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Harvest and Wine Math

by Gabe Jackson

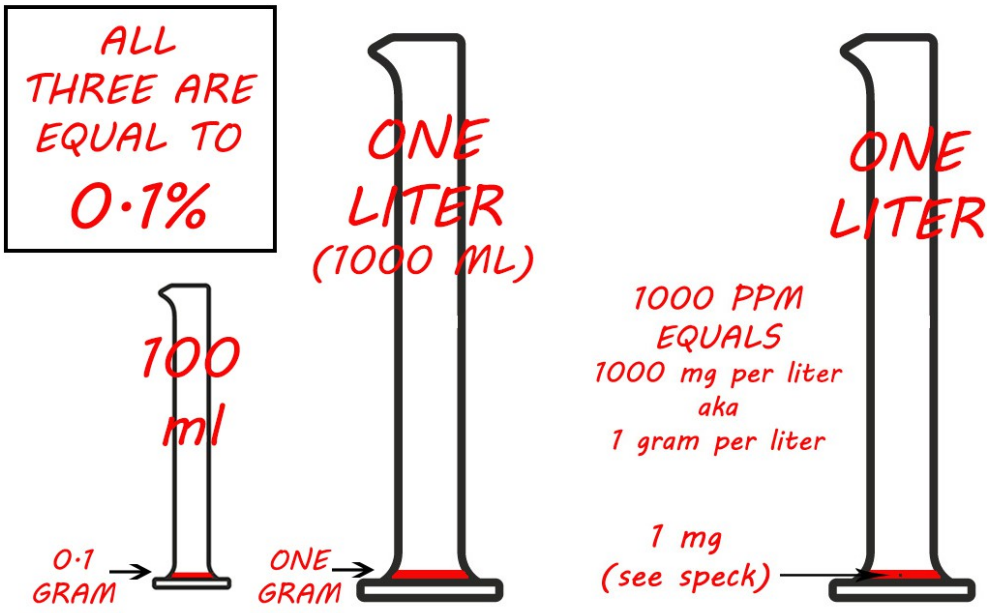
You can call it *wine season*, you can call it *harvest*. For some of us, including those of us employed in the trade of winemaking consultation, it is *math season*. In our line of work, we help folks translate standard to metric, vine counts to grape volumes, sugar adjustments, acidity adjustments, and dozens of other calculations necessary to get through the process from fruit to bottle. This article is a review of some of the calculations we have found most common and most important at The Beverage People. Our staff has found it useful to review these calculations each year just before the harvest to "get our head in the game" after 9 months without need for harvest math.

A good place to start is **units of measurement**. Every winemaker with a season of experience knows that they must measure and potentially adjust the Brix of their grapes. So let's start with Brix. What is a Brix? Few winemakers know that it is a metric measurement. It is a good beginning to understanding how to convert between common units of expression used in winemaking.

There are four commonly used expressions of metric measurements you will find in our discussions, and all of them can be considered equivalents as follows.

1 g per liter = 0.1 g per 100 ml = 1000 ppm (parts per million) = 0.1% mass/volume

For example, if you have a sugar level of 1 g per liter, it can also be expressed as:



1.0 g per liter = 0.1 g per 100 ml = 1000 ppm (parts per million) = 0.1% mass/volume

AND WHAT ABOUT BRIX??

Brix = % sugar mass/volume

$$= \frac{\text{grams of sugar}}{100 \text{ ml}}$$

Therefore, 0.1% mass/volume = 0.1° Bx (from above example)

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Estimating Grape Yield From the Vineyard

Vineyard Manager Carmine Indindoli, a long time consultant and guide of our Sonoma County winegrowers, taught our staff the following calculation to estimate vine yield based on grape clusters. Take note that for the vineyard manager, this approach can be used to control yield and avoid over-cropping if that is desired. It can also be useful in preparing totes, buckets, tanks and other equipment for the harvest based on anticipated yield.

Estimating Vine Yield Based on Clusters

Clusters weigh between 4 oz (cool AVA Pinot) to 8 oz (hot AVA Chenin Blanc)
Buds will produce clusters
Clusters can be controlled by controlling the buds allowed on the shoots

Calculation Example:

12 buds x 2 shoots = 24 clusters
Clusters are Cool Region Pinot Noir = 4 oz per cluster
= 6 lbs per vine
= assume 800 plants an acre (43,560 sq ft)
= 4,800 lbs or 2.4 tons*

*Only 60-80% of potential clusters will successfully yield fruit, therefore a better estimation would be to reduce the estimation to 2,800 – 3,800 lbs

Commercial growers talk in "tons per acre,"---in a cool Sonoma County climate, such as the Petaluma Gap, common yields are about 3 tons per acre, whereas in a warmer climate like Dry Creek Valley or Alexander Valley, yields of 5 to 7 tons an acre will be common. In hot climates like California's Central Valley, growers may produce as much as 10 to 12 tons per acre. These ranges translate to approximately 7 to 16 lbs of grapes per vine in Sonoma County, assuming about 800 vines planted per acre. For a home grower with just a few vines and an expectation of yields somewhat less than obtained in commercial vineyards, a starting guess without much details available might be a very rough 10 lbs. per plant.

To estimate more closely, use this calculation:

≈ (# Clusters per shoot) X (# Shoots per Vine) X (Avg Cluster Weight - 4 to 8 oz)
≈ 6 – 12 lbs per Vine in Sonoma County

<u>Vine Yield Estimates for Sonoma County</u>

1) Cool area, lower yield grapes – use 7.5 lbs per vine
2) Moderate temperature area or Sonoma Co. grapes of unknown specifics – use 10 lbs per vine
3) Hot areas and vines known to be high yield – 12 lbs per vine

Select an estimated vine yield above and fill in the equation below.

# of Vines	
	x
Estimated Yield Per Vine	**lbs.**
	=
Total Grapes to be harvested	**lbs.**

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Estimating Volumes in the Field and the Winery

Totes Needed for Taking Grapes Home

To estimate what containers you need to transport whole clusters from the vineyard to your home, we use a figure of about 4 lbs per gallon equivalent (for reference, water weighs about 8.3 lbs per gallon and wheat flour weighs about 5 lbs per gallon). At that rate, a 6.5-gallon bucket holds about 26 lbs, a 10-gallon bucket holds 40 lbs, a 20 gallon bucket holds 80 lbs, a 32-gallon bucket holds 125 lbs, and a 44-gallon bucket holds 250. The usual "half ton bin" (also called by the brand name Macro bin) is about 2' tall and 4' x 4' square. That makes it 32 cu ft, which is 240 gallons. 240 x 4 = 960 or nearly a thousand pounds, hence "half ton bin."

Calculate your own volume of buckets needed for *picking* the grapes:

Total Grapes to be harvested	**lbs.**
	÷ 4
	=
Volume of Harvest Buckets Needed	**Gallons**

Fermentors Needed in the Winery

For red wine, you need an estimate of the ***must volume*** to choose an ***open top fermentor (ie. Buckets and Bins)***. Our rule of thumb here is to estimate that crushed and destemmed grapes will occupy about one gallon for every ten pounds. So 100 lbs will occupy about 10 gallons of space after being crushed. If the grapes are going to be fermented on the skins, as in red winemaking, additional space must be allowed for the floating of the cap during fermentation. The fermentors should only be filled up about 75%, with a 25% head space available to avoid overflows during the most active periods of fermentation. These figures ultimately lead to our usual advice for the fermenters we sell, allowing enough head space for a cap to rise: 75 lbs in a 10-gallon pail, 150 in a 20-gallon, 240 in a 32-gallon, and 330 in a 44-gallon. Note that this makes using three 44-gallon pails a very viable alternative to a half-ton bin for fermenting a thousand pounds of grapes.

Calculate your own volume of buckets/tanks needed for fermenting *crushed* grapes?

Total Grapes to be harvested	**lbs.**	
	÷ 10	
	=	
Volume of Crushed Grapes	**Gallons**	
	X 1.33	
Fermentor Capacity Needed	**Gallons**	***For Reds, use this #.***

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For white wine, you need an estimate of the ***juice volume*** to choose a ***sealed fermenter (ie. Carboys, Demijohns, Sealed Buckets, and Tanks)***. The following calculation will help you estimate the amount of space needed for the juice, as well as the 25% of empty head space needed for fermentation, in a single calculation.

Calculate your own volume of sealed vessels needed for fermenting *juice* without skins?

Total Grapes to be harvested	**lbs.**	
	X 0.09	
	=	
Fermentor Capacity Needed	**Gallons**	***For whites & rosé, use this #.***

Pressing The Grapes

When grapes or must are pressed, we like to estimate yield at about 6.5 gallons per hundred pounds. Commercial wineries plan on 150 gallons per ton, which is 7.5 gallons per 100 lbs, but we estimate lower for two reasons. First, small ratchet presses do not squeeze as hard as big commercial bladder presses, so yield will be lower. This is especially true when pressing white (or rosé) juice, where the pressed pomace typically remains noticeably moist. The second reason is that if you estimate 6.5 gallons and then you get 7 or 7.5, what a great and happy surprise that will be!

For Red Wine:

Red grapes are pressed AFTER fermentation. The grapes are very soft ***and about half of the juice will flow quickly through the press as "free run"***. The remaining volume of fermented red grapes will need to be pressed. You can select your press size based on this volume remaining after the free run.

Volume of Crushed Grapes (from above)	**Gallons**
	÷ 2
	=
Volume of Grapes in Need of Pressing after the Free Run	**Gallons**

For White Wine:

White grapes are pressed BEFORE fermentation. The juice tends to stay in the crushed grape until being squeezed in the press. You can select your press size based on the **Volume of Crushed Grapes (from above)**.

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Press Sizes Available at The Beverage People:

We have presses with capacities of 7 gallons (#30), 12 gallons (#35), 18 gallons (#40), 21 gallons (80 liter Bladder Press), 25 gallons (#45), 34 gallons (#50), and 42 gallons (160 liter Bladder Press). Other press options are available as special order.

Bulk Wine Storage

After fermentation, the wine will be stored in carboys, demijohns, tanks or barrels, topped up and sealed for the long wait until bottling time. Our calculation for estimating the bulk wine storage volume directly from the weight of grapes is as follows. As discussed above, we like to estimate this yield of pressed wine at about 6.5 gallons per hundred pounds. The estimation will be the same for both reds and whites.

Calculate your volume of storage vessels needed for the wine in bulk?

Total Grapes to be harvested	**lbs.**
	X 0.065
	=
Bulk Storage Volume Needed for the Wine	**Gallons**

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Other Common Estimations & Calculations

Adjusting the Brix

INCREASE BRIX:

1.33 ounces sugar per gallon ⌈ Brix by 1

~1.9 fluid ounces of grape concentrate (standard 68 Brix) per gallon ⌈ Brix by 1

Volume of concentrate to add =

$$= \frac{\textit{Volume of juice} \times \textit{Desired Brix addition}}{\textit{Brix in Concentrate}}$$

DECREASE BRIX:

$$\frac{\text{starting Brix}}{\text{desired Brix}} \times \text{must volume in gallons} - \text{must volume in gallons} = \#\text{ gallons of water to add}$$

Dry White target 22-24 Brix Dry Red target 24-27 Brix

Adjusting Acidity

INCREASE TOTAL ACIDITY:

3.4 grams tartaric acid/gallon raises TA by 0.1% (1 gram per liter)

(1 tsp. tartaric acid = 4.8 grams)

Pre-fermentation target 0.6-0.9% TA
Post-fermentation target 0.55-0.7% TA (Iverson)

DECREASE TOTAL ACIDITY:

3.8 grams potassium bicarbonate/gallon lowers TA by 0.1%

(1 tsp. potassium bicarbonate = 5.9 grams)

Brix = % sugar

$$= \frac{\text{grams of sugar}}{100\text{ mL}}$$

ppm = parts per million

$$= \frac{\text{mg}}{\text{L}}$$

$$\% = \frac{\text{grams}}{\text{L}}$$