METHODS OF CROP ESTIMATION IN GRAPES

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Crop estimation also called crop prediction is the process of projecting as accurately as possible the quantity of crop that will be harvested. Why estimate the crop? Obviously, growers need to know how much crop they produce and whether their vines are overcropped or undercropped in order to conduct the necessary crop adjustment by cluster thinning. Vintners would also like to know how much fermentation tank space is needed.

At the 2005 Ohio Grape-Wine Short Course, Rick Hamman, Viticulturist at Hogue Cellars, gave an excellent talk on how they estimate crop at the winery. Crop estimation methods include 'eyeballing', seat of pants, and more rigorous and methodical protocol. Basically, he indicated that, based on his experience, the quick and less rigorous methods gave the worst crop estimates.

In this article, I will summarize two methods considered to be the most accurate and popular in most viticultural regions across the country. Both methods provide only an "estimate" of yield which should never be considered "final".

Method 1: Traditional Method

This method relies on determining the average cluster weight at harvest in one season and uses that number to estimate yield in the following season. The following formula can be used to estimate yield:

PY = (ANV x NC x CW) / 2000

Where:

PY = predicted yield (tons per acre)
ANV = actual number of vines / acre
NC = number of clusters per vine
CW = cluster weight (in pounds).

According to the formula, the grower needs to measure 3 parameters each year; the actual number of vines per acre, the number of clusters per vine, and the cluster weight. These parameters are discussed below with examples.

1. *Actual number of bearing vines per acre*:

The maximum number of vines per acre is determined by the row and vine spacing. For example, a spacing of 6 x 9 feet vineyard will have 807 vines per acre. Almost always the

"actual number" is lower than the "maximum number" of vines per acre due to missing vines for several reasons such as diseased vines (crown gall), winter-injured vines, replanting, etc. For these reasons, each year, growers need to physically count the missing vines, subtract the number from the maximum number to get an accurate count of bearing vines. If 5% of the 807 vines/acre (i.e. about 40 vines) were missing or nonbearing then the actual number of bearing vines/acre is 767.

2. *Number of clusters per vine*:

This number will depend on how many nodes (buds) are left after pruning. Counting clusters per vine can be determined as soon as they are visible (before bloom) or as late as pre-veraison. The advantage of early count is that clusters are readily visible and are not obscured by leaves. This information is also needed by vintners so they can plan on the quantity to purchase from each grower. The number of vines on which to count clusters depends on vineyard size and uniformity. For example, in 1 to 3 acre-vineyard with vines of a uniform age, size, and pruned to the same bud number, only 4% of the vines need to be counted. In practice, a minimum of 20 vines is counted. Growers need to bear in mind that the higher the number of vines selected for cluster count the more accurate the yield estimate will be. In larger, non-uniform vineyards, more vines should be selected. All the clusters on the sample vines should be counted. Also, the vines should be selected methodically; e.g. select every 10th vine in every other row.

3. *Cluster weight*:

It is the component of yield that varies the most from year to year. It is affected by environmental conditions. For example, wet weather during bloom could cause poor set and may lead to low cluster weight; also a dry summer tends to reduce berry size and thus may decrease average cluster weight. Other factors that may affect cluster weight include cultural practices (irrigation, fertilizers), diseases, insects, and birds. Cluster weight at harvest is a key part of any yield prediction program. The goal of obtaining cluster weight at harvest is not to predict the yield that year, but to provide records for yield prediction in subsequent years. AT HARVEST, it is best to sample clusters from vines rather than from bins. The same vines used for cluster counts could be used for cluster weights. Average cluster weight is obtained by sampling at least 100 clusters throughout the vineyard, weigh the total, and divide by the number of clusters sampled. Growers who do not have these data (hopefully will in the future) may use estimates of cluster weights shown in the following table.

4. *Example: Crop estimation of Cabernet franc*

- Spacing = 6 x 9 feet or 807 vines/acre
- Missing/nonbearing vines = 5% or about 40 vines/acre
- Actual number of bearing vines: 807 - 40 = 767 vines/acre
- Average cluster count = 40 clusters/vine
- Average cluster weight = 0.23 lbs
- Predicted yield = (767 x 40 x 0.23) / 2000 = 3.5 tons/acre.

Average cluster weight (in pounds) of common grape varieties

Variety	Small (< 0.3)	Variety	Medium (0.3 -0.4)	Variety	Large (>0 .4)
Cabernet franc	0.23	Concord	0.30	Chambourcin	0.42
Chardonnay	0.23	Chardonel	0.36	Marquis	0.50
Pinot gris	0.22	Lemburger	0.30	Neptune	0.53
Riesling	0.18	Niagara	0.35	Seyval	0.43
Traminette	0.24	Vidal blanc	0.34		

Method 2: Lag Phase Method

This method is based on collecting cluster weights during the "lag phase". The lag phase corresponds to the time when seeds begin to harden, which is also the period when berry growth slows temporarily. Typically, the lag phase occurs about 55 days after first bloom which corresponds to the accumulation of 1000-1300 growing degree days (GDD) or heat units. GDD of 1200 is the benchmark time for many varieties. In general, at the lag phase, berries have reached about 50% of their final weight. Thus a measurement of average cluster weight at the lag phase can be multiplied by an "increase factor" or "multiplier" of 2 to predict cluster weight at harvest. In other words, this method is based on the premise that cluster weights will double from the lag phase to harvest. The multiplier "2" varies among varieties and seasons. In future estimation, you have to determine your own multiplier for each variety. To perform the lag phase method, the following information is needed:

1. Number of bearing vines per acre: same as in traditional method
2. Number of clusters per vine: same as in traditional method
3. Cluster weight at lag phase: weigh 100-200 representative clusters per acre or block during the lag phase. This phase typically occurs 55 days after first bloom.
4. GDD can be obtained from weather stations near your vineyard. The information is readily available on weather websites. Another alternative is to use OSU-GDD calculator website by entering your zip code at: http://www.oardc.ohio-state.edu/gdd/
5. Use the following the formula to estimate yield at harvest:

PY = (ANV x NC x Lag CW x 2) / 2000

Where:

PY = predicted yield (tons per acre)
ANV = actual number of vines / acre
NC = number of clusters per vine
Lag CW = cluster weight at lag phase (in pounds).

Bottom Line:

- Best to use one method or the other rather than doing nothing. Crop estimation is a “MUST” in viticulture regions producing quality grapes and wines. If you have never conducted crop estimation, begin this year. It is never late.
- In general, 70% of the variation in yields comes from year-to-year variation in the number of clusters per vine, and 30% from year-to-year variability in cluster weight.
- Consider a good estimate if it is within 15% of the actual yield. Do not get discouraged if first attempts at crop estimation are inaccurate, because the more experience and data acquired, the more accurate the estimates will become.
- *MAINTAIN RECORDS OF CLUSTER WEIGHTS FROM YEAR TO YEAR IN ORDER TO IMPROVE ESTIMATION.*