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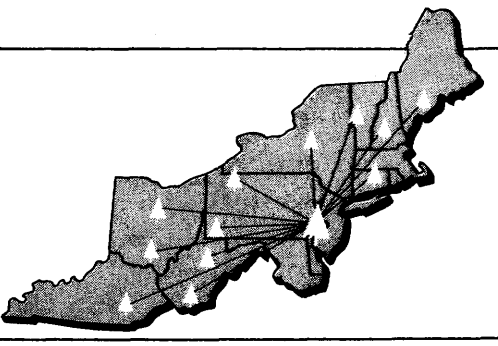

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TESTING SUGAR MAPLE SAP FOR SWEETNESS WITH A REFRACTOMETER

Abstract.—We studied the consistency of refractometer sugar readings as influenced by sap evaporation, temperature, and the drying, cleaning, and calibration of the instrument. From the study results, we suggest field procedures for using the refractometer to insure reliable measurements.

The amount of sugar in sap collected from maple trees is extremely important to the sugar maple industry. Sweeter sap means lower cost in converting sap to syrup.

Sugar values are determined by measuring the percentage of sugar in the sap. A sugar refractometer is a handy instrument for doing this in the sugarbush or at the sugarhouse (fig. 1). However, improper techniques can result in inaccurate measurements.

We studied the variation in sap-sugar readings as measured with a refractometer, observing effects of sap evaporation, temperature, and the drying, cleaning, and calibrating of the refractometer. From this information we recommend procedures for using the instrument.

How to Use It

A sugar refractometer is a fast and dependable device for measuring the amount of sugar in the sap. A drop of sap is placed on the dark circular area of the refractometer (fig. 2). The cover is then closed and the sugar reading is observed through the eyepiece. Sugar in the sap changes the angle of light as the light passes through the prism of the instrument. The amount of sugar in the sap can be determined to the nearest 0.1 percent.

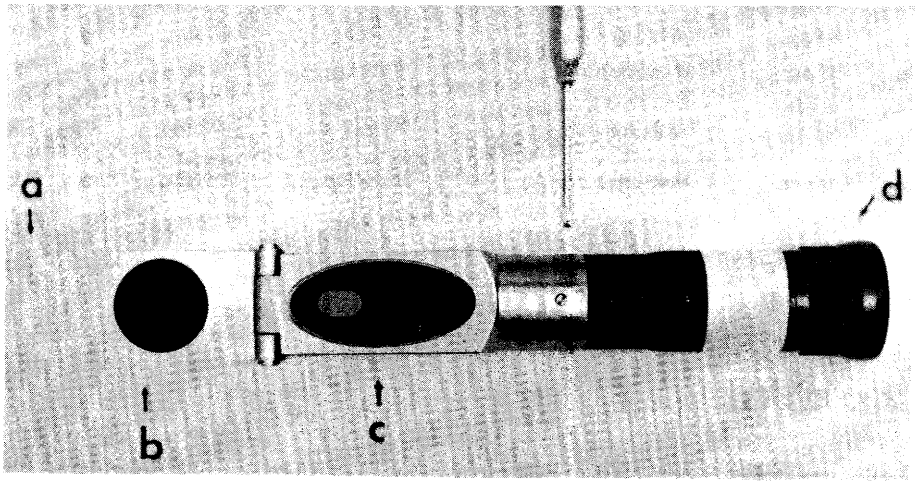

Figure 1.—The sugar refractometer: a, cover; b, dark circular area where drop of sap is placed; c, glass prism; d, eyepiece. Not shown in photo is a small adjustment screw used in calibrating the instrument.

Calibrating the Refractometer

Consistent sap-sugar readings depend on calibrating or "zeroing in" the refractometer. The optical parts of the refractometer change slightly at different temperatures. Therefore the refractometer must be adjusted immediately before the first reading and must be checked for consistency. Without proper calibration, sap-sugar readings will be inaccurate.

To calibrate a refractometer, place a drop of water on the dark circular area and close the cover. Distilled water is preferred, but any source of water could be used. A shadow or dark area is visible on the scale inside the eyepiece (fig. 3). Turn the calibration screw until the shadow falls on the zero mark. Open the refractometer cover and dry the cover and glass prism, using soft tissue paper or a clean cotton

Figure 2.—A drop of sap about to fall on the dark circular area of the refractometer cover. The refractometer can be used at the tree as well as in the sugarhouse.

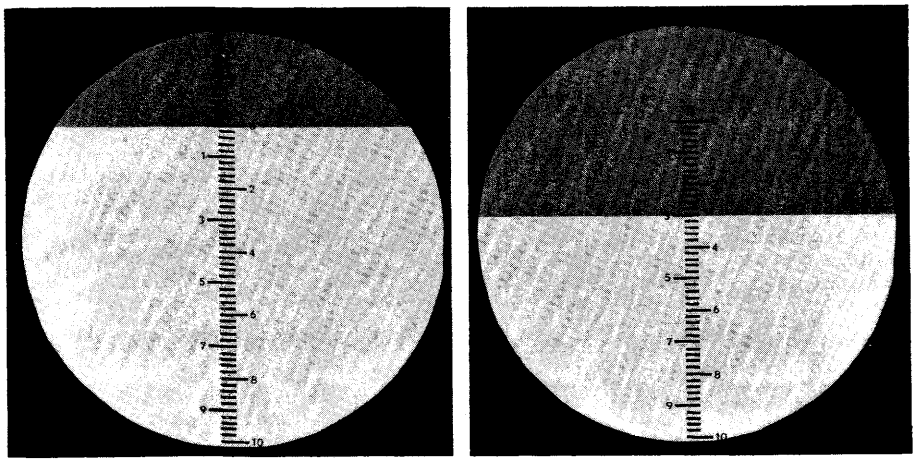

Figure 3.—View through the eyepiece of the refractometer. Left: with water, the meter is calibrated by bringing the shadow line onto zero. Right: in testing sap, the meter shows a sugar content of 3.0 percent.

cloth material. The instrument is now calibrated, and the sap sweetness measurements can be recorded.

Calibrate the refractometer immediately before the first sugar reading. If a number of sugar readings are taken in a short time (one per minute), the refractometer should be calibrated after each reading until the shadow consistently reads zero. Once stable, the calibration should be checked after every 15th reading or after each cleaning. If only an occasional sap-sugar reading is taken, the instrument should be calibrated before each sugar measurement.

Procedures and Recommendations

1. Focus the refractometer scale. The eyepiece can be adjusted; and once it is in focus, a piece of tape can be placed around the eyepiece to keep it from moving.
2. Calibrate the refractometer, using water.
3. After calibrating, put a drop of sap on the dark circular area, close the refractometer cover, look through the eyepiece, and determine the sugar reading from the scale (fig. 3). A drop of sap can be exposed on a refractometer cover for about 1 minute without changing sugar concentration. However, the refractometer cover should be closed and the sap-sugar measured as soon as possible.
4. Observe the sap-sugar concentration value on the refractometer scale viewed through the eyepiece (fig. 4). The sugar content can be read to the nearest 0.1 percent.

Figure 4.—Using a refractometer to measure the sap sugar concentration.

5. After each sugar measurement, use a soft piece of tissue paper or cotton cloth material to dry the refractometer cover and glass prism. After 15 consecutive sugar readings (at 1 minute intervals or less) the refractometer parts should be cleaned with water and then thoroughly dried before the next series of sugar readings. It is also convenient to check the calibration during the cleaning of the instrument. If only occasional sugar measurements are to be taken, the instrument should be cleaned, washed, dried, and recalibrated after each reading.
6. In the field, sap-sugar measurements can be made if the sap is dripping more than 1 drop every 8 seconds. This 8-second estimate is conservative; it was determined from laboratory experiments where a drop of sugar water was exposed to several wind velocities (6, 8, and 10 miles per hour).
7. The temperature of the sap does not appear to influence the sugar reading. Tests were made at 36°F. and 72°F.

If these procedures and recommendations are followed, sugar producers can confidently measure the sweetness of the sap at the taphole, in collection tanks, or at the sugarhouse. The refractometer is useful not only during a sugaring operation, but can also be used in selecting sweet trees for sugarbush-management purposes. Refractometers can be purchased from most sugaring equipment dealers for about $40 to $50.

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