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Crop Estimation and Thinning

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Crop estimation is an important tool for the grape grower that enables appraisal of potential yield before harvest. Prior knowledge of potential crop levels is critical to managing the vineyard to produce a target yield that is often stipulated in winery contracts. It is also important for making plans for harvesting the fruit. Excessive crop levels are reduced by selective thinning practices that remove flower or fruit clusters.

Methods of Crop Estimation

Crop yield is a function of three factors—the number of bearing vines, the number of clusters per vine, and the cluster weight. Therefore, crop estimation methods use these factors at various times during the season to predict yield prior to harvest. Crop estimates must be done on an individual block basis because of the variability typically existing among vineyard blocks.

Pre-bloom Estimate

A simple method is used to provide a crop estimate early in the season. The number of bearing vines in a block is counted and multiplied by a count of the average number of clusters per vine (see below for advice on making these estimates). Then this product is multiplied by the average historical cluster weight at harvest to give a yield estimate for the block (Equation 1). This method provides an early rough estimate of yield potential that can be obtained prior to bloom. But it must rely on the historical average cluster weight at harvest, and it assumes that final cluster weight in the current season will be close to the average historical cluster weight at harvest. Because it is conducted before bloom, the effects of weather and growing conditions on fruit set and berry development are not accounted for by this method. Therefore, it is most suitable for early-season rough predictions of crop potential, but it is not accurate enough for final, pre-thinning estimates in regions or for grape varieties that commonly experience significant annual variation in cluster size.

Lag-phase Estimate

Many Oregon growers use the lag-phase crop prediction method developed by Price (1992). The following discussion is adapted from that description. The method uses the average cluster weight at lag phase multiplied by an "increase factor" as a better predictor of final cluster weight than the historical average cluster weight at harvest. Conducting the estimate at lag phase also allows enough time before harvest to reduce yields by thinning, if necessary, to the desired level.

The lag-phase method requires four factors to be measured or estimated each season for a block: the number of bearing vines; number of clusters per vine; cluster weight at lag phase; and cluster weight at harvest.

Vine Count. An accurate count of bearing vines per block is the starting point of a good crop estimate. Do not assume that the present number of bearing vines is the same as the number of vines originally planted, or even the number of vines in the previous season. Rate of establishment varies among vines, and the number of bearing vines is commonly the main variable affecting total yield in a young vineyard. In an established vineyard, the count of bearing vines can change from year to year because of temporary or permanent loss from disease-, insect-, or weather-related damage. Vine counts can be made by first determining the maximum number of vines possible in the block, then counting and subtracting the number of nonbearing vines. In a rectangular block with uniform spacing, multiply the number of vines per row by the number of rows. Rows of irregular length require individual row counts. Once an accurate count is made of an established vineyard, only nonbearing vines need to be counted each year. Go down every other row with a hand counter and count missing vines. This should be done after flower clusters are visible to ensure identification of bearing vines.

Equation 1. Pre-bloom yield estimate

Estimated Yield = No. of Bearing Vines per Block X No. of Clusters per Vine X Historical Avg. Cluster Weight

Clusters per Vine. The average number of clusters per vine can be determined easily prior to bloom, when flower clusters have emerged but are not yet obscured by foliage. Cluster counts are most accurate if conducted after shoot thinning is completed, since that procedure removes clusters along with shoots. A critical aspect of determining average cluster number is the collection of a sample that accurately represents the entire block. The number of vines necessary for a representative sample depends on vineyard uniformity. For small blocks of one to three acres, where all the vines are the same size, same age, and pruned to the same bud number, it is recommended that 4% of the vines be counted for the sample. Larger uniform blocks can sample a smaller percentage of vines. Methods to determine the required sample size for crop estimates are discussed by Wolpert and Vilas (1992).

Nonuniformity in the block makes collection of a representative sample more difficult, and the only solution is to sample a larger percentage of the vines. Price reported that, for one trial, a non-uniform vineyard required 30% of the vines to be counted to give an accurate, representative sample. Yield prediction in nonuniform blocks thus requires more time and greater cost compared to that in uniform vineyards.

Sample vines can be selected either randomly throughout the block or by a grid system (e.g., every tenth vine in every other row). It is best to determine the sampling system before you enter the block, and do not vary from the prescribed sampling routine. All the clusters on the sample vines are counted; a handheld counter and notepad facilitate collection of the data.

As mentioned above, an early-season estimate of yield potential can be calculated with Equation 1 after vine and cluster counts are completed.

Cluster Weight at Lag-Phase. Cluster weight at harvest is difficult to predict because it is sensitive to growing conditions throughout the cluster development period. However, at about the halfway point between bloom and harvest, the effects of many of the variable factors that influence final cluster weight are apparent. This halfway point corresponds to the “lag phase” of berry development. It also corresponds to the time when seeds begin to harden, so this stage is sometimes referred to as “seed-hardening.”

Grape berry development goes through three phases. The first and third stages are periods of rapid growth; the middle stage, the lag phase, is a period of relatively slow growth. Generally, at lag phase the berry has attained approximately 50% of its final weight. Thus, a measurement of average cluster weight at lag phase can be multiplied by an “increase factor” of about 2 to give an approximate prediction of the average cluster weight at harvest. It is recommended that new vineyards with no production history use an increase factor of 2.2 as a starting point for yield estimates. Lag-phase cluster weights should be collected and recorded each year to develop a long-term lag weight for each vineyard block.

Perhaps the most difficult aspect of this method is determining when the lag phase occurs each season. Price reported that the midpoint of lag phase for Pinot noir averaged 55 days after first bloom in a three-year trial. This corresponded to the time seeds within the berries were hardening. Since seed hardening is usually associated with the lag phase of growth, he recommends standardizing the timing of lag-phase cluster sampling to correspond with the occurrence of 75% hard seed tips. Seed tips are considered hard when they cannot be cut easily with a sharp knife or razor blade.

Just as with cluster counts, representative sampling of clusters is critical to a good cluster weight estimate. Sampling strategies are varied, but there is thought to be more variability within clusters on a single vine than variability between vines. Therefore, most recommendations are to collect all of the clusters on randomly selected vines representing all parts of the vineyard block. Bethel Heights Vineyard applies this method by identifying a set number of average vines per block and harvesting all of the fruit from these vines for lag-phase cluster weights. This method has been pretty accurate, and if you flag and reuse the same vines year after year the information can be even more useful.

A random sample of 200–400 clusters per block is usually adequate for Pinot noir and related varieties. This is weighed and divided by the number of clusters in the sample (keep an accurate count) to calculate an average cluster weight. Sample size should be increased for circumstances or varieties, such as Chardonnay or Merlot, with a wide range in cluster weights.

Cluster Weight at Harvest. Measuring and recording the average cluster weight at harvest every year enables development of a long-term average for each vineyard block. As described earlier, this figure can be used with Equation 1 for an early-season rough estimate of yield. But it can also be used to calculate an average increase factor by obtaining the ratio of average cluster weight at harvest to average lag-phase cluster weight. In his three-year study with Pinot noir, Price reported increase factors ranging from 1.9 to 2.5. Another vineyard in the Willamette Valley recorded increase factors ranging from 1.86 to 2.0 for Pinot noir (greater variability was seen in a young block) and from 1.90 to 2.54 for Chardonnay over a four-year period (MacDonald, 1993). The precision of your increase factor estimates is improved by collecting annual lag-phase and harvest yield cluster weights for each block to develop historical averages.

Harvest cluster weights should be collected by the same procedure used for lag-phase cluster weights. Although it is simpler and easier to collect cluster samples from picking bins, random samples from vines correlate better with lag-phase samples. Bin sampling may not be as random, and additional sampling error can result from difficulty in distinguishing whole clusters from partial clusters.

The four measured factors for each block are used at lag phase to predict the final harvest yield with a simple modification of Equation 1. Instead of using the historical average cluster weight at harvest, the current season's lag-phase estimate of cluster weight is multiplied by the increase factor calculated from historical data (Equation 2). This estimate of harvest cluster weight is then multiplied by the number of clusters per vine and the number of vines per block to estimate total yield.

The lag-phase cluster weight method is not foolproof. Reasonable accuracy requires that variability within vineyards be accounted for by adequate size and randomization of samples. Also, dependence on the increase factor means that the prediction can overestimate final yield if the vines experience water stress or other unfavorable conditions that reduce berry size and thus cluster weight from the predicted value. Similarly, yield can be underestimated if unusual factors contribute to greater than average berry growth in the final phase of development. Annual records of lag-phase and harvest cluster weights, accompanied by seasonal weather notes, will enable an experienced grower to adjust the increase factor for seasonal conditions.

Thinning to Adjust Crop Level

A variety of circumstances may lead to the situation of having more than the desired amount of fruit per vine. Correction of this problem by the selective removal of fruit clusters is called "cluster thinning" (or simply "thinning") and is sometimes referred to as "green harvest" since it is often conducted prior to color development of the fruit. Except in seasons with exceptionally poor fruit set, crop reduction of Pinot noir by cluster thinning is a routine practice in Oregon; thinning is commonly practiced on other varieties as well. Vineyard managers typically have a target range of yield that often is stipulated in the winery contract. The Oregon experience has been that fruit thinning can hasten ripening in late years or on cooler sites, especially on Pinot noir where thinning to levels of 2 tons per acre or less is commonplace for ultra-premium wines. Enhanced ripening can enable production of wines with greater intensity of aroma and flavor. The crop prediction methods described above can help determine the extent of thinning required to achieve the target yield desired for the vineyard.

Target Yields. Target yields are commonly established during contractual discussions between vineyard and winery. Many factors enter into cropping-level decisions and, ideally, vines are cropped at a level that is appropriate for their capacity and enables fruit to ripen to the desired quality level. Thus target yield levels are highly vineyard-specific and dependent on the inherent capacity of the variety and site and the weather conditions of the current season. Target yields must take into consideration the desired fruit quality and the market value of the grapes. These factors are directly related to the winery's price-point intentions for the wine produced from the grapes and are influenced by other market factors such as supply and demand. Vineyard management practices, including crop thinning, are often selectively applied to specific blocks depending on the market value of their fruit.

One large vineyard uses the lag-phase estimation method slightly differently—to estimate the number of clusters per vine that should be retained to achieve a target yield (personal communication, Betty O'Brien, Elton Vineyards). This is a very practical modification, since pruning crews cannot be told how many clusters to remove per vine because of vine-to-vine variability, but they can be told the number of clusters to retain per vine that will produce the target yield. This modified method is also simpler because it does not require cluster counts.

Calculations are "worked backward" from the target yield (Equation 3). Target yield (in pounds) is divided by the number of bearing vines in the block. The result is the average number of pounds per vine necessary to produce the target yield (Step A). This is divided by the product of the average lag-phase cluster weight multiplied by the increase factor to determine the average number of clusters to retain per vine (Step B).

What to Remove. Standard practice is to remove all clusters on short shoots, since their smaller leaf area may not have the capacity to ripen the fruit fully. Third clusters, if present, are routinely removed. Clusters

Equation 2. Lag-phase yield estimate

Yield Estimate = No. of Bearing Vines per Block X No. of Clusters per Vine X Lag-Phase Avg. Cluster Weight X Increase Factor

Equation 3. Number of clusters per vine to achieve target yield

Step A

$$\frac{\text{Target Yield (pounds)}}{\text{\# Bearing Vines per Block}} = \text{Yield per Vine (pounds)}$$

Step B

$$\text{No. Clusters per Vine} = \frac{\text{Yield per Vine (pounds)}}{\text{Lag-phase Average Cluster Weight X Increase factor}}$$

that are lagging in development can be identified when veraison is 75–80% complete; clusters with green or pink fruit are selectively removed. Removal of the greener fruit on the vine improves the overall uniformity of fruit ripeness at harvest. For similar reasons, growers sometimes thin within a cluster, removing shoulders or wings and retaining only the main body of the cluster. The berries on shoulders and wings may be somewhat behind in development compared to those on the main cluster.

Some growers thin to one cluster per shoot; the question becomes which one to retain. Basal clusters are usually more mature than those farther out on the shoot (Wolpert et al., 1983), but some growers prefer to leave the second cluster, which is usually smaller. Thinning to one cluster usually leads to a crop reduction of about 1/3 and spreads the remaining load equally over the vine. Moreover, instructions to the crew are straightforward, so there is a greater likelihood of achieving the desired result. The disadvantage of thinning to one cluster per shoot is that it is considerably more expensive than most other approaches.

Timing. The timing of thinning practices varies among vineyards. Some Oregon growers thin clusters at the onset of veraison. By this time in the growing season, the grower is able to make a reliable crop estimate, which an informed thinning requires. The onset of coloring in the ripening fruit also enables easier identification of clusters that are behind in development. Other growers prefer to thin earlier (lag phase or before), when it is usually less time consuming because the canopy is smaller and the clusters are easier to find.

Thinning Strategy. A thinning strategy should be developed for each vineyard block prior to the beginning of the season based on the target yields and market value of the crop. Implementation of the strategy is adjusted as crop estimates become available and the seasonal weather characteristics (e.g., cooler than usual) become evident. It must be recognized that the cost of elaborate thinning practices cannot be recovered with grapes sold at low prices. Therefore, grapes intended for reserve wines may require extensive crop adjustment and should receive appropriate price compensation to justify the expense.

Recently, a fairly standard practice has evolved for Pinot noir vineyards where reserve wines are expected. Clusters are thinned to one per shoot at lag phase or earlier. In years of exceptionally good fruit set, additional crop reductions may be necessary to meet the targeted fruit quality.

References

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