

Apple Maturity Protocol

Tests for apple flesh firmness and starch conversion are important tools for monitoring crop maturity. Flesh firmness, as measured with a pressure gauge, determines how long apples can be stored successfully in controlled atmosphere (CA) storage or other storage methods and still maintain adequate firmness for fresh market or processing uses.

A second common assay for apple maturity is for starch conversion. During ripening, long chain amylose starch molecules break down into smaller units, producing a fruit with a less starchy and sweeter taste. The starch conversion assay uses an iodine and potassium iodide solution that reacts with long-chain starch molecules to produce a deep blue color. As amylose is converted to smaller carbohydrate units during ripening, less reaction with iodine occurs and the blue color is not produced.

Pressure testing for fruit firmness

Standard mechanical pressure gauges fitted with 7/16" diameter plungers are available from farm supply businesses. Common brands are Magness-Taylor, Effegi, and McCormick.

Calibration of mechanical tester (adapted from Silsby):

- make sure pressure gauge is clean and lubricated
- loosen up the test by working the plunger in and out about a dozen times
- hold the tester in a vertical position on the pan of a reliable bench scale
- press down slowly until the scale registers a weight close to your anticipated readings
- adjust tester if needed according to instrument directions and test again

Test each apple twice, once on each side. Use flat area on cheek, halfway between calyx and stem ends, rather than on shoulders or calyx end. Before testing remove a disk of skin between the size of a nickel and a quarter. M.E. Heuck Co. makes a low cost peeler on a stand that is handy if you are doing a lot of samples.

Use the 7/16" diameter plunger tip (usually the larger of two provided). Try to take 2 seconds to insert the tip of the plunger to the inscribed mark on the plunger. Mounting the pressure tester on a drill press improves the uniformity and accuracy of the test. Round values to the nearest half pound. It takes some care and practice to operate the pressure tester the same each time to get consistent results. If possible, have the same person do all the pressure tests.

If you are also testing brix, it is handy to mount the pressure tester on a drill press, sideways so that the juice from the pressure tester drops in a container.

The Michigan State University apple maturity program uses the Cornell University technique (reference: "Predicting Harvest Date Windows for Apples" for starch-iodine testing. An

immature apple will have a relatively high amount of starch and will stain blue. As the fruit matures, it will show less blue staining as the starch is converted to sugar.

Recipe for the iodine solution for the starch conversion test from that publication is as follows:

Reagents can be ordered from chemical supply companies.

Dissolve 8.8 grams of potassium iodide in 30 ml of warm water. Gently stir until dissolved. A magnetic stir plate with a plastic coated stir bar works well. Add 2.2 grams of iodine crystals. Shake or stir until crystals are dissolved. This step takes several hours. Dilute with water to make 1 liter of iodine solution. Store iodine solution in an amber bottle (photographic supply type) or a glass bottle with aluminum foil wrapper. The cap should be non metallic, as the solution will disintegrate metals.

Old iodine solution can deteriorate; as it breaks down the solution becomes clearer. You can test the solution on the cut surface of an immature apple. Dip the cut surface for a second or two. It should stain dark blue within a few seconds.

Iodine is highly poisonous. Treated apples are also poisonous and should not be used in composts or as animal feed.

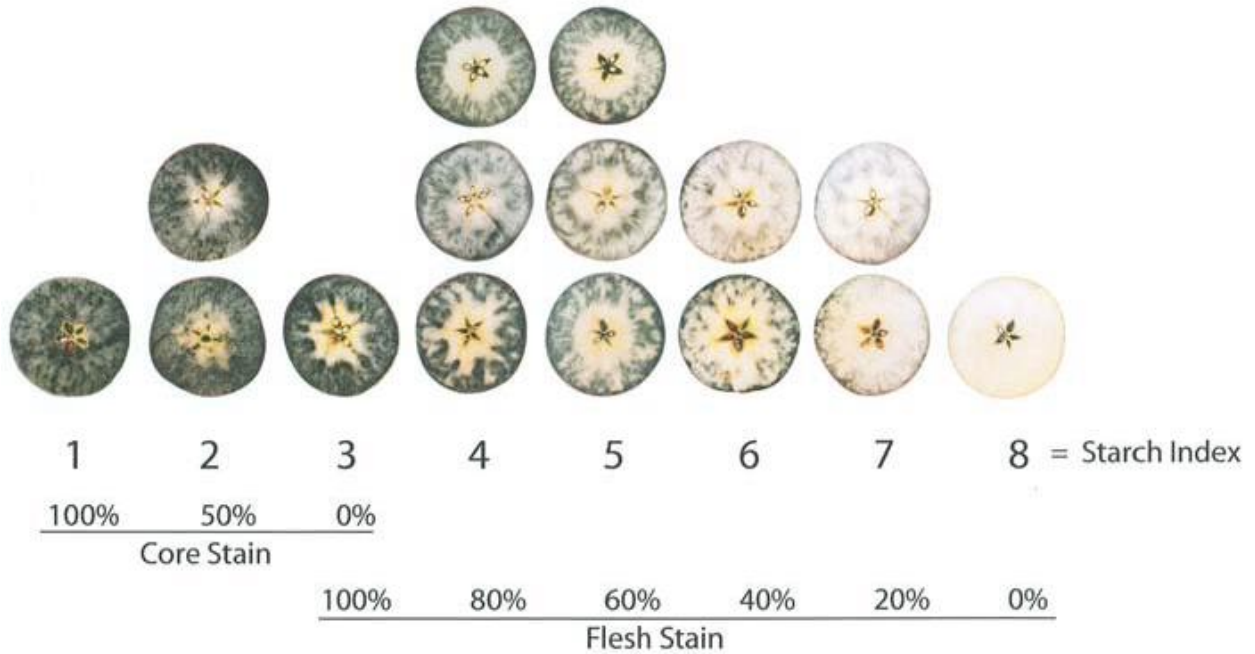
Testing procedure for starch conversion

Cut the apples in half through the equator. Apply the iodine solution to the cut surface of one half. A handy way is to put a thin layer (no more than one-quarter inch thick) of iodine solution in a glass baking dish. Hold the apple half by the stem. Lower in solution, swish slightly to wet the entire cut surface, lift, bumping against side to remove excess, set treated side up.

Compare against Cornell diagrams and record to the nearest whole number. There are other rating scales.

It is typical to test 10 apples per variety per site. The juice from pressure testing all 10 apples is collected in a weighing boat. This is swirled to mix, then tested with a standard refractometer to get a single brix reading for the bulked juice.

Cornell starch-iodine starch staining pattern



Acknowledgements

Blanpied, G. D. and Kenneth J. Silsby. "Predicting Harvest Date Windows for Apples." Cornell University Cooperative Extension Bulletin 221. The article is posted on the [Cornell University web site](#).

"Proper User of Manual Pressure Testers" - Bulletin. K. Silsby

"Observations on Apple Maturity Testing" - Kenneth J Silsby, Sun Orchard Fruit Co., February 1997