Mid-Atlantic Fruit Maturity Program and Honeycrisp Fruit Quality

Christopher Walsh
Audra Bissett and Kathleen Hunt
University of Maryland
Tara Baugher and Norma Young
Penn State Extension

Apple Maturity Trials Span Three Months

- Premier Honeycrisp (cv. DAS -10)
- Honeycrisp
- Brookfield, Buckeye, D-8 and Ultima Gala
- Autumn Crisp and CrimsonCrisp (Disease-resistant)
- Daybreak Fuji (cv. Rankin)
- Aztec Fuji and Nagafu Fuji
- GoldRush
- Evercrisp (Honeycrisp x Fuji cross)
- Granny Smith
- Cripps Pink (a.k.a. Pink Lady)

Maturity Assessments

- Replicated samples were spot picked by Chris Walsh and Tara Baugher, and taken to College Park, MD lab for evaluating fruit maturity.
- We measured six standard maturity indices:
  Red Color, Ground Color, Fruit Size,
  Firmness, Soluble Solids and Starch Index
- Weekly summaries were posted by Tara Baugher and Norma Young in Fruit Times.

http://agsci.psu.edu/frec/growing-season-information/apple-maturity-assessments

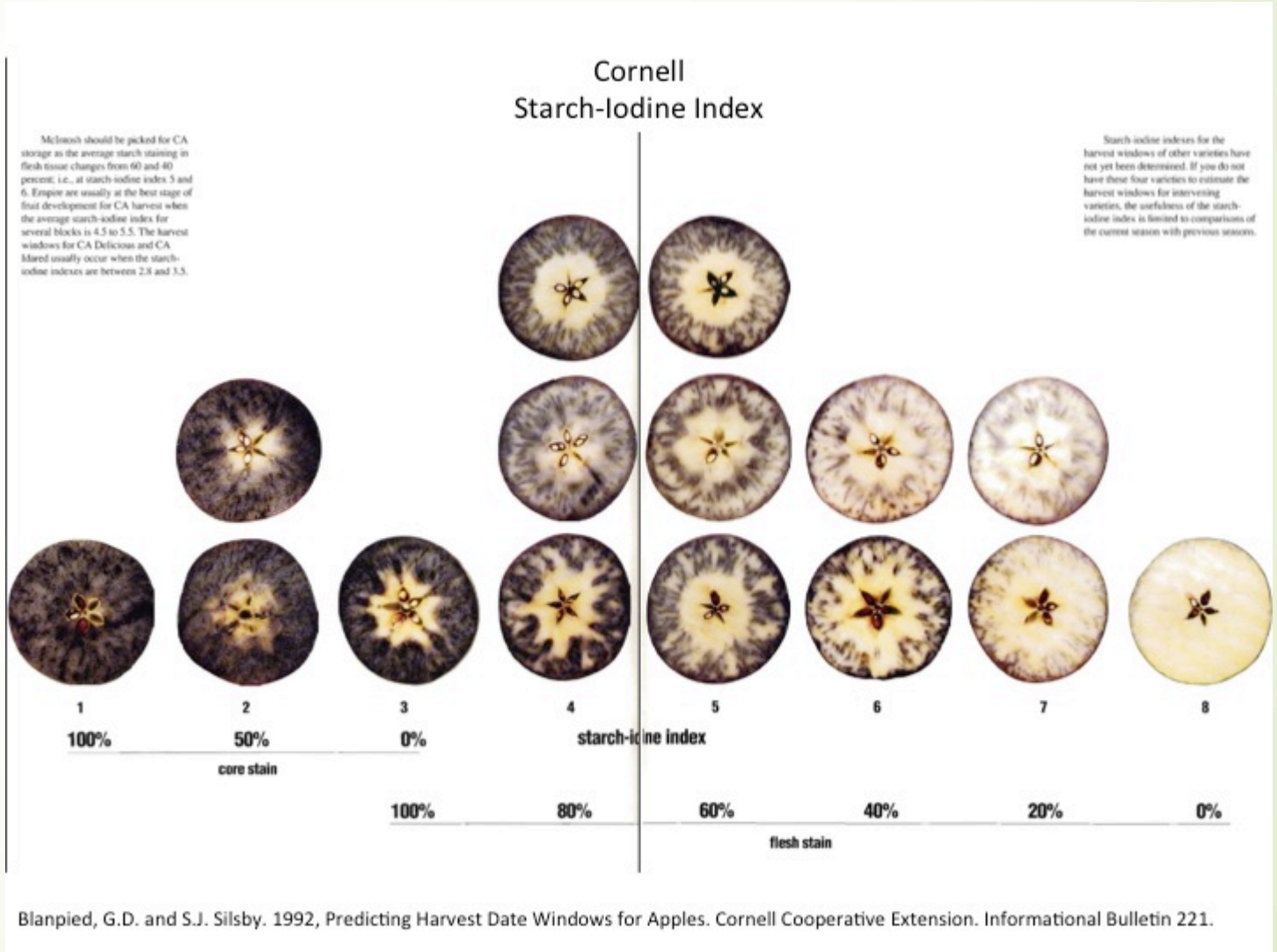
Coordinated Maturation: The Relation Between Visible Attributes and Hidden Attributes Differs with Cultivar

Visual Attributes:
Ground Color and Surface Color

Destructive Sampling of Honeycrisp Fruit for Starch Pattern

Hidden Attributes: Starch Pattern Index (SPI) for Maturity

- Blue color indicates presence of starch
- Widely used but "counter-intuitive"
- Destructive and time consuming



Blanpied, G.D. and S.J. Silsby. 1992, Predicting Harvest Date Windows for Apples. Cornell Cooperative Extension. Informational Bulletin 221.

Premier Honeycrisp and Honeycrisp

- Premier Honeycrisp matured 3 weeks before Honeycrisp in 2016 and 2017 and 3.5 weeks ahead in 2018.
- Honeycrisp and Premier both mature and tree-ripen rapidly.
- We noticed a pronounced “final swell” in Honeycrisp this year. Fruit increased from 195 to 233 grams in the week prior to harvest. This is about a 3 percent increase in fresh weight per day.

Premier Honeycrisp (Left)
Honeycrisp (Right)
Brookfield Gala (Middle)

Early-Season Apples

- Gala fruit ripened more quickly than expected; fruit moved from immature to overripe very quickly in all three years of our research.
- Autumn Crisp was a large attractive fruit that ripened in early September.
- Crimson Crisp was smaller and quite firm (20+ lb at harvest). We saw some water core in 2016, but not 2017 or 2018.

Apple Fruit Maturity Central Maryland September 7, 2018

CrimsonCrisp

Autumn Crisp

Daybreak Fuji

Red Color development in 2018 was poor due to warm, wet August and September weather.

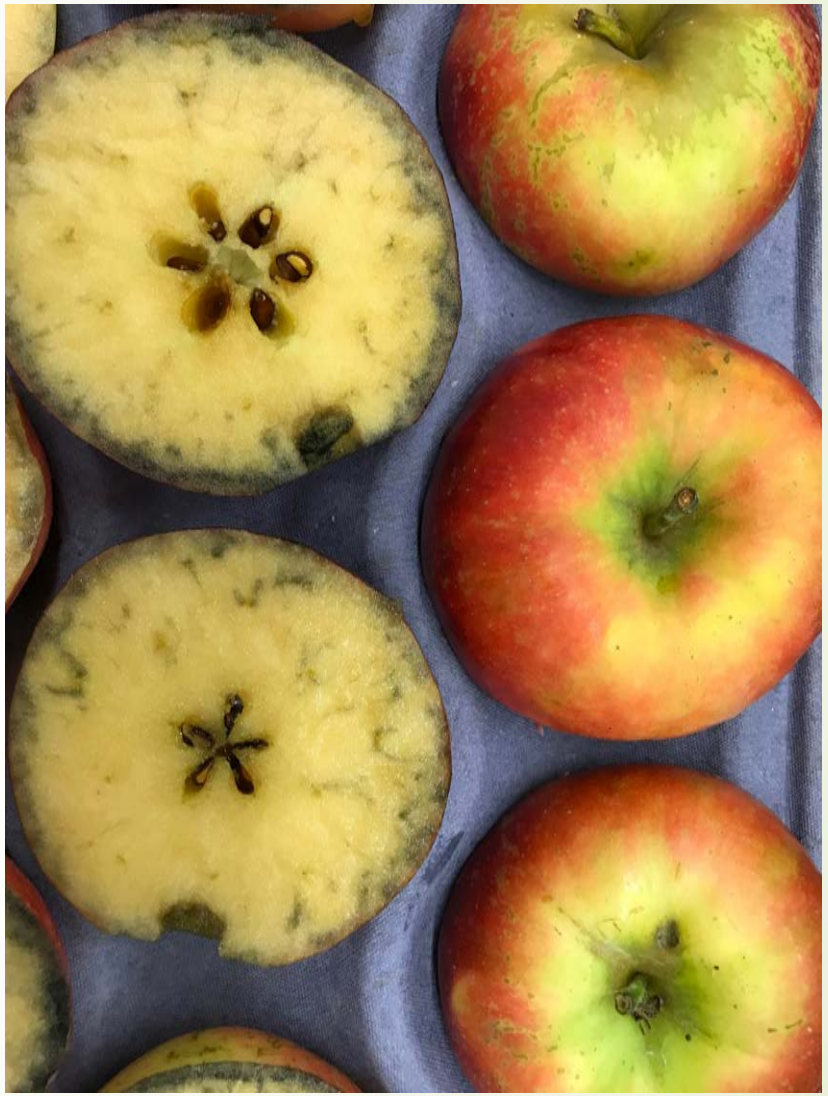
The clouds and high humidity trapped ground heat, increasing night temperatures. Soluble solids were also lower in 2018 than in 2016 and 2017.

Apple Fruit Maturity Central Maryland September 7, 2018

CrimsonCrisp apples are small despite having a full complement of seeds.

While we were cutting fruit for starch staining, we noticed a number of the fruit had six well-developed locules.

It is not unusual to see more than five locules in some varieties. CrimsonCrisp was unusual as all six locules appeared to be well developed.



Water Core in CrimsonCrisp – Symptoms in September, 2016 but not in 2017. CrimsonCrisp was very firm.

Crimson Crisp, Daybreak Fuji and Nagafu Fuji

September 20, 2016

Daybreak Fuji and Fuji

- Daybreak Fuji was tree-ripe in mid-September 2016, early-September 2017 and 2018.
- Fuji fruit were edible in early October, but slowly continued to tree-ripen with little pre-harvest drop for 3 to 4 weeks.
- Watercore, red color and soluble solids were slower to develop in 2018.

Cool Spring Weather Leads to Russet in Fuji

Daybreak Fuji (Top)
Aztec Fuji (Center)
Nagafu Fuji (Bottom)

September 20, 2016

October Apples

- GoldRush was the first late-season variety to show color. There was a poor relationship between its visual attributes and hidden attributes.
- GoldRush had the greatest soluble solids in 2018 (19° Brix). Despite this, fruit still tasted acidic.
- High solids, large size and a rough peel combined to cause fruit cracking.

GoldRush Cracking, Oct 23, 2018

Fruit Size	3.3 in
Weight	240 g
Firmness	19.7 lb
Soluble Solids	19.1° Brix

GoldRush Maturity, Oct 24, 2018

Poor correlation between visual attributes and Starch Pattern Index.

Low starch fruit tasted acidic, despite high soluble solids.

GoldRush Maturity, Oct 24, 2018

- Poor Correlation Between Peel Color and Starch Pattern Index

EverCrisp Maturity, Oct 23, 2018

- In Spring 2017 we noticed bitter pit and senescent breakdown in stored Evercrisp. This "Child of Honeycrisp" appears to have many of the positive and negative traits of that parent. (The apple doesn't fall far from the tree.)

Late-October Apples

- Granny Smith apples began maturing before Cripps Pink (a.k.a. Pink Lady). Granny was slower to tree ripen, but Cripps eventually caught up.
- Cripps Pink was storage-mature in late-October and tree-ripe in early November, the week of Election Day.
- Neither variety developed the level of soluble solids in 2018 that was measured in previous years.

Cripps Pink and Granny Smith

November 1, 2018

What is the Effect of Preconditioning on Premier Honeycrisp and Honeycrisp Apples Grown in Southern Pennsylvania?

Christopher Walsh

Audra Bissett and Kathleen Hunt

University of Maryland

Tara Baugher

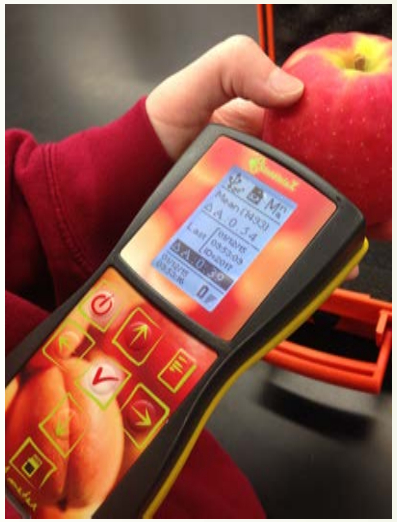
Penn State Extension

Coordinated Maturation: The Relation Between Visible Attributes and Hidden Attributes Differs with Cultivar

Visual Attributes:
Ground Color and Surface Color

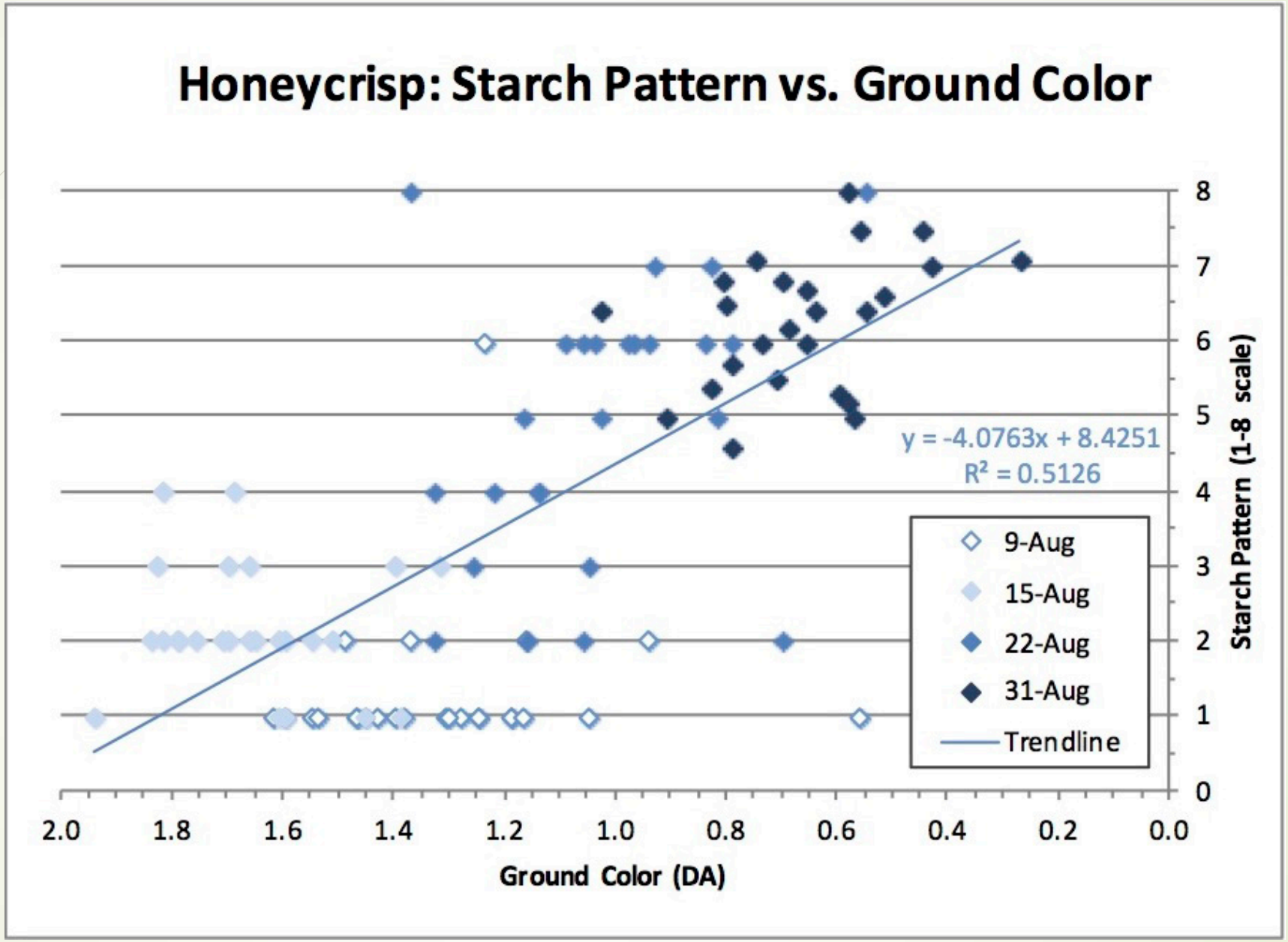
Delta A Meter (ΔA)

- Estimate of fruit chlorophyll unaffected by red color
- Chlorophyll content has been suggested as a non-destructive maturity index for Honeycrisp apples
- ΔA values *decrease* as fruit matures



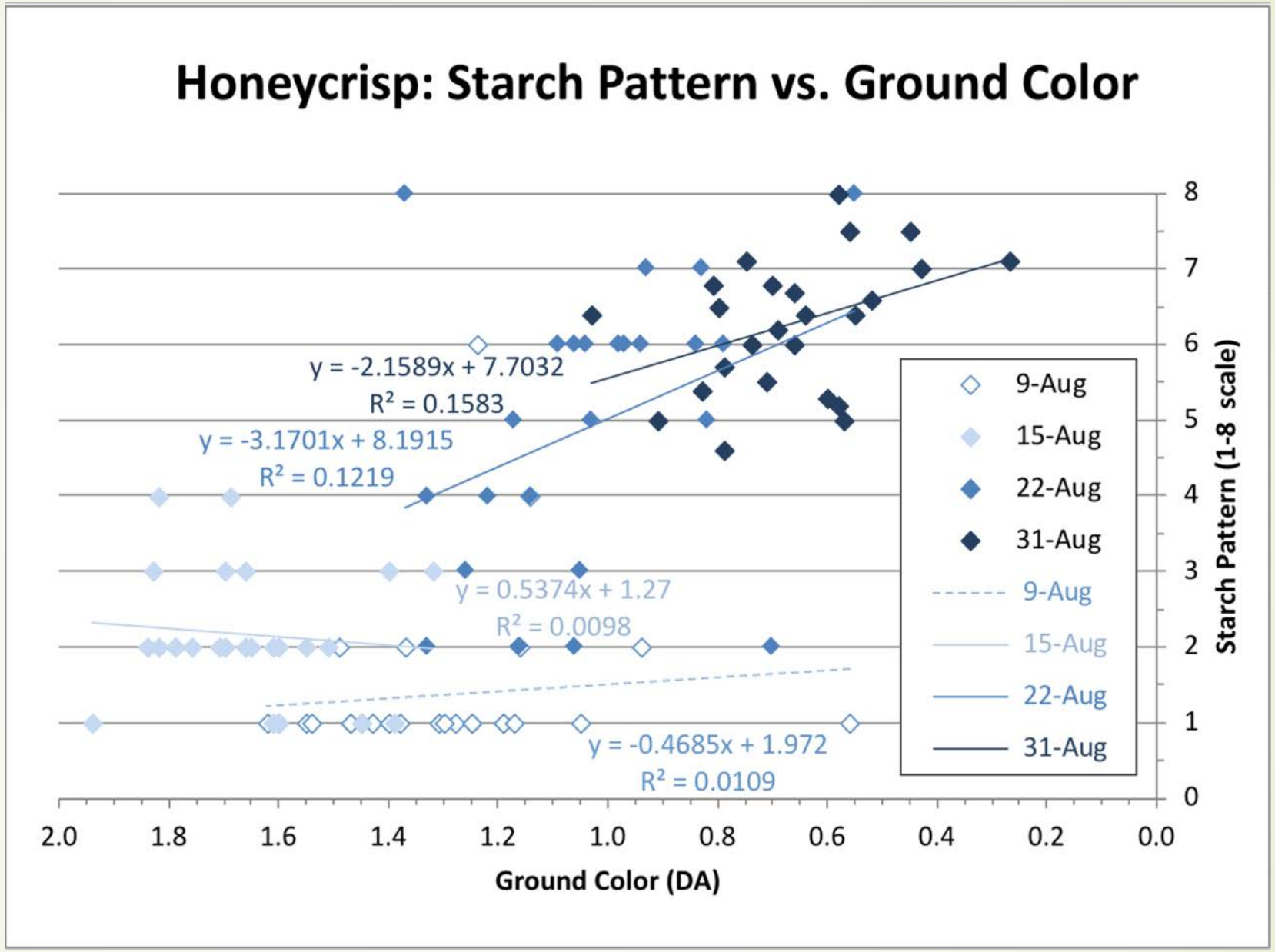
Delta Absorbance (DA)

Fruit maturity meter


Honeycrisp: Starch Pattern vs. Ground Color
y = -4.0763x + 8.4251
R² = 0.5126
9-Aug
15-Aug
22-Aug
31-Aug
Trendline
Starch Pattern (1-8 scale)
Ground Color (DA)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
1
2
3
4
5
6
7
8

Honeycrisp Maturity

- Regression analyses indicated that red color, ground color (Chips or Delta A) were not well-correlated with the starch-pattern index.
- Honeycrisp storage disorders are likely enhanced by poorly-coordinated ripening, making it difficult to manage fruit maturity.


Honeycrisp: Starch Pattern vs. Ground Color
y = -2.1589x + 7.7032
R² = 0.1583
y = -3.1701x + 8.1915
R² = 0.1219
y = 0.5374x + 1.27
R² = 0.0098
y = -0.4685x + 1.972
R² = 0.0109
9-Aug
15-Aug
22-Aug
31-Aug
9-Aug
15-Aug
22-Aug
31-Aug
Starch Pattern (1-8 scale)
Ground Color (DA)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
1
2
3
4
5
6
7
8

A closer look at the data….

- Regression analyses by date showed no correlation with the starch-pattern index in early August.
- While this improves as apples mature, ground color is still poorly correlated with internal quality.

Preconditioning Treatments Premier Honeycrisp and Honeycrisp

- Fruit were harvested in a ‘pie slice’ from trees in commercial orchards in PA.
- Following harvest, fruit were sorted by ground color.
- Replicated samples from the color-sorted fruit were held at room temperature (20°C) for 0, 2 and 4 days prior to storage at 5°C.

Hand Sorting Honeycrisp Apples Prior to Preconditioning and Storage Treatments

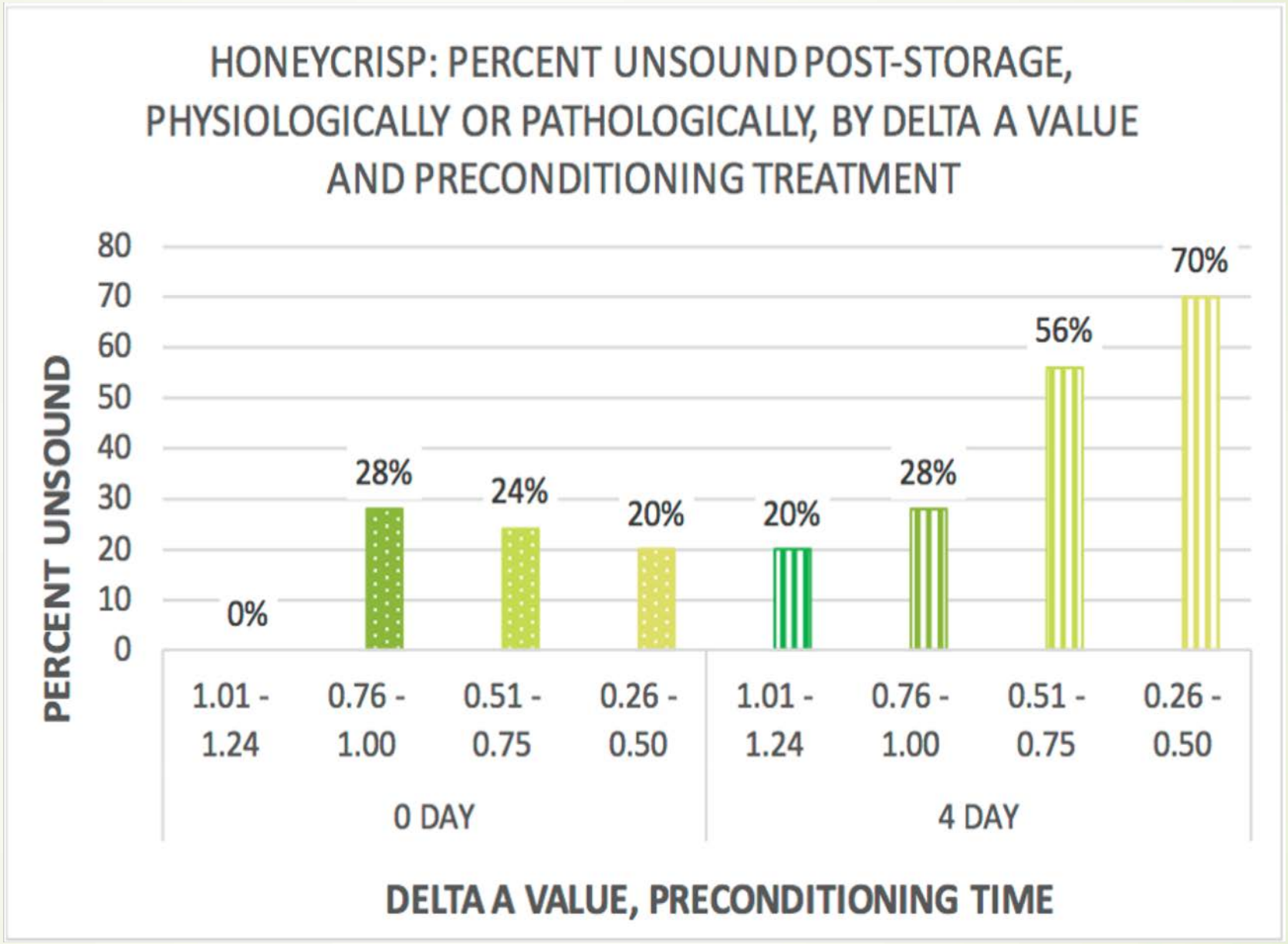
Honeycrisp Fruit Maturity at Commercial Harvest on September 13, 2018

Honeycrisp Disorders

This year we saw a number of problems with harvested fruit.

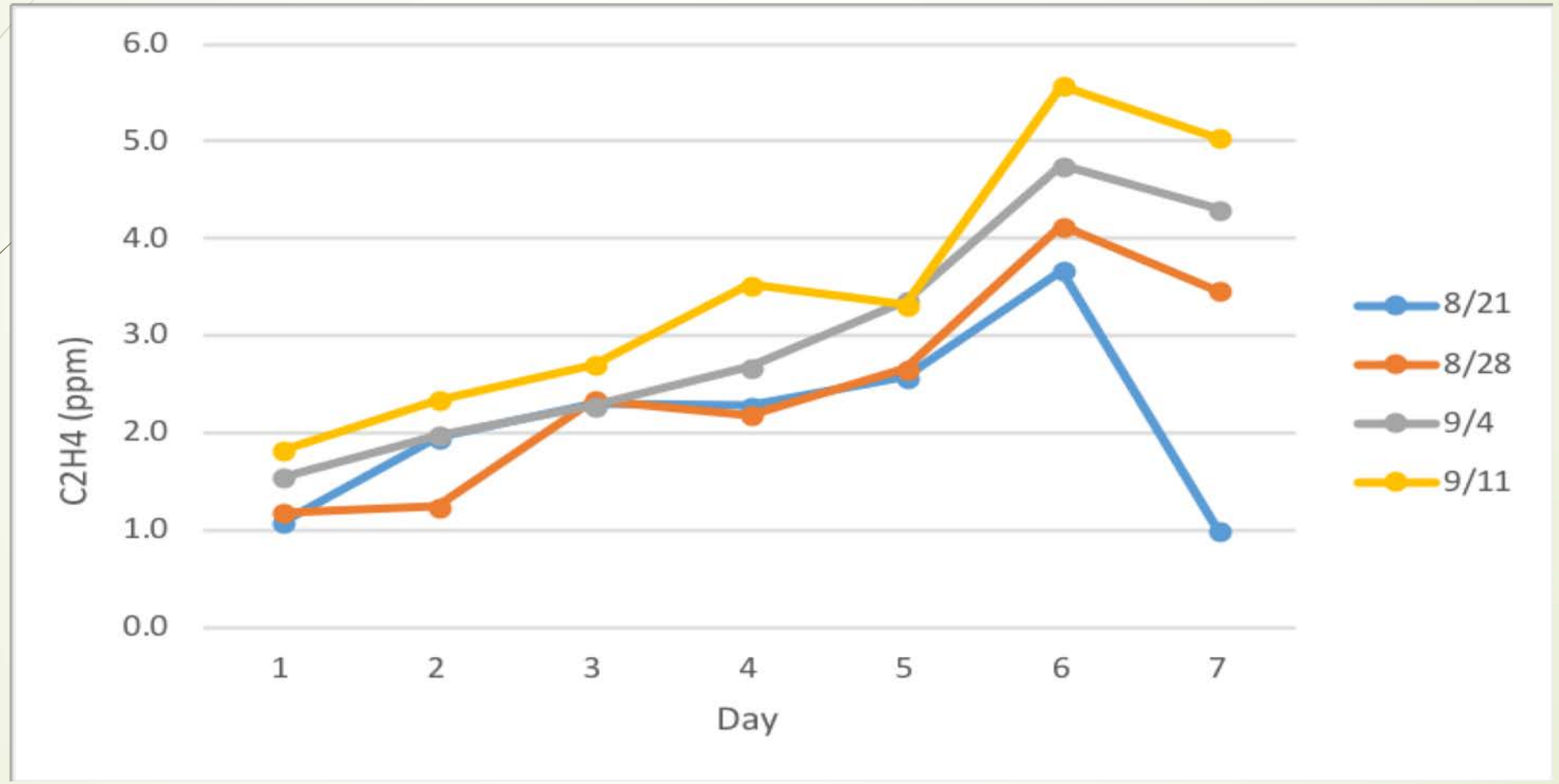
Excessively large fruit were prone to bitter pit, peel roughness and cracking.

We also noted a dramatic ‘final swell’ in 2018.


HONEYCRISP: PERCENT UNSOUND POST-STORAGE, PHYSIOLOGICALLY OR PATHOLOGICALLY, BY DELTA A VALUE AND PRECONDITIONING TREATMENT
PERCENT UNSOUND
80
70
60
50
40
30
20
10
0
0%
28%
24%
20%
20%
28%
56%
70%
1.01 - 1.24
0.76 - 1.00
0.51 - 0.75
0.26 - 0.50
1.01 - 1.24
0.76 - 1.00
0.51 - 0.75
0.26 - 0.50
0 DAY
4 DAY
DELTA A VALUE, PRECONDITIONING TIME

Ethylene Evolution of Honeycrisp Apples at Room Temperature

Ethylene Production in Honeycrisp held at 20°C (68°F) Preconditioning and Maturity Increase Ethylene Rate



Preconditioning Treatments Premier Honeycrisp and Honeycrisp

- Preconditioning showed little value in our storage trials.
- The fewest storage losses were seen in green fruit, directly stored in 2017-18 trial.
- Postharvest rots increased in ripe fruit with preconditioning.
- Final-swell cracks in Honeycrisp appeared to enhance postharvest rots.

Concerns: Honeycrisp Apples on Display at Harris Teeter on October 5, 2018

Concerns: Senescent Breakdown in Stored Honeycrisp. November 20, 2018

Acknowledgements

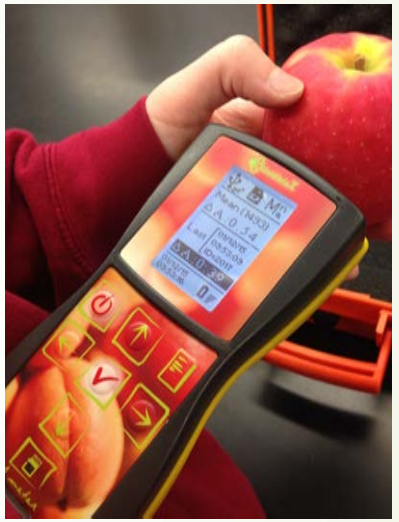
- State Horticultural Association of Pennsylvania for funding this research project (2015 – 2019).
- Cooperating fruit growers in Adams County, Pennsylvania and Central Maryland.
- Brian Butler and Doug Price at WMREC (Keedysville) and Mike Newell at WyeREC.

Granny Smith and Cripps Pink

Each Column Represents a Weekly Harvest

Superficial Scald Studies in Granny Smith and Cripps Pink Apples

- Compare ΔA values and red color as predictors of storage scald susceptibility
- Evaluate apples after 5 months in air storage at 4°C

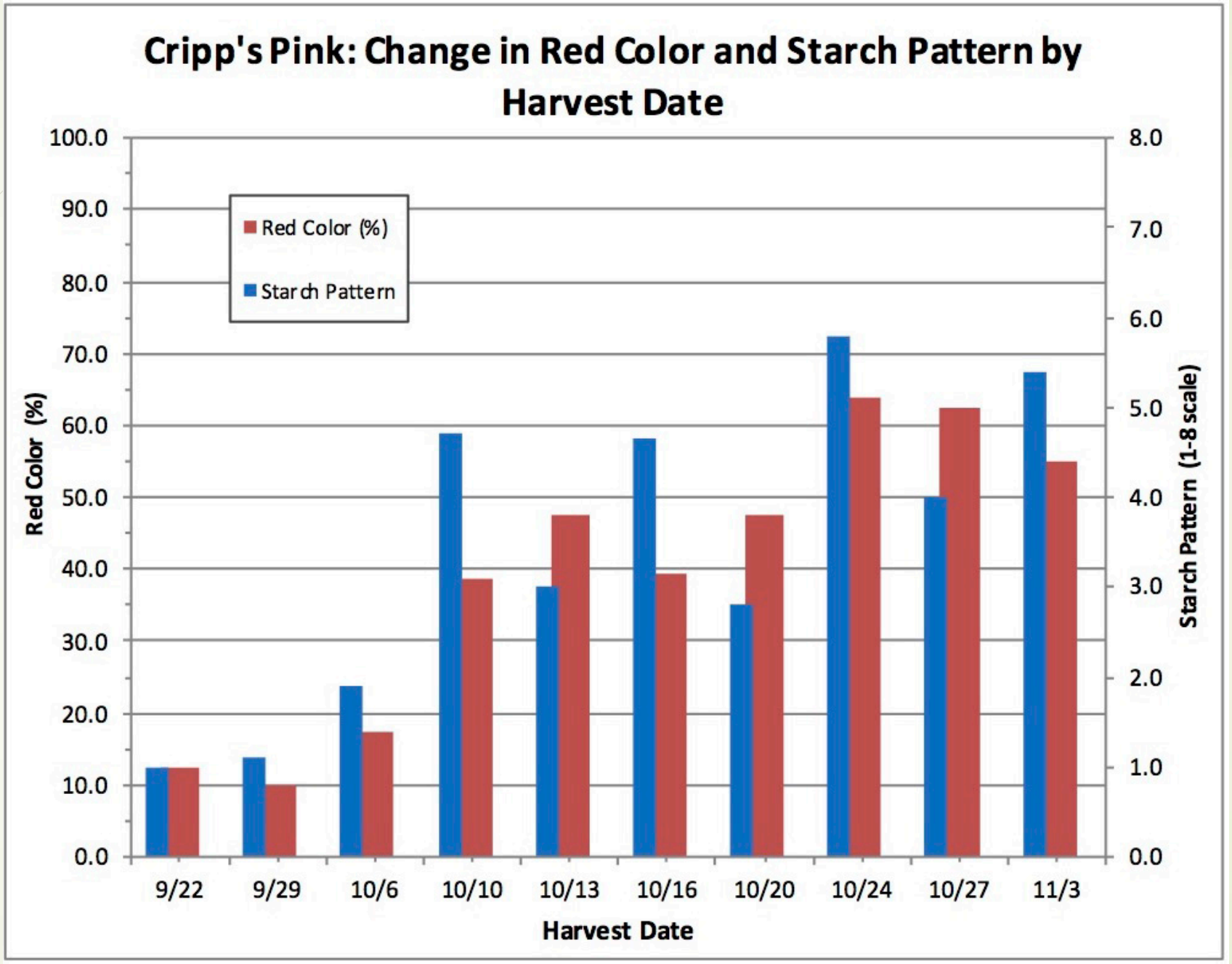


Delta Absorbance (DA)

Fruit maturity meter

Superficial Scald on Cripps Pink

Each Column Represents a Weekly Harvest


Cripp's Pink: Change in Red Color and Starch Pattern by Harvest Date
Red Color (%)
Starch Pattern
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Red Color (%)
Starch Pattern (1-8 scale)
9/22
9/29
10/6
10/10
10/13
10/16
10/20
10/24
10/27
11/3
Harvest Date

Summary – Scald Studies 2014 - 2017

- Ground color changes in Granny Smith occurred slowly in the three years of our studies
- Scald appears to decrease prior to the decrease in DA values
- DA values did not appear to be a good predictor of susceptibility
- Temperatures below 10°C triggered red color development and reduced storage scald
- As anthocyanin developed in Cripps Pink, scald susceptibility decreased in both Cripps and Granny Smith
- Anthocyanin synthesis reduces chlorogenic acid level, and perhaps the chance of peel browning in stored fruit

Summary – Maturity and Storage Studies

- Preconditioning in our trials has not shown the benefits that are seen for stored Honeycrisp in northern regions.
- As we wait for color to develop, Honeycrisp and Premier Honeycrisp are tree-ripened.
- As the starch breaks down, there's an apparent 'final swell.' Riper fruit have a short storage life and do not appear to benefit from preconditioning.
- Cold weather in October triggers anthocyanin production and reduces Superficial Scald susceptibility.
- Red color development in Cripps may be a useful marker for predicting scald susceptibility in Granny Smith