Mechanical harvest of stem-on sweet cherries for brine

Jim Flore, Nikki Rothwell, Greg Lang, and Steve van Nocker

Julia Rice, Karen Powers, Lynne Sage, Lingxia Sun, and Tammy Wilkinson

Cherry Bay, Send-Emeott, and Orchards

Primary Objective: To develop near-term strategies for improving stem-on retention on mechanically harvested fruit for the brine market.

- Hypotheses (based on grower observations):

1) Can the optimal window for mechanically harvesting stem-on fruit can be predicted? **By GDH; Fruit size, FRF, Soluble solids)?**

2) Are single fruits easier to harvest than spurs with multiple fruits?

3) Can pre-harvest application of plant growth regulators preferentially promote fruit separation at the branch-stem abscission zone?

4) Does ethylene or pectinase activity continue to work at the stem-fruit abscission zone in brine solution, causing increased stem loss in the brine pits?

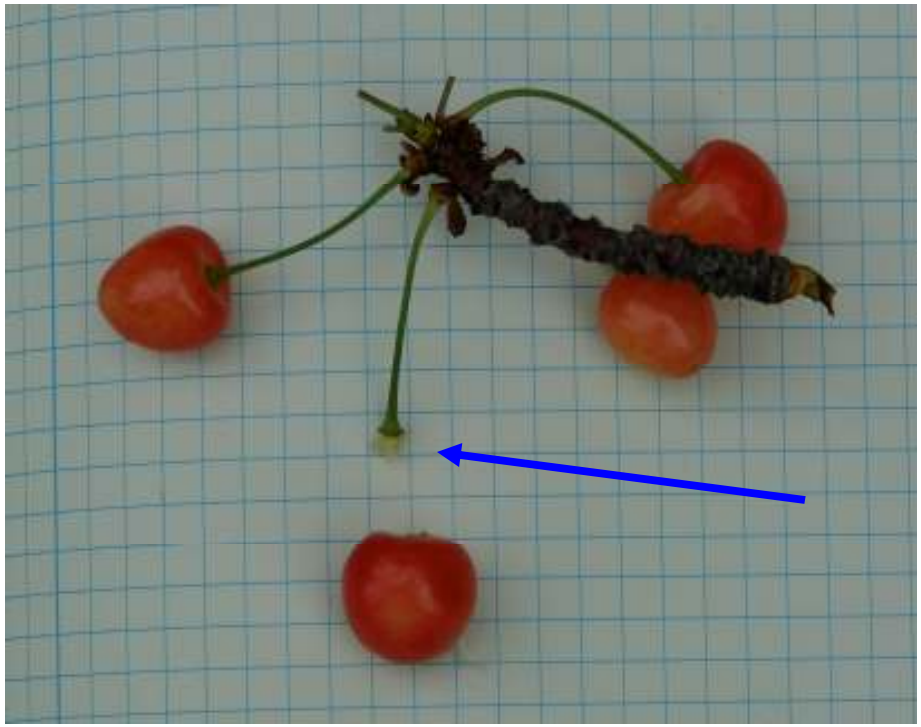
How is the fruit removed?

Stem Abscission Zones

- Upper Zone

('Andersen' stem separation was unusual)

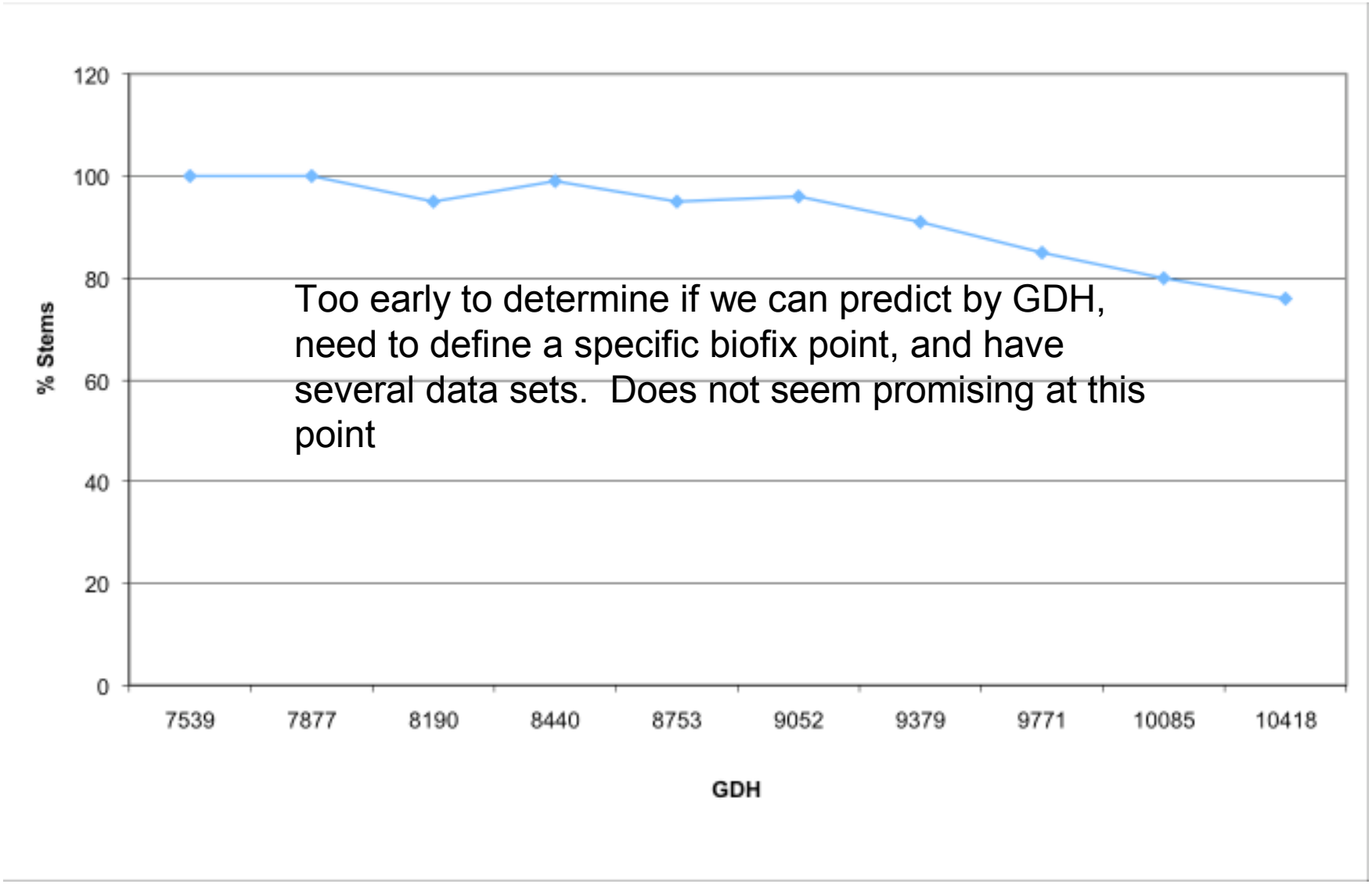
- Lower Zone

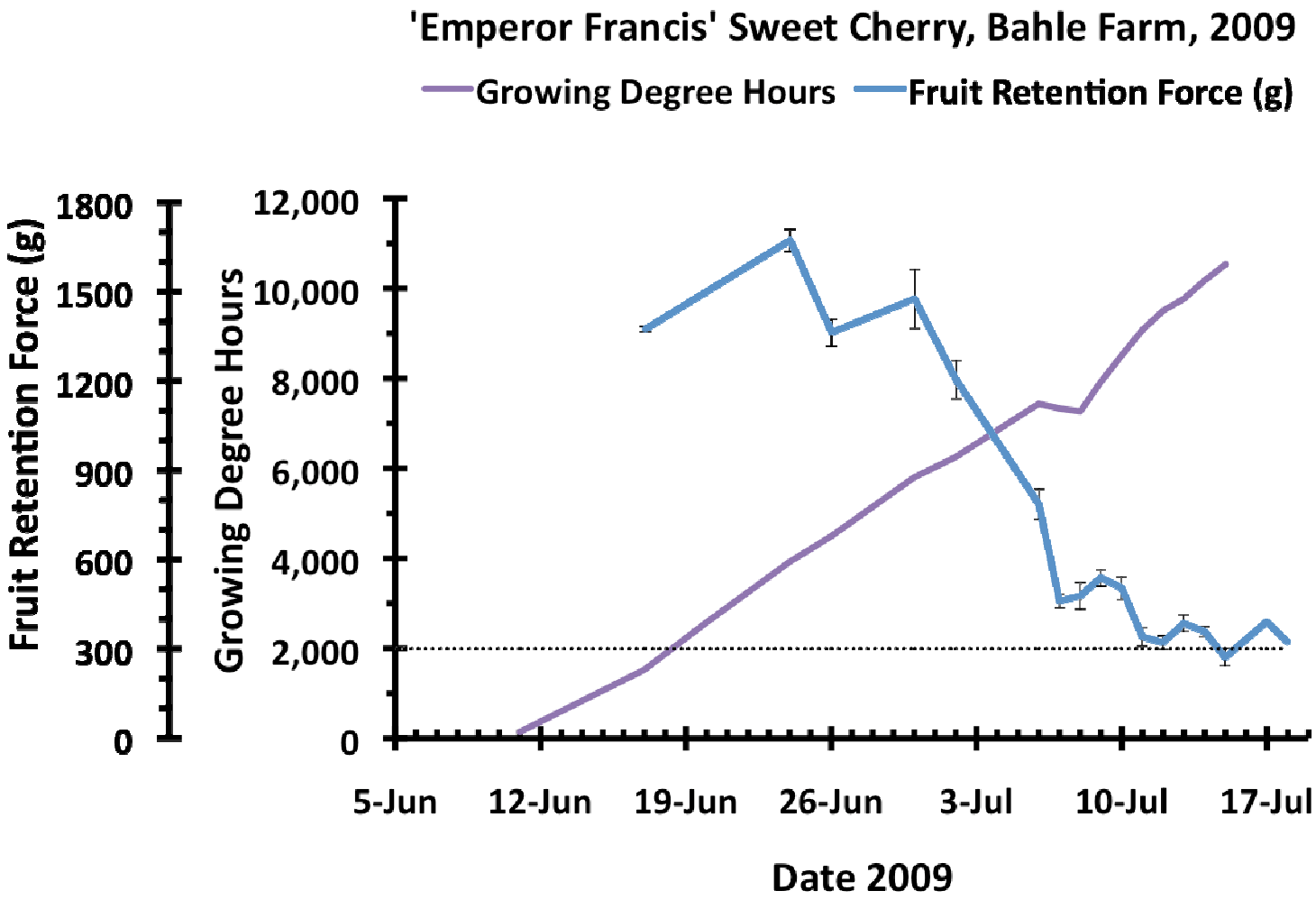


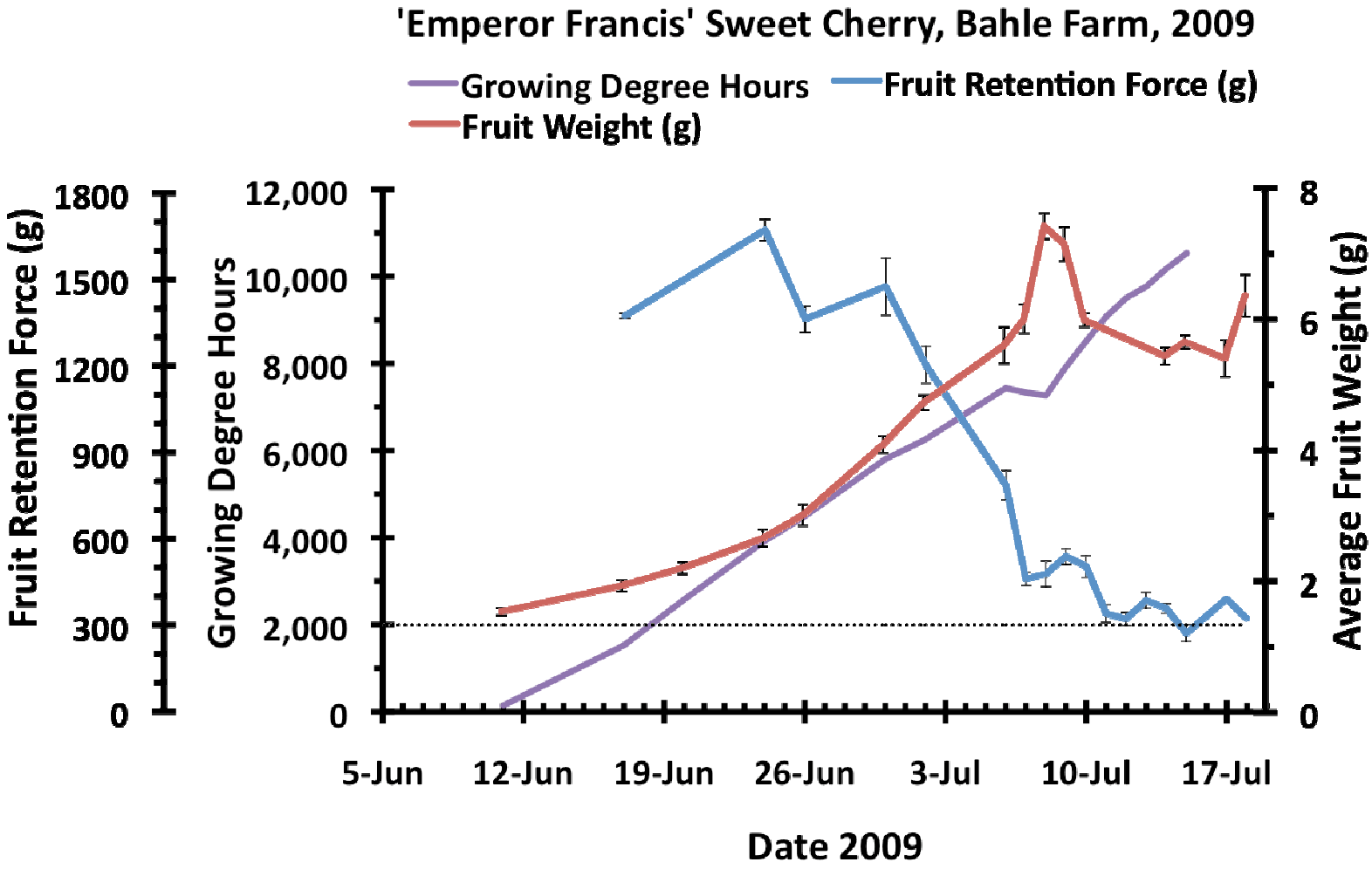
Experiment 1: Optimal Harvest Window Prediction Factors

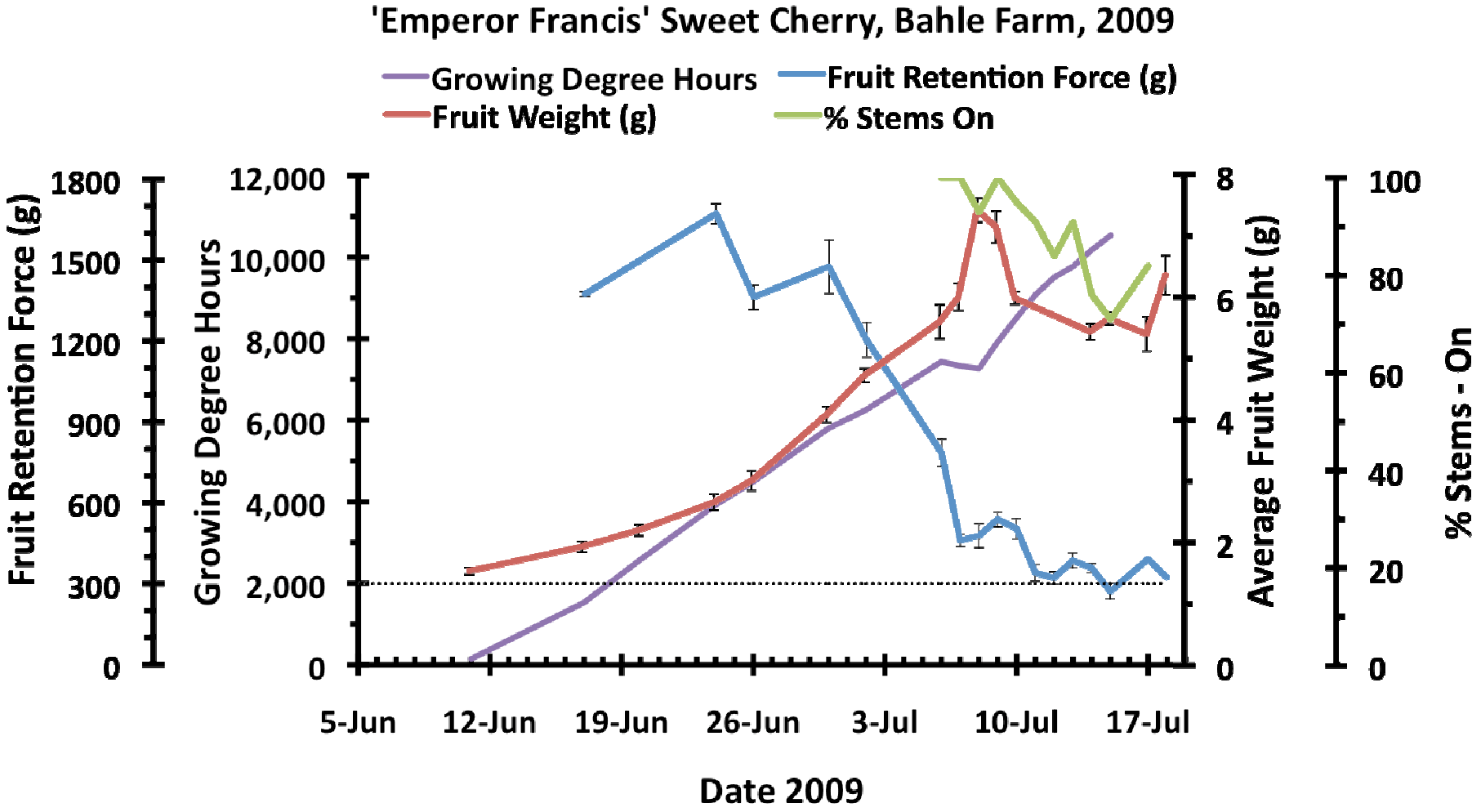
- Orchards at 3 climatically different locations (Clarksville, Suttons Bay, Northport)
- Measured Growing Degree Hours, fruit size, weight, soluble solids, and FRF (fruit-stem zone) of Emperor Francis, Gold, and Ulster
- Trees were harvested mechanically from end of Stage II through Stage III (<50% stem-on)
  - Determined % stem retention of harvested fruit
  - Did not determine % fruit removal from tree

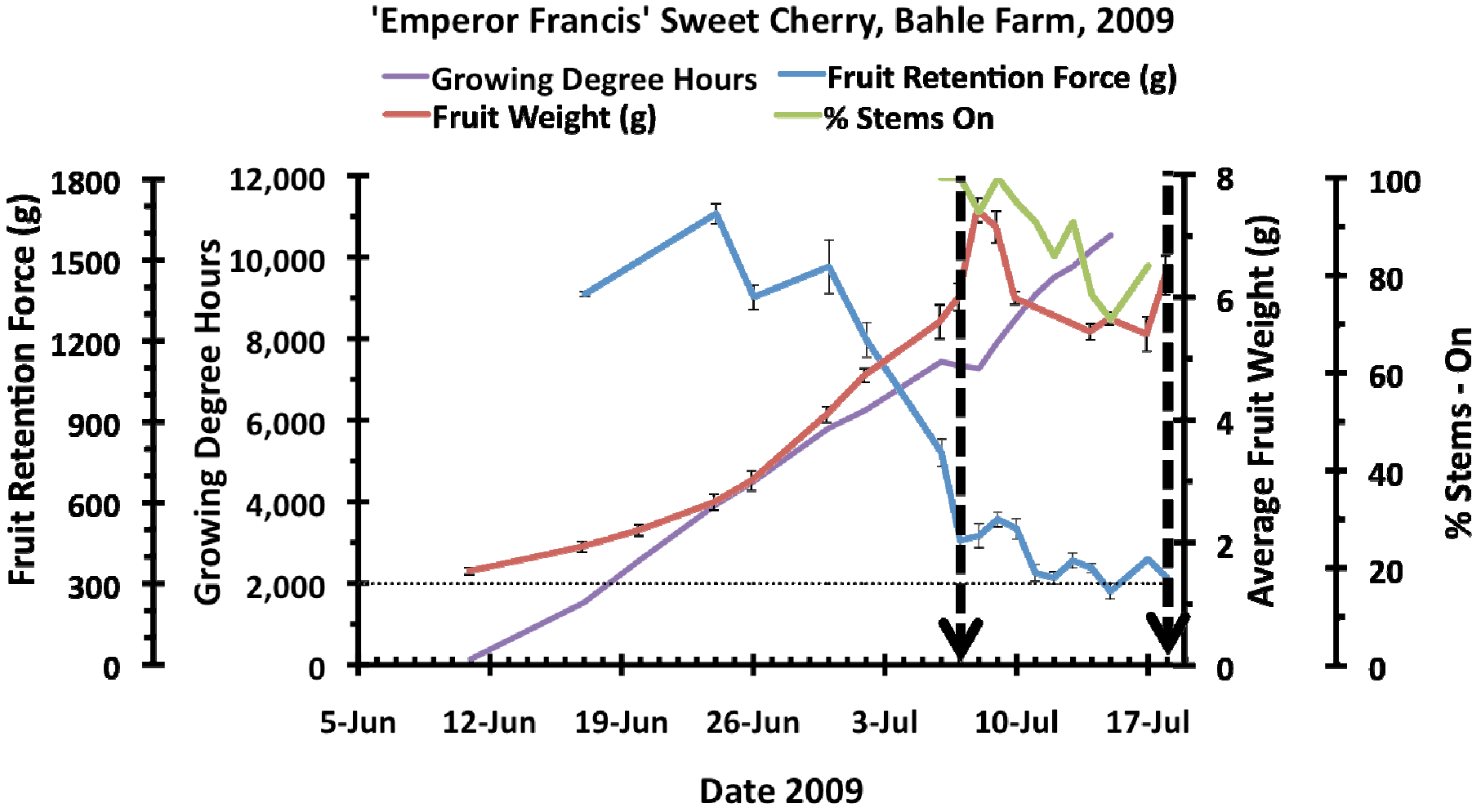
% Stem Retention vs. GDH for 'Emperor Francis'




'Emperor Francis' Sweet Cherry, Bahle Farm, 2009
Growing Degree Hours
Fruit Retention Force (g)
Fruit Retention Force (g)
1800
1500
1200
900
600
300
0
Growing Degree Hours
12,000
10,000
8,000
6,000
4,000
2,000
0
5-Jun
12-Jun
19-Jun
26-Jun
3-Jul
10-Jul
17-Jul
Date 2009


'Emperor Francis' Sweet Cherry, Bahle Farm, 2009
Growing Degree Hours
Fruit Retention Force (g)
Fruit Weight (g)
Fruit Retention Force (g)
1800
1500
1200
900
600
300
0
Growing Degree Hours
12,000
10,000
8,000
6,000
4,000
2,000
0
Average Fruit Weight (g)
8
6
4
2
0
5-Jun
12-Jun
19-Jun
26-Jun
3-Jul
10-Jul
17-Jul
Date 2009

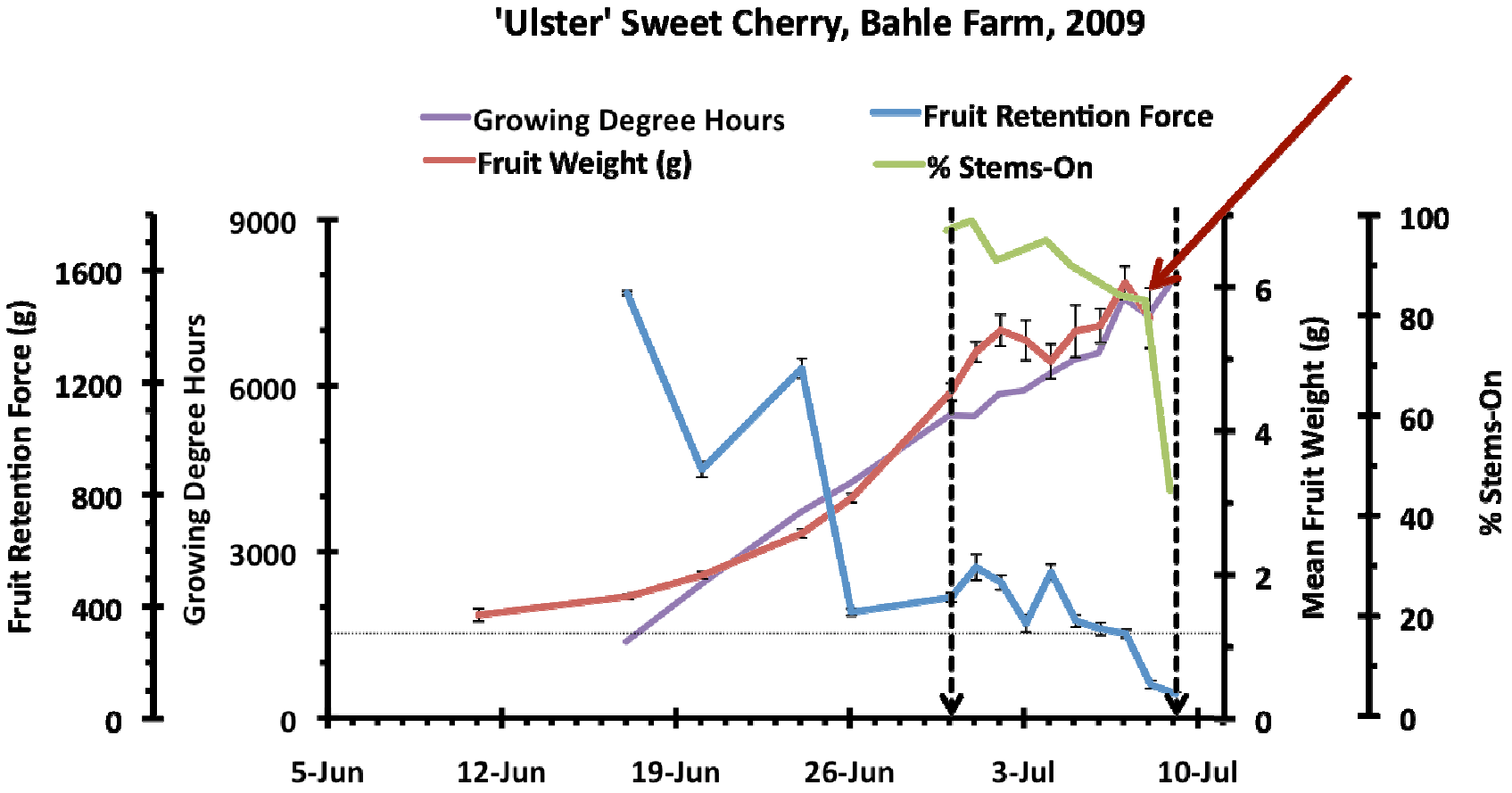

'Emperor Francis' Sweet Cherry, Bahle Farm, 2009
Growing Degree Hours
Fruit Retention Force (g)
Fruit Weight (g)
% Stems On
Fruit Retention Force (g)
1800
1500
1200
900
600
300
0
Growing Degree Hours
12,000
10,000
8,000
6,000
4,000
2,000
0
Average Fruit Weight (g)
8
6
4
2
0
% Stems - On
100
80
60
40
20
0
5-Jun
12-Jun
19-Jun
26-Jun
3-Jul
10-Jul
17-Jul
Date 2009


'Emperor Francis' Sweet Cherry, Bahle Farm, 2009
Growing Degree Hours
Fruit Retention Force (g)
Fruit Weight (g)
% Stems On
Fruit Retention Force (g)
1800
1500
1200
900
600
300
0
Growing Degree Hours
12,000
10,000
8,000
6,000
4,000
2,000
0
Average Fruit Weight (g)
8
6
4
2
0
% Stems - On
100
80
60
40
20
0
5-Jun
12-Jun
19-Jun
26-Jun
3-Jul
10-Jul
17-Jul
Date 2009

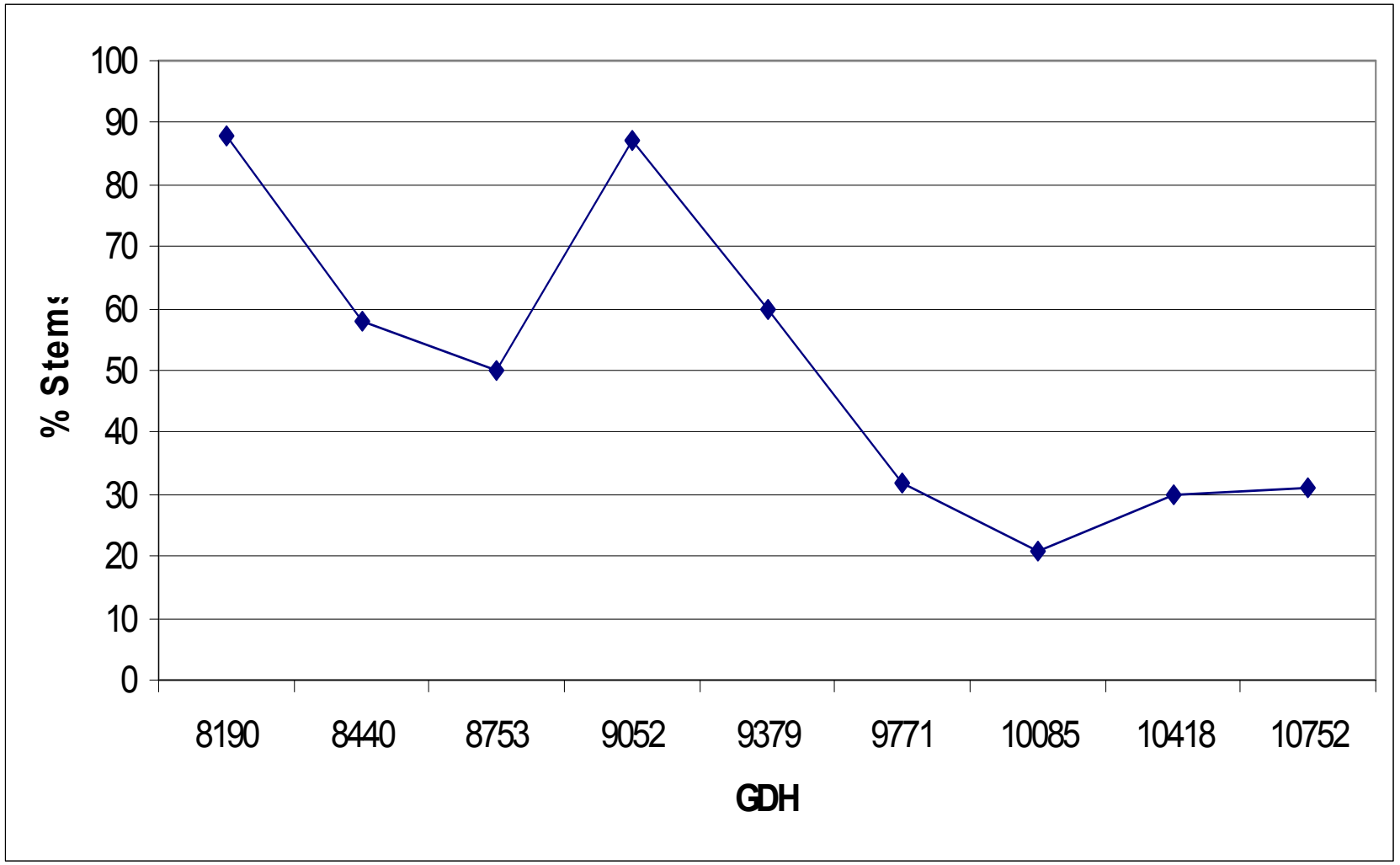
% Fruit Removed From the tree and amount of foliage!

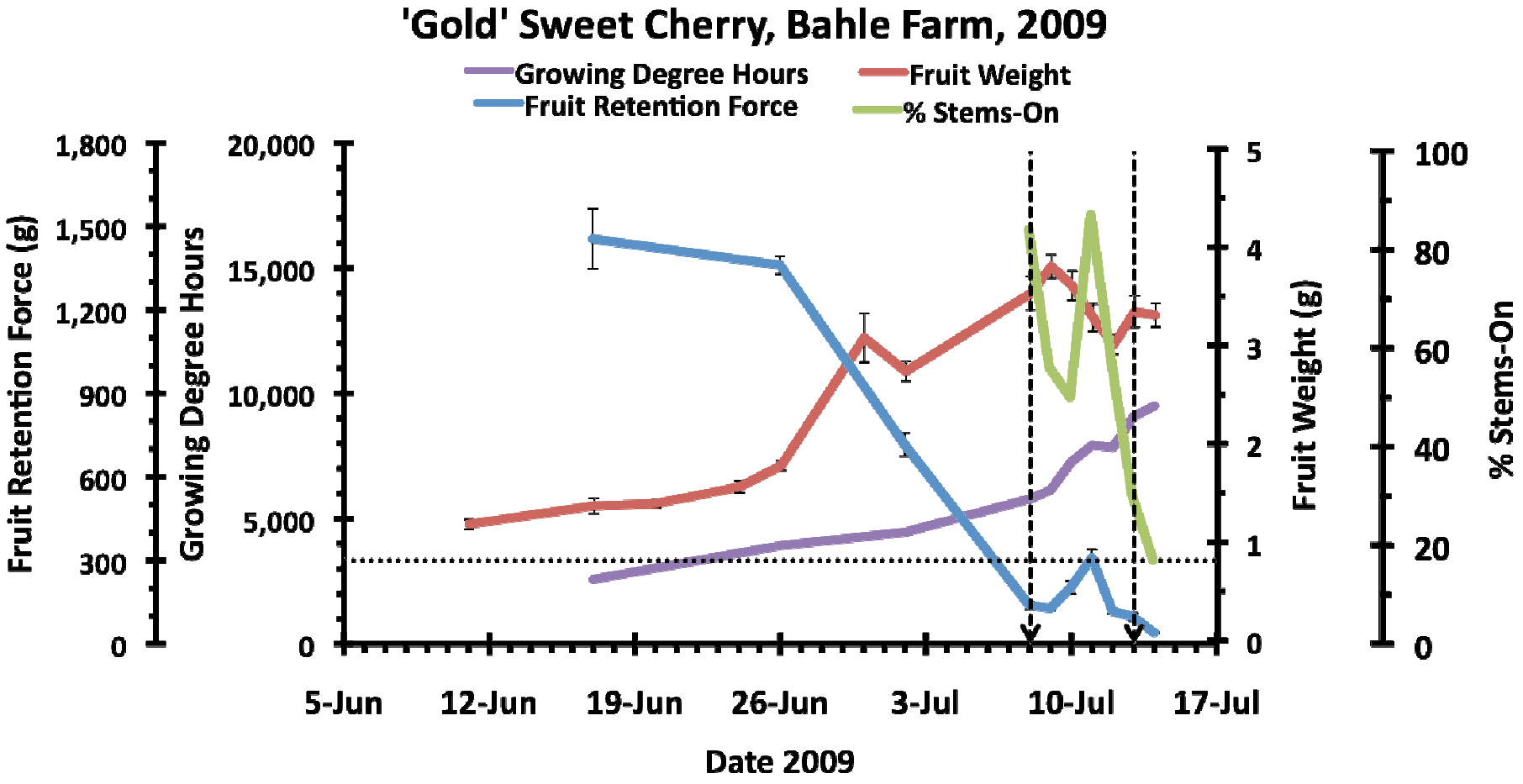
Trash!!

- Trash and % left on the tree are inversely related

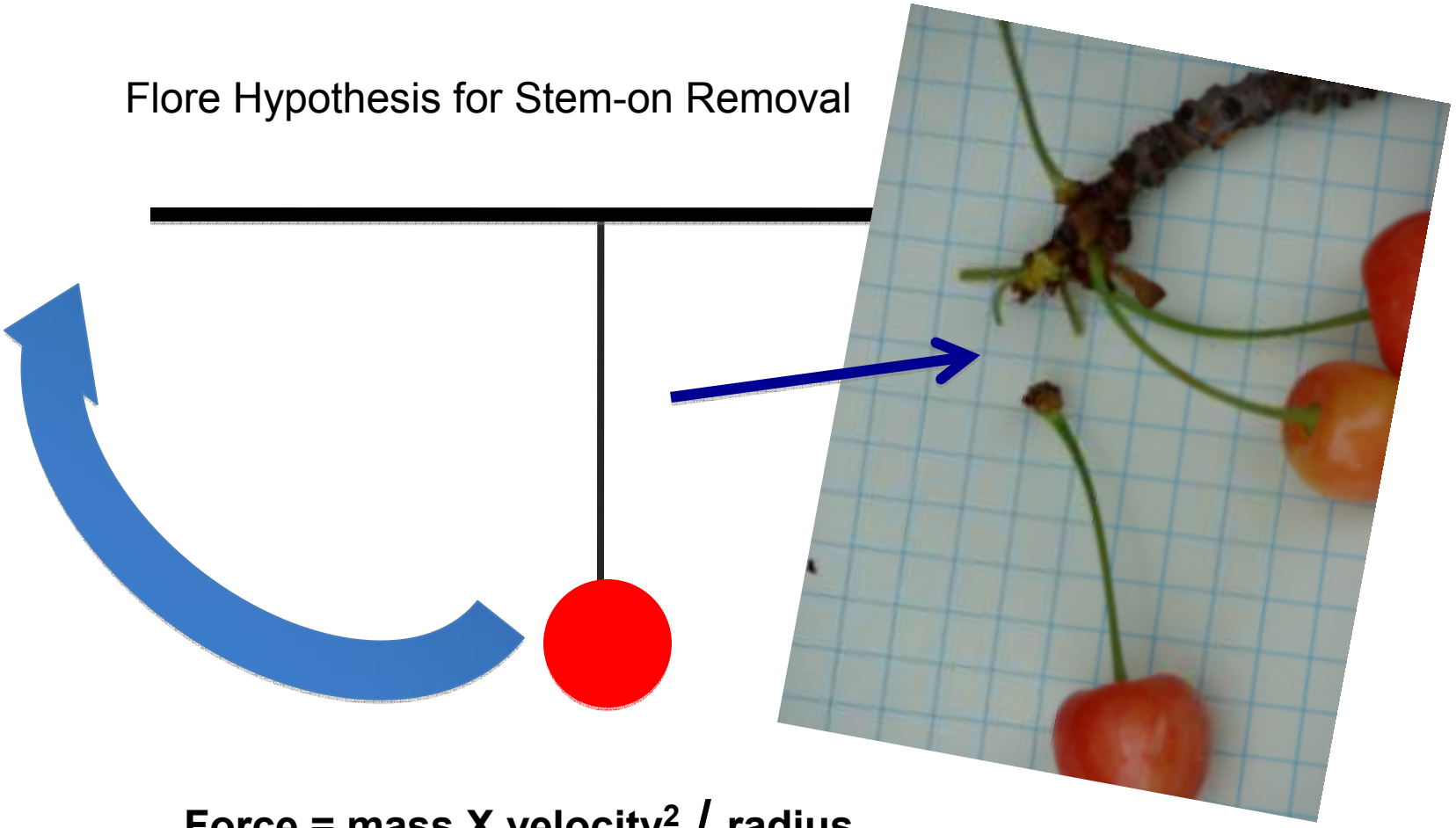

'Ulster' Sweet Cherry, Bahle Farm, 2009
Growing Degree Hours
Fruit Weight (g)
Fruit Retention Force
% Stems-On
Fruit Retention Force (g)
Growing Degree Hours
Mean Fruit Weight (g)
% Stems-On
0
400
800
1200
1600
0
3000
6000
9000
0
2
4
6
0
20
40
60
80
100
5-Jun
12-Jun
19-Jun
26-Jun
3-Jul
10-Jul

% Stem Retention vs. GDH for ‘Gold’




'Gold' Sweet Cherry, Bahle Farm, 2009
Growing Degree Hours
Fruit Weight
Fruit Retention Force
% Stems-On
Fruit Retention Force (g)
1,800
1,500
1,200
900
600
300
0
Growing Degree Hours
20,000
15,000
10,000
5,000
0
Fruit Weight (g)
5
4
3
2
1
0
% Stems-On
100
80
60
40
20
0
5-Jun
12-Jun
19-Jun
26-Jun
3-Jul
10-Jul
17-Jul
Date 2009

Flore Hypothesis for Stem-on Removal



Force = mass X velocity^2 / radius

Requirements for stem-on abscission:

Fruit Mass X Shaker Velocity squared must be large enough to tear the pedicel from the shoot. The lower abscission zone FRF must be high enough that the fruit does not abscise from the pedicel.

Experiment 1: Conclusions

- Generally, the fruit is torn from the spur, not at any true abscission zone.
- Therefore, the force applied must be at an angle from the branch, not perpendicular.
- The mass of the fruit and the length of the stem must be sufficient to rip the stem from the spur in response to the applied force.
- The FRF at the stem-fruit abscission zone must be high enough to prevent fruit separation.

Experiment 2: Lower Crop Loads(singles) Have Higher Stem Retention(than clusters)

- Six trees were hand-thinned on 3 June to one fruit/spur
- Six trees were untreated
- Stem retention was measured following mechanical harvest

	% Stem Retention
Control	90.8 ± 2
Thinned	94 ± 2

Singles vrs clusters!

Experiment 3: PreHarvest PGRs Can Preferentially Promote Abscission Site

- Treated 3 trees with standard rate of ethephon on 3 July
- Trees were harvested mechanically on 10, 11, and 12 July
- Measured stem retention, FRF, brix

	% Stem Retention	FRF	Brix
Ethephon-treated	79%	245	13.1
Control	89%	462	13.5

Don't use ethephon if you want to harvest stem-on!

Experiment 4: Does Abscission Activity Continue During Brining?

- 150 Gold and Emperor Francis (+/- ethephon) cherries were placed into brine

- After 101 days, 99% of all cherries retained stems

- Hand-harvested stem-on cherries were treated with ethephon and with MCP after harvest, then brined

- After 100 days, stem loss only occurred with the ethephon-treated fruit and even more from the MC-treated fruit

Observation: Tree structure Pruning is important.

- The shake must be transferred to the fruit.
- No hangers.
- Stiffen up the tree.

Conclusions

- In 2009, brine cherries were mechanically harvested with stems on over a significant period during early Stage III fruit enlargement.
- The only parameters associated with the optimum time for successful harvest were FRF of the lower zone and fruit size.
- Varieties differed in response to mechanical harvest - 'Gold' was unsuitable for stem-on harvest in 2009.
- Shaker velocity/oscillations, fruit mass, stem length, and tree canopy "stiffness" were key to effective force transmission.

Future Directions

- Crop load thinning strategies may be pursued *if* fruit clusters remain an industry issue.
- Industry practices should focus on fruit size, tree pruning, and shaker operation, with *no use of ethephon* (which preferentially promotes *stem-fruit* separation more than *stem-spur* separation).
- Stem loss during brining appears primarily to be a result of the use of ethephon, which likely is exacerbated by pumping of brined fruit.

Early Recommendations

- 1. Be sure you have a home for the stem on fruit.
- 2. Choose the variety: Emperor Francis and Ulster were acceptable. Gold was not.
- 3. Prune the trees to stiffen them up.
- 4. Don’t use ethephon
- 5. Watch for a break in color of the fruit.
- 6. Begin harvest when fruit are 5-5.5 grams in weight.
- 7. Cool season is better than hot.