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Using °Brix as an Indicator of Vegetable Quality Instructions for Measuring °Brix in Cucumber, Leafy Greens, Sweet Corn, Tomato, and Watermelon

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Crop quality is important to everyone in the vegetable value chain, including growers, buyers, managers, handlers, processors, restaurateurs, and consumers. Various measures are used to assess and describe different aspects of quality but few may be as popular and important as soluble solids or °Brix. As described in other fact sheets in this series, °Brix has the attention of many throughout the vegetable value chain for three primary reasons. First, °Brix can be measured inexpensively, quickly, and reliably at essentially all

stages of production through preparation. Second, °Brix readings can be an early indication of how "sweet" the consumer may consider the product to be when eating it. Thirdly, °Brix values fluctuate with many factors. Indeed, °Brix levels appear to be a function of primarily crop, variety, maturity, and growing and storage conditions. It is clear, then, why business-minded members of the value chain are interested in measures of soluble solids and why they consider basing some management decisions on them.

When obtained and applied correctly, °Brix readings can be useful in variety selection, harvest scheduling, and crop irrigation, fertility, and post-harvest management. Over time, they may also influence soil management. Regardless, to be useful, °Brix values must be obtained correctly.

Four fact sheets have been prepared to assist members of the vegetable value chain in making the best use of °Brix readings. This *Instructions* fact sheet provides specific methods for measuring °Brix in five vegetable crops. We recommend following these instructions after consulting the fact sheets describing additional aspects of °Brix measurement and the use of °Brix values in crop production and marketing. Additional information on °Brix is available in other publications listed in these fact sheets.

For specific methods refer to: Cucumber—page 2 Leafy Crops—page 4 Sweet Corn—page 6 Tomato—page 8 Watermelon—page 10

1. Cucumber

Routine measurement of soluble solids is currently less common in the cucumber than in other vegetable value chains. However, there is anecdotal evidence that cucumber buyers, processors, and consumers have strong preferences regarding product flavor, with "sweetness" as a component. Certainly, it is clear that cucumber varieties are genetically predisposed to differ in flavor and that crops experience a wide range of growing conditions. Together, these factors make it likely that cucumber °Brix values vary widely among crops. Worse, some crops may be below desired quality thresholds and cost growers and others repeat sales opportunities. In 2011, a total of 60 °Brix readings were taken on cucumber fruit collected on four Ohio farms. Values ranged from 2.2%–5.4%, a more than two-fold difference between the lowest and highest values.

Select Cucumber Fruit for Measurement

Select fruit samples at regular intervals throughout the growing season and choose a consistent time of day to do so. Collect several healthy, representative plants from around the growing area to include potential variability in soil type, moisture, fertility, etc. Select mature and saleable fruit of similar age and position on the plant.

Prepare Cucumber Samples

The location of the sample in the fruit can influence its °Brix value. So, we suggest taking samples from a standard location, such as the center of the cucumber fruit. This suggestion also applies to zucchini and summer squash. The peel can interfere with efficient movement of the tissue through the press. So, we also suggest peeling. Multiple slices can be taken from a single fruit.





Press and Collect the Pulp Sample

Use a hand press or electric blender to prepare samples that are well mixed and representative of the larger cucumber from which they were taken.





Filter the pressed or blended sample with cheesecloth or a delicate task wipe to prevent larger pieces of the sample from landing in the sample well. Pieces of tissue in the well will cause inaccurate readings. Prior to each sampling period, calibrate refractometers with water. Take measurements on room temperature samples soon after harvest to obtain the most accurate and consistent readings throughout the growing season.





Clean

Clean the refractometer and press with water and dry the well and the press between each measurement. Use only a delicate, non-scratching wipe to clean the refractometer. The lens contains glass and should not be damaged. Drying the well between readings reduces measurement error by eliminating sample carryover or excess water which dilutes the next sample, lowering its reading.

Record

°Brix values can be important in your operation. These values represent a snapshot of one key aspect of cucumber crop quality and, potentially, buyer or consumer liking. Like other information important in your operation, °Brix readings should be recorded, not discarded or "committed to memory." A record of °Brix values can become a useful reference; however, for that to happen, other information must be recorded alongside the °Brix reading. This additional information will give the °Brix values meaning going forward. Consider recording the information below along with each °Brix value.

- date and time of harvest and measurement
- crop and variety name
- identity and location of samples within the growing area (number samples gathered from a single crop field and their location in the field)
- identity of samples within the fruit (number samples from within a single fruit)
- fruit weight prior to preparation for measurement
- crop management including planting date, number of pickings, watering and fertilization regime, etc., and recent weather conditions.

2. Leafy Crops

The leafy greens crop category includes many species grown under many different conditions and harvested at many stages. Also, in contrast to other major vegetable crops, nearly all leafy vegetables are consumed fresh or following minimal processing. Therefore, their inherent sensory quality, including potential "sweetness," is key at meal preparation. Finally, for production, marketing, and consumption reasons, leafy vegetable crops stand out for being leaves (the primary site of photosynthesis) as opposed to botanical fruits. Leaves generally supply sugars whereas fruits, seeds, stems, tubers, rhizomes, and other plant organs tend to receive and accumulate them. That said, leafy vegetable crop plants not producing seeds or other organs that typically accumulate sugars, maintain these sugars in their stems, leaves, and roots or employ them in growth. Therefore, monitoring °Brix levels in leafy vegetable crops is worthwhile.

Select Leaf Samples for Measurement

Select leaf samples at regular intervals throughout the growing season and choose a consistent time of day to do so. Collect several healthy, representative plants from around the growing area to include potential variability in soil type, moisture, fertility, etc. Select mature and saleable leaves of similar age, size, and condition. The maturity and location of a leaf can influence composition; therefore, choose leaves from a similar position on all plants.

Prepare Leafy Crop Samples

Soil particles and excess water should be removed from leafy crops prior to measurement. The location of the leaf on the head can influence its °Brix value. So, we suggest taking leaf samples from a standard location, such as the 2nd or 3rd leaf counting from the base on each head. Multiple leaf samples can be taken from a single head.





Press and Collect the Pulp Sample

Use a hand press or electric blender to prepare samples that are well mixed and representative of the larger leaf from which they were taken.





Filter the pressed or blended sample with cheesecloth or a delicate task wipe to prevent larger pieces of the sample from landing in the sample well. Pieces of tissue in the well will cause inaccurate readings. Prior to each sampling period, calibrate refractometers with water. Take measurements on room temperature samples soon after harvest to obtain the most accurate and consistent readings throughout the growing season.





Clean

Clean the refractometer and press with water and dry the well and the press between each measurement. Use only a delicate, non-scratching wipe to clean the refractometer. The lens contains glass and should not be damaged. Drying the well between readings reduces measurement error by eliminating sample carryover or excess water which dilutes the next sample, lowering its reading.

Record

°Brix values can be important in your operation. These values represent a snapshot of one key aspect of leafy vegetable crop quality and, potentially, buyer or consumer liking. Like other information important in your operation, °Brix readings should be recorded, not discarded or "committed to memory." A record of °Brix values can become a useful reference; however, for that to happen, other information must be recorded alongside the °Brix reading. This additional information will give the °Brix values meaning going forward. Consider recording the information below along with each °Brix value.

- date and time of harvest and measurement
- crop species and variety name
- identity and location of samples within the growing area (number samples gathered from a single crop field and their location in the field)
- identity of samples within the fruit (number samples from within a single fruit)
- fruit weight prior to preparation for measurement
- crop management including planting date, number of pickings, watering and fertilization regime, etc., and recent weather conditions.

3. Sweet Corn

The novelist, humorist, and entertainer Garrison Keillor once wrote that, in effect, his family was prepared to resist all forms of sin, but if "Satan had come around with sweet corn, we at least would have listened to what he had to sell." This anecdote speaks to the passion that many have for sweet corn. Its name is fitting in part because people adore sweet corn for its sweetness. However, a wealth of commercial experience and scientific data also indicate that people also prize sweet corn for its texture and aroma. Regardless of specific consumer preferences for blends of sweetness, texture, and aroma, °Brix readings have a role throughout the sweet corn value chain. Making the best use of sweet corn °Brix values requires knowledge of the fact that they differ among endosperm types, stages of maturity, and in-field and post-harvest crop management regimens. Sweet corn °Brix values are unlikely to increase once the crop is picked or has passed "milk" stages of maturity.

Select Sweet Corn Ear Samples for Measurement

Select ear samples at regular intervals throughout the growing season and choose a consistent time of day to do so. Collect several healthy, representative plants from around the growing area to include potential variability in soil type, moisture, fertility, etc. Select mature and saleable ears of similar age and position on the plant.

Prepare Sweet Corn Samples

The location of the kernels on the ear (tip to stem) can influence its °Brix value. So, we suggest slicing a sample from the middle 2–3 inches of the ear to standardize the samples. Multiple samples can be taken from the center region of a single ear.





Press and Collect the Pulp Sample

Use a hand press or electric blender to prepare samples that are well mixed and representative of the larger ear from which they were taken.





Filter the pressed or blended sample with cheesecloth or a delicate task wipe to prevent larger pieces of the sample from landing in the sample well. Pieces of tissue in the well will cause inaccurate readings. Prior to each sampling period, calibrate refractometers with water. Take measurements on room temperature samples soon after harvest to obtain the most accurate and consistent readings throughout the growing season.





Clean

Clean the refractometer and press with water and dry the well and the press between each measurement. Use only a delicate, non-scratching wipe to clean the refractometer. The lens contains glass and should not be damaged. Drying the well between readings reduces measurement error by eliminating sample carryover or excess water which dilutes the next sample, lowering its reading.

Record

°Brix values can be important in your operation. These values represent a snapshot of one key aspect of sweet corn crop quality and, potentially, buyer or consumer liking. Like other information important in your operation, °Brix readings should be recorded, not discarded or "committed to memory." A record of °Brix values can become a useful reference; however, for that to happen, other information must be recorded alongside the °Brix reading. This additional information will give the °Brix values meaning going forward. Consider recording the information below along with each °Brix value.

- date and time of harvest and measurement
- crop species and variety name
- identity and location of samples within the growing area (number samples gathered from a single crop field and their location in the field)
- identity of samples within the fruit (number samples from within a single fruit)
- fruit weight prior to preparation for measurement
- crop management including planting date, number of pickings, watering and fertilization regime, etc., and recent weather conditions.

4. Tomato

Measures of total soluble solids (°Brix) have long been a staple among tomato growers and processors. °Brix measurement is more common in the processing tomato industry but is gaining recognition in the fresh market industry. In the processing industry, °Brix is a predictor of potential energy and additive needs for producing sauces and other products. In the fresh market, soluble solids levels suggest how "sweet" the tomato may taste; however, it is important to note that sugars, acids, volatiles, and other compounds are responsible for the characteristic flavor of each fruit. So, a higher °Brix value does not guarantee a sweeter flavor. Regardless, tomato soluble solids levels fluctuate with variety and growing conditions. With practice, members of the tomato value chain can adjust management to achieve target °Brix values.

Select Tomato Fruit for Measurement

Select fruit samples at regular intervals throughout the growing season and choose a consistent time of day to do so. Collect several healthy, representative plants from around the growing area to include potential variability in soil type, moisture, fertility, etc. Select mature and saleable fruit of similar age and position on the plant.

Prepare Tomato Samples

Tomato fruit should be washed and dried prior to sampling to remove excess soil and moisture. Cut the fruit from stem to blossom end in wedges. Remove the core. Tomato wedges provide good samples because they represent all types of tissue in the fruit. When pressed, pulp from a tomato wedge contains soluble solids from all fruit tissues. Multiple wedges can be taken from a single fruit.





Press and Collect the Pulp Sample

Use a hand press or electric blender to prepare samples that are well mixed and representative of the larger tomato from which they were taken.





Filter the pressed or blended sample with cheesecloth or a delicate task wipe to prevent larger pieces of the sample from landing in the sample well. Pieces of tissue in the well will cause inaccurate readings. Prior to each sampling period, calibrate refractometers with water. Take measurements on room temperature samples soon after harvest to obtain the most accurate and consistent readings throughout the growing season.



Clean

Clean the refractometer and press with water and dry the well and the press between each measurement. Use only a delicate, non-scratching wipe to clean the refractometer. The lens contains glass and should not be damaged. Drying the well between readings reduces measurement error by eliminating sample carryover or excess water which dilutes the next sample, lowering its reading.

Record

°Brix values can be important in your operation. These values represent a snapshot of one key aspect of tomato crop quality and, potentially, buyer or consumer liking. Like other information important in your operation, °Brix readings should be recorded, not discarded or "committed to memory." A record of °Brix values can become a useful reference; however, for that to happen, other information must be recorded alongside the °Brix reading. This additional information will give the °Brix values meaning going forward. Consider recording the information below along with each °Brix value.

- date and time of harvest and measurement
- crop and variety name
- identity and location of samples within the growing area (number samples gathered from a single crop field and their location in the field)
- identity of samples within the fruit (number samples from within a single fruit)
- fruit weight prior to preparation for measurement
- crop management including planting date, number of pickings, watering and fertilization regime, etc., and recent weather conditions.

5. Watermelon

Watermelon stands out as a crop for which "sweetness" is very important. Everyone wants and expects watermelon fruit to be clearly sweet. In fact, the USDA has codified this expectation by requiring watermelon and also cantaloupe flesh °Brix levels to exceed 8% and 9%, respectively, in order for them to meet USDA AMS standards for "good" quality. Texture, color, firmness, and other characteristics also contribute to consumer perception of quality in watermelon but "sweetness" also ranks high. So, °Brix readings are particularly important to members of the watermelon value chain.

Select Watermelon Fruit for Measurement

Select fruit samples at regular intervals throughout the growing season and choose a consistent time of day to do so. Collect several healthy, representative plants from around the growing area to include potential variability in soil type, moisture, fertility, etc. Select mature and saleable fruit of similar age and position on the plant.

Prepare Watermelon Samples

The location of the sample within the fruit (both from stem to blossom end and from soil to exposed side) as well as tissue type can influence the °Brix value. So, we suggest quartering the melon and taking samples from the center or heart of the melon. Some growers also take melon cores instead of slicing to measure °Brix. Both methods are appropriate but only one should be used—be consistent. Multiple samples can be taken from a single melon.





Press and Collect the Pulp Sample

Use a hand press or electric blender to prepare samples that are well mixed and representative of the larger melon from which they were taken.





Filter the pressed or blended sample with cheesecloth or a delicate task wipe to prevent larger pieces of the sample from landing in the sample well. Pieces of tissue in the well will cause inaccurate readings. Prior to each sampling period, calibrate refractometers with water. Take measurements on room temperature samples soon after harvest to obtain the most accurate and consistent readings throughout the growing season.



Clean

Clean the refractometer and press with water and dry the well and the press between each measurement. Use only a delicate, non-scratching wipe to clean the refractometer. The lens contains glass and should not be damaged. Drying the well between readings reduces measurement error by eliminating sample carryover or excess water which dilutes the next sample, lowering its reading.

Record

°Brix values can be important in your operation. These values represent a snapshot of one key aspect of watermelon crop quality and, potentially, buyer or consumer liking. Like other information important in your operation, °Brix readings should be recorded, not discarded or "committed to memory." A record of °Brix values can become a useful reference; however, for that to happen, other information must be recorded alongside the °Brix reading. This additional information will give the °Brix values meaning going forward. Consider recording the following information along with each °Brix value.

- date and time of harvest and measurement
- crop and variety name
- identity and location of samples within the growing area (number samples gathered from a single crop field and their location in the field)
- identity of samples within the fruit (number samples from within a single fruit)
- fruit weight prior to preparation for measurement
- crop management including planting date, number of pickings, watering and fertilization regime, etc., and recent weather conditions.

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Fact sheets in this series:

Using °Brix as an Indicator of Vegetable Quality: An Overview of the Practice, HYG-1650-12

Using °Brix as an Indicator of Vegetable Quality: Linking Measured Values to Crop Management, HYG-1651-12

Using °Brix as an Indicator of Vegetable Quality: A Summary of the Measurement Method, HYG-1652-12

Using °Brix as an Indicator of Vegetable Quality: Instructions for Measuring °Brix in Cucumber, Leafy Greens, Sweet Corn, Tomato, and Watermelon, HYG-1653-12

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