

PRE HARVEST SUGAR TESTING

by
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Red wines made from grapes picked at 22.5 Brix will be lighter in color and flavors will be less intense than wine made from the same grapes picked at 23.5 Brix. One degree Brix can make a large difference in red wine quality, so many winemakers try to measure pre harvest sugar content to an accuracy of about 1/4 Brix. But, 0.25 divided by 22.5 is about 1 percent, and measuring grape sugar content to an accuracy of 1 percent is a difficult task.

The Measurement Problem

Sugar content varies from grape to grape, from cluster to cluster and from vine to vine. Berries near the shoulder of a cluster will be more mature than berries near the bottom. Clusters exposed to sunlight develop faster than clusters hanging in heavy shade, so clusters from the north side of vines are less generally mature than clusters from the south side. Grape sugar content also varies from vine to vine across a vineyard primarily due to changes in soil conditions, water content and wind exposure.

Usually, the largest variation in grape sugar content is due to the extended bloom period. In average years, most of the flowers bloom over a period of about ten days. Clusters produced by early blooming flowers will be about ten days more mature than clusters formed from late blooming flowers. Some years, when the early spring is cold and damp, bloom may last twice as long.

Table 1 shows the magnitude of some important sources of sugar variation. In general, these are independent variables. They tend to cancel, so RSS (square root of the sum of the squares) values are more appropriate than a simple sum. The table indicates a 3.2 Brix variation in sugar content can be expected under average conditions.

Source	Variations	Variations Squared

Grape to Grape	1.3 Brix	1.7 Brix
Cluster to Cluster	1.5	2.2
Vine to Vine	1.4	2.0
Extended Bloom Time	2.1	4.4

Sum of squares of variations		10.3
Square root of sum of squares		3.2 Brix

Table 1. Source and magnitude of sugar variations.

Taking Sugar Samples

This 3.2 Brix variation is a large statistical variant when an accuracy of 0.25 Brix is desired, and the only practical way to increase the accuracy is to sample a large number of grapes. In general, accuracy increases as the square root of the number of samples taken, and Table 2 shows how the expected precision varies with the number of grapes sampled. The table shows about 150 grapes must be sampled to obtain a precision of 0.25 Brix, and note that each grape must be taken from a different cluster to achieve the predicted increase in precision. Consequently, large size samples must be collected or the results will not be accurate. A sample of about 150 individual berries is considered the minimum sample size for small vineyards, and most winemakers prefer to take samples of from 250 to 1000 berries.

Besides sample size, measurement accuracy also depends on how the sample grapes are collected. The sample grapes must be collected in a consistent way from the entire vineyard area to be picked. For example, in a small vineyard containing 100 vines, a uniform and reasonable size sample

could be collected by picking two grapes from each vine. A larger sample would be more appropriate for a vineyard containing several thousand vines. Here, a sample of several hundred grapes might be collected by picking one grape from every fourth or fifth vine. Collecting a representative sample of grapes from the area to be picked is very important. If the intent is to pick the first six rows in a block of vines, then only first six rows should be sampled. If the whole vineyard will be picked, then the entire vineyard should be sampled.

Number of Grapes Sampled	Precision Expected
1	3.2 Brix
9	1.0
25	0.60
50	0.42
100	0.30
200	0.21
500	0.13
1000	0.09

Collection Procedure

The following grape collection procedure has been used for some time, and the method produces good results. This procedure is particularly useful when several blocks or several different vineyards are sampled on the same day.

Table 2. Expected precision as a function of the number of grapes sampled.

- (1). A 1 quart size, heavy weight, zip-seal “baggy” is used to collect the grapes. The date and the vineyard block being sampled can be written on the baggy with a “magic marker.”
- (2). Grapes can be collected from each vine, every other vine, every fifth vine, etc., but at least 100 grapes should be collected from the vineyard block of interest.
- (3). Most of the sample grapes should be picked from the bottom of the clusters (watch out for bees), and most of the sample grapes should be picked from clusters growing in the heavy shade. (This procedure produces more conservative results).
- (4). The baggy should be sealed and the grapes kept cool until the sugar measurement is made.

Sugar Measuring Instruments

Grape sugars are usually measured with a Brix hydrometer or an optical instrument called a refractometer. Refractometers are handy sugar measurement instruments because they can measure the sugar content of a single drop of juice with good accuracy. In most instruments, each degree is subdivided into five parts, and a value of 0.2 Brix can be read directly on the refractometer scale. Well built, temperature compensated refractometers cost about \$300, and good, uncompensated instruments can be purchased for less than \$150. Most winemakers prefer compensated instruments, but data obtained with an uncompensated refractometer can be corrected for temperature easily using the calibration chart supplied with the refractometer. The major advantage of refractometers is their ability to measure small quantities of juice quickly and easily.

Both short range (16 to 25 Brix) and long range (-2 to 30 Brix) hydrometers are available. Short range instruments cost about twenty dollars, and long range hydrometers cost about seven dollars. The scale on good short range hydrometers can be read directly to 0.1 Brix, and good quality hydrometers have a “certified” calibration. About 100 milliliters of juice are required to make a measurement when hydrometers are used with small diameter cylinders.

All hydrometers must be used at their calibration temperature, or a correction for temperature must be applied to the readings. A typical hydrometer correction chart is shown in Table 3. Note the significant errors that can occur unless temperature is taken into account. Some winemakers avoid temperature corrections by making sure the temperature of the grapes and the hydrometer is at the calibration temperature. Grape samples are brought into the winery lab and allowed to come to

temperature equilibrium. When the grapes have cooled to room-temperature, the grapes and hydrometer are at (or close to) the calibration temperature, and corrections are not needed. High accuracy and low cost are the major advantages of Brix hydrometers.

Sugar Measurement Procedure

The measurement procedure described below assumes the sugar content is being measured with a short range hydrometer. However, once the juice has been collected (at the end of step three), the sugar could be measured with either a hydrometer or a refractometer.

- (1). Remove any air from the baggy. Seal the baggy tightly, and lay it on a smooth flat surface. Use a heavy, flat-bottomed glass tumbler to crush the grapes in the baggy. Crush all the grapes. But be careful not to press too hard or the seeds will puncture the baggy and cause messy leaks.
- (2). Use both hands to knead the grapes in the baggy for several seconds to extract the juice.
- (3). Unseal the baggy. Hold the lip of the baggy over the hydrometer cylinder with the left hand, and carefully squeeze the juice out of the baggy with the right hand. The seeds, skins and pulp can be retained in the baggy (with a little practice).
- (4). When the cylinder is about half full of juice, lower the hydrometer into the cylinder. Then carefully add more juice until the hydrometer is floating at a convenient height.
- (5). Wait a minute to let the hydrometer settle. Then tap the cylinder a few times to make sure the hydrometer is not “stuck” to the side of the cylinder.
- (6). Read the hydrometer scale at the bottom of the meniscus and record the Brix value.
- (7). Remove the hydrometer from the sample, and measure the temperature of the juice with a thermometer. Record the temperature value.
- (8). Use a temperature correction chart (see Table 3) and apply the appropriate correction to the measured value.

TEMP	CORRECTION
56	-0.38
58	-0.32
60	-0.26
62	-0.20
64	-0.14
66	-0.08
68	0.00
70	+0.07
72	+0.14
74	+0.22
76	+0.30
78	+0.38
80	+0.46
82	+0.54
84	+0.62
86	+0.71
88	+0.80

Table 3. Brix hydrometer temperature corrections.

Summary

A difference in ripeness of one degree Brix can produce significant changes in wine characteristics, so most winemakers try to sample pre harvest sugars to an accuracy of about 0.25 Brix. Unfortunately, grapes do not ripen uniformly, and variations in grape sugar content always exist. These variations are larger than the desired accuracy of 1/4 Brix by more than ten times, and large size samples must be collected to accurately measure pre harvest sugar content. About 150 grapes are minimum size samples. The sample grapes should only be taken from the area to be picked. Temperature errors for hydrometers and uncompensated refractometers can be large, so a thermometer is necessary for making accurate sugar measurements.