2009 Orchard and Vineyard Show

MSHS Trust

# Management of Cropload on Honeycrisp to optimize fruit quality and return bloom

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- Michigan State Horticultural Society
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Wittenbach
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Prilliwitz
Jelenick

## THE PROBLEM

### Factors Affecting Fruit Size, Quality, Return Bloom & Fruit Set

Yellowing of Leaves

Bitter Pit

Variable Bloom

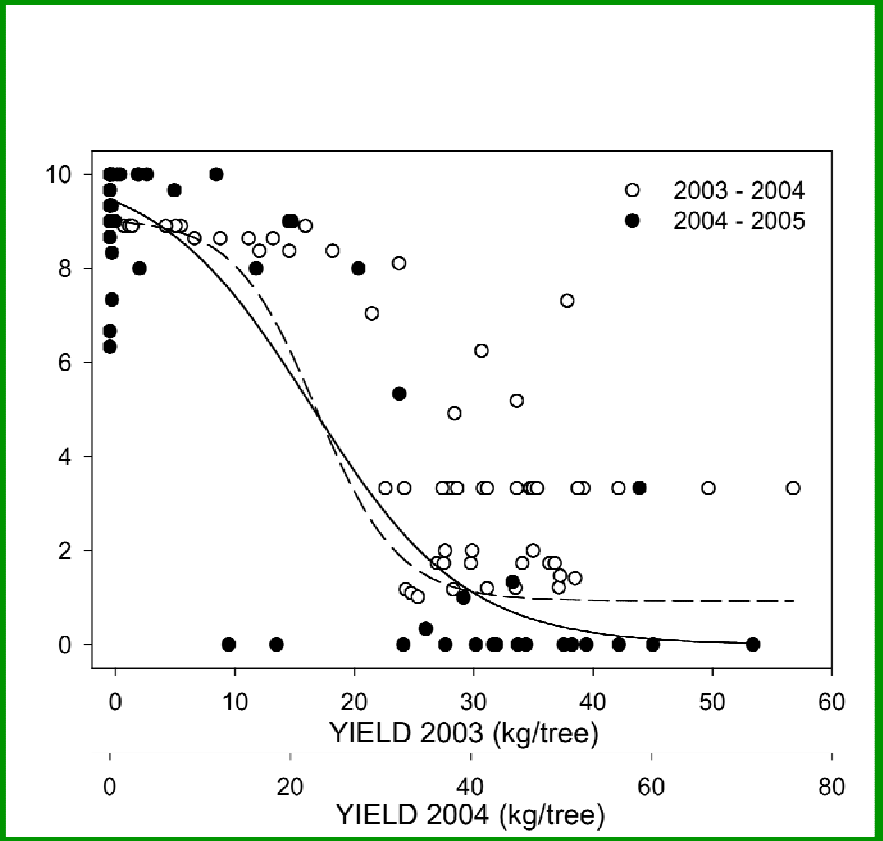
Defoliation (Japanese Beetle Damage)

PROBLEM

## Return Bloom

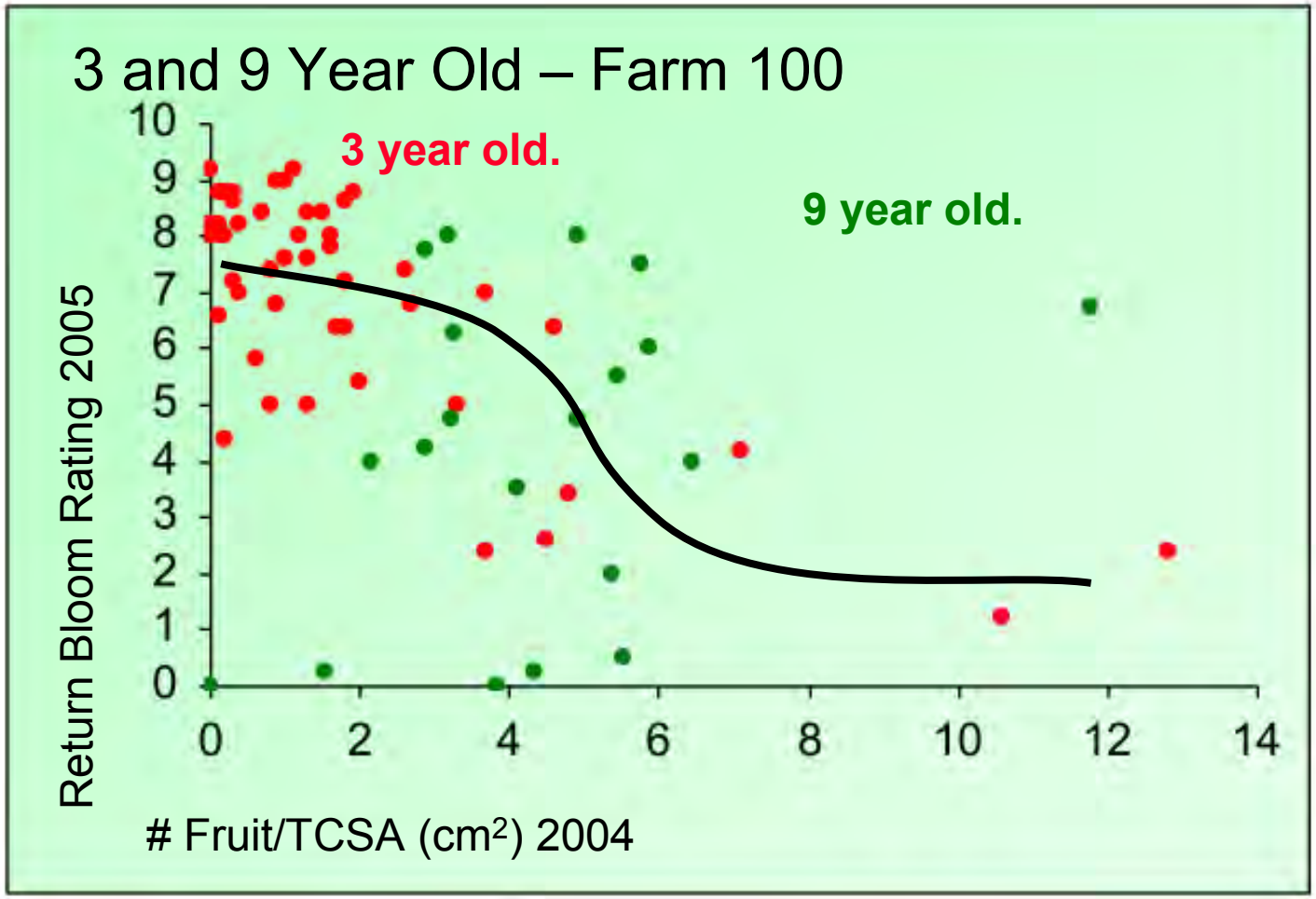
**Literature...**

- Related to yield and vigor.
  - Mainly Crop Load
- Small optimum range 4-6 fruit per TSCA




**Does leaf yellowing affect floral bud differentiation and therefore, return bloom? CROP LOAD EFFECT?**

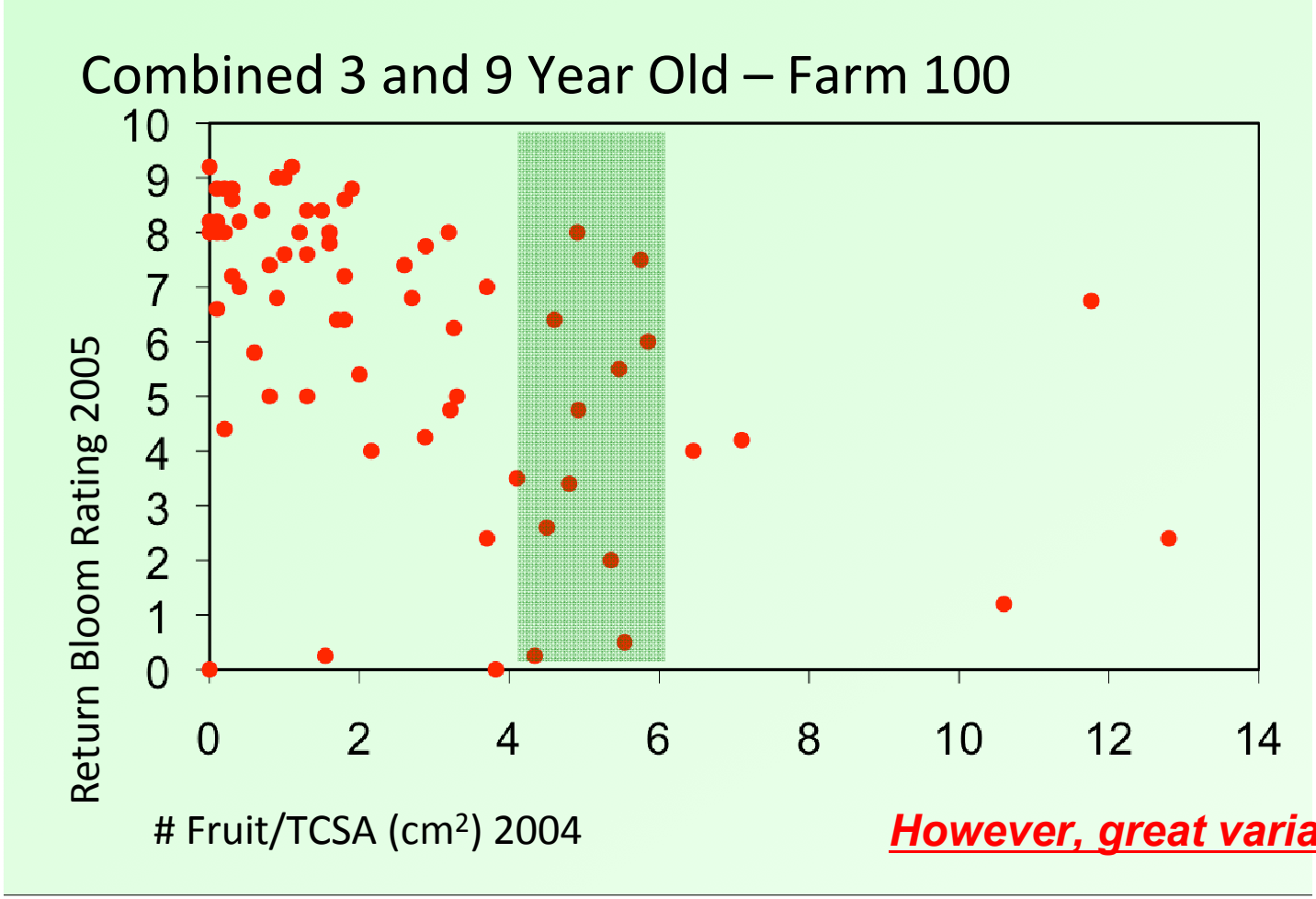
# Honeycrisp
# # of Fruit/TCSA vs Return Bloom




4 to 6 Fruits per TSCA

Too much cropload = no return bloom

# Honeycrisp
## # of Fruit/TCSA vs Return Bloom




4 to 6 Fruits per TSCA

>4-6 = Poor RBR

***However, great variability***

# TREATMENTS

Honeycrisp Apple, 3 orchards; Randomized complete block design
5 treatments (4 trees/treatment); Crop load adjustment applied after June drop

High Crop Load
(**HCL** )

Medium -High
Crop Load
(**M-HCL** )

Medium Crop Load
(**MCL** )

Medium -Low
Crop Load
(**M-LCL** )

Low Crop Load
(**LCL** )

~270

~4 Fruit / Spur
Natural cropping

~200

3 Fruit / Spur or
Hand-spread

~140

2 Fruit / Spur or
Hand-spread

~70

1 Fruit / Spur or
Hand-spread

~30

1 Fruit / 2 Spur

**Table 1. The influence of crop load adjustment at fruit set on production characteristics of Honeycrisp at the Belding site.**

| | | 2006 Crop Load Treatment | | | |
|---|---|---|---|---|---|
| Season | Defining Data | High | Medium | Med. High | Low |
| 2006 | Fruit / Tree | 111.1 | 89.3 | 67.0 | 30.3 |
| 2006 | Fruit / TCSA | 18.1 | 14.3 | 8.4 | 4.7 |
| 2006 | Leaf to Fruit Ratio | 8.6 | 12.9 | 26.6 | 35.0 |

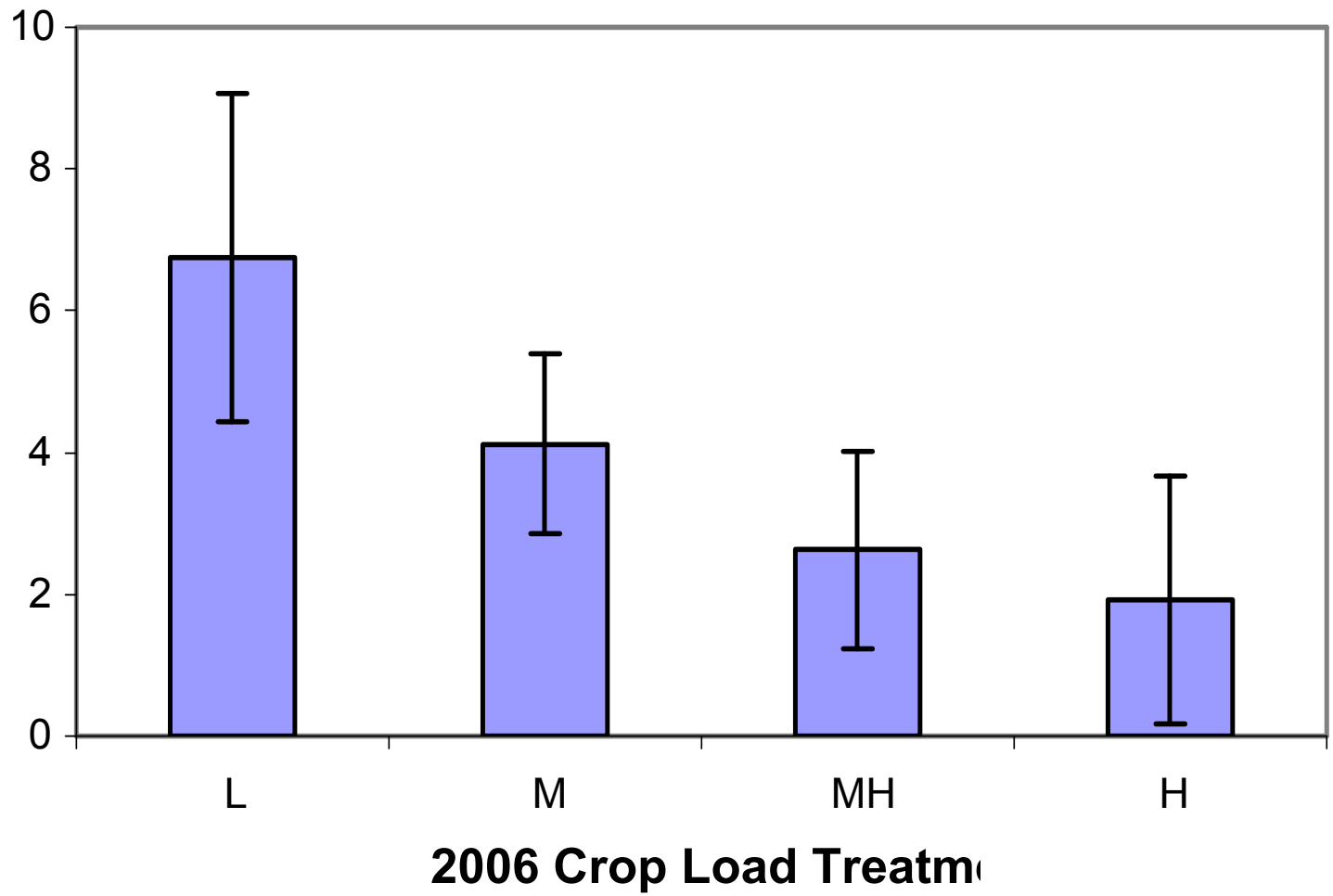
| | | 2006 Crop Load Treatment | | | |
|---|---|---|---|---|---|
| Season | Resulting Data | High | Medium | Med. High | Low |
| 2006 | Yield (kg/tree) | 17.7 a | 16.6 a | 12.7 b | 8.3 c |
| 2006 | Color pick (%) | 55.4 a | 65.0 a | 78.7 b | 95.2 b |
| 2006 | Drop (%) | 13.1 a | 8.1 a | 7.9 a | 0.9 b |
| 2006 | Fruit weight (g) | 170.5 a | 189.0 a | 229.2 b | 252.9 c |
| 2006 | Fruit diameter (mm) | 74.2 a | 76.0 a | 80.1 b | 83.8 c |
| 2006 | Yellow (1 to 10) | 2.5 a | 3.5 a | 3.8 a | 4.0 a |
| 2006 | Bitterpit (%) | 1.6 a | 2.6 a | 1.6 a | 3.3 a |
| 2007 | Return Bloom* (0 to 10) | 1.9 | 2.6 | 4.1 | 6.8 |
| 2007 | Return Crop** (0 to 5) | 1.0 | 1.2 | 2.2 | 3.2 |
| 2007 | Yellow** (0 to 10) | 1.9 | 2.1 | 1.6 | 1.2 |
| 2007 | Bitterpit** (0 to10) | 0.9 | 1.6 | 2.0 | 2.3 |
| 2007 | Vigor** (1 to 3) | 2.0 | 2.0 | 2.3 | 2.1 |

**Means between row followed by the same letter are not significantly different at P = 0.05 by Tukey's.**

*Visual Rating 8-May 2007

** Visual Rating 4-Sept 2007

# Return Bloom Evaluation -- Wittenbach
# Crop Potential Based on Presence of Flc



Department of Horticulture
Michigan State University

# 1997 Orchard

| | | 2006 Crop Load Treatment | | | | |
|---|---|---|---|---|---|---|
| Season | Defining Data | High | Med. High | Medium | Med. Low | Low |
| 2006 | Fruit / TCSA | 32.8 | 22.4 | 22.9 | 13.4 | 9.2 |
| 2006 | Leaf to Fruit Ratio | 3.3 | 6.6 | 8.5 | 22.1 | 37.0 |

| | | 2006 Crop Load Treatment | | | | |
|---|---|---|---|---|---|---|
| Season | Resulting Data | High | Med. High | Medium | Med. Low | Low |
| 2006 | Yield (kg/tree) | 20.8 a | 20.0 a | 19.4 a | 15.2 b | 10.8 b |
| 2006 | Color pick (%) | 30 a | 25.0 a | 27.0 a | 45.8 a | 85.2 b |
| 2006 | Drop (%) | 37.2 a | 36.8 a | 20.2 a | 26.2 a | 8.9 b |
| 2006 | Fruit weight (g) | 132.2 a | 151.2 a | 175.8 b | 177..7 b | 184.8 b |
| 2006 | Fruit diameter (mm) | 72.0 a | 73.4 a | 74.5 a | 76.2 a | 77.4 b |
| 2006 | Bitterpit (%) | 4.6 a | 7.8 a | 5.8 a | 3.2 a | 13.8 b |
| 2007 | Return Bloom* (0-10) | 2.4 | 3.7 | 5.8 | 6.6 | 5.5 |
| 2007 | Return Crop** (0-5) | 0.5 | 0.3 | 0.6 | 0.9 | 0.3 |
| 2007 | Yellow** (0-10) | 1.3 | 1.5 | 1.2 | 0.8 | 1.2 |
| 2007 | Bitterpit** (0-10) | 0 | 0 | 0 | 0 | 0 |
| 2007 | Vigor** (1-3) | 1.6 | 1.8 | 1.8 | 1.8 | 2.1 |

Means between row followed by the same letter are not significantly different at P = 0.05 by Tukey's.

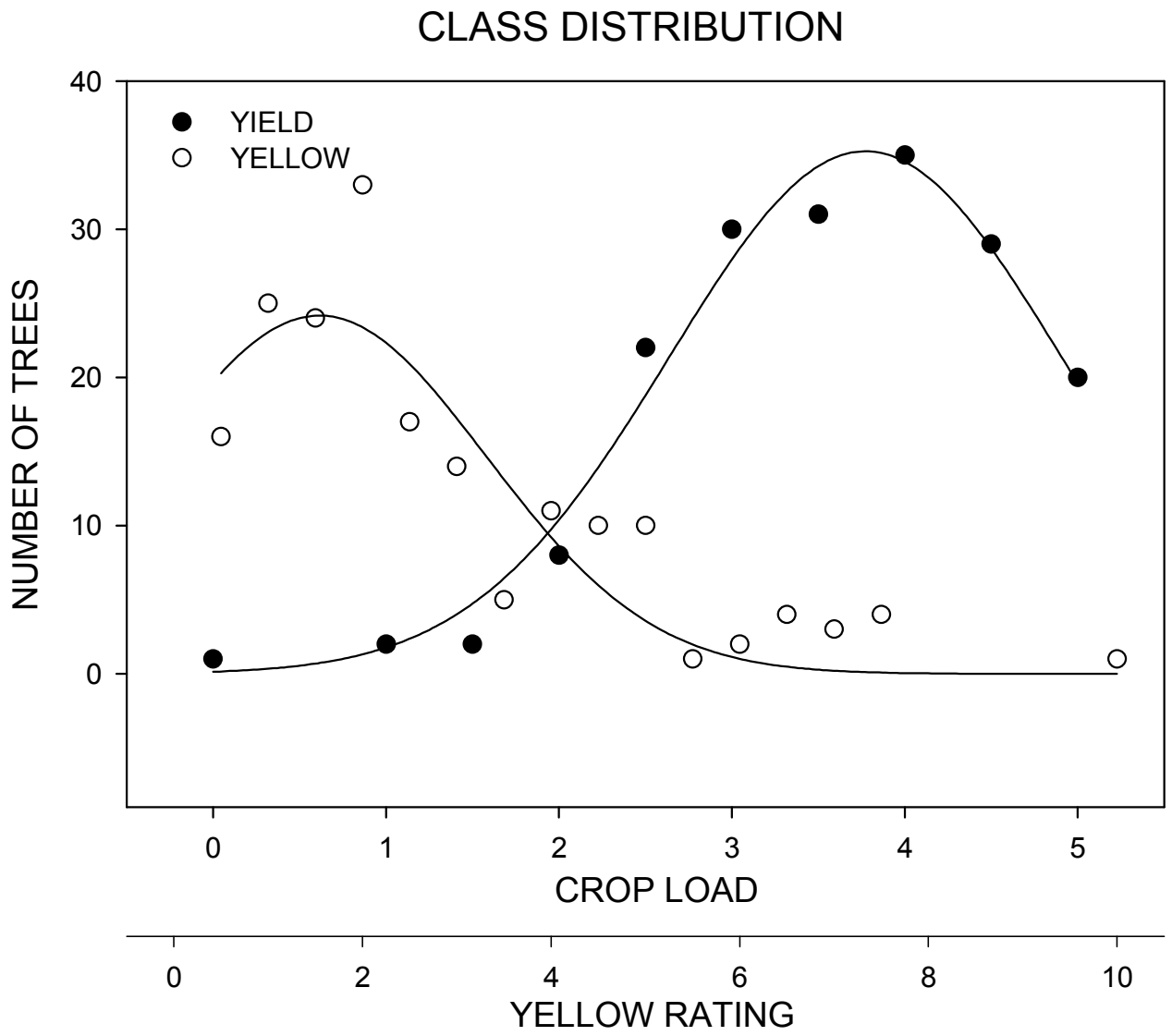
*Visual Rating 8-May 2007

** Visual Rating 4-Sept 2007

The influence of crop load adjustment at fruit set on production characteristics of Honeycrisp at the Sparta site.

## 2002 Orchard

| | | 2006 Crop Load Treatment | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Season | Defining Data | High | | Med. High | | Medium | | Med. Low | | Low | |
| 2006 | Fruit / TCSA | 15.7 | | 8.1 | | 6.2 | | 2.4 | | 1.9 | |
| 2006 | Leaf to Fruit Ratio | 6.6 | | 10.4 | | 16.1 | | 25.4 | | 37.8 | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | **2006 Crop Load Treatment** | | | | | | | | | |
| Season | Resulting Data | High | | Med. High | | Medium | | Med. Low | | Low | |
| 2006 | Yield (kg/tree) | 11.1 | a | 7.8 | b | 7.6 | b | 3.6 | c | 3.1 | c |
| 2006 | Fruit weight (g) | 197.2 | a | 211.5 | b | 225.3 | b | 269.3 | c | 285.0 | c |
| 2006 | Fruit diameter (mm) | 79.6 | a | 82.5 | b | 84.8 | b | 86.5 | b | 87.6 | b |
| 2006 | Bitterpit (%) | 4.6 | a | 3.6 | a | 9.6 | a | 23.1 | b | 65.0 | c |
| | | | | | | | | | | | |
| * 2007 | Return Bloom* (0-10) | 1.9 | | 3.3 | | 5.1 | | 4.9 | | 8.3 | |
| 2007 | Return Crop** (0-5) | 0.5 | | 1.1 | | 1.2 | | 1.7 | | 2.5 | |
| 2007 | Yellow** (0-10) | 1.8 | | 1.8 | | 1.0 | | 1.4 | | 1.2 | |
| 2007 | Bitterpit** (0-10) | 0 | | 0 | | 0 | | 0 | | 0 | |
| 2007 | Vigor** (1-3) | 1.4 | | 1.5 | | 1.7 | | 1.5 | | 1.4 | |
| | | | | | | | | | | | |


CLASS DISTRIBUTION
YIELD
YELLOW
NUMBER OF TREES
40
30
20
10
0
0
1
2
3
4
5
CROP LOAD
0
2
4
6
8
10
YELLOW RATING

## Leaf Yellowing

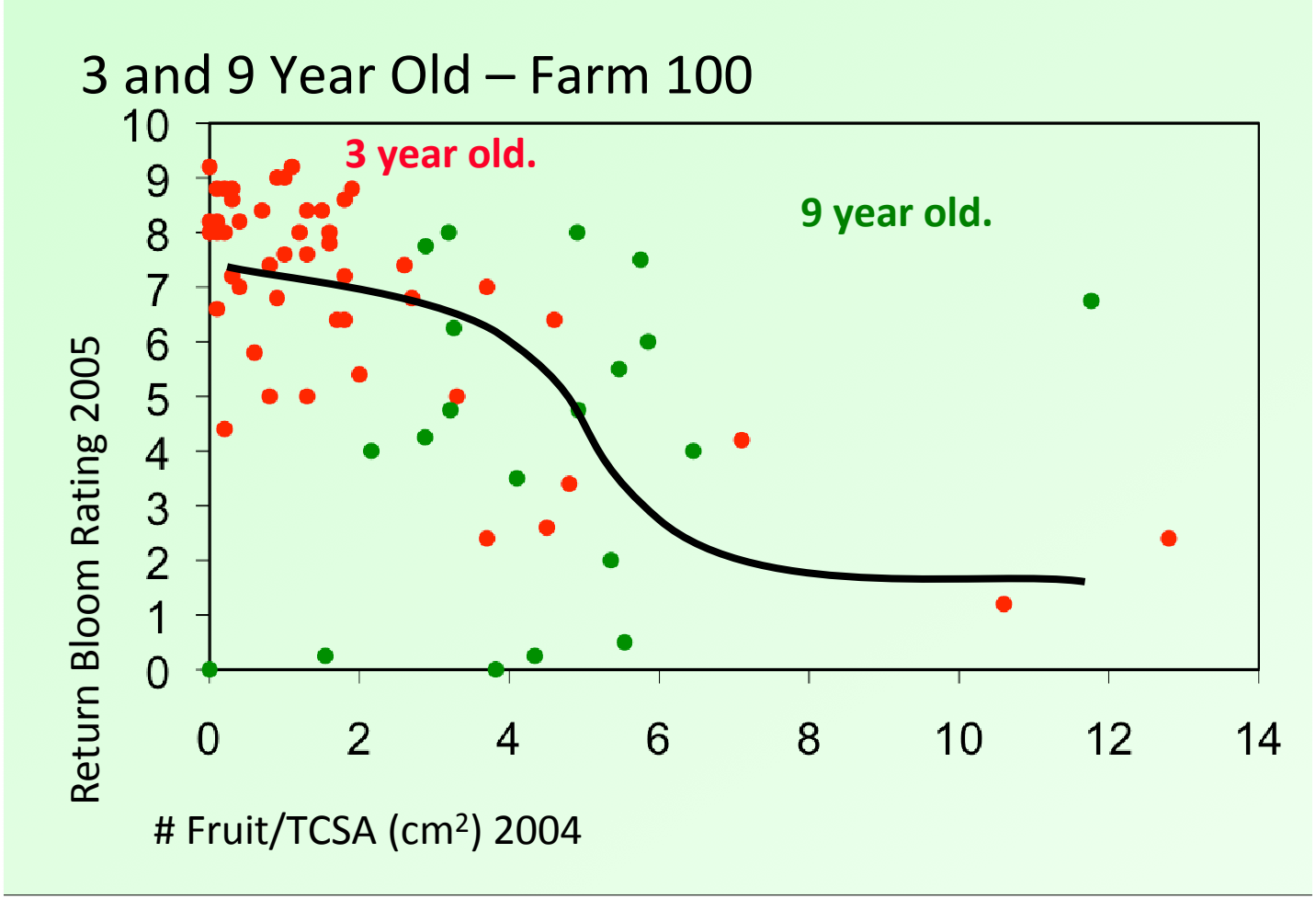
**Literature...**

- Related to accumulation of sugar and starch in slow growing shoots.
- More evident in low cropping trees.

**Does leaf yellowing affect floral bud differentiation and therefore, return bloom?**

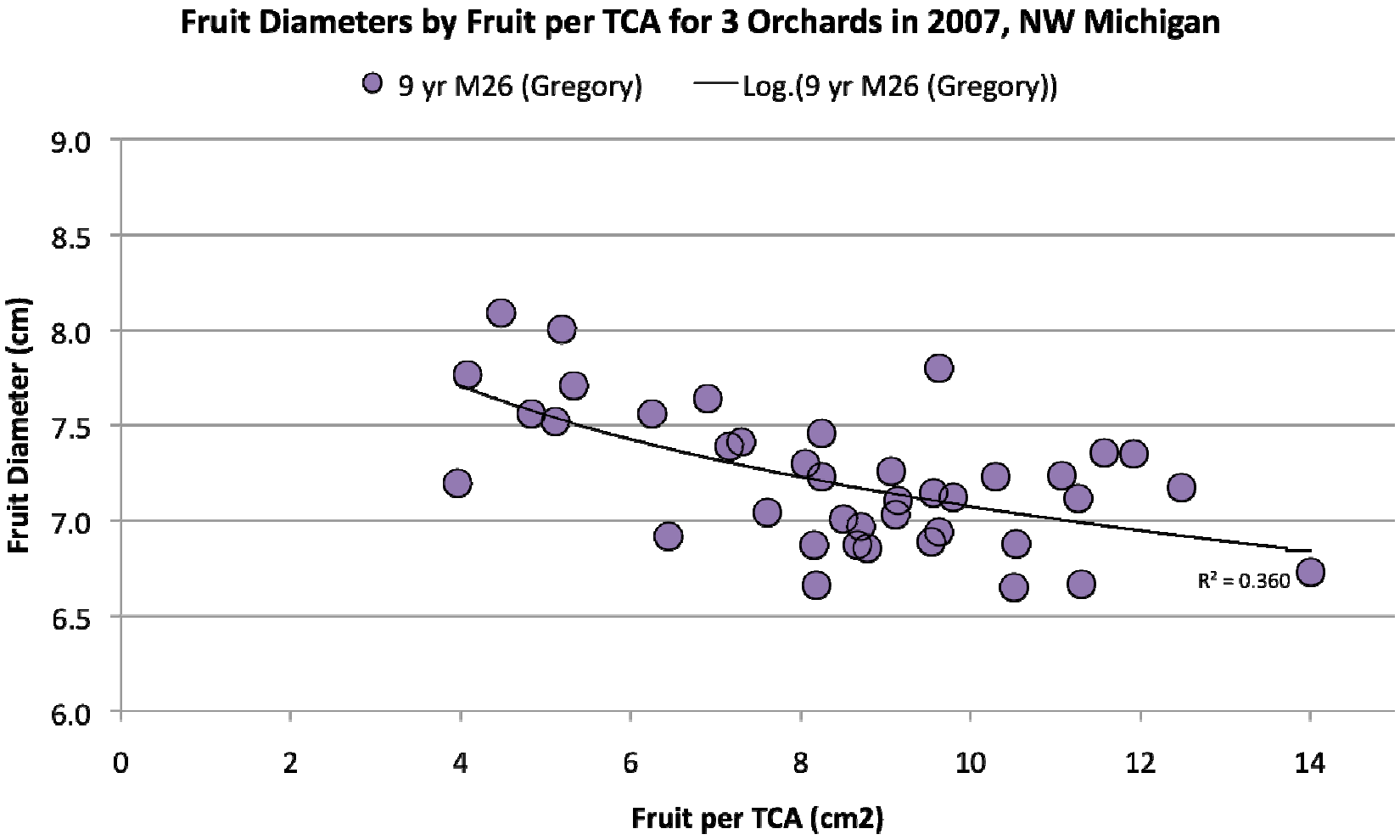
NO

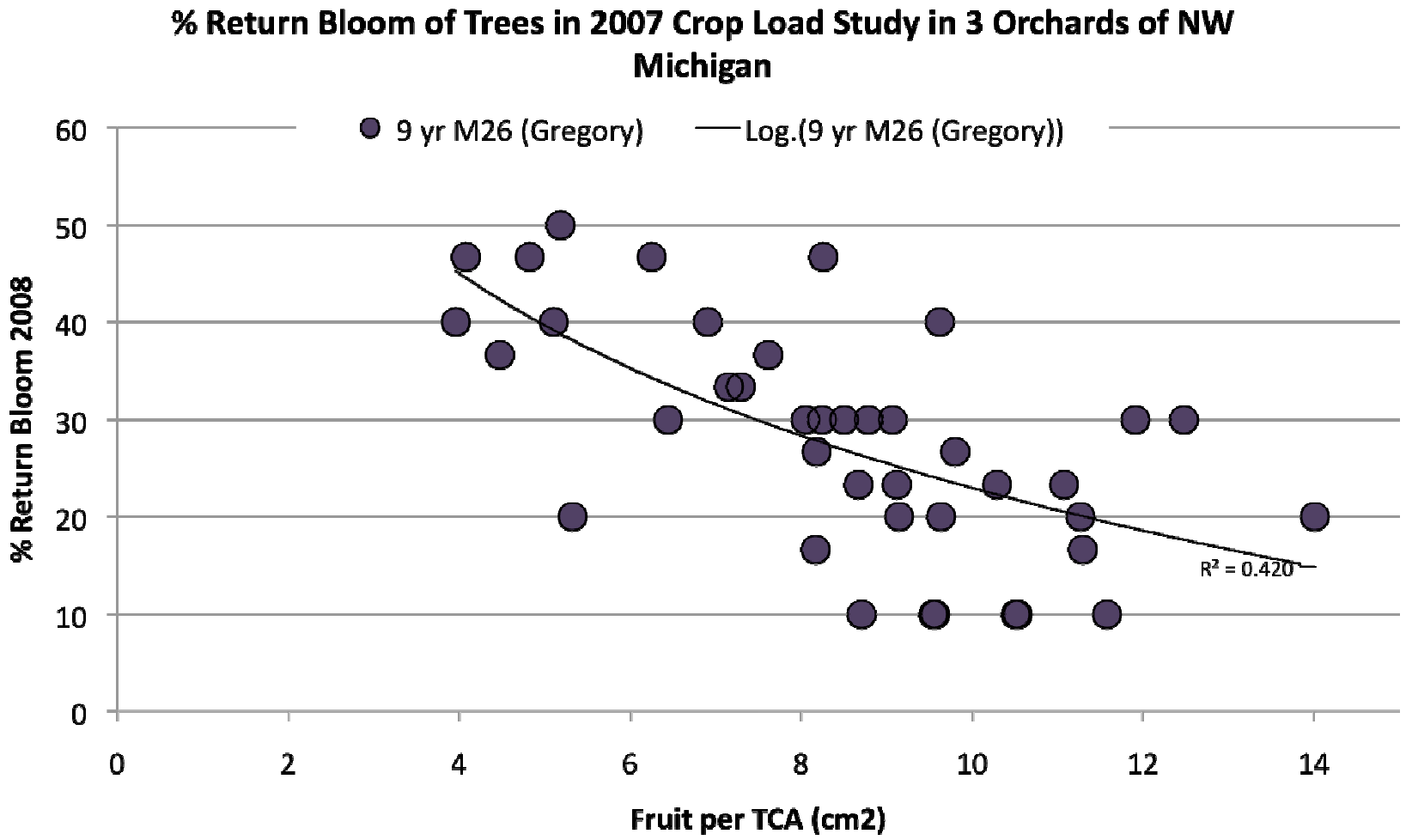
# Honeycrisp
## # of Fruit/TCSA vs Return Bloom

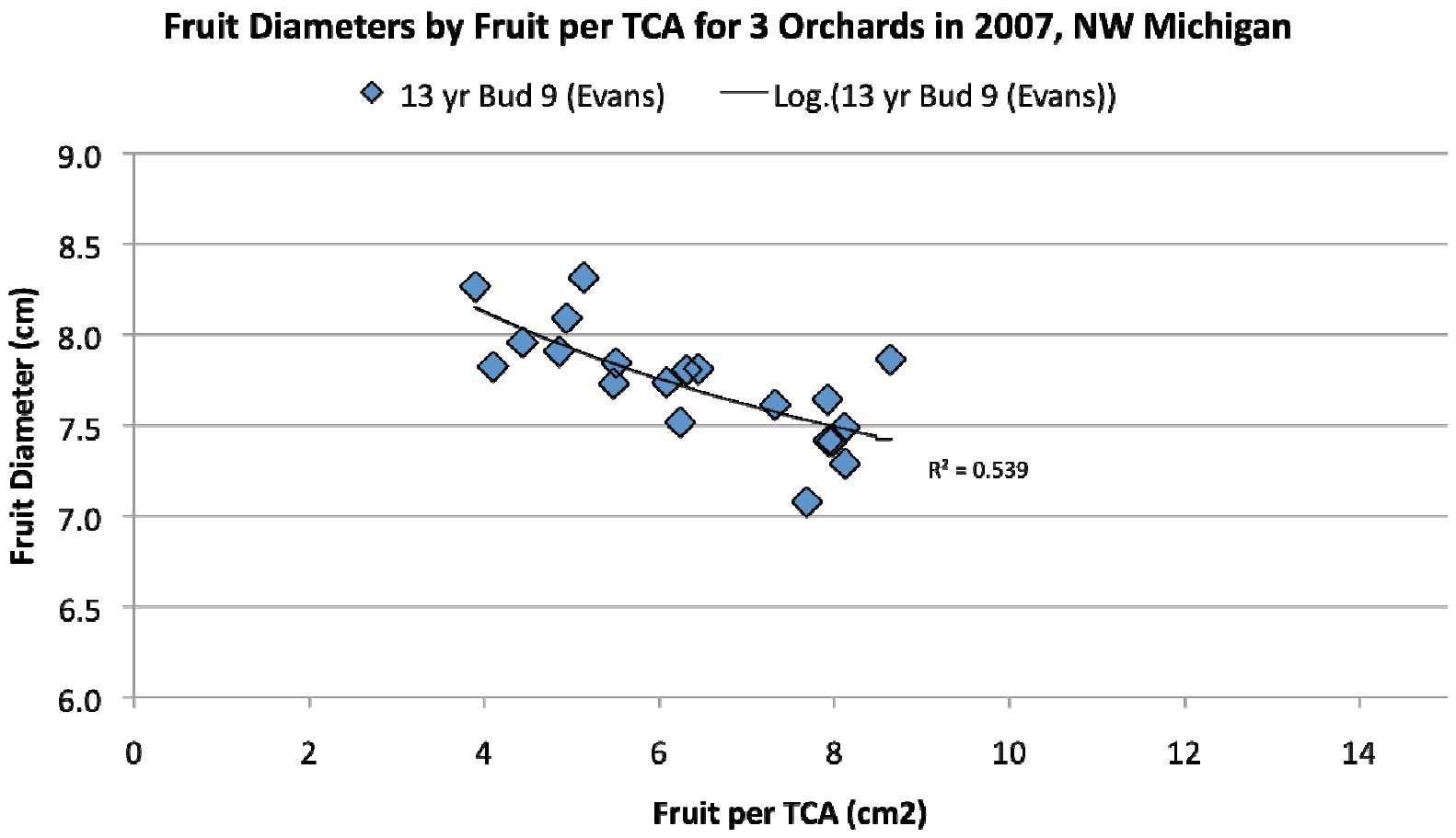


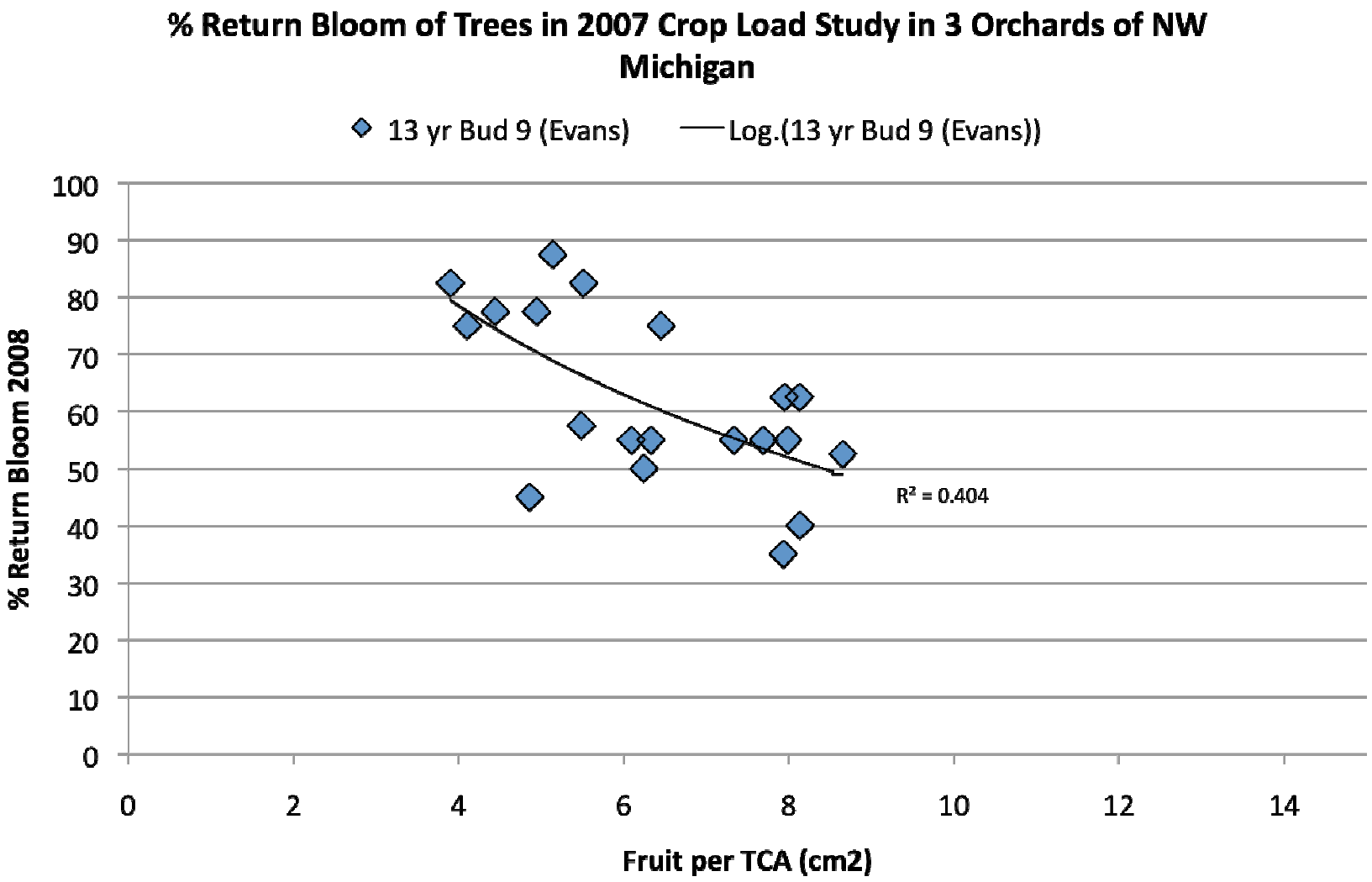

4 to 6 Fruits per TSCA

Too much cropload = no return bloom


Fruit Diameters by Fruit per TCA for 3 Orchards in 2007, NW Michigan
9 yr M26 (Gregory)
Log.(9 yr M26 (Gregory))
Fruit Diameter (cm)
9.0
8.5
8.0
7.5
7.0
6.5
6.0
0
2
4
6
8
10
12
14
Fruit per TCA (cm2)
R² = 0.360


% Return Bloom of Trees in 2007 Crop Load Study in 3 Orchards of NW Michigan
9 yr M26 (Gregory)
Log.(9 yr M26 (Gregory))
% Return Bloom 2008
Fruit per TCA (cm2)
R² = 0.420
0
10
20
30
40
50
60
0
2
4
6
8
10
12
14


Fruit Diameters by Fruit per TCA for 3 Orchards in 2007, NW Michigan
13 yr Bud 9 (Evans)
Log.(13 yr Bud 9 (Evans))
9.0
8.5
8.0
7.5
7.0
6.5
6.0
Fruit Diameter (cm)
0
2
4
6
8
10
12
14
Fruit per TCA (cm2)
R² = 0.539


% Return Bloom of Trees in 2007 Crop Load Study in 3 Orchards of NW Michigan
13 yr Bud 9 (Evans)
Log.(13 yr Bud 9 (Evans))
% Return Bloom 2008
Fruit per TCA (cm2)
R² = 0.404
100
90
80
70
60
50
40
30
20
10
0
0
2
4
6
8
10
12
14

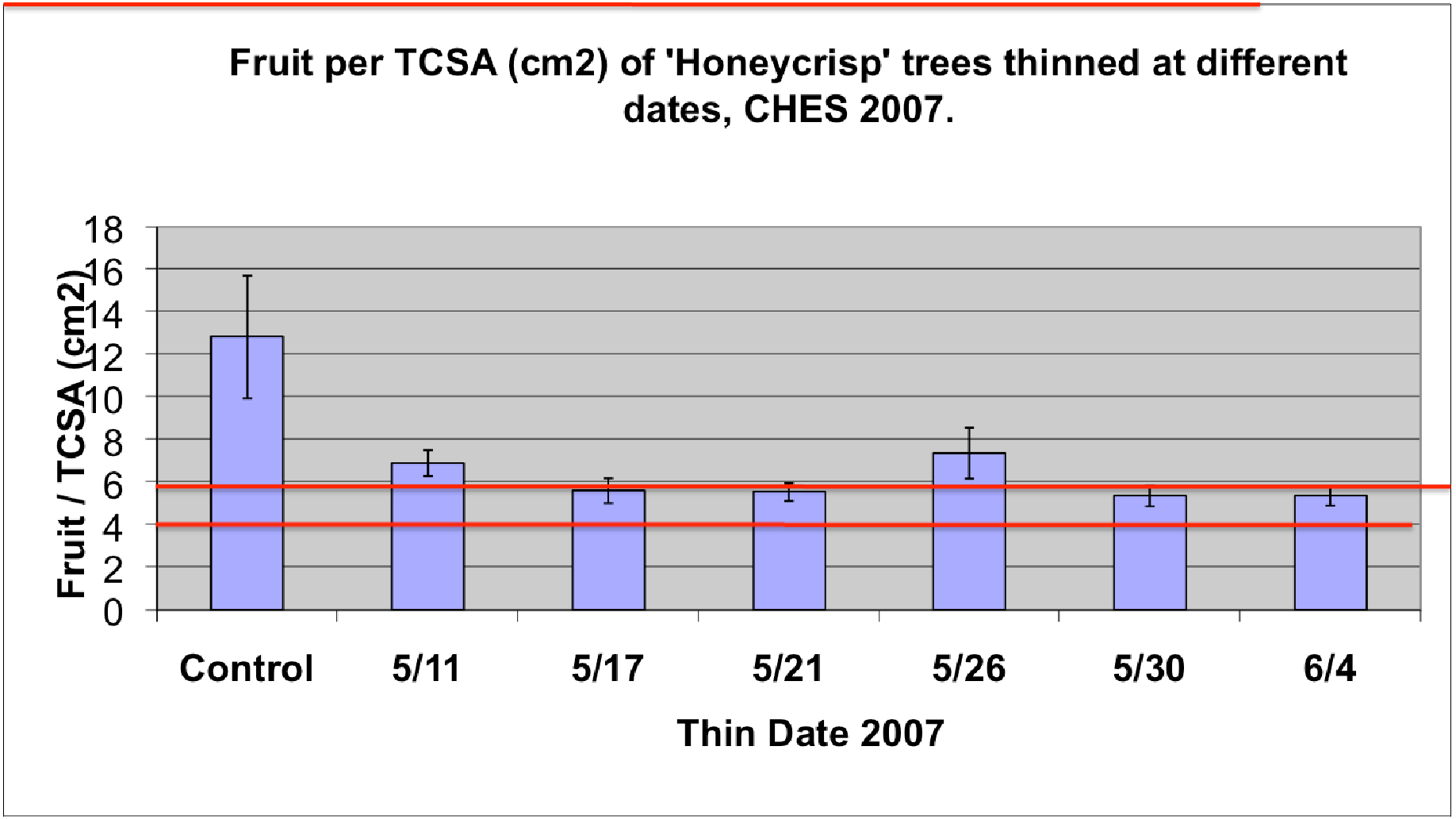
# Crop load

Negatively related to size
Negatively related to yield
Negatively related to return bloom
Return bloom is variable, even if thinned to 4-6 fruit/TCA
Negatively related to Yellowing
Yellowing is not effect  fruit quality
Yellowing is positively related to return bloom

# Time of thinning study

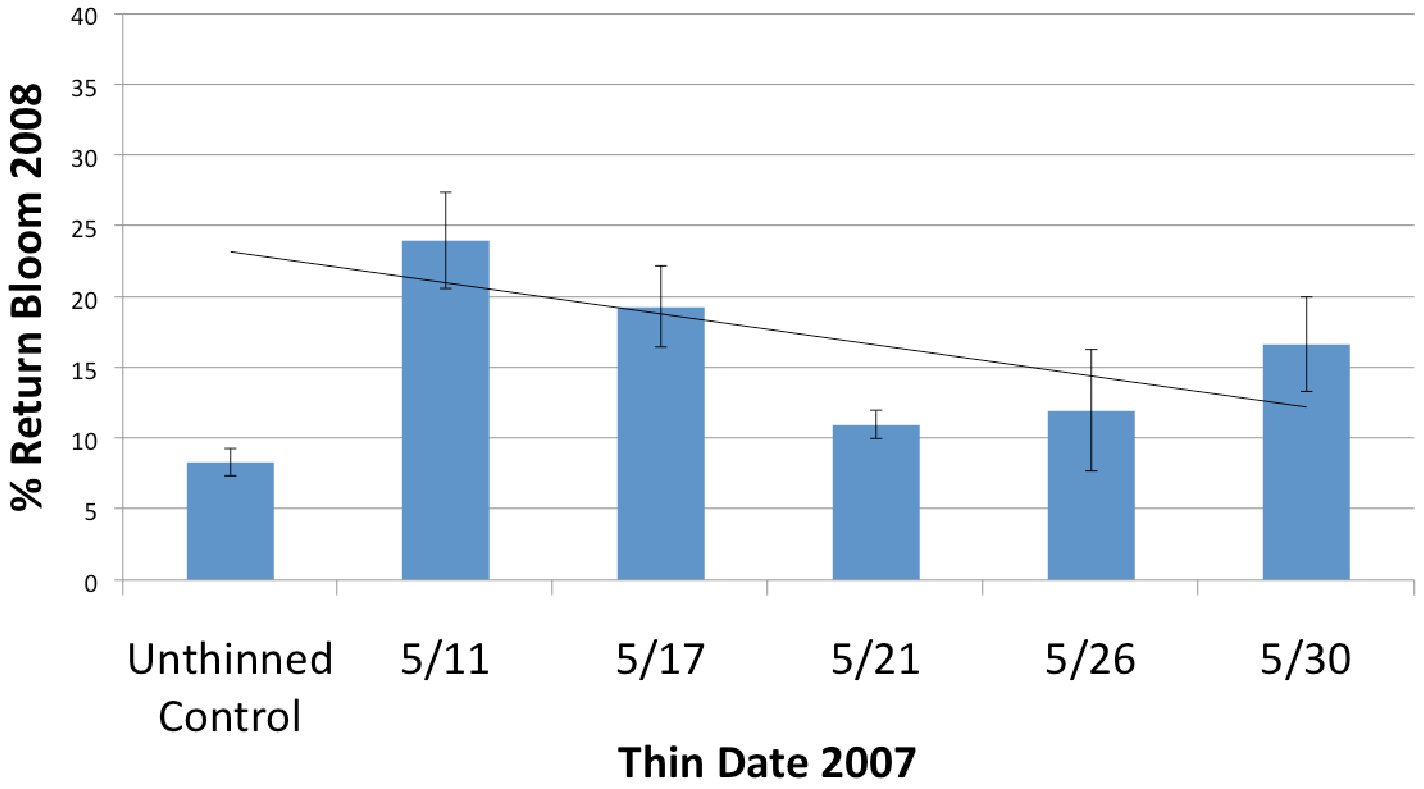
- Does time of thinning effect
  - Return Bloom?

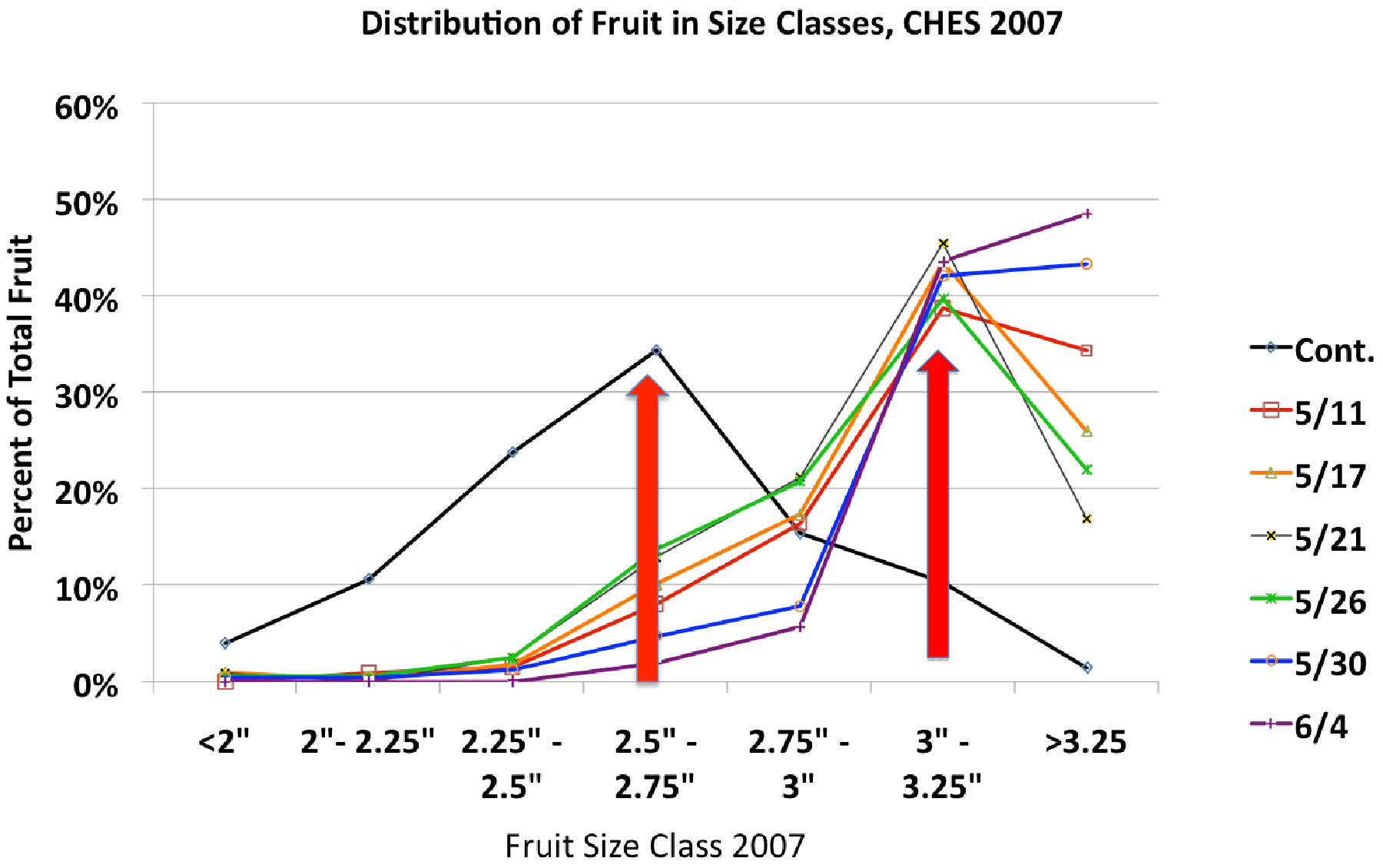
# Fruit load by thinning date



# The effect of time of thinning on return bloom on Honeycrisp, CHES 2007-2008

(thinning done by hand 1 fruit per spur)

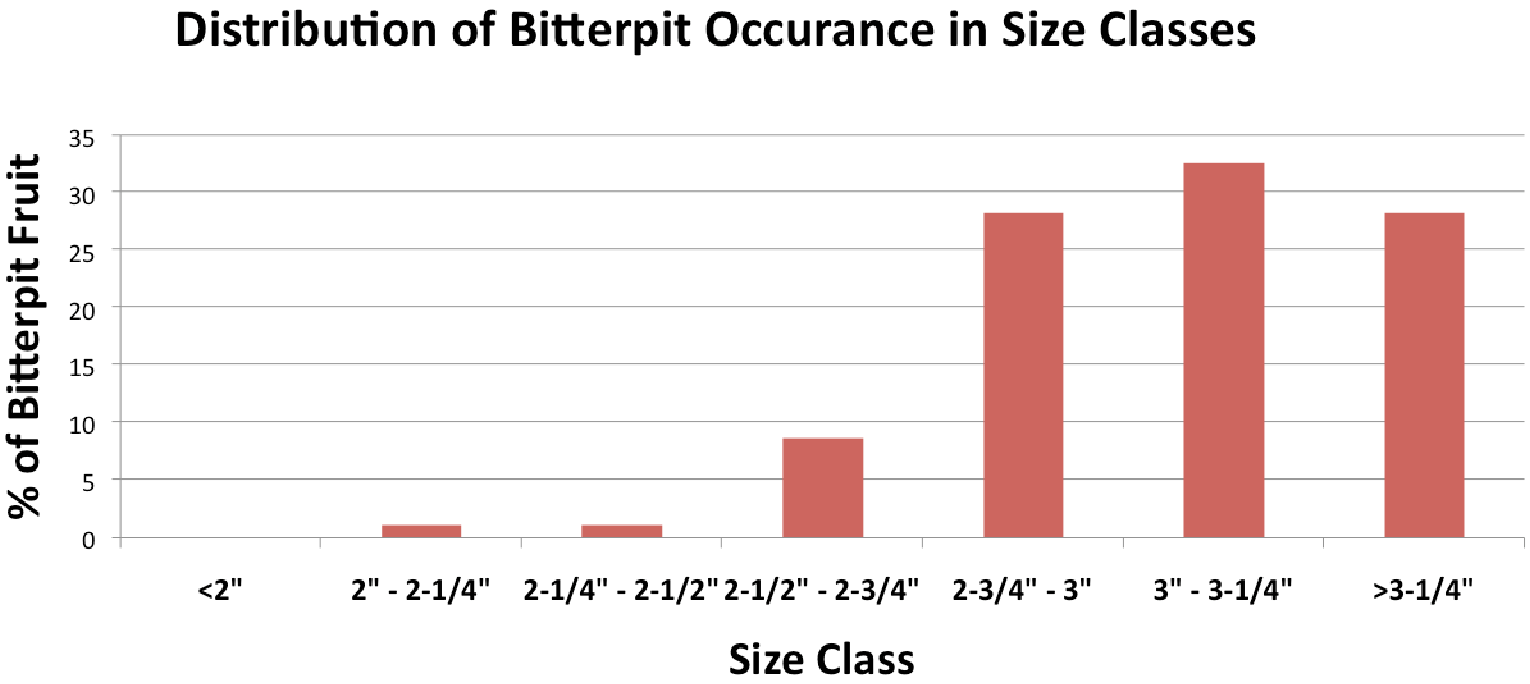





Bitterpit greater than 10% for fruit 2.75 inch and up

# BITTERPIT

# Fruit size is related to bitterpit



# CROP LOAD

- Great variability in the 4-6 fruit per TCA range
- Why?
  - Could it be related to either seed # or fruit size.
  - Could GA produced by the seed be effecting return bloom
  - It is well known that GA applied before FBI, inhibits flowering.

  How could we study the effect of seed number?

  - It has been reported that king fruit and lateral fruit have different seed numbers.

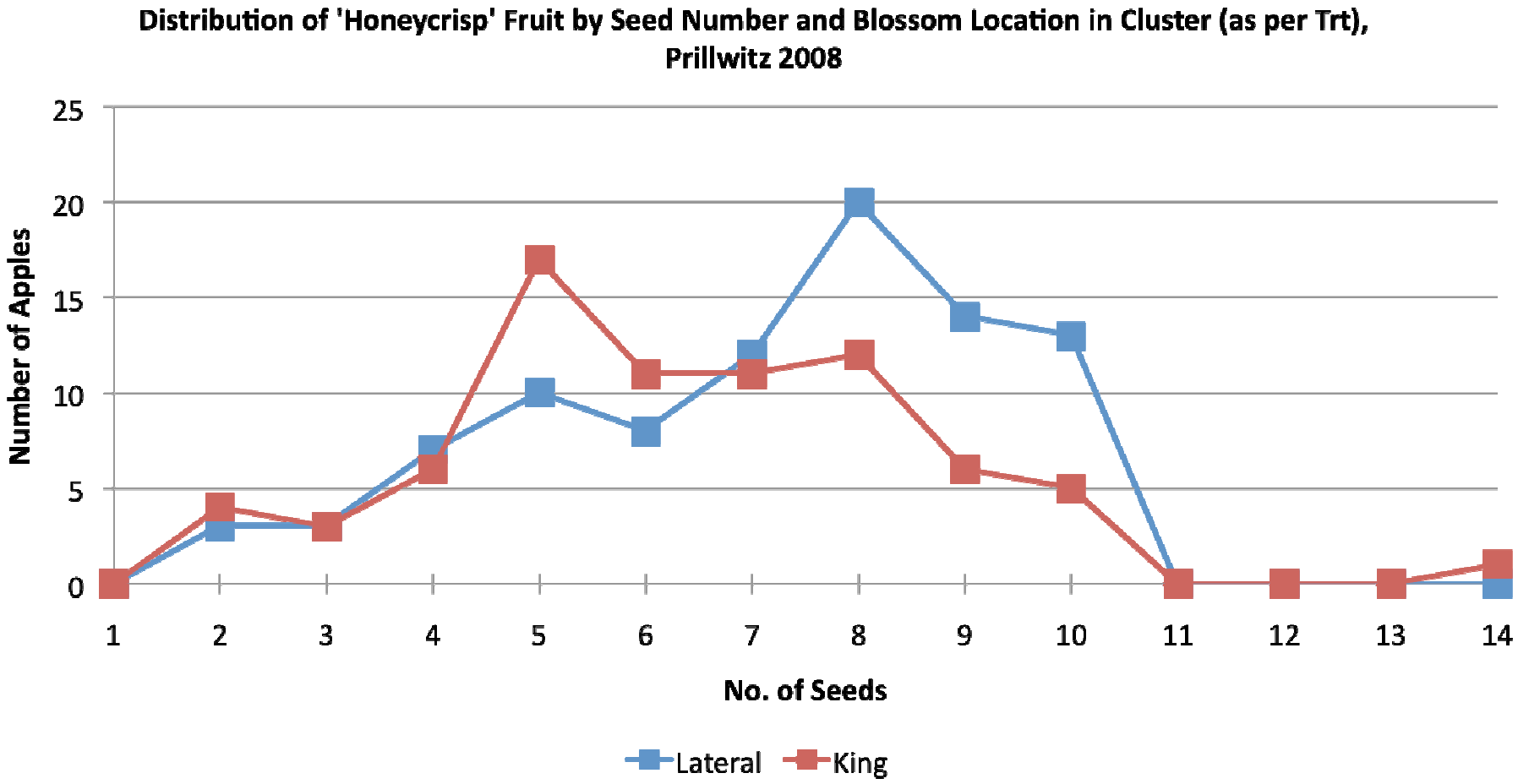
  - We initiated an experiment to alter seed # by eliminating king fruit or lateral fruit.

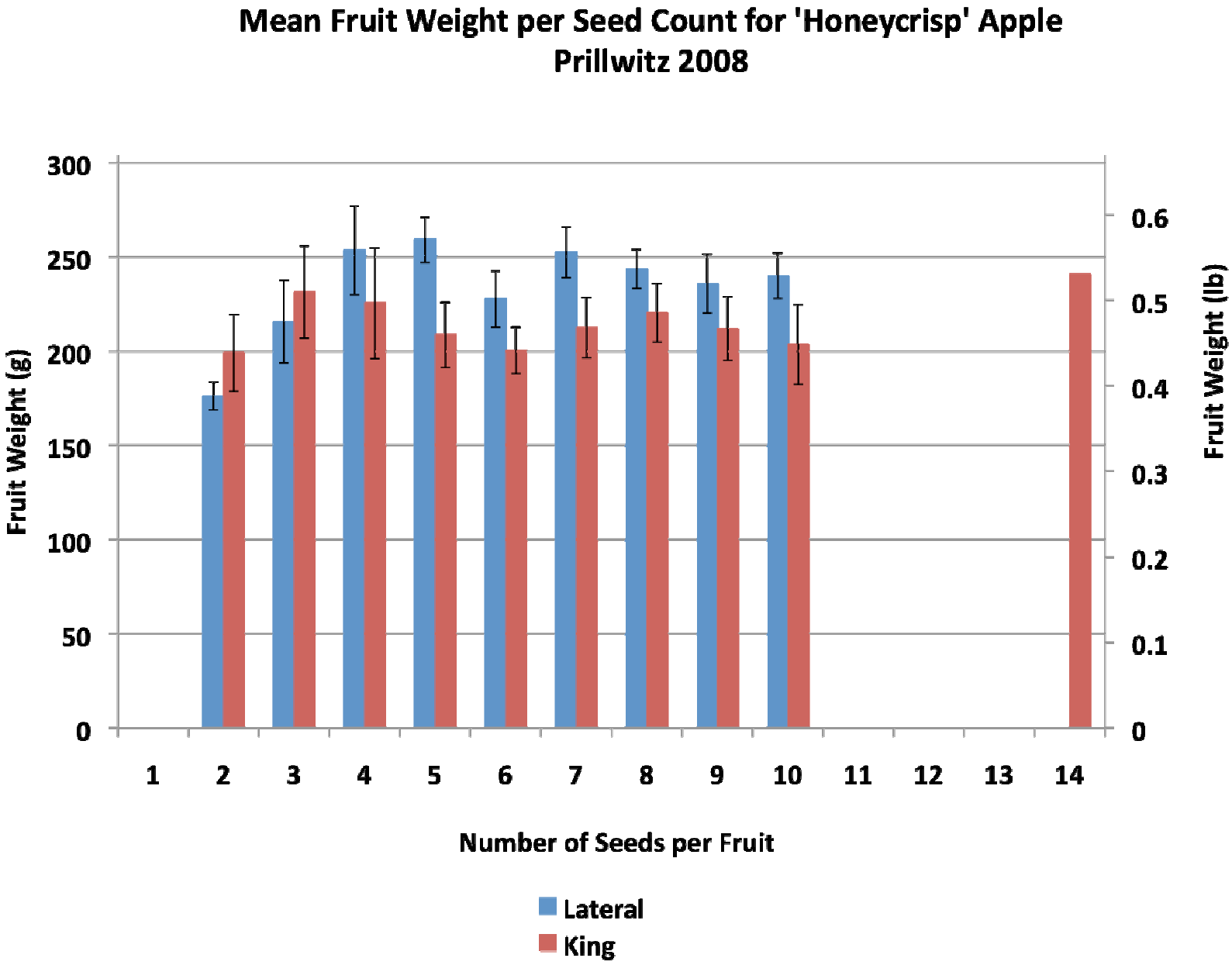
# KING VRS. LATERAL FLOWER?

King

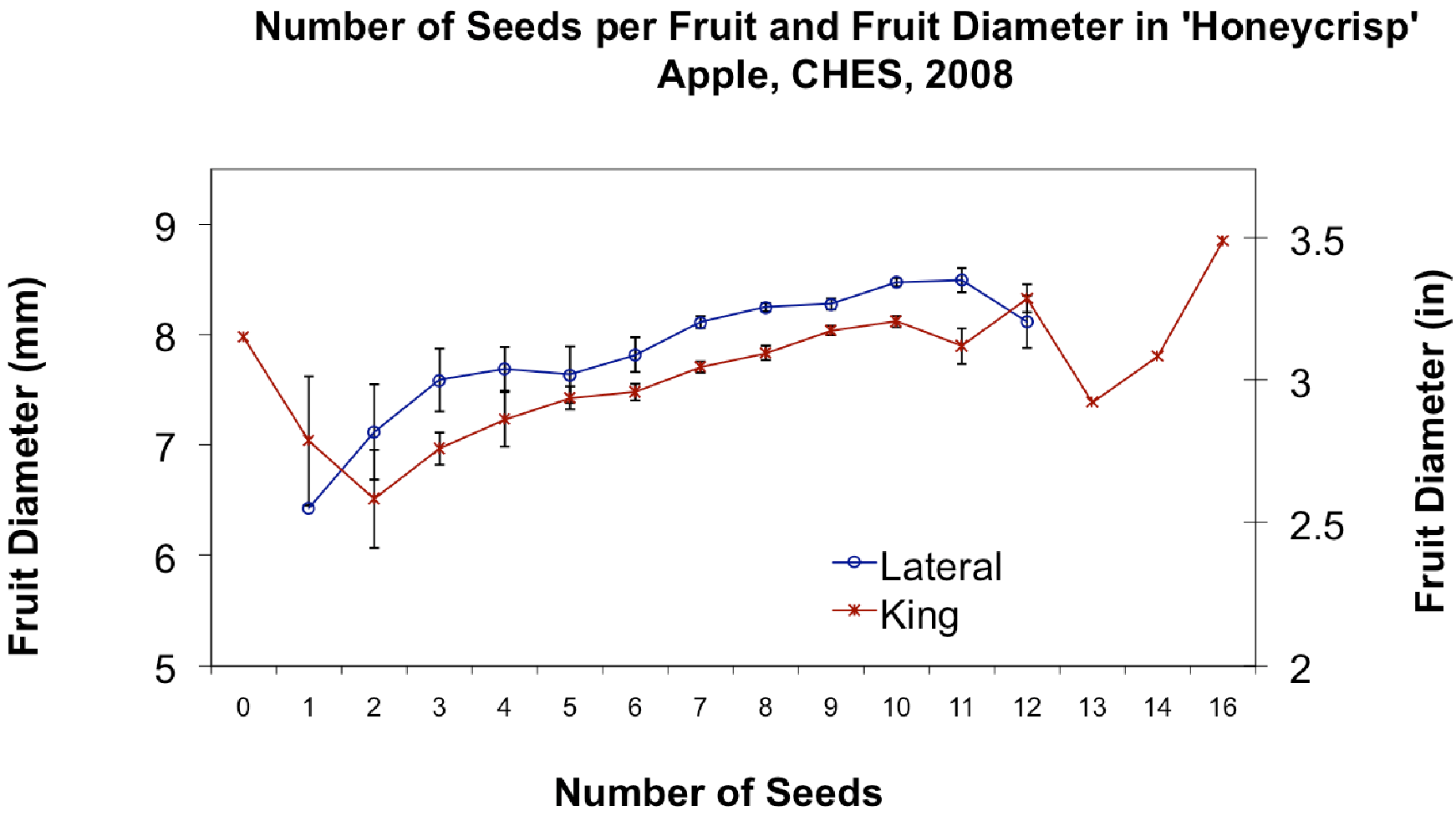
Lateral

# KING FRUIT

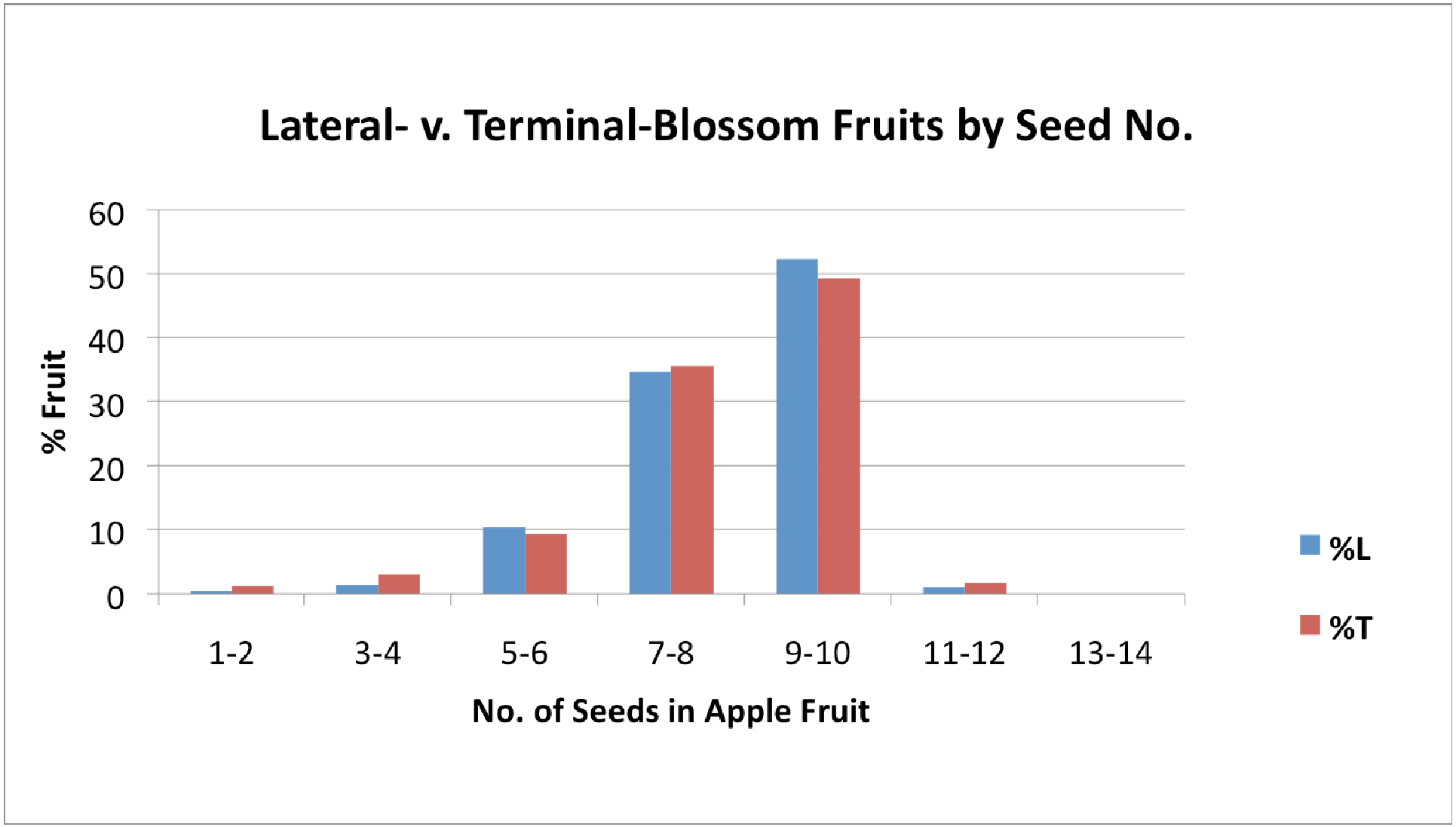

Distribution of 'Honeycrisp' Fruit by Seed Number and Blossom Location in Cluster (as per Trt), Prillwitz 2008
Number of Apples
25
20
15
10
5
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
No. of Seeds
Lateral
King


Mean Fruit Weight per Seed Count for 'Honeycrisp' Apple
Prillwitz 2008
Fruit Weight (g)
300
250
200
150
100
50
0
Fruit Weight (lb)
0.6
0.5
0.4
0.3
0.2
0.1
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Number of Seeds per Fruit
Lateral
King

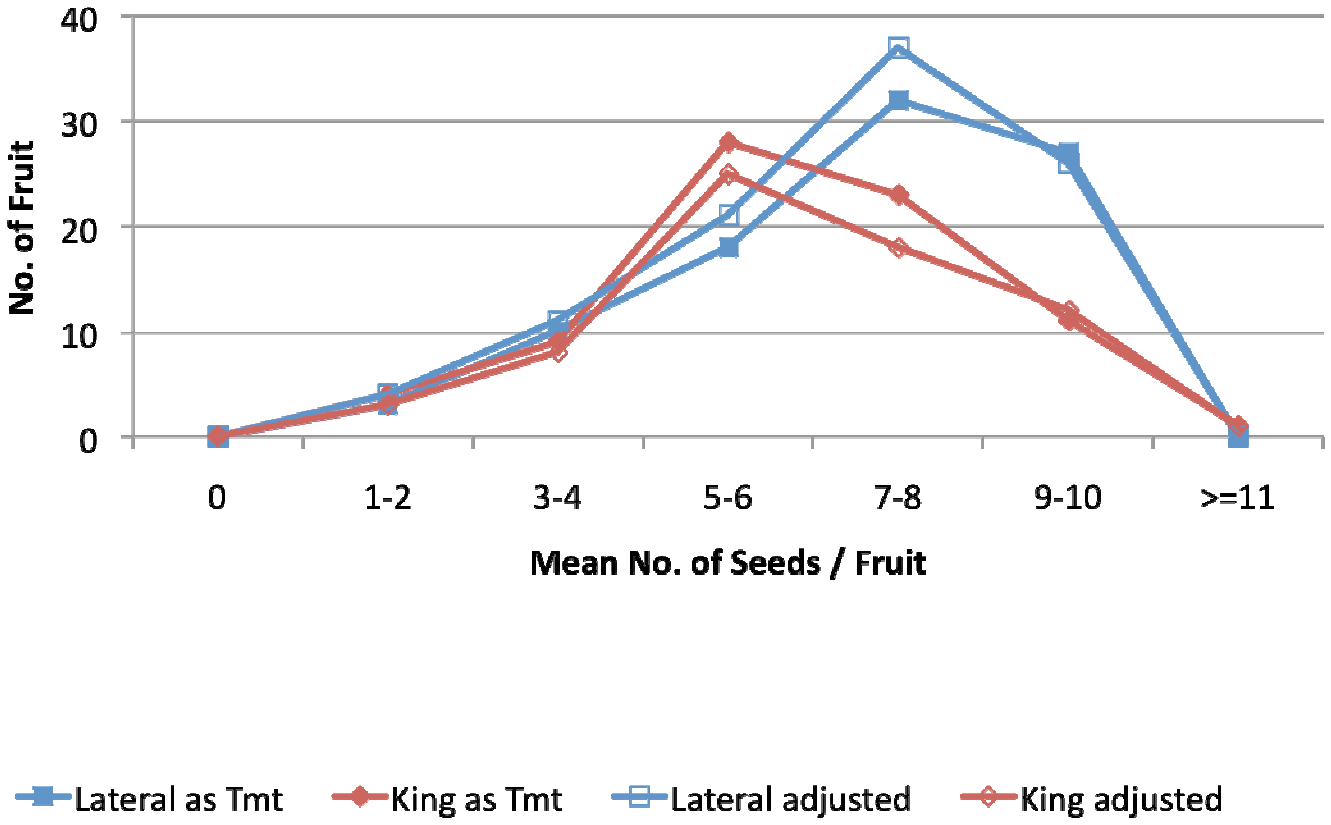
# Fruit size in lateral and king fruit in relation to seed number



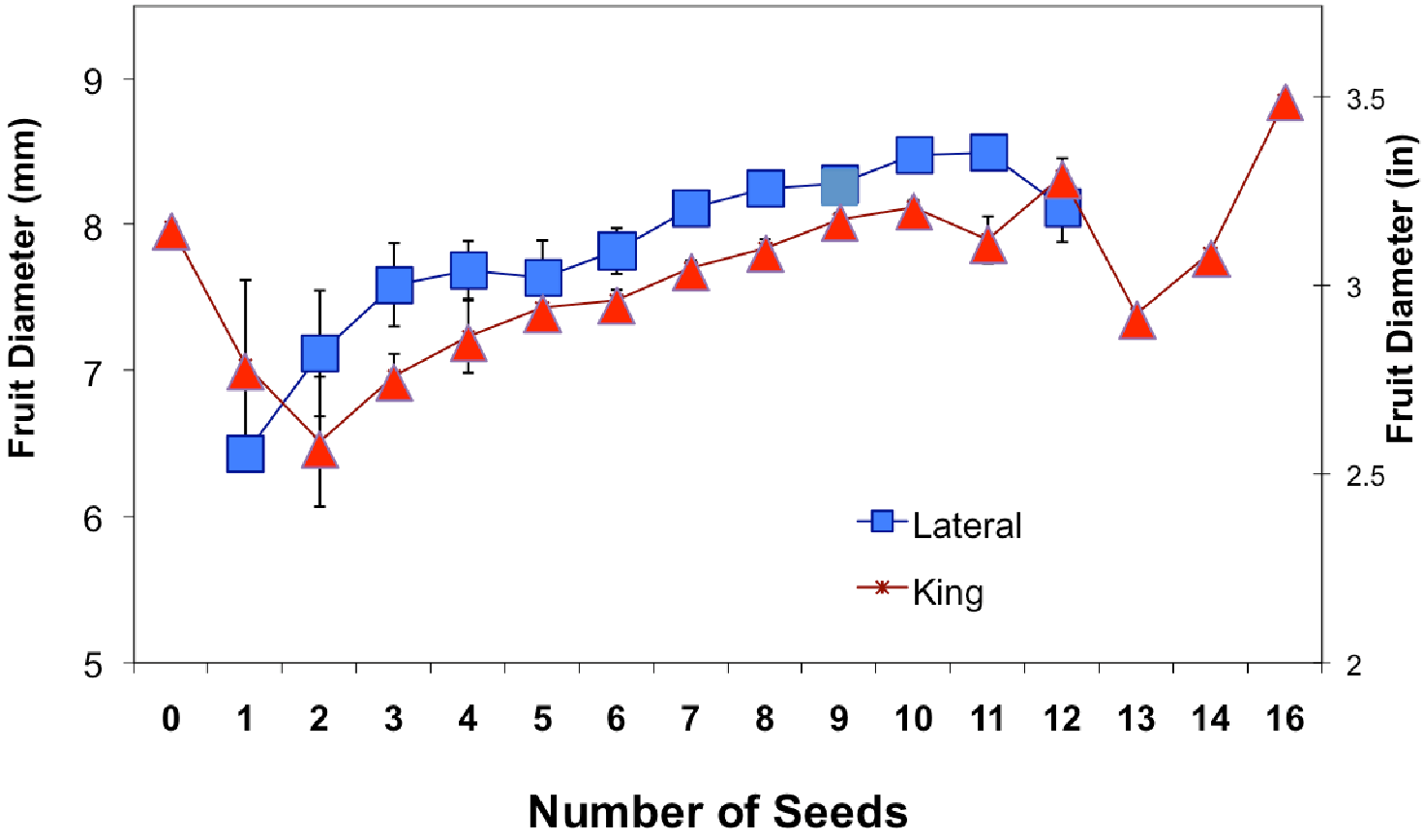
# The effect of fruit position on seed number @ CHES 2007

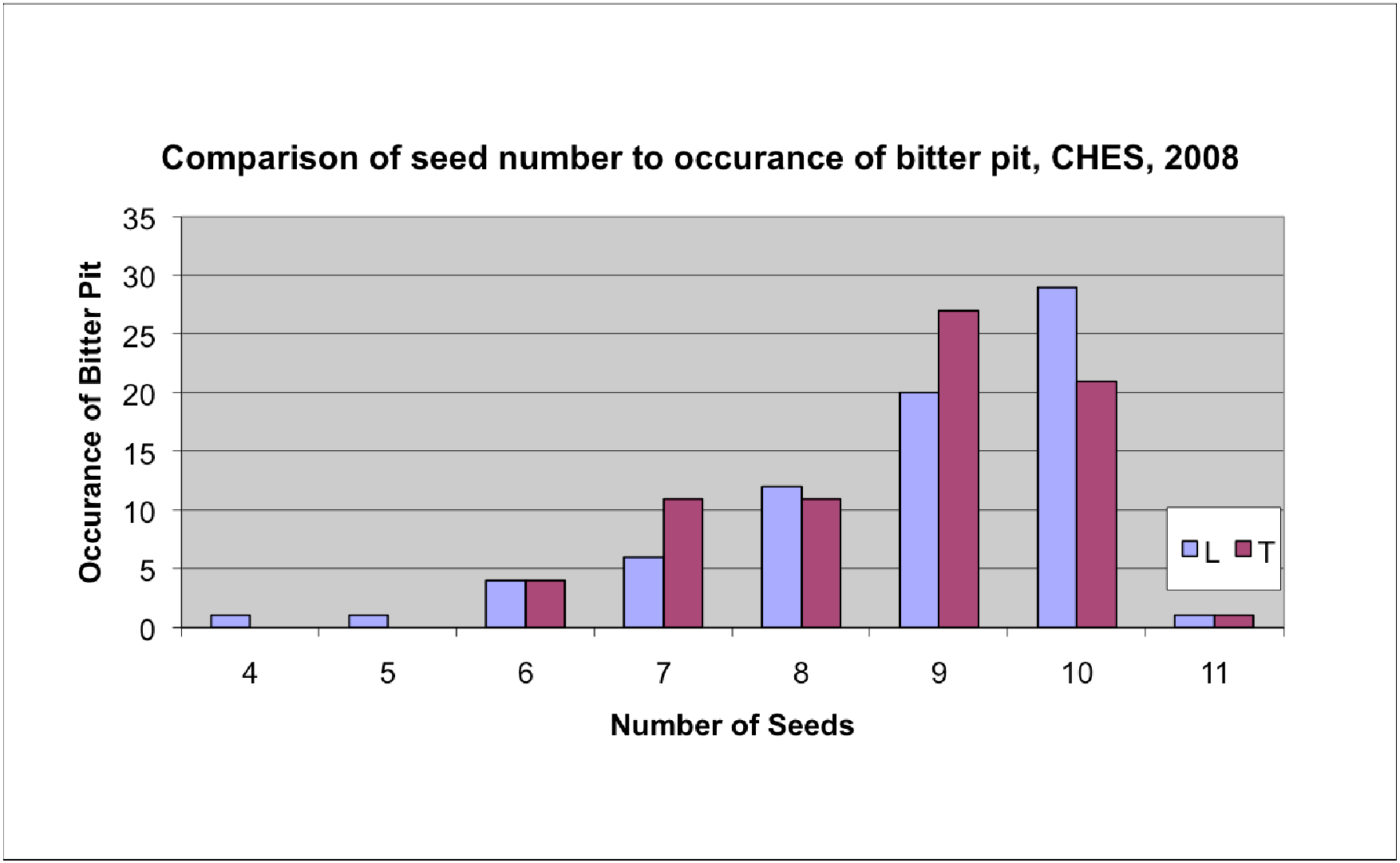


**Comparison between number of seeds when actual cluster locations are considered**



**Number of Seeds per Fruit and Fruit Diameter in 'Honeycrisp' Apple, CHES, 2008**




Comparison of seed number to occurance of bitter pit, CHES, 2008
Occurance of Bitter Pit
35
30
25
20
15
10
5
0
4
5
6
7
8
9
10
11
Number of Seeds
L
T

# THE EFFECT OF SEED NUMBER

- Seed number is greater in lateral fruit.
- Fruit size is larger with increased seed number.
- Lateral fruit are larger than king with the same number of seeds.
- What is the relationship between seed. number and return bloom?
- Apple seeds produce GA.
- GA inhibits Flower Bud Initiation.
    - Does seed number inhibit return bloom, if so since Honeycrisp produced large fruit, can we inhibit seed number?