96oz/acre) + Sevin (2pt/acre + Oil (1pt/100gal) (directed to the upper part of the tree)

Option 2

1. Apply a Petal Fall Spray (6mm)
 - NAA (6oz/acre) + Sevin (2pt/acre)
2. Apply a 12 mm Spray
 - Maxcel (96oz/acre) + Sevin (2pt/acre)
3. Apply an 18 mm spray (if needed)
 - Maxcel (96oz/acre) + Sevin (2pt/acre + Oil (1pt/100gal) (directed to the upper part of the tree)

Two Options in 2014 for Precision Thinning of Honeycrisp

Option 1

1. Apply a Bloom Spray
 1. NAA (8oz/acre)
2. Apply a Petal Fall Spray (6mm)
 - NAA (8oz/acre) + Sevin (2pt/acre)
3. Apply a 12 mm Spray
 - NAA (6oz/acre) + Sevin (2pt/acre)
4. Apply an 18 mm spray (if needed)
 - Sevin (2pt/acre + Oil (1pt/100gal)
(directed to the upper part of the tree)

Option 2

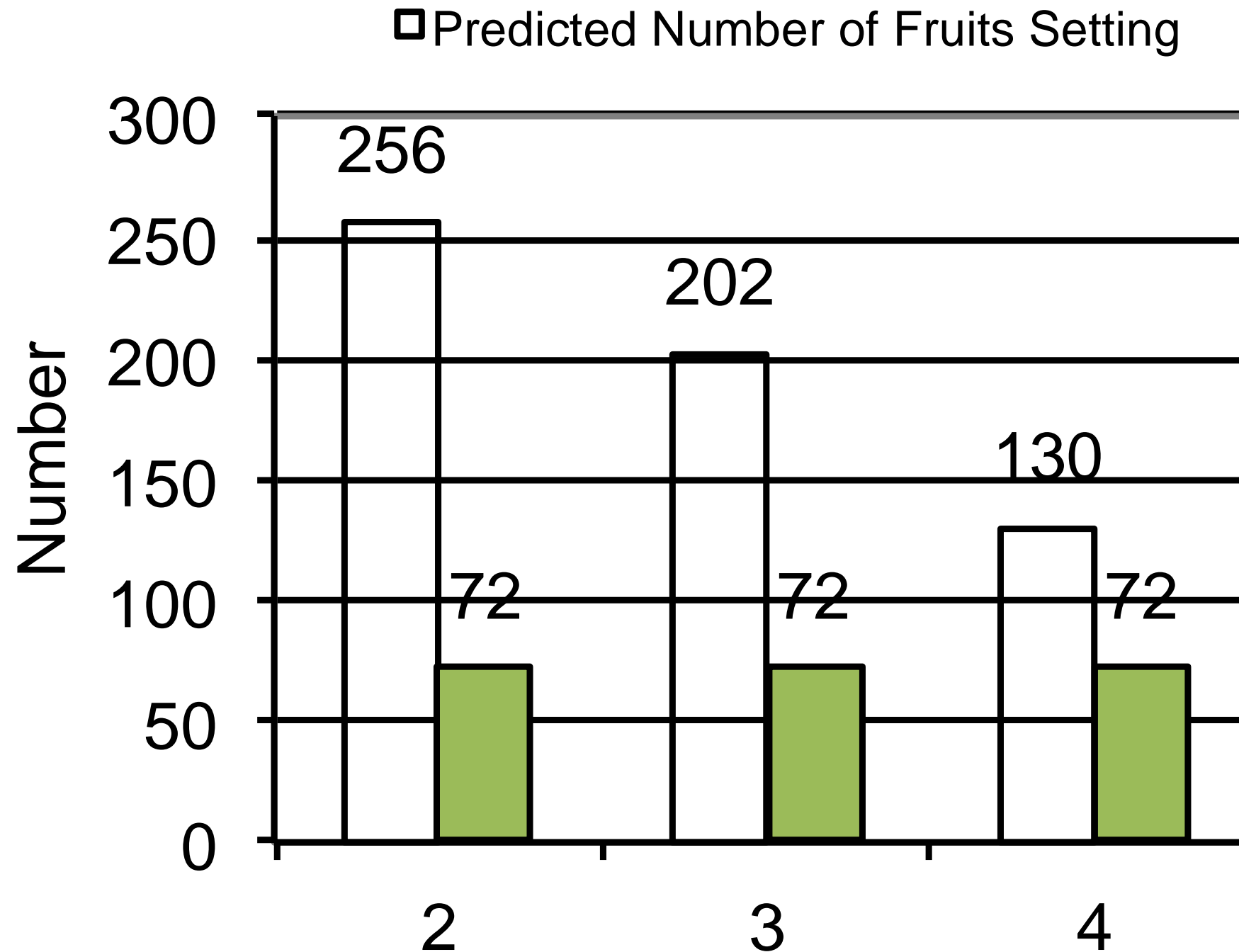
1. Apply a Petal Fall Spray (6mm)
 - NAA (8oz/acre) + Sevin (2pt/acre)
2. Apply a 12 mm Spray
 - NAA (6oz/acre) + Sevin (2pt/acre)
3. Apply an 18 mm spray (if needed)
 - Sevin (2pt/acre + Oil (1pt/100gal)
(directed to the upper part of the tree)

Precision Thinning Orchards in HV in 2014

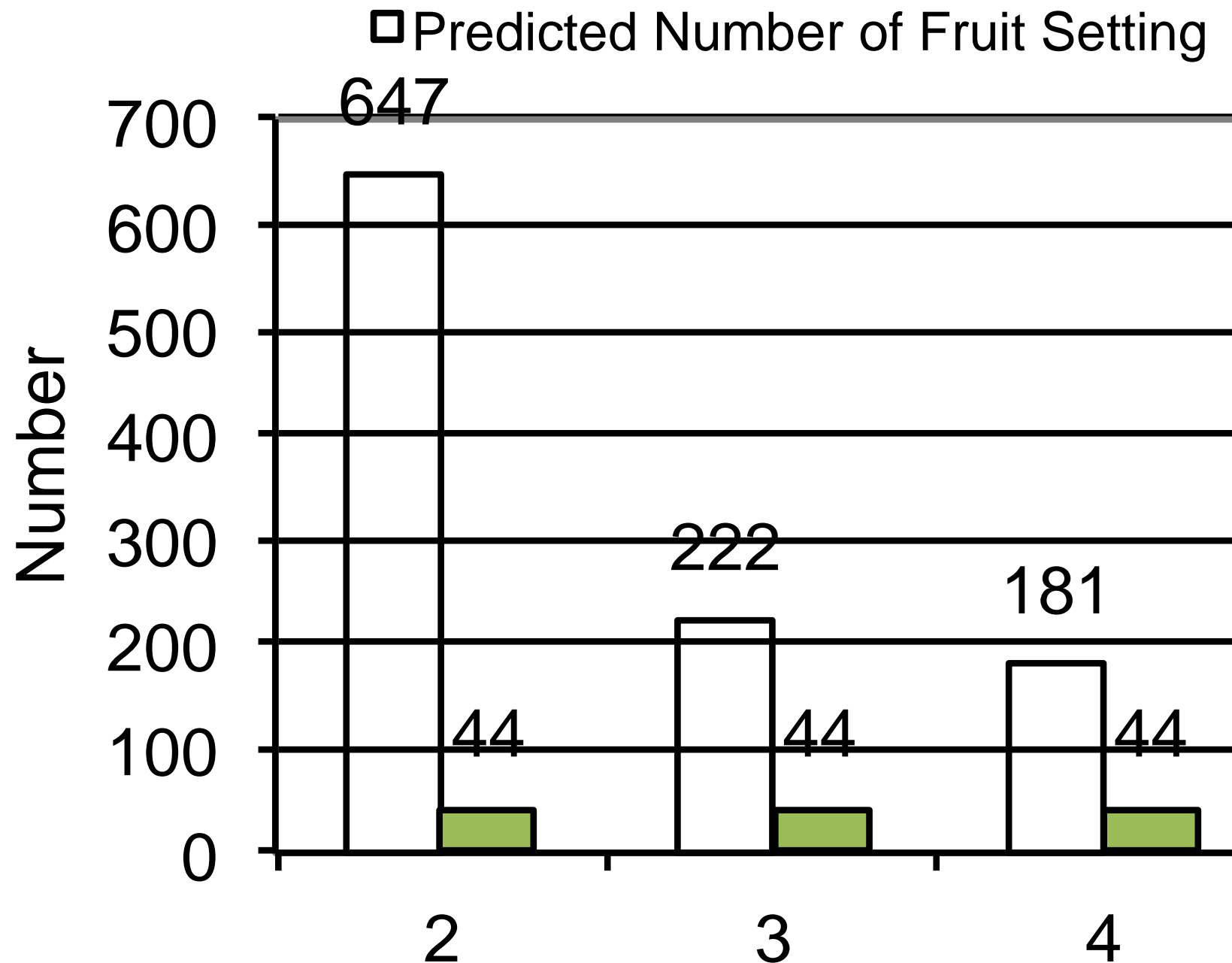
Block	Variety	Estimated	Target	Bud Load Ratio
		Total Initial Fruitlets	Number of Fruitlets	
1	HC	775	176	0.9
2	HC	1075	82	2.6
3	HC	1085	72	3.0
4	HC	1190	44	5.4
5	Gala	1880	125	3.0
6	Gala	1825	102	3.6
7	Gala	2080	132	3.2
8	Gala	1895	349	1.1
9	Gala	2725	450	1.2
10	Gala	3090	248	2.5
11	Gala	1985	100	4.0
12	Gala	1080	72	3.0
13	Fuji	1060	170	1.2
14	Fuji	1260	110	2.3
15	Fuji	2440	454	1.1
16	Fuji	1880	182	2.1
17	Fuji	1640	76	4.3

Initial Results of the Precision Thinning Protocol in 2014	Block	Variety	Target Number of Fruitlets	Calculated Number of Fruits on Tree on May 28, 2014	Extra Fruits Still on Tree	Recommendation
	1	HC	176	172	-4	Thinning is done
	2	HC	82	175	93	Need another 3/4 dose spray of NAA+Sevin
	3	HC	72	168	96	Need another 3/4 dose spray of NAA+Sevin
	4	HC	44	657	613	Need another full spray of NAA+Sevin
	5	Gala	125	416	291	Need another full spray of Maxcel+Sevin
	6	Gala	102	430	328	Need another full spray of Maxcel+Sevin
	7	Gala	132	494	362	Need another full spray of Maxcel+Sevin
	8	Gala	349	394	45	Hand Thin only
	9	Gala	450	1017	567	Need another full spray of Maxcel+Sevin
	10	Gala	248	717	469	Need another full spray of Maxcel+Sevin
	11	Gala	100	408	308	Need another full spray of Maxcel+Sevin
	12	Gala	72	253	181	Need another full spray of Maxcel+Sevin
	13	Fuji	170	294	124	Need another 3/4 dose spray of Maxcel+Sevin
	14	Fuji	110	158	48	Hand Thin only
	15	Fuji	454	442	-12	Thinning done
	16	Fuji	182	496	314	Need another full spray of Maxcel+Sevin
	17	Fuji	76	324	248	Need another full spray of Maxcel+Sevin

Gala fruit set at HVL after 3 sprays with an initial bud load of 3 (1080 flowers)



Honeycrisp fruit set at HVL after 3 sprays with an initial bud load of 5.4 (1190 flowers)



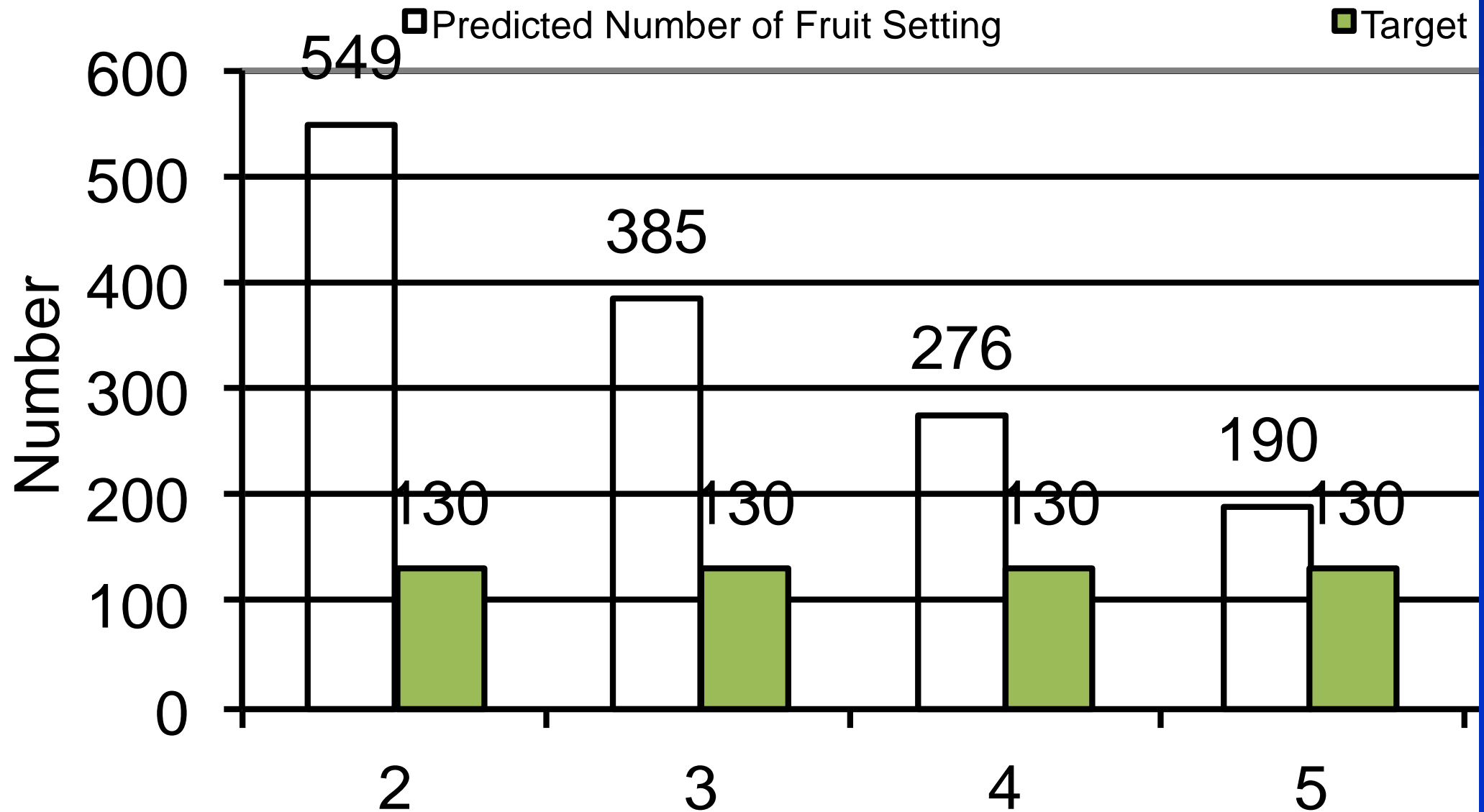
Final Results of the Precision Thinning Protocol in 2014

Block	Variety	Target Number of Fruitlets	Extra Fruits Still on Tree May 28	Recommendation May 28	Final Fruit/ tree in July	Extra fruits on tree in July
1	HC	176	-4	Thinning is done	157	-19
2	HC	82	93	Need another 3/4 dose spray of NAA+Sevin	134	52
3	HC	72	96	Need another 3/4 dose spray of NAA+Sevin	71	-1
4	HC	44	613	Need another full spray of NAA+Sevin		
5	Gala	125	291	Need another full spray of Maxcel+Sevin	134	9
6	Gala	102	328	Need another full spray of Maxcel+Sevin	76	-26
7	Gala	132	362	Need another full spray of Maxcel+Sevin	108	-24
8	Gala	349	45	Hand Thin only	255	-94
9	Gala	450	567	Need another full spray of Maxcel+Sevin		
10	Gala	248	469	Need another full spray of Maxcel+Sevin	192	-56
11	Gala	100	308	Need another full spray of Maxcel+Sevin	85	-15
12	Gala	72	181	Need another full spray of Maxcel+Sevin		-72
13	Fuji	170	124	Need another 3/4 dose spray of Maxcel+Sevin	109	-61
14	Fuji	110	48	Hand Thin only	74	-36
15	Fuji	454	-12	Thinning is done		
16	Fuji	182	314	Need another full spray of Maxcel+Sevin	159	-23
17	Fuji	76	248	Need another full spray of Maxcel+Sevin	84	8

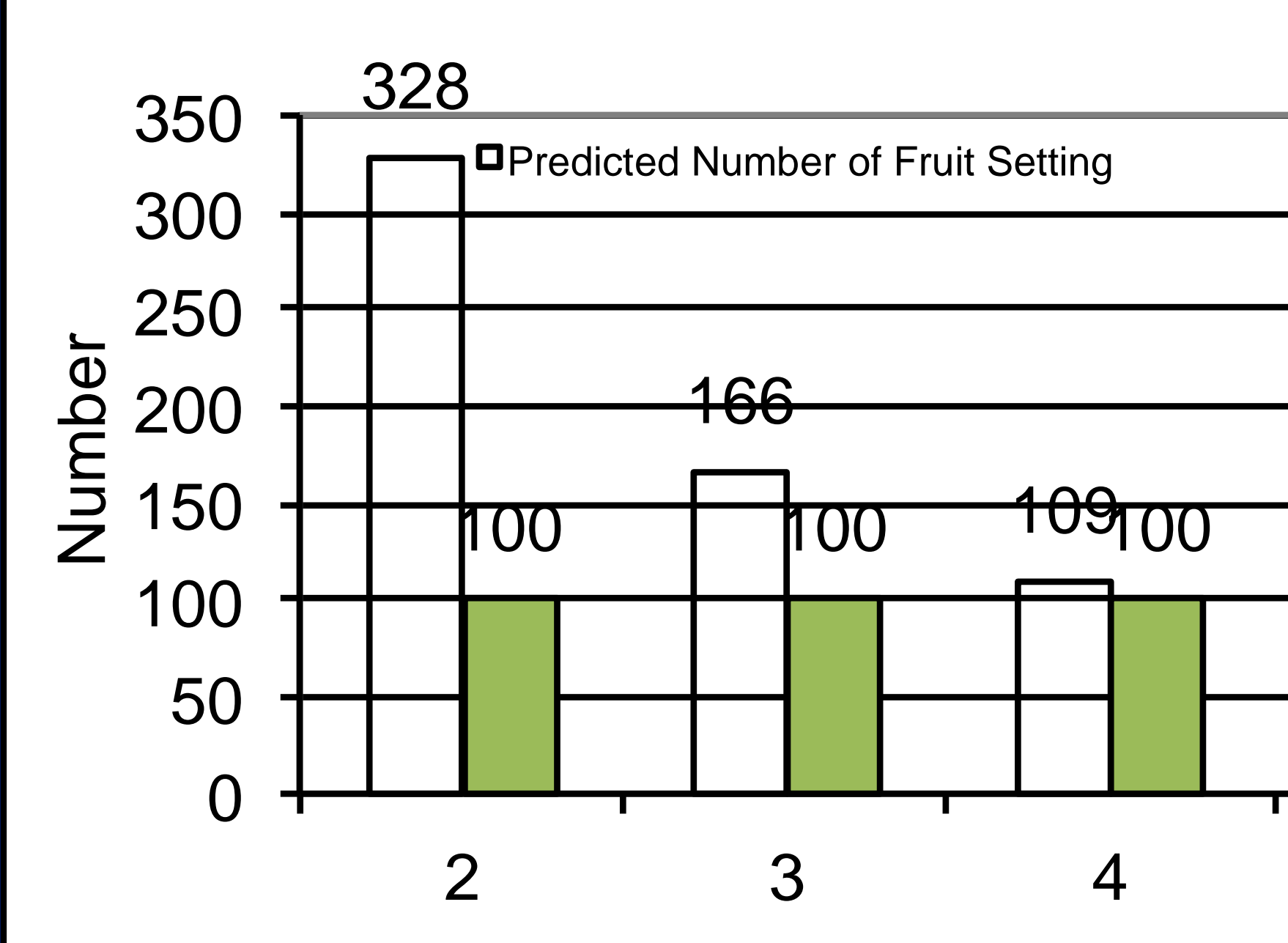
Carbohydrate Balance Hudson Valley Lab 2014

6/2	82	54	28.0	110.16	71.63	38.53	10.19	Increase chemical thinner rate by 30%
6/3	86	63	23.7	86.14	91.36	-5.22	1.66	Increase chemical thinner rate by 30%
6/4	78	61	23.9	98.09	80.53	17.56	10.68	Increase chemical thinner rate by 30%
6/5	71	59	12.8	62.48	72.60	-10.11	9.51	Increase chemical thinner rate by 30%
6/6	74	53	15.2	76.86	72.45	4.41	-6.85	Apply standard chemical thinner rate
6/7	80	53	26.5	112.24	81.38	30.86	-19.45	Apply standard chemical thinner rate
6/8	83	56	25.9	105.72	92.85	12.87	-44.85	Decrease chemical thinner rate by 30%
6/9	68	62	4.0	6.77	82.31	-75.54	-65.7	Decrease chemical thinner rate by 50%
6/10	79	62	12.4	55.25	101.24	-45.99	-68.84	-
6/11	71	60	5.3	16.96	87.69	-70.73	-55.53	-
6/12	65	58	3.5	6.52	77.07	-70.55	-28.22	-
6/13	74	65	5.0	10.83	98.92	-88.09	-5.87	-
6/14	70	55	16.7	87.77	80.52	7.25	8.18	-
6/15	74	52	25.8	119.84	81.33	38.51	-0.96	-
6/16	82	55	26.5	115.27	96.42	18.85	-16.62	-
6/17	87	64	20.9	85.32	117.23	-31.91	-14.8	-
6/18	84	67	21.8	88.71	118.01	-29.30	-3.02	-
6/19	80	61	16.1	78.78	102.91	-24.13	7.02	-
6/20	75	53	22.2	110.98	84.85	26.12	15.28	-
6/21	77	52	19.4	101.10	85.88	15.23	-4.68	-
6/22	80	54	21.3	104.64	93.78	10.86	-26.48	-

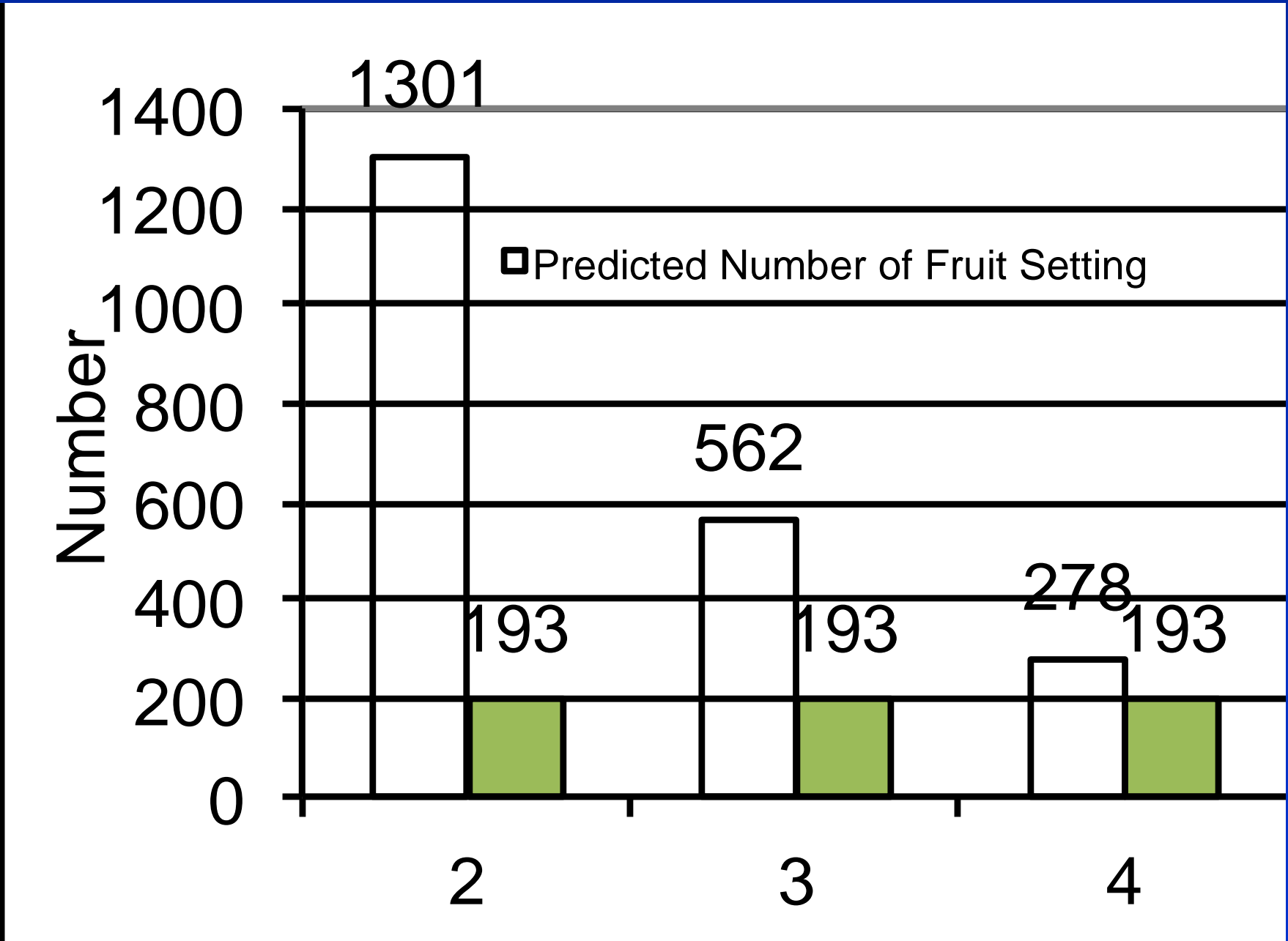
Gala fruit set at Geneva after 4 sprays with an initial bud load of 2 (1300 flowers)



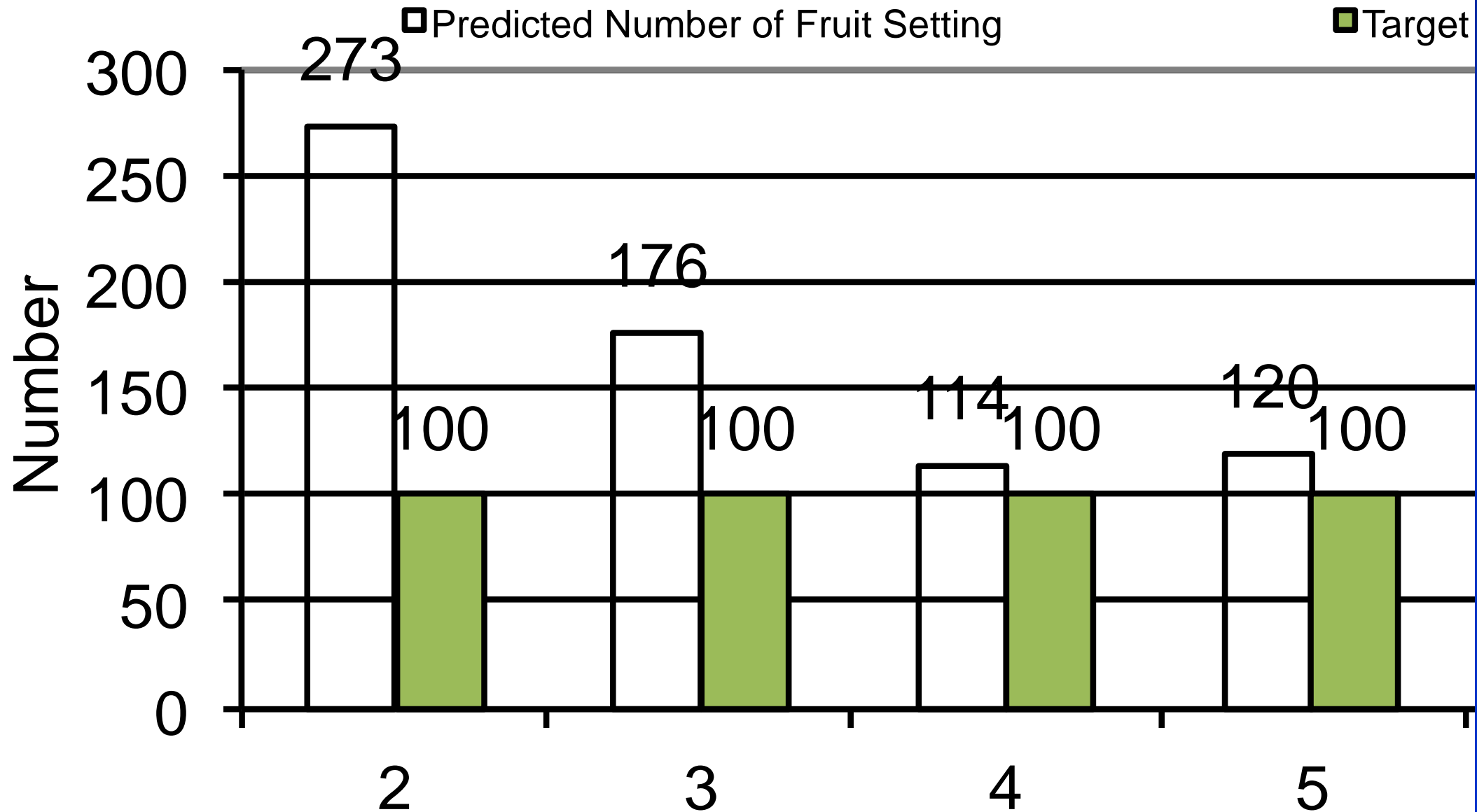
Gala fruit set at Lyndonville after 3 sprays with an initial bud load of 1.38 (690 flowers)



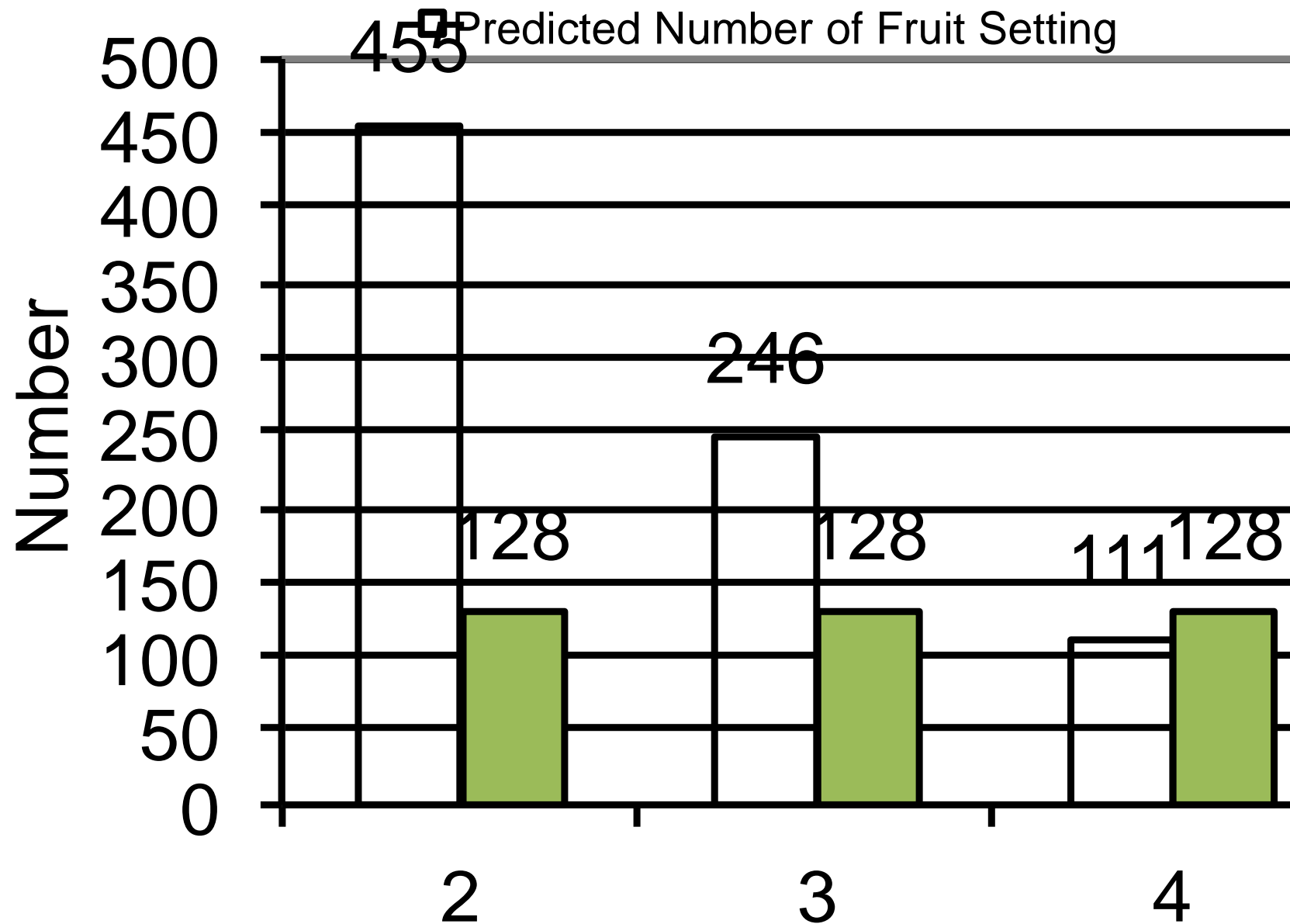
Gala fruit set in CNY after 3 sprays with an initial bud load of 2.2 (2130 flowers)



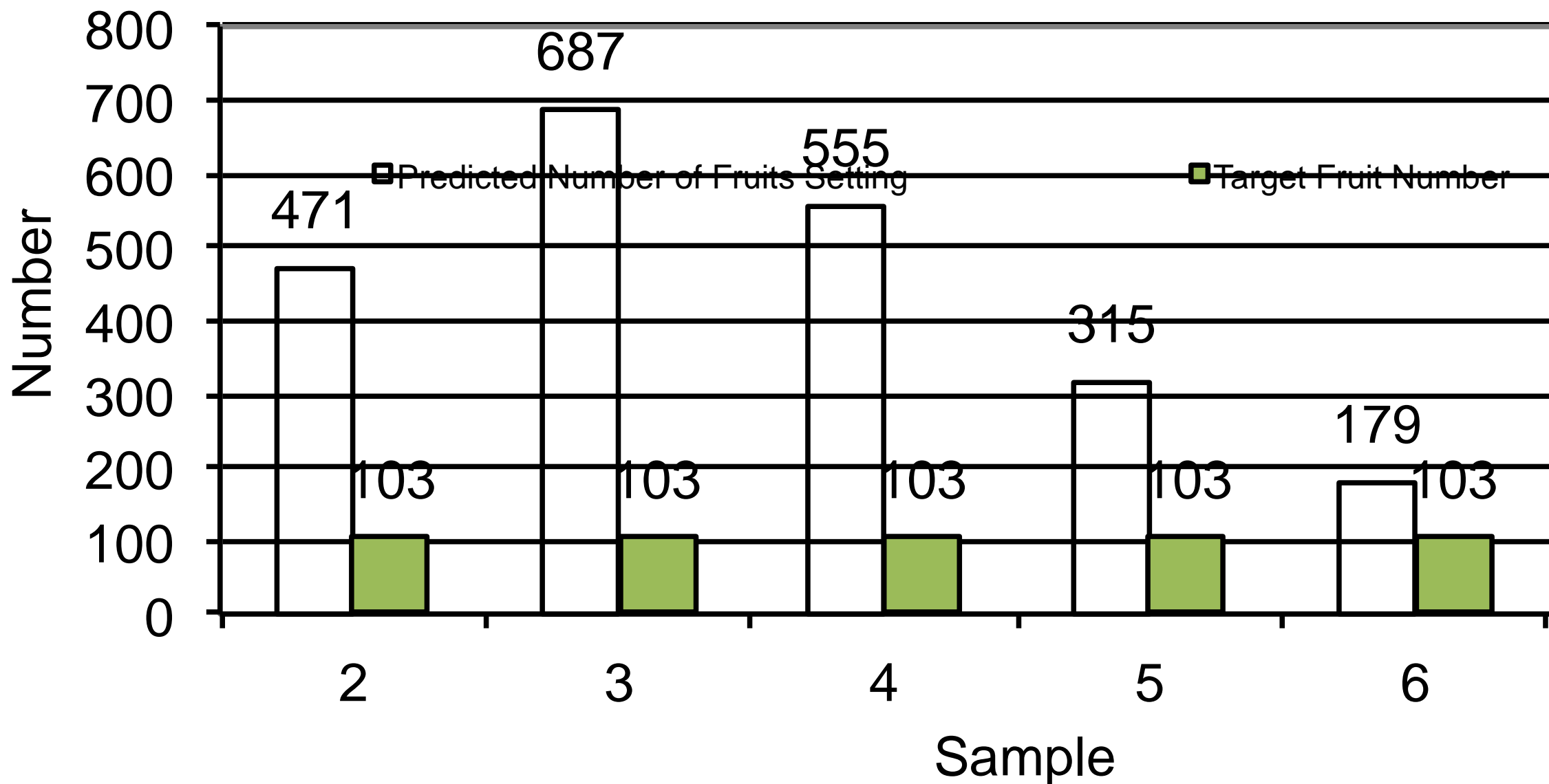
HC fruit set at Geneva after 4 sprays with an initial bud load of 2.6 (1300 flowers)



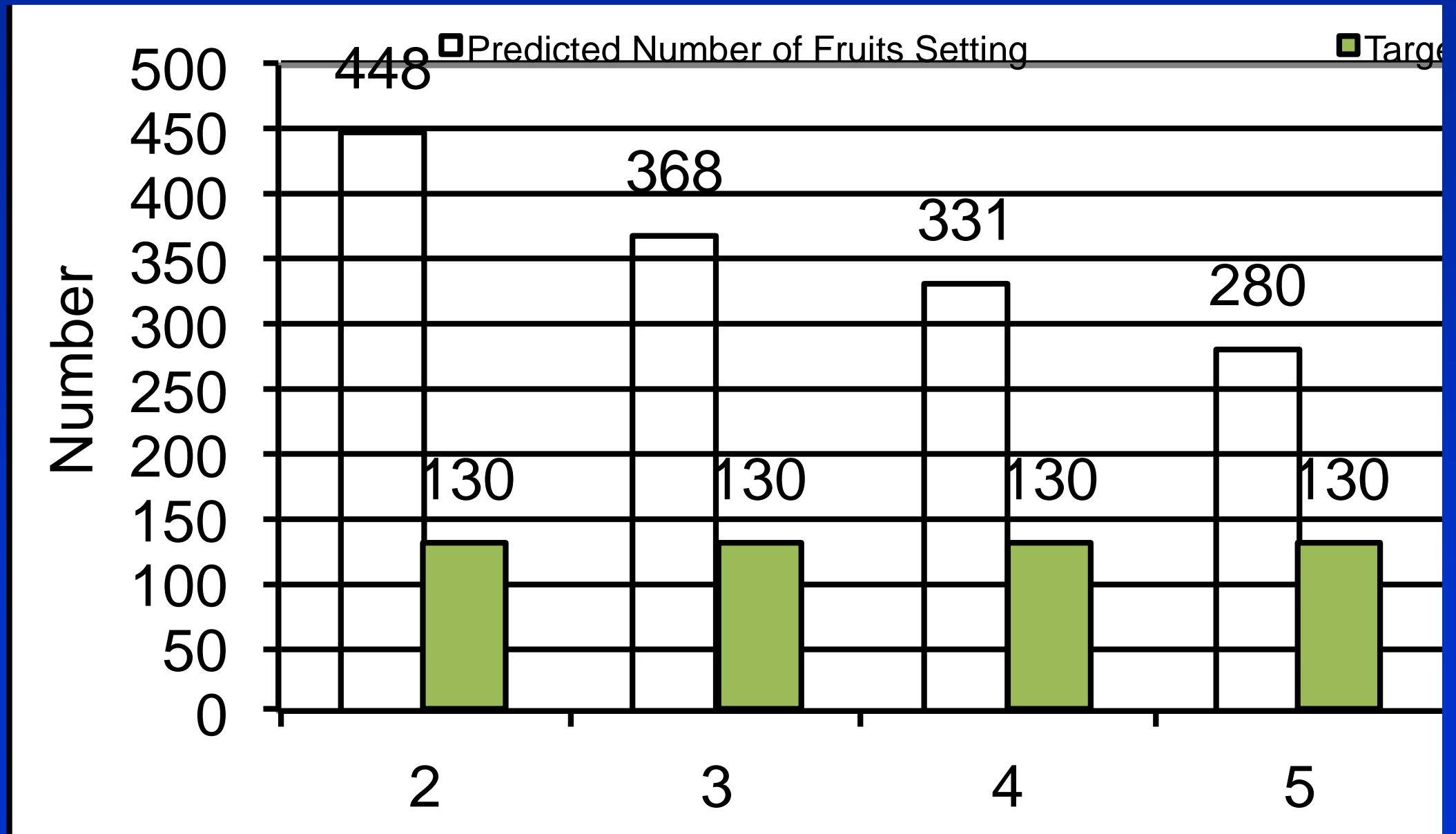
Honeycrisp fruit set in CNY after 3 sprays with an initial bud load of 1.8 (1185 flowers)



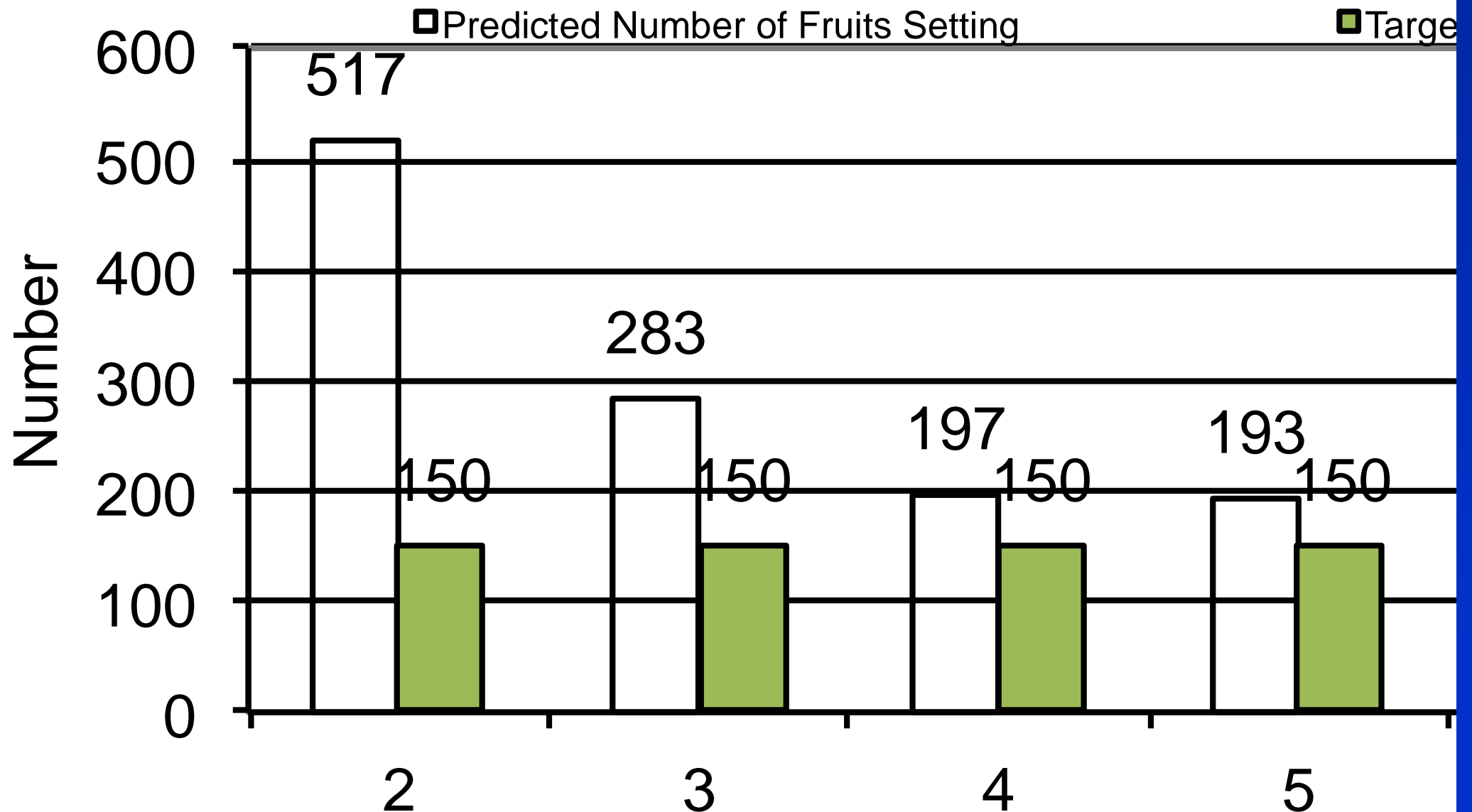
Honeycrisp fruit set at Chazy after 4 sprays with an initial bud load of 3.4 (1765 flowers)



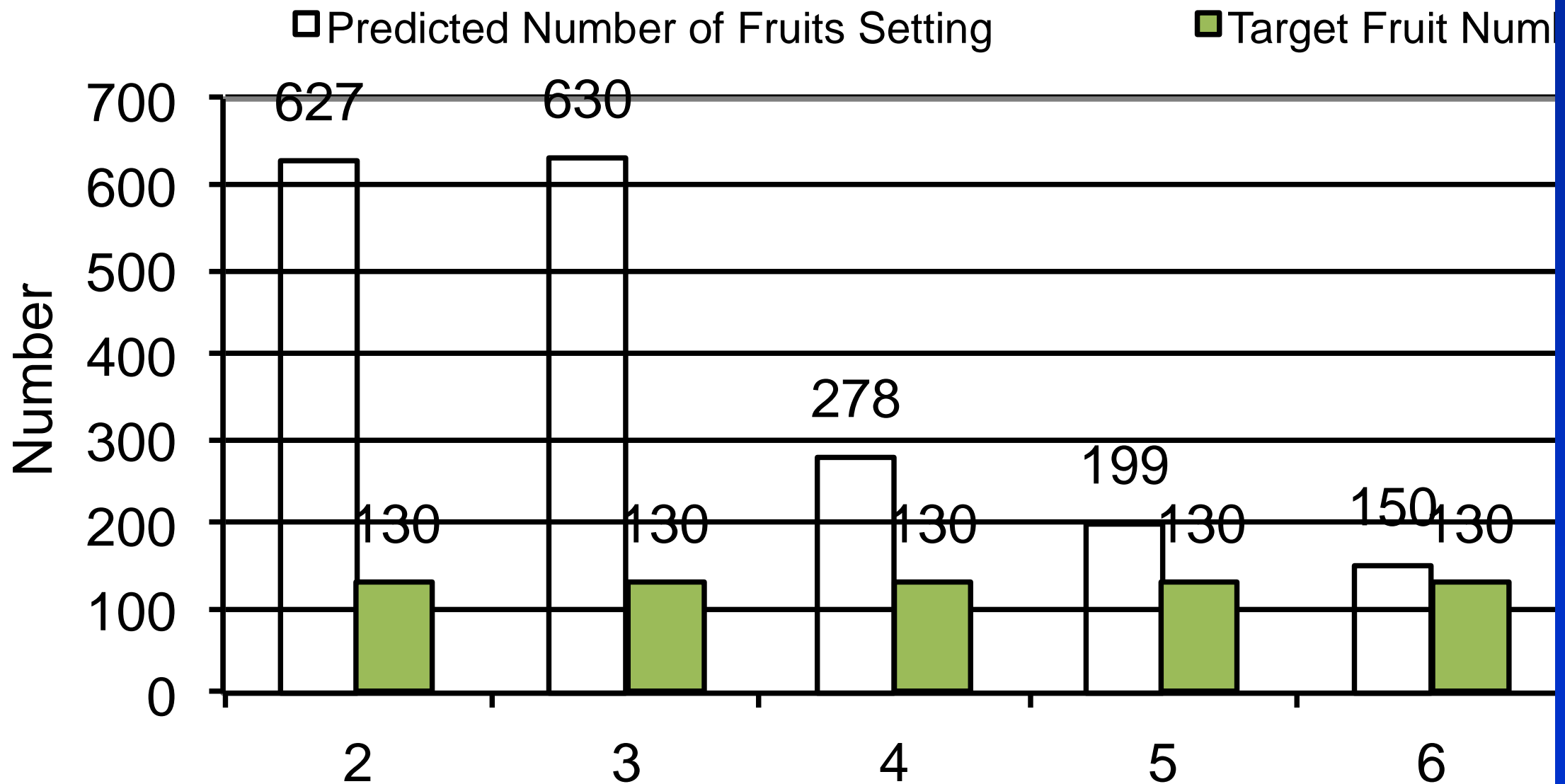
Honeycrisp fruit set at Peru after 3 sprays with an initial bud load of 1.5 (1000 flowers)



Honeycrisp fruit set at Sullivins at Peru after 3 sprays with an initial bud load of 1.7 (1250 flowers)



Gala fruit set at Albany after 4 sprays with an initial bud load of 1.9 (1225 flowers)

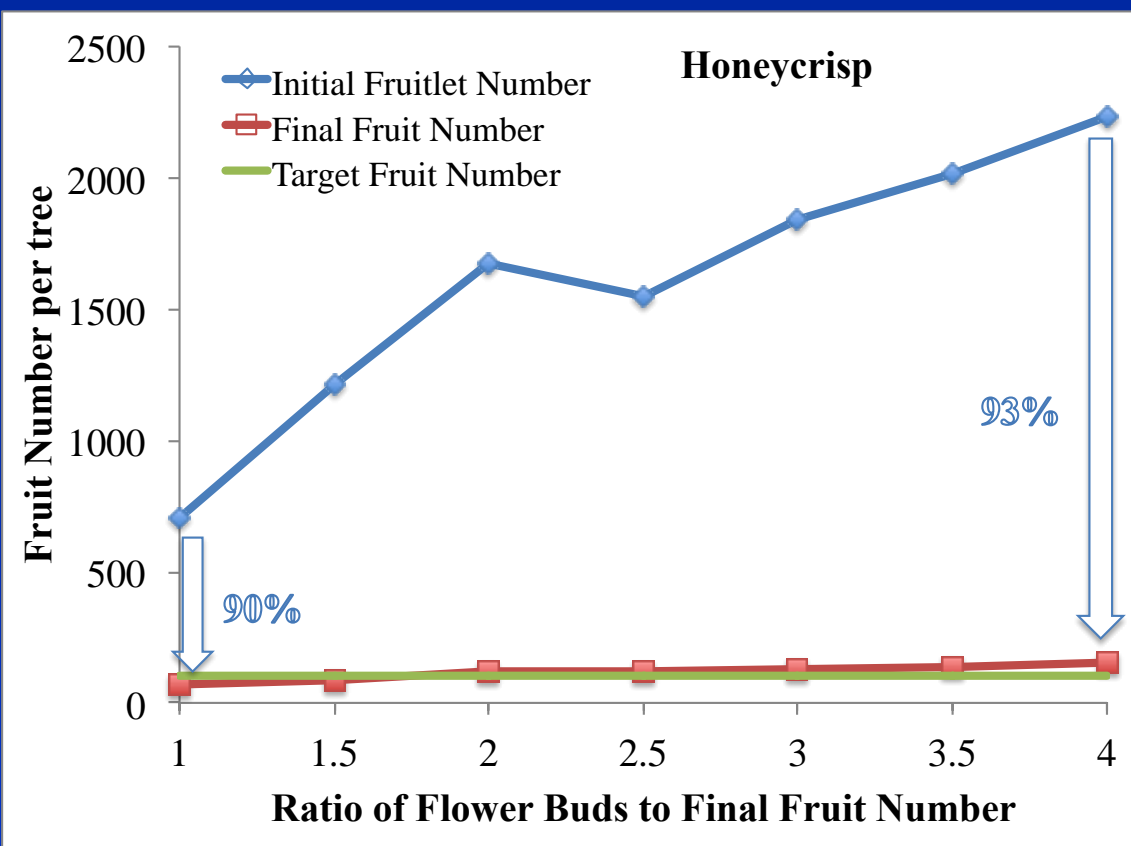
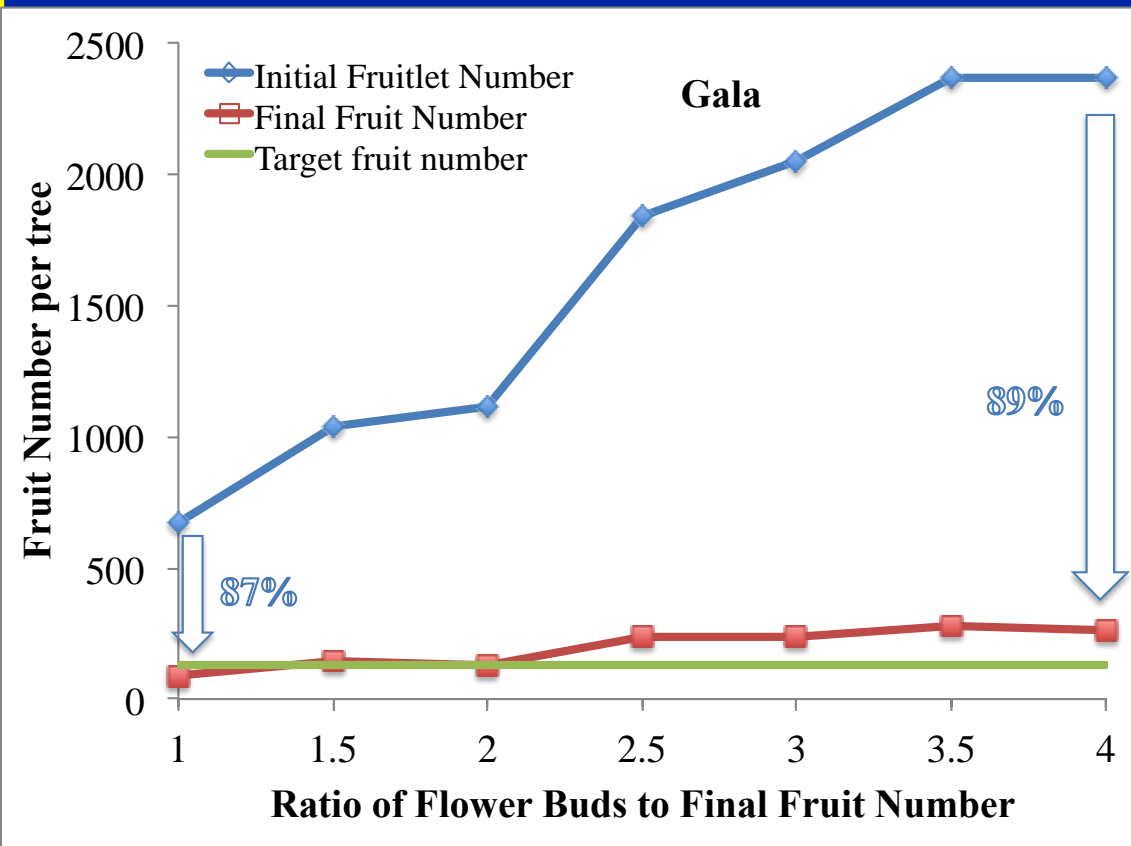


Pruning to Reduce Bud Load

Target 1.5 flower buds : 1 final fruit

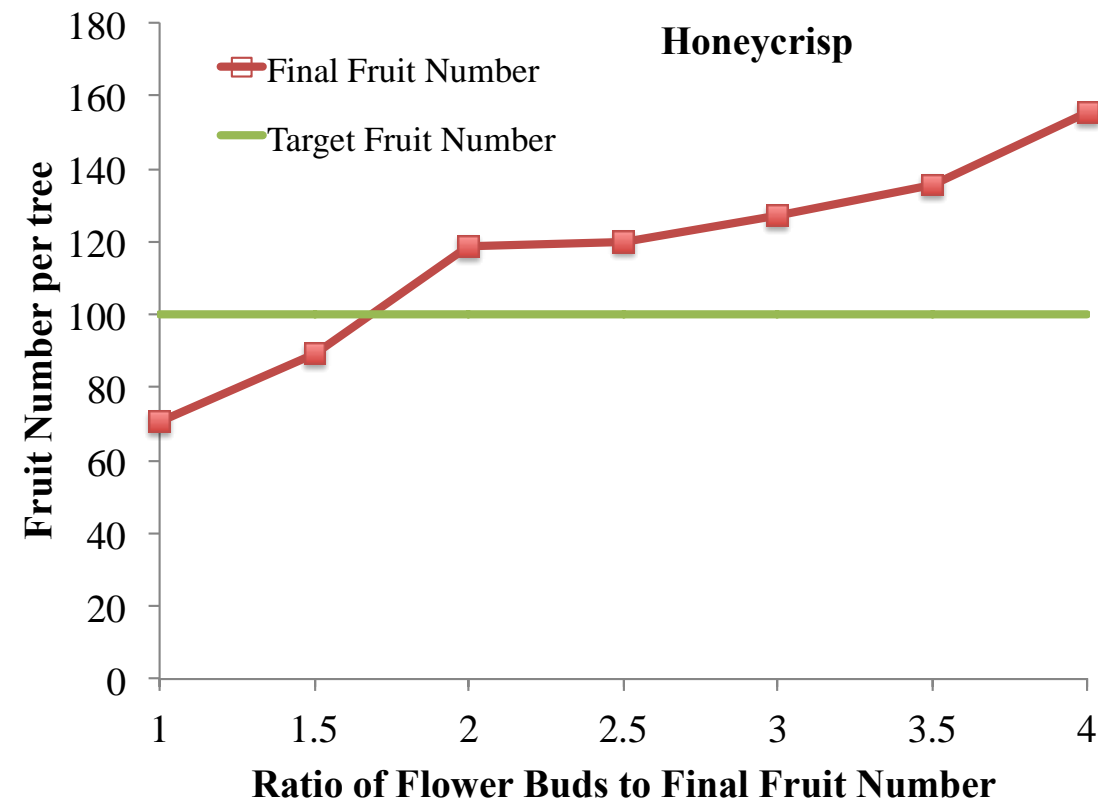
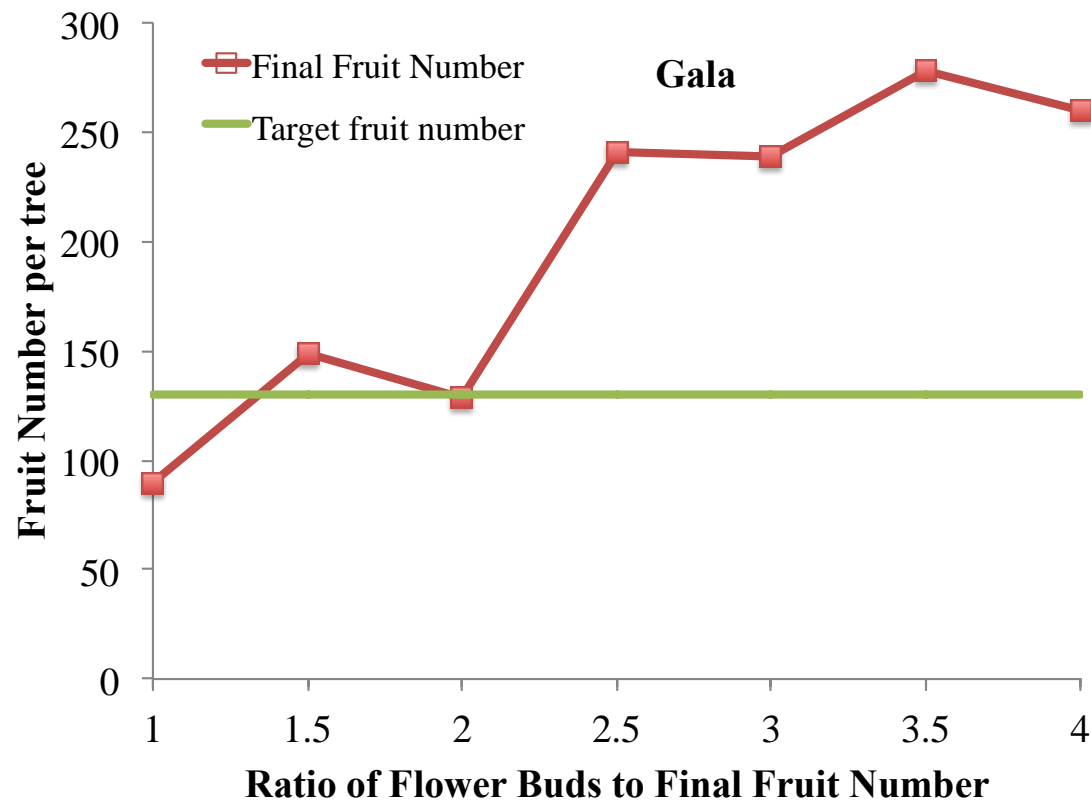


Gala and Honeycrisp Bud Load Study



- Leaving more buds resulted in more final fruit/tree
- The percent reduction in fruit numbers with and aggressive thinning program was quite similar regardless of initial flower bud load.

Gala and Honeycrisp Bud Load Study



- Leaving more than 2 buds : final fruit resulted in a large job of hand thinning
- Was my target right?

Conclusions from the Group Precision Thinning in 2013 and 2014

1. Both Gala and Honeycrisp needed more pruning to reduce bud load to 1:1.5
2. Most Gala blocks did not thin enough in both 2013 and 2014 and had significantly more fruit than the target fruit number
 - This required significant hand thinning
3. Most Honeycrisp blocks did not thin enough in 2013 but some slightly overthinned in 2014
4. Bloom thinning sprays were quite effective in 2013 but not in 2014
 - Bloom sprays of Maxcel did a nice job
5. The 10-12mm spray was not effective in 2013 but gave good thinning in 2014
6. The sequential sprays gave excellent crop load control.

Precision Thinning Group Effort in 2015

Protocol for group effort of willing participants in 2015

1. Select a mature orchard of either Gala or Honeycrisp.
2. Spray the protocol thinning recipe.
3. Tag 15 spurs per tree on each of 5 representative trees (75 total spurs) at pink and measure fruitlet diameter 4 times (3 and 8 days after petal fall spray, 8 days after 12mm spray and 8 days after 18 mm spray).
4. Send the data to Terence Robionson within 24 hours after each measurement to Terence Robinson.
5. Get back an assessment within 24 hours of thinning progress before next spray.

Take-Home Plan to Manage Crop Load in 2014:

1. Precision Prune

1. Count flower buds on 5 representative trees per variety.
2. Prune to 1.5 buds per desired fruit number

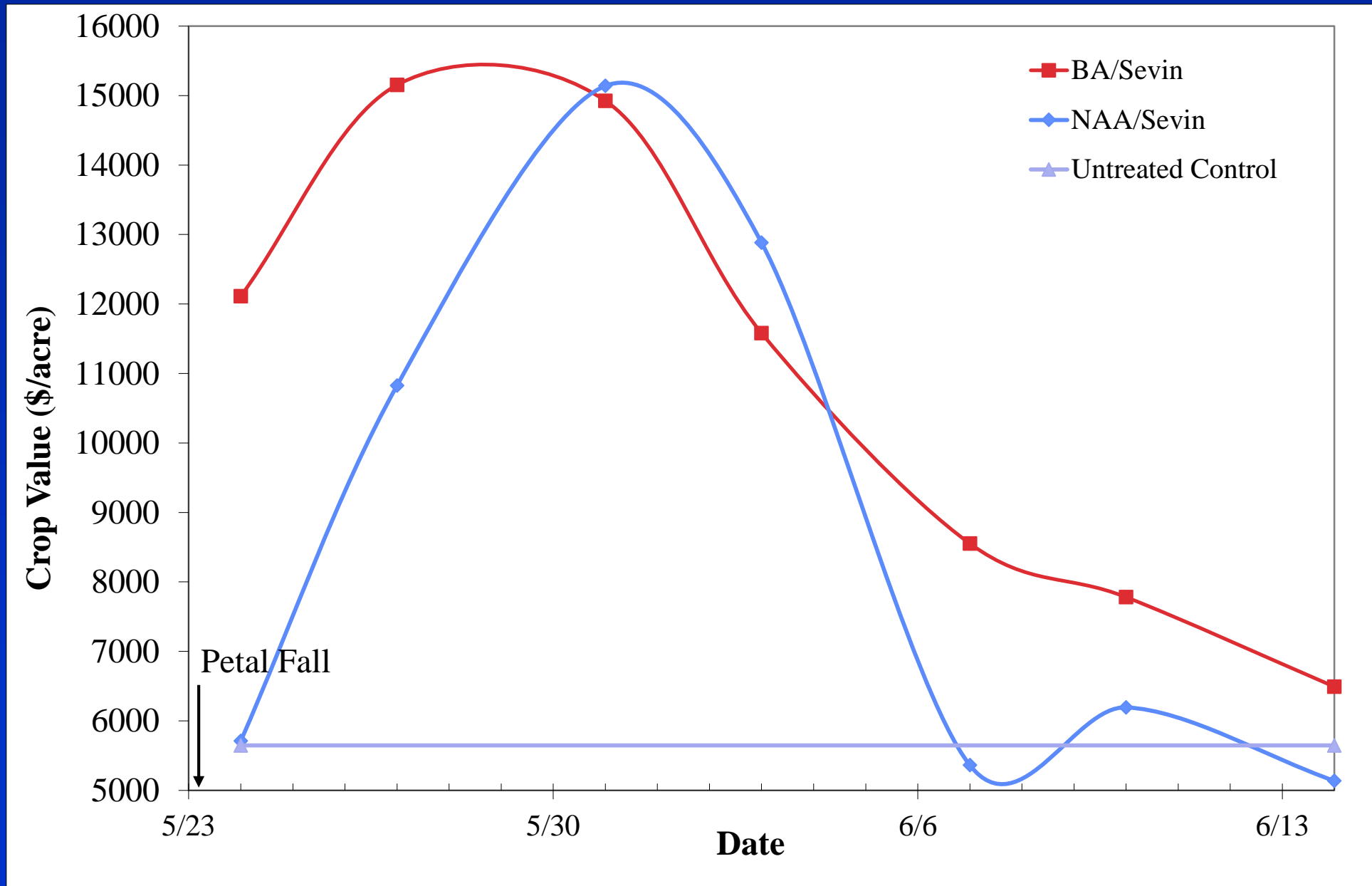
2. Chemically thin using the “Precision Thinning Program”

1. Begin with a full bloom spray
2. Apply a petal fall thinning spray
3. Assess response
4. If necessary, apply a thinning spray at 10-13mm
5. Re-assess response
6. If necessary apply a thinning spray at 18-20mm

3. Hand thin with Precision Hand Thinning

- Count number of fruits per tree
- Zone thin using multi-level platform with each person removing his assigned number of fruits.

Is Precision Thining Worth the Effort?





Thank You for Your Attention

Questions?

Plan to attend:

- **Pruning workshop Mar. 2, 2015 Ulster and Columbia Counties**
- **Precision Thinning Training in Early May 2015**