Grapes 101

Grapes 101 is a series of brief articles hilighting the fundamentals of cool climate grape and wine production.

How many grapes are in a bottle of wine?

Conversion Factors: From Vine to Bottle v. 2.0

By Chris Gerling

Figure 1. *Grapes come in different shapes and sizes, which will be reflected in different juice yields. Photo by Chris Gerling, Cornell University.*

Author's Note: *Ten years ago (2011) I wrote an article for Appellation Cornell entitled "Conversion Factors: From Vineyard to Bottle", about some common unit conversions winemakers use as they navigate the various weights and measures of liquids, solids and vineyards while also speaking metric and imperial. To provide a little direction, I attempted to answer the question: How many grapes are in a bottle of wine?*

That article gained fairly good traction by our standards, and when I revisited it to see what made it so great, the overwhelming answer was: not the writing. I had my loving and supportive spouse confirm my suspicions by reading it, and she all-too-willingly agreed I had not bottled lightning, or even a lightning bug. While the article was not particularly compelling, my hunch is that the topic does hold interest, and perhaps it's worth re-visiting with that focus in mind.

Grapes within clusters can vary in size. Photo by Jennifer Phillips Russo, Lake Erie Regional Grape Program.

How many grapes are in a bottle of wine?

I have a colleague who teaches people to make cider, and when someone asks him a question that is highly dependent on variables, conditions and circumstances, he replies by asking back: how long is a piece of string? It depends. Wine is made with a combination of natural resources and human input, resulting in plenty of opportunity for natural and human variation.

The good news is that we can do some calculations and arrive at reasonable answers, especially if we know the specifics about the wine. I will now provide you my best estimate based on data we've collected, some tools for you to calculate your own in case you want to go further, and some reasons for why your mileage, or at least tonnage, will vary. Remember to show your work.

First, imagine a green, leafy vineyard with red grapes ripening in the sun. As you look out across the rows of vines and set a mental reminder to check that website with the houses in Italy for sale for one euro, focus on a few clusters of grapes.

Now, as you consider your life choices to date and how you might make a living with this kind of view, your thoughts move to the commercial endpoint. Imagine a store shelf with two bottles of wine sitting next to each other. The bottles are from neighboring wineries and were in fact made from the same grapes you were just observing. Each winery bought some of the grapes from that vineyard and have made wines that now sit next to each other on the shelf.

Those wines will probably be similar in character, but they will definitely not be the same. They will have differences in aroma, taste and mouthfeel. Each chapter in the journey from clusters in the field to bottles on the shelf brings opportunities for the path to fork and the course to diverge, slightly or by a large degree. The same holds for the basic question of volume yield. With every step and every winemaking choice, differences will creep in.

Pre-requisite question: How many grapes are actually in 'them 'thar hills'?

An acre of vineyard will contain a few tons of grapes, and by a few, I mean between two and thirty. For grapes that will end up as wine, I will refine that number to what I believe to be a reasonable average of four tons per acre. It's very tempting to dig deeper regarding tons per acre vs. pounds per meter of leaf area and all of the arguments grape growers and winemakers can have about yield, crop load, quality, profitability and more, but this discussion doesn't really bear on our primary question. Suffice to say that different grape cultivars (e.g., Cabernet Sauvignon, Chardonnay, Concord, etc.) grown in different places with different weather on different soils using different training systems can result in wildly different yields.

Part 1: Grapes in a Bottle of Wine

Table 1. Variation by Variety
(data from 2018 Veraison to Harvest Newsletter)

Cultivar	Average Berry Weight (grams) at Final Sample
Cabernet Franc	1.64
Cayuga White	3.19
Frontenac	1.14
Merlot	1.92
Riesling	1.66

From tons to bottles

We will start with one ton of grapes. This is an imperial ton, as opposed to Imperial Teen, which is a band who had a song on WICB in Ithaca in the late 90s and it took me until the pandemic lockdown to find on YouTube and remember what it was

called ("You're One"). Wait, I mean an imperial ton as opposed to a metric ton, or 2,000 pounds of grapes.

Today we will assume there are 150 gallons of finished wine in that one ton, which equates to 63 cases or 756 bottles. Depending on the type and condition of the grapes, the presspad equipment employed and then the loss through racking, fining and filtration, the gallons of wine per ton can vary quite a bit. Some say that 60 cases is a safe, rounder number, but some also think they can get a lot more than 150 gallons, so we'll stick with 63 cases and you can change the numbers if you wish. To finish that conversion, its 13.3(33333) pounds of grapes per gallon of wine.

Table 2. Cabernet Franc Year to Year
(data from Veraison to Harvest Newsletter)

Year	Average Berry Weight (grams)
2012	1.62
2013	1.76
2014	1.65
2015	1.45
2016	1.66
2017	1.32
2018	1.64
2019	1.37
2020	1.43
Average	**1.54**

Key estimates/ conversions:

- Gallons of wine per ton = 130-180
- Gallons of wine per case = 2.378 (9 Liters)
- Cases per ton = 63 (people often use 60 cases/ ton)
- Pounds of grapes per gallon of wine at 150 gallons/ ton = 13.3
- Grapes per bottle, *see* **Part 2: Berries to Bottles**

About those grapes. One metric we collect for samples in the *Veraison to Harvest* newsletter is average berry weight, so we have a lot of that data. You probably knew this already, but grapes are not all the same size. We weigh 100 and then divide by 100 to get an average.

Different grapes varieties are different sizes, of course (*see* **Table 1**), and even for the same grape the average weight fluctuates from year to year (*see* **Table 2**), which means we'll get a slightly different number of grapes per bottle depending on which year and/ or grape we choose.

Table 3. Berries per Bottle

Grape	Average Berry Weight (grams)	Berries per Gallon	Berries per 750 ml Bottle
Cabernet Franc	1.54	3925	778
Chardonnay	1.77	3415	677
Lemberger	2.01	3008	596
Merlot	1.92	3149	624
Riesling	1.66	3642	721

Using the data we have here, the range extends from roughly 600-800 grapes per bottle (*see* **Table 3**). That's a relatively wide range. Why is there so much variation? Once we've factored in nature above, the next reason is winemakers

Part 2: Berries to Bottles

Variability in the Cellar

Knowing the size of the berries is useful and a big part of helping us make our calculations for this exercise, but berry weight alone does not determine the liquid yield. Returning to the introduction, if we take two one-ton bins from the same vineyard, do everything in our power to include the same number of grapes of similar size, and then deliver those bins to two different wineries, we will almost certainly end up with a different number of bottles of wine.

Figure 2. *Stems may or may not be removed before the grapes are pressed.*

It helps to think of the initial processing steps as a decision tree for a winemaker, depending on the goals for the wine and equipment on the press deck. Do we toss

the grapes straight into the press (aka “whole-cluster pressing”) or remove the stems and crush the berries first, or remove the stems but not crush the berries? Modern presses are often programmable, so we can set all sorts of different cycles for a specified pressure and duration, then release and spin the grapes around, then do it all again, or perhaps differently. Do we add a press-aid to increase the juice yield? Do we separate the first juice received before the press even activates (“free run”) or last juice that has come from really intense squeezing to be used in different wines? And there’s more.

Even if two wineries were each given the same amount of the same juice, they will almost certainly bottle a different number of bottles. Let’s start by imagining a tank that has just arrived. First of all, after juice is pressed, it's still not all juice. There are pieces of grape skin, the occasional seed, and possibly even a stem or two in the tank.

Given time, this stuff will settle to the bottom or float to the top (see **Figure 3**). Depending on technique or technology, two different wine cellars will probably have two different volumes of juice left after separating the solids from the liquid. Some wineries will also put the leftover solids through a filter and recover more juice.

Figure 3. *Grape juice clarification.*

And so it goes down the line for fermentation, fining, filtration, fill-in-the-blank. With each step in the winemaking process, different tools are used, and even the same tools may be used in different ways or to a different extent. These slight differences explain why no two wines are ever exactly the same in terms of how they smell and taste, and the variation also extends to volume.

Figure 4. *Programmable presses mean plenty of options.*

Why it's so great there isn't one answer.

Hopefully I've shed some light on why the answer to the berries in a bottle question is not as cut and dry, or even semi-dry, as it may have seemed. Intentional or not, variation creeps in at every stage. Winemakers rarely have secrets because they know that no matter how closely someone else follows their methods, the resulting wine will be different, and volume at the end of the (bottling) line is one of these differences, albeit a potentially minor one. This is a feature, not a bug. It's the reason two wines made from the same vineyard can be as different as wines made with grapes from far-off places, and it's part of what makes wine so interesting and fun.

Every wine that is made is the only one exactly like it that has ever been or ever will be. Even if the same winemaker with the same tools uses the same grapes from the same vineyard next year, those two wines will also be different. In a world where we've so efficiently homogenized so many aspects of our lives, wine is a glorious outlier. That's better than clean math any day.

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