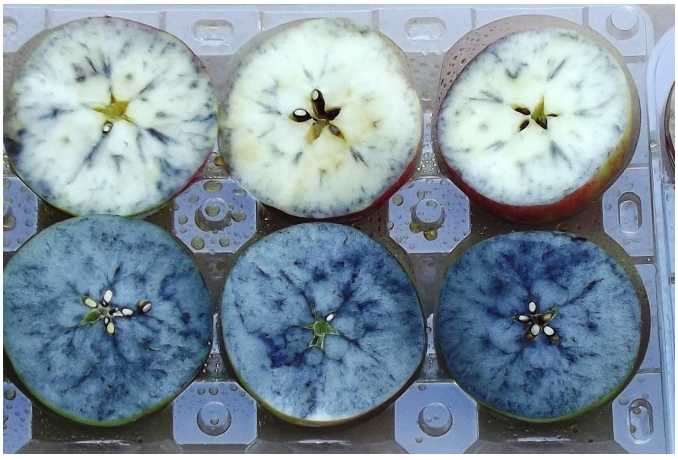
Determining Apple Fruit Maturity

To allow time to schedule labor, growers must estimate optimum harvest dates well before picking fruit. In addition, there are different optimum maturity levels for the same cultivars, depending on intended use and storage life desired. Harvesting too early results in fruit that is off-flavor or lacking flavor, poorly colored, small, and subject to bitter pit and storage scald. Leaving fruit on the tree too long results in softer fruit, the potential development of watercore, and a shorter storage life.



Stage of maturity can be assessed by performing the starch-iodine test to document starch disappearance. Applying an iodine solution to the cut surface of fruit stains the starch a blue black.

Apple Maturity Indices

The obvious first step in marketing a high-quality product is to grow a high-quality product. Early tree training, annual pruning, proper fertilization, and sound pest management can greatly affect tree vigor and, thus, fruit condition. Light crops, crops from extended bloom periods, or crops with high nitrogen levels may differ markedly in maturity date and subsequent storage potential. Each block and cultivar or strain should be evaluated separately for its maturity and storage potential.

Within the list of maturity indices (starch, firmness, juice sugar and acid content, seed color, flesh color, presence of watercore, background color, and internal ethylene concentration [IEC]), there is a priority order for making decisions. Identifying the targeted consumer is the first decision to make. Will the harvested fruit be made available for immediate fresh market consumption, future fresh market consumption following regular or controlled atmosphere storage, or is the fruit destined for the processor? Once the targeted consumer is identified, the relative importance of the specific maturity indicators will be known. With the exception of IEC, which involves the use of a gas chromatograph, all these indicators are relatively easily measured.

Of all the indicators, background color, starch content, and firmness are the most important factors in guiding harvest timing. They are correlated to some extent with sugar content, acidity, flavor, aroma, texture, IEC, and potential storage life. If a fruit lacks the characteristic background color of a specific variety, obviously it will be difficult to sell as a fresh market item. A fruit harvested without desirable color will not change significantly during storage. Fruit lacking characteristic background color is most likely going to be firm, starchy, and immature. The only viable outlet for such fruit is most likely the processing market. However, fruit destined for processing also has minimum maturity standards. Fruit with low starch readings of 1–2 on an index of 1–8 are still immature and will lack flavor and sugar content. They will have a desirable firmness, but the flavor aspect will overshadow this. In general, a combination of the presence of background color, starch conversion of 25–35 percent, and firmness above 15 pounds will qualify for a good storage or processing candidate. For immediate consumer consumption, the presence of background color, starches in the range of 4.5–6.0, sugar content above 13 percent, and firmness readings greater than 13 pounds should meet consumer expectations.

Before doing any measurements, collect a representative sample of fruit. Choose five to eight trees per block per cultivar and rootstock that are typical of the trees in the block, and carefully mark them so that you can collect weekly samples. Trees should have a uniform crop load and be of uniform vigor. Begin sampling approximately 4 to 5 weeks before normal harvest is anticipated. Sample four fruits from the periphery of each tree (recognizing that this represents the most mature fruit on the tree), selecting fruit that is free of any visible insect injury or disease damage. Fruit temperature can affect certain test results; therefore, measurements of the

samples' maturity should be performed within 2 hours of harvest.

Days after full bloom (DAFB)

DAFB should be used as a general reference to indicate when fruit might mature. There may be a 5- to 20-day spread between the average harvest date and the optimum harvest date for a particular cultivar. Record full bloom by block and cultivar each spring, since full bloom may vary from one site on your farm to another.

Fruit firmness

Fruit firmness can be measured with either an Effigi fruit tester or a Magness-Taylor pressure tester. Both work on the principle that fruit flesh becomes softer as it matures. Many factors, including watercore and fruit size, can affect firmness readings. The presence of watercore will give higher readings that are inaccurate. Therefore, discard firmness measurements of apples that have watercore. Large apples are usually softer than smaller ones, so for firmness measurements try to choose apples of a relatively uniform diameter and that are representative of the fruit in the block.

The most critical feature of firmness testing is the speed with which you apply force to the plunger. The proper speed is about 2 seconds, and to regulate your speed you might say to yourself, "one, one thousand, two, one thousand" as you insert the plunger into the fruit. Applying pressure too fast is probably the most common way of getting a false reading.

For apples, use the 11 mm tip supplied with the pressure tester and penetrate to a depth of 7.9 mm as marked on the plunger. Test each apple on both the blush side and the nonblush side, then average both readings.

Percent soluble solids (or sugar levels)

As fruit matures, starch is converted to sugars. To measure the percentage of Brix, or sugar, in a solution, a refractometer can be used. As fruit matures, refractometer readings increase, indicating fruit maturity is progressing.

Fruit from trees with a heavy crop will have lower readings than fruit from trees with a light crop under similar growing conditions. Sugar content will be higher in years of reduced moisture availability, high temperatures, and high sunlight. As with firmness, refractometer readings will also vary by fruit position within the tree and nutritional status. Fruits located in exposed areas, where considerable photosynthesis is taking place, have higher soluble solids. Fruits heavily shaded and located inside the tree or on weak spurs have the lowest soluble level of fruit on that tree.

A refractometer can be purchased for around $200 from a number of sources. (Refer to the buyer's guide in each July issue of American Fruit Grower). Measurements are made by squeezing a small amount of juice from the fruit onto the prism of the refractometer. A small garlic press works well to produce the juice. Hold the instrument up to the light and read the percentage of soluble solids by looking through the lens.

After each sample of juice, rinse the prism face off and wipe with a soft tissue to avoid contamination among samples. One can calibrate refractometers by zeroing with distilled water and at 10 percent with a solution of 10 grams of sucrose dissolved in 90 grams of water.

Acidity

As fruit mature, their acid content decreases. Malic acid is the major acid in apple juice, and it plays a major role in the flavor attribute. Table 7-3 categorizes several varieties of apples based on their sugar and acid content. Granny Smith apples have developed a well-known image based on their tart or acidic flavor. Some apple varieties, such as Pink Lady, attain acid values as high as 1.4–1.5 percent in juice. There are no guidelines for maturity based on acid level. The amount of acid present is related to the variety and maturity stage. A drop in acid level is an indicator of advancing maturity. Measuring acidity is somewhat cumbersome and involves the use of common laboratory instruments such as a titrator or a buret. For best use as a maturity indicator, acid level should be recorded over a number of harvests to develop patterns and guidelines.

Starch levels

Stage of maturity can also be assessed by performing the starch-iodine test to document starch disappearance. Applying an iodine solution to the cut surface of fruit stains the starch a blue black. The iodine solution can be made by dissolving 10 grams of iodine crystals and 25 grams of potassium iodide in 1 liter of water. The pattern of starch disappearance is specific for each variety. Delicious loses its starch in a fairly even ring, while Golden Delicious shows an uneven pattern.

Fruit used for firmness testing and soluble solids readings can also be used for the starch-iodine test. Cut the fruit at right angles to the core, approximately halfway from the stem to the calyx end. Apply the iodine solution to the cut surface, drain away any excess, and rate the fruit after 2 minutes. The reaction of iodine and starch is temperature-dependent. Under cold conditions, the reaction will take longer. An external heating source will speed up the reaction in cold environments. Avoid contact and be cautious when mixing and applying iodine solution. Test a minimum of 10 fruits per block, preferably 20. A commonly used rating system is a scale of 1 to 6, as follows:

1 = full starch (all blue-black) 2 = clear of stain in seed cavity and halfway to vascular area 3 = clear through the area including vascular bundles 4 = half of flesh clear 5 = starch just under skin 6 = free of starch (no stain)

In Washington State, general guidelines have been established for using this scale to rate the long-term storage potential of Delicious and Golden Delicious: a 1.5-2.0 rating and a 2.0-3.0 rating, respectively. Growers should develop scales of their own for their varieties and growing conditions.

A good reference for starch testing is " Predicting Harvest Date Windows for Apples " by G. D. Blanpied and K. J. Silsby, Information Bulletin 221, Cornell Cooperative

Extension

Source: Penn State Tree Fruit Production Guide.

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