

Monitoring and Utilizing Fruit Maturity
to Improve Harvest and Storage Decisions of New Apple Cultivars
and Reduce Storage Disorders of Honeycrisp

Christopher S. Walsh, Professor
2121 Plant Sciences Building
4291 Field House Drive
University of Maryland, College Park
College Park, MD 20742-4452
240.461.5149 (cell)
cswalsh@umd.edu

Duration of Project:

Two years: This is the second year of a two-year project.

Justification:

During the past few years, apple growers have planted a number of new apple cultivars. With the decline in value of Red Delicious and the superior returns from high quality, early-season fruit, growers have planted a number of new cultivars such as Premier Honeycrisp, Honeycrisp, Gala, Crimson Crisp and Daybreak Fuji. Later season additions to the variety mix – Fuji, GoldRush, and Cripps Pink - have turned apple picking into a three-month operation.

Many of these new orchards have been planted using tall-spindle, high-density systems. The interactions between new apple cultivars, planting systems and warmer summer and fall weather have led to problems managing fruit maturity, planning for harvest, and maintaining fruit quality in stored apples.

Growers frequently delay harvest of early-season cultivars such as Gala and Honeycrisp to ensure adequate fruit size and color. Delayed harvest can lead to problems of fruit softening, rain cracking, preharvest drop, and overripe, unmarketable fruit after storage. Fruit maturity in Honeycrisp is particularly problematic as it is a spot-pick variety prone to bitter pit and other physiological disorders. Picking immature fruit exacerbates bitter pit in storage, while delaying harvest can increase fruit drop, internal browning, and soft scald.

Most research on pre-conditioning Honeycrisp has been conducted in NY, MI, ON and NS. When we began these studies, soft scald was not thought to be as troublesome in Pennsylvania as bitter pit. Results in our lab with Pennsylvania fruit have not supported the need for preconditioning. During the past three years we have also seen a relatively poor correlation between visible attributes such as red color and ground color and the internal maturity of Honeycrisp apples as measured by firmness and Starch Pattern Index

In 2018, Honeycrisp harvest was delayed considerably due to warm, wet weather in August and early September. When we evaluated the fruit at harvest, they had good size, poor red color development, low soluble solids, little remaining starch and were soft. We also noted a dramatic “final swell” where Honeycrisp fruit grew 3% in fresh weight per day. In late-fall 2018 internal browning was found in a few preliminary fruit tests. As a result, we are concerned about the potential for internal breakdown in stored Honeycrisp fruit.

Expanded knowledge of the effects of harvest date, fruit maturity and preconditioning on storageability of Pennsylvania apples will provide useful information and reduce the chance of postharvest disorders.

This proposal addresses the following three areas listed in the 2019 Topical Priority List:

Horticulture

- Strategic Management of Apple Variety Maturity Progression
- Maintaining Fruit Quality

Postharvest Physiology

- Methods of Retaining Fruit Firmness and Quality

Objectives:

1. Conduct weekly measurements of the commonly used maturity indices of ‘new’ apple cultivars during August, September and October, 2019.
2. Provide data on the change in fruit maturity of these cultivars measured in Objective 1 to the fruit industry through weekly postings of the data in *Fruit Times*.
3. Test the interaction of harvest date, visible maturity at harvest and preconditioning on fruit quality and storage disorders of Honeycrisp and Premier Honeycrisp apples.

Procedures:

1. Conduct weekly measurements of the commonly used maturity indices of ‘new’ apple cultivars during the critical periods in August, September and October.

Apple fruit used in this objective will be grown and harvested from commercial orchards in southern Pennsylvania and the University of Maryland farm at Keedysville. Our research plantings at Keedysville have a number of new cultivars grown on tall-spindle system on G.41, G.935, G.202, Bud 9 and M.9 rootstocks. We believe Keedysville provides early data on maturity as its southern latitude and lower elevation makes it similar to, or ahead of Pennsylvania orchards.

Cultivars studied in this objective will include red strains of Gala, Premier Honeycrisp, Honeycrisp, CrimsonCrisp, Daybreak Fuji, Aztec Fuji, GoldRush, Granny Smith and Cripps

Pink. Spot-picked fruit will be harvested weekly from cooperating Pennsylvania orchards. Fruit from Keedysville will be tested during September, October and early November.

On the day after harvest apples will be evaluated in the Postharvest Laboratory (PLS 0123) at the University of Maryland for:

- Fruit size (fresh weight and diameter).
- Surface color (percent red color)
- Ground color (color chips and Delta A measurement)
- Fruit firmness (penetrometer)
- Soluble solids (benchtop refractometer)
- Starch Pattern index (iodine-potassium iodide solution)

Numerical data and photographic records will be saved for each cultivar tested at each picking date.

We envision beginning harvest and maturity studies of Premier Honeycrisp, Gala and Honeycrisp in August. These will take four to five weeks. Once the Gala and Honeycrisp maturity evaluations are completed, we will begin trials on Daybreak Fuji, Fuji, Granny Smith, Autumn Crisp, Crimson Crisp, Cripps Pink and GoldRush.

2. Provide data on the change in fruit maturity of these cultivars measured in Objective 1 to the fruit industry through weekly postings of the data in *Fruit Times*.

We will make weekly submissions to *Fruit Times* as in 2016, 2017, and 2018. Penn State Faculty and Staff, Dr. Tara Baugher, Dr. Daniel Weber and Ms. Norma Young, have again agreed to include weekly summaries of these data, plus publish photographic records of fruit appearance and starch pattern index (SPI) in that electronic newsletter. (See email from Dr. Weber on p. 6)

3. Test the interaction of harvest date, visible maturity at harvest and preconditioning on fruit quality and storage disorders of Honeycrisp and Premier Honeycrisp apples.

Honeycrisp and Premier Honeycrisp apples grown in commercial orchards in Pennsylvania will be used for this study. Fruit will be harvested just prior to the grower's commercial harvest date for each location and cultivar. A 'pie slice' of fruit harvested from the top of the tree to the lowest hanging limbs will be picked. This approach will ensure that the full range of fruit maturity is harvested.

On the day after harvest, fruit will be sorted on ground color using a Delta A meter at the University of Maryland. Fruit will be sorted into equal categories using the following protocol:

- Yellowish-green fruit (Delta A values greater than 0.5)
- Greenish-yellow fruit (Delta A values between 0.26 and 0.50)
- Yellow fruit (Delta A values between 0.00 and 0.25)

After sorting, we will impose a factorial study of fruit maturity level and pre-storage conditioning at 68°F (20°C). Fruit will be preconditioned for zero to 100 growing degree days.

Following preconditioning, fruit will be moved into walk-in refrigerated storage where they will be held for about 150 days. One day after removing from cold storage, fruit will be evaluated for size, color, firmness and soluble solids. After one week at room temperature, fruit storage disorders, including bitter pit, scald, internal breakdown, and rots will be assessed. Texture, flavor and eating quality will also be evaluated.

Budget:

Budget Items	Year Two April 2019 – March 2020	Total Period April 2018 – March 2020
Salary (Dr. C.S. Walsh)	2,520.00	5,040.00
Hourly Labor	3,434.00	6,868.00
Travel	1139.80	2,279.80
Supplies	250.00	500.00
Capital Equipment	0.00	0.00
Total Direct Cost	7,343.80	14,687.60
Total Indirect Cost	0.00	0.00
Total Cost	7,343.80	14,687.60

Other Support: This proposal has not been submitted to another agency.

Results: Research results will be presented orally to the Pennsylvania apple industry at the Hershey meeting. In addition we will prepare a poster for Hershey and text for publication.

Budget Justification

Salary

Christopher Walsh	\$2,520.00
-------------------	-------------------

Labor

A. Lab Work (Objective 1)

\$12.00 an hour x 8 hours per week x 13 weeks	\$1,248.00
---	------------

B. Report Preparation (Objective 2)

\$20.00 an hour x 2.5 hours per week x 13 weeks	\$650.00
---	----------

C. Lab Work (Objective 3)

\$12.00 an hour x 16 hours per day x 4 days in August	\$768.00
---	----------

D. Lab Work (Objective 3)

\$12.00 an hour x 16 hours per day x 4 days in January	\$768.00
--	----------

Total Labor	\$3,434.00
--------------------	-------------------

Travel

5 trips to Pennsylvania x 200 miles per trip x .535 a mile	\$535.00
--	----------

8 trips to Keedysville, MD x 160 miles per trip x .535 a mile	\$684.80
---	----------

Total Travel	\$1,139.80
---------------------	-------------------

Supplies	\$250.00
-----------------	-----------------

Capital Equipment	0.00
--------------------------	-------------

Overhead	0.00
-----------------	-------------

TOTAL REQUESTED FOR APRIL 2019 – MARCH 2020	\$7,343.80
--	-------------------

**Text of Email sent on December 17, 2018 in Support from Daniel Weber, Penn State,
Tree Fruit Extension Educator, Adams County.**

Chris,

It was good to meet you as well since I have heard much about you from Tara.

If you need a formal letter on letterhead, please let me know and I will draft one for you in short order. Otherwise, then please consider this an acceptance of your offer to participate in your on-going research. I would like to continue the work you and Tara have established in 2019 and hope to provide the same level of support that Tara has been providing in the past and to contribute to this research. Since the two of us will overlap in employment this summer, I am confident the group of us can quickly bring me up to speed on the work that needs to be done.

I look forward to working with you and please let me know what I can do to move forward.

Daniel Weber