

MSU Apple Maturity Note No. 1
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Interpreting the Starch Index.

The starch index is a highly useful tool for gauging the stage of development of apple fruit. The starch level declines (and the index goes up) as the starch in the fruit is converted to sugars. For most varieties and in most years, the starch level in the fruit begins to decline well before the onset of ripening and is complete by the time the fruit is fully ripe. The starch content can be visualized and, in part, quantified by staining it with an iodine solution (40 grams of potassium iodide and 10 grams of iodine crystals per gallon of water). Starch-iodine charts such as the Cornell chart pictured are very useful for this purpose.

While the starch index can provide a measure of the developmental stage of the apple fruit, its interpretation needs to be taken in context. Several environmental and biological factors can influence the level of starch in apple fruit and thereby alter the starch index. For instance, more starch will accumulate in fruit from lightly cropped trees, leading to a darker staining pattern. Some fruit cultivars like Fuji, tend to stain poorly, likely because of a higher proportion of starch known as amylopectin, which does not bind the iodine stain as efficiently. Warm summer nighttime weather (and other stresses) can reduce starch levels because the fruit and the tree respire more actively during the night, using up carbohydrate resources that would normally be loaded into the fruit.

Because of the variability that can be encountered with starch content, it is best to estimate fruit maturity using the starch index in combination with other physiological measures of fruit development. There are situations where firmness, as measured by a penetrometer, might be high and background color quite green while starch disappearance indicates the fruit to be more mature. In such a case, it would be prudent to estimate the fruit maturity to be somewhat less, and fruit storage potential somewhat better, than the starch index would imply. The reverse situation is entirely possible also where the starch index indicates the fruit is less mature than it really is.

Some of the better measures of maturity turn out to be those processes driven by the ripening hormone ethylene. Interestingly, starch degradation is largely separate from ethylene action. In fact, there are some unusual strains that maintain a significant amount of starch even when the fruit is fully ripe. However, firmness loss, the change in background color, and increase in red coloration are all processes that are responsive to ethylene and provide valuable information for judging maturity. While measuring ethylene levels is useful and forms a part of the MSU Maturity program output, it is not very feasible for most commercial operations, so we suggest firmness and background color to be evaluated regularly for a given block. Red coloration for pigmented cultivars can also be very useful (and is essential for their marketability), but high coloring strains make it difficult to use this physiological indicator in some cases.

In the end, the best policy is to watch each fruit block closely, to test and record maturity indices of starch index, firmness and coloration regularly, and, whenever possible, use the

weekly maturity information from the MSU Apple Maturity Program offered by the MSU Fruit Team in your region.

Cornell starch-iodine starch staining pattern

