

APPLE FRUIT PHENOTYPING PROTOCOL

OVERVIEW

Apple fruits from individuals to be evaluated will be harvested at a defined stage of maturity based on starch pattern index and evaluated for various at 3 times:

1. Harvest
2. 10 weeks postharvest cold storage + 1 week room temp
3. 20 weeks postharvest cold storage + 1 week room temp

CROPLoad & THINNING

- After any chemical thinning (if done), trees should be hand-thinned (beginning 5-6 weeks after bloom) to retain 20-25 fruit per tree for younger trees, or 4 fruit per foot of branch length for older trees (not including current season's extension growth) and no more than 2 fruit per spur or cluster.
- 15 fruit is minimum needed to cover all evaluation stages (5 fruit x 3 evaluation times), and extra fruit provides some backup in case of fruit rot in storage. We would like to harvest a minimum of 10 fruit per tree to allow for evaluations at harvest and after 10 weeks of storage.

FRUIT MATURITY & HARVEST

Check trees weekly for fruit color changes that indicate onset of fruit maturation – changes in background color (from green to cream or light yellow) and brightening in red blush color development.

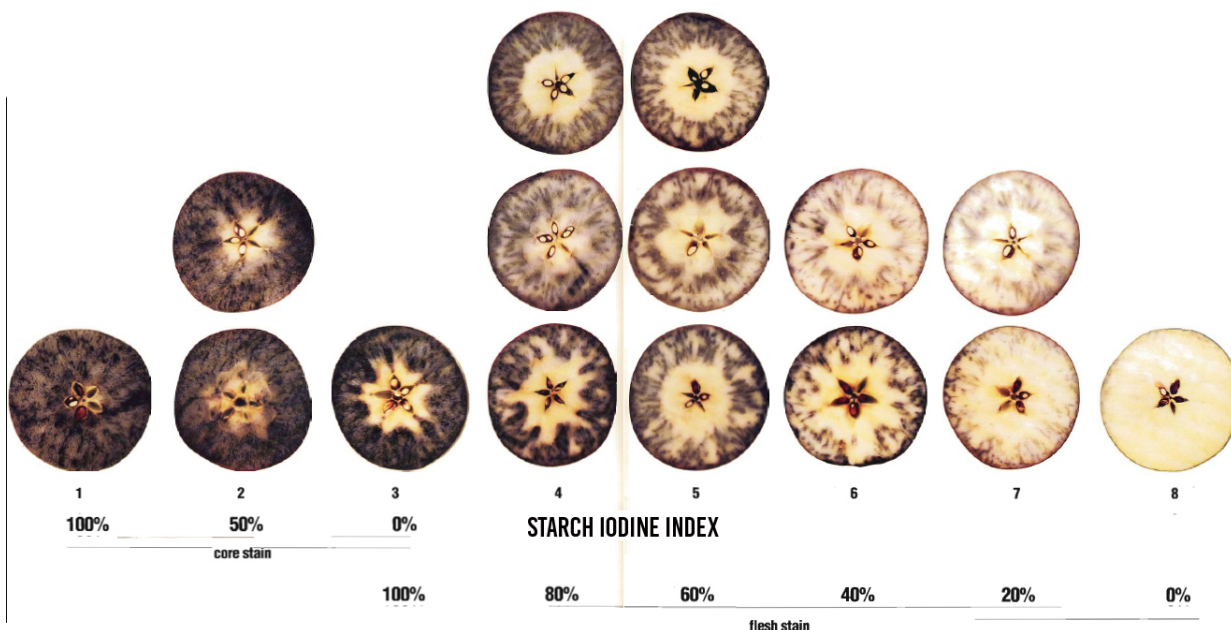
- When the tree looks like it may be ready for the first harvest sampling, select 1-2 fruit with the most advanced maturity appearance and conduct a starch-iodine test. Aim for a maturity indicator of SPI 3-5 on the 1-8 Cornell (Blanpied) Chart below (available at: <http://bit.ly/1ESebt4>) or 1.5-2.5 on a 0-6 starch pattern chart as a generic harvesting 'go date'. This is equivalent to commercial harvest, and is a good intermediate range where it is unlikely for any trees to be too immature or overmature.

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- If the SPI indicates onset of maturation for a tree, visually evaluate the remaining fruit on the tree for their range in maturity. If ~50 % of the fruit have a „harvest-mature“ appearance (roughly similar to the SPI-tested fruit), take the sample of 15-40 fruit selectively picked to be at the correct harvest maturity. 15 fruit is minimum to cover all evaluation stages (5 fruit x 3 evaluation times), and extra fruit provides some backup in case of fruit rot in storage.
- Fruit should be harvested wherever possible from well exposed areas of the tree but avoiding the top and bottom of the canopy. Avoid sunburned fruit, cracked fruit, etc. if possible. Careful harvest is also required because fruit can be readily damaged by stem pulls, finger bruising, etc.

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- Harvest into tray-lined plastic lugs for storage, labeled with following information
 - Row No. and Tree No. (i.e., tree location)
 - Designation of cultivar/selection/seedling (e.g. “Honeycrisp”, or “WSU47”, or “RGxBB #23”)
 - Harvest date
 - Number of fruit
- Transfer fruit to cold storage as soon as possible.

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DATA COLLECTION AT HARVEST

Record data for the following traits at harvest:

- Harvest date
 - When maturity indicator of SPI 1.5-2.5 on a 0-6 starch pattern chart or 3-5 on the 1-8 Cornell Chart
- Crop load (rating) (note: with thinning advised above, this should usually be medium or less)
 - 1=very light
 - 2=light
 - 3=medium
 - 4=heavy
 - 5=very heavy
- Preharvest dropping (rating)
 - 1=none
 - 2=light (<5%)
 - 3=medium (5-30%)
 - 4=heavy (30-60%)
 - 5=very heavy (>60%)

Disease traits may also be recorded from field plots at harvest if conditions permit:

- Diseases (rated 0=none, 1=slight, 2=medium 3=severe)
 - Apple scab severity (rating)
 - Fireblight severity (rating)
 - Powdery mildew (rating)
- These cropping traits can be derived from annual harvest data
 - Annual bearing (based on annual crop load rating)
 - Precocity (yr. to bearing)

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TRAITS EVALUATED USING AGGREGATE RATING ON FIVE WHOLE FRUIT



The following traits are rated based on an aggregate sample five fruit at harvest and/or after 10 or 20 weeks of storage:

Harvest only

- Ground color
- Blush/strip color
- Overcolor type
- Red/blush stripe coverage
- Russet location
- Russet coverage
- Fruit cracking
- Fruit shape
- Calyx opening
- Sunburn

Harvest and Storage

- Greasiness (not common at harvest)
- Shriveling (likely only after storage)
- Bitter pit
- Scald (not common at harvest)

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GROUND COLOR

WHEN: HARVEST ONLY

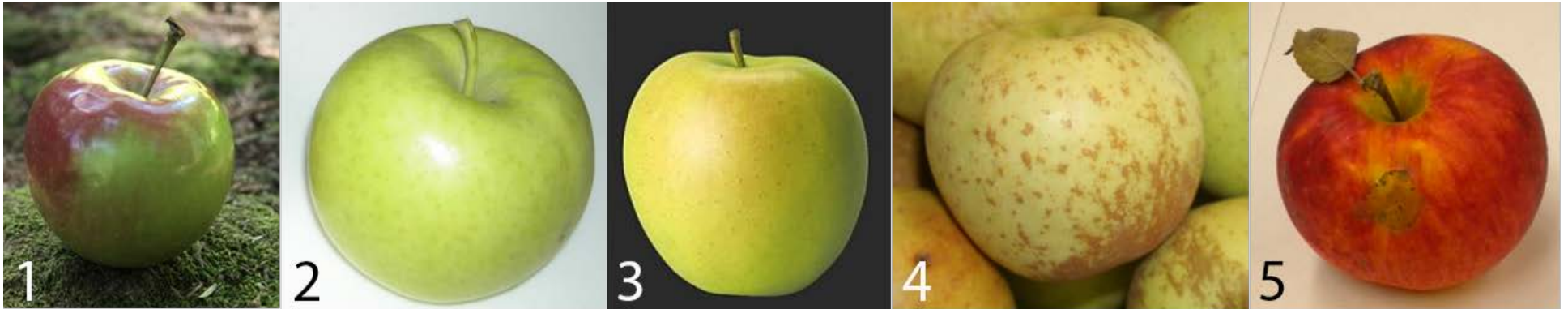


Photo References:

<http://www.shop.globalfayre.com/images/McIntosh.jpg>

<http://www.seasonalchef.com/051406f.jpg>

http://www.isons.com/images/apple_yellow_delicious_sm.JPG

<http://www.haneysappledalefarm.com/images/apples/grimesgolden2.jpg>

1 – GREEN

2 – PALE GREEN

3 – GREEN-YELLOW

4 – PALE YELLOW

5 – YELLOW

BLUSH-STRIPE COLOR

WHEN: HARVEST ONLY



Photo References:

<http://www.orchardworld.co.uk/graphics/content/fruit/tentation.jpg>

<http://fruitforum.files.wordpress.com/2010/03/pinklady2.jpg>

www.boyernurseries.com/images/apple_close_ups/Rome.jpg

http://www.plant.photos.net/images/thumb/8/81/Apple_williams_pride.jpg/180px-Apple_williams_pride.jpg

1 – ORANGE

2 – ORANGE RED

3 – PINK RED

4 – RED

5 – DARK RED

OVER COLOR TYPE

WHEN: HARVEST ONLY

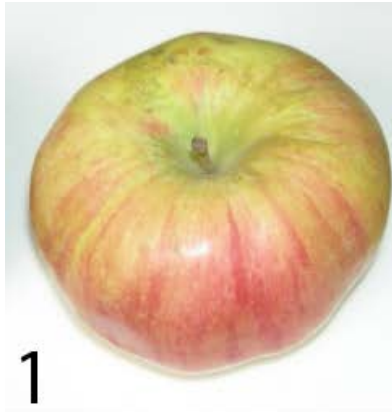


Photo Reference:
www.seasonalchef.com/051406f.jpg

1 – STRIPED

2 – STRIPED-BLUSH

3 – BLUSH-STRIPED

4 – BLUSHED

% RED BLUSH/STRIPE COVERAGE

WHEN: HARVEST ONLY

COVERAGE OF THE FRUIT WITH:

- 1 – NONE
- 2 – <25%
- 3 – 25-50%
- 4 – 50-75%
- 5 – >75%

RUSSET LOCATION (ALL THAT APPLY)

WHEN: HARVEST ONLY

- 1 – STEM CAVITY
- 2 – SHOULDERS
- 3 – BODY BASIN/CALYX
- 4 – LENTICELS



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% RUSSET

WHEN: HARVEST ONLY

- 1 – NO RUSSET (RARE BUT CAN OCCUR)
- 2 – STEM CAVITY RUSSET BUT NOT EXTENDING OVER SHOULDERS OR ON BODY OF FRUIT
- 3 – SLIGHT – ONE TO 2 FRUIT WITH RUSSET EXTENDING OVER SHOULDERS OR ON BODY OF FRUIT
- 4 – SEVERE – THREE OR MORE FRUIT WITH RUSSET EXTENDING OVER SHOULDERS OR ON BODY OF FRUIT

FRUIT CRACKING

WHEN: HARVEST ONLY

This will usually occur at the stem or calyx end of the fruit.

- 1 – NONE
- 2 – SLIGHT – ONE FRUIT AFFECTED
- 3 – MEDIUM – 2 OR 3 FRUIT AFFECTED
- 4 – SEVERE – 4 OR 5 FRUIT AFFECTED



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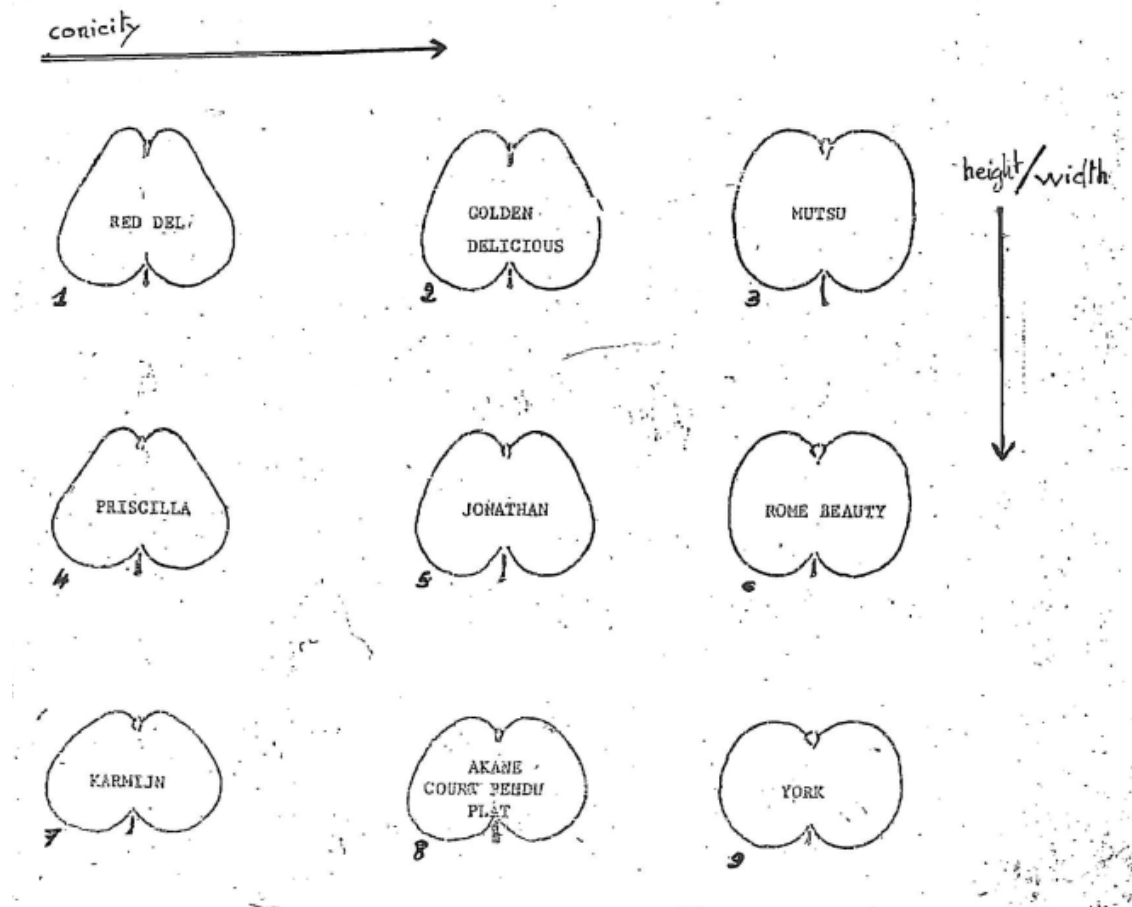


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FRUIT SHAPE

WHEN: HARVEST ONLY

A scale developed by INRA (France) is used. Shape is rated from 1 to 9 as shown based on amount of conicity and height/width ratio.



CALYX OPENING

WHEN: HARVEST ONLY

- 1 – ALL CLOSED
- 2 – MIXED
- 3 – ALL OPEN



OPEN



CLOSED

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SUNBURN

WHEN: HARVEST ONLY



Use photo collage above as a guide:

- 1 – NONE (GRADE 0)
- 2 – SLIGHT (GRADE 1-2)
- 3 – MEDIUM (GRADE 3)
- 4 – SEVERE (GRADE 4-5)

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GREASINESS (TACKINESS)

WHEN: HARVEST AND AFTER STORAGE

- 1 – NONE – FINGER SLIDES WITH NO RESISTANCE, MAY MAKE AUDIBLE SQUEAK IF GREAT PRESSURE IS APPLIED
- 2 – SLIGHT – SLIGHT RESISTANCE AND TACKINESS
- 3 – MEDIUM – CONSIDERABLE RESISTANCE AND PERSISTENT TACKINESS THAT LINGERS ON FINGER
- 4 – VERY GREASY – EXTREME FORCE IS NEEDED TO SLIDE FINGER



SHRIVEL

WHEN: HARVEST AND AFTER STORAGE

Note shriveled skin indicating water loss in portions of fruit with sound skin (ignore areas damaged by disease or mechanical contact)

- 1 – NONE
- 2 – SLIGHT – ONE FRUIT AFFECTED
- 3 – MEDIUM – TWO OR THREE FRUIT AFFECTED
- 4 – SEVERE – FOUR OR FIVE FRUIT AFFECTED



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BITTER PIT

WHEN: HARVEST AND AFTER STORAGE

- 1 – NONE
- 2 – SLIGHT – AT LEAST ONE PIT OBSERVED ON ONE FRUIT
- 3 – MEDIUM – 2 OR 3 FRUITS HAVE PITS
- 4 – SEVERE – 4 OR 5 FRUITS HAVE PITS



SCALD

WHEN: HARVEST AND AFTER STORAGE

Discoloration and may have an epoxy glue-like flavor.

- 1 – NONE
- 2 – SLIGHT – ONE FRUIT AFFECTED
- 3 – MEDIUM – 2 OR 3 FRUITS AFFECTED
- 4 – SEVERE – 4 OR 5 FRUITS AFFECTED



Photos: D. Rudell, USDA-ARS

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