Crop Estimation

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Accurately estimating the size of your winegrape crop is important for several reasons. Many contracts limit the amount of winegrapes that a winery will take from the vineyard. If you overestimate the size of the crop you may do an unnecessary thinning ending up with salable fruit on the ground and an even lower yield. If you underestimate the size of the crop a thinning may have to be done just before harvest, increasing farming costs for that year, or grapes will go un-harvested. For premium winegrapes, under or over estimating crop size means that the desired vine balance you are aiming for may not be achieved and wine quality will be affected.

Based on my observations, crop estimation is in a category of viticulture techniques that are critically important yet most would admit we have a long way to go before we do them well. There are several reasons for this in relation to crop estimation. First, to do it properly one may have to take a lot of samples which translates to high cost. Second, doing crop estimation research is not a very sexy endeavor compared to exciting topics such as genomics, so either researchers are unwilling to work on it or organizations that fund research are not interested in funding it, or both.

Some researchers have taken on this area of viticulture and are working on new ways of estimating crop size which may significantly reduce the cost of these measurements. Last year's American Society of Enology and Viticulture Annual Meeting featured a panel put together by John Cole, Production Manager of Kendal Jackson Estates, which focused on these research efforts. Tina Caputo wrote a summary of their presentations which was published in *Wines & Vines* in the June 2006 issue. I therefore will only briefly mention each of the crop estimation techniques presented by that panel since you can refer to this article for more details. I will end with a discussion of what growers are currently using to estimate yield.

New Techniques for Crop Estimation

Possibly the most imaginative approach to crop estimation at the moment is being researched by Douglas McMakin, an engineer for the Pacific Northwest National Laboratory. It involves using holographic radar imaging to estimate crop size. This technology comes from equipment developed for security screening of passengers using public transportation. While very intriguing I can't imagine people growing grapes to make wine with price points below $20 ever being able to afford the equipment that is going to come out of this project.

Right behind the above project, in terms of imagination, is one being done by Julie Tarara, from the USDA Agriculture Research Service. Her technique involves putting a load cell in the trellis wire that supports the cordons and measuring the tension on the wire during the season as bunches gain weight. There appears to be a good correlation with tension and the weight of the crop. This technique has two great advantages, it is

cheap and you can make continuous measurements. It shows promise and Julie is continuing to refine it.

A much more straightforward technique was reported on by Gregg Dunn from the University of Melbourne in Australia. His research showed a significant increase in the accuracy of crop estimation by counting the number of primary branches on bunches six to eight weeks after budbreak. However, whether this technique can become a viable alternative to what is used now partly depends on how many bunches one need to count primary branches on. It is a lot easier to cut bunches and weigh them than it is to count primary branches on the clusters.

Mike Trought, science leader for the New Zealand's Marlborough Wine Research Centre, also was a member of the ASEV Annual Meeting Crop Estimation panel. However, his technique was more useful to someone wanting to make region-wide crop estimation predictions since it is based on weather data to predict crop size rather than for an individual vineyard.

How are Growers Estimating Crop Size

To get an idea of what growers are really doing in terms of crop estimation I contacted colleagues from around the US and asked them what techniques they thought growers were using. I was able to get responses from viticulturists in California, Oregon, Washington, and Texas.

In all cases growers making crop estimates based on vineyard sampling use some combination of counting the number of producing vines per acre, estimating the average number of clusters per vine, and estimating the average cluster weight. Yield is then calculated by multiplying these all together. One of the trickiest parts of this method of crop estimation is determining at what point in the growing season to weigh the clusters to get the average cluster weight. In most instances growers use the 'lag phase' approach. The grape berry has 3 basic growth phases during the season. The berry grows very rapidly during the first and third periods but grows very little during the middle one, which is called the lag phase. A number of clusters are sampled during the lag phase, an average cluster weight is calculated and this weight is multiplied by an 'increase factor'. Many people use an increase factor of 2 because the berry has reached about 50% of its final weight by the middle of the lag phase.

A study done by Price in Oregon is often mentioned as a good reference for crop estimation[1] using the lag phase method. He determined for Pinot noir that the mid point of the lag phase was 55 days after first bloom. Lag phase also corresponds to the time the seeds begin to harden, which is when the seed tips cannot easily be cut with a sharp knife or razor blade. He then determined that an increase factor of 2 gave him the best estimate of cluster weight at harvest.

[1] Price, S. 1992. Predicting yield in Oregon vineyards. In T. Casteel (ed.). *Oregon Winegrape Grower's Guide*, 4th Edition. Oregon Winegrower's Association. Portland.

Growers and consultants differ in how they determine when the lag phase occurs. The techniques varied from 'pick some time before veraison' to carefully monitor flowering and start counting days when 50 to 75% of the flowers are open. They then designate anywhere from 50 to 55 days from bloom as the mid point of lag phase. Growers also differ in the increase factor used, some use 2, others use 1.7 or 1.8.

One thing that can really throw off crop yield estimates is hot weather near harvest. One consultant said that 4 days of hot weather in September one year resulted in a 16% drop in cluster weights. Another factor that will affect the accuracy of crop estimation is the current trend of hang time; leaving bunches out on the vine until the flavors develop often accompanied by a significant desiccation of berries and therefore lower yield. There is no way of knowing at lag phase how long the winery will want you to keep your grapes on the vine before they will take them.

Putting the above uncertainties aside, the single most important factor that will affect the accuracy of crop yield estimates when using the lag phase method is the amount of variation in the vineyard. That is because in the end, as with any other estimation of vineyard attributes, accuracy in estimation is a statistical problem. The more variation in the vineyard, whether it is due to soil, slope, aspect, etc. the more samples one needs to take to get an accurate estimate of clusters per vine and average cluster weight. A highly variable vineyard will require a lot of samples. For example, Price determined that in one highly variable vineyard 30% of the vines needed to be sampled to get an accurate estimate.

Obviously no one can afford to sample 30% of the vines. What is a reasonable sample? One viticulturist I communicated with uses the following regime. He weighs the clusters on 5 to 10 randomly sampled vines per acre to get average cluster weight. To get an average number of clusters per vine he then counts clusters on another 10 to 20 vines to add to the cluster counts from the vines used for cluster weight measurements. Using an increase factor of 1.7 or 1.8 his estimate is usually is within 10% of final yield.

One very interesting observation that I got from most of the viticulturists I contacted in various wine regions was that many growers are reluctant to believe the crop estimate they obtain based on their sampling and subsequent calculations. They look at the estimate based on their sampling, look at the grapes on the vine and often feel their visual estimate does not jive with the results of their calculations. So they go with their 'gut feeling' even though they have gone to the effort and expense of taking samples to estimate crop yield, trusting their instincts over their measurements. However, it is important to learn to rely on good data go make good management decisions. If you have doubts about the numbers you have collected take a few more samples to see if they corroborate those you have already collected. Remember that if you can't measure it you can't manage it. Instincts are great in the right situations but are best when you are doing things like driving your car or playing a pickup game of basketball.