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Predicting Yield in Oregon Vineyards

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Cool weather during fruit initiation and bloom can cause wide yield fluctuations in Oregon vineyards. These fluctuations in clusters per vine, flowers per cluster, and berries per cluster make yield prediction difficult. Over- or underestimates of yield have caused problems in marketing grapes and viticultural decision making.

Oregon State University has been testing methods of estimating yield for the last three years. A system we developed appears to work well for Pinot noir and, with some modification, should work for other varieties. Growers interested in trying this system should collect data this season, as long term records are important.

The system requires a grower to measure or estimate four factors each season: 1) bearing vines per block, 2) clusters per vine, 3) cluster weight at the lag phase of berry growth, and 4) cluster weight at harvest. These data will allow a grower to make two crop estimates each season. The first is pre-bloom, early enough for sales and winery planning. The second is pre-veraison, still early enough to revise sales plans and to make crop adjustments through cluster thinning. Each factor will be discussed below and will be followed by examples of how yield estimates can be developed from this information.

VINES PER BLOCK

An accurate count of bearing vines per block is important for two reasons. First, the grapevine is the basic unit of a vineyard. An estimate of yield per vine or clusters per vine can be used to estimate yield or cluster number per block only with accurate information on vine number. Second, vines per block can change from year to year. In a young vineyard all the vines are not in production. The number of bearing vines will increase each year and probably be the main variable affecting total yield. A more grim example is the need to monitor the effects of something destroying vines such as phylloxera or crown gall. Once again the major effect on yield is the change, in this case a decrease, in the number of bearing vines per block.

Vine counts are simple to make. First, the potential number of vines in the block needs to be determined. In a rectangular vineyard, simply multiply vines per row by the number of rows. In an irregular vineyard, a row by row count may need to be done. From there on only non-bearing vines need to be counted each year (one would hope this is a smaller number than the bearing vines). Walk every other row in early spring with a hand counter and count missing vines, and if that is too serene an ATV can speed up the process.

CLUSTERS PER VINE

Clusters per vine is affected by variation in several yield components. Nodes per vine, shoots per node, and clusters per shoot all change from year to year and all affect the total number of clusters per vine. Nodes per vine is determined by vine size and pruning severity. Shoots per node is affected by pruning severity and weather conditions during bud initiation the previous year. Clusters per shoot is also affected by the weather the year prior to cropping. Counting clusters per vine before bloom will determine the effect of all these factors.

Clusters can be counted as soon as the clusters are visible. Two weeks before bloom the clusters have emerged and are not yet obscured by the foliage. Not all vines have to be counted. Sample vines can be selected either randomly throughout the block or by a grid system such as every tenth vine in every other row. All the clusters on the sample vines should be counted. The number of vines in the sample depends on the vineyard uniformity. In a uniform vineyard, where all the vines are the same size, the same age, and pruned to the same bud number, only four percent of the vines need to be counted for small blocks of 1-3 acres. This number could be reduced in larger blocks. If a block is not uniform, and vine size and vine age varies greatly, either the percentage of vines counted must be increased or the level of accuracy will be decreased. A non-uniform vineyard in one trial required 30% of the vines to be counted. This adds considerably to the cost of yield prediction.

CLUSTER WEIGHTS AT LAG PHASE

Cluster weights are difficult to predict. Final cluster weight is sensitive to environmental influences up to harvest. However, the effects of all but one of the variable factors that affect final cluster weight can be seen at the lag phase of cluster growth. The lag phase occurs about mid-way between bloom and harvest. It is a period when the growth weight of berries slows temporarily. Generally, it is associated with the lignification or hardening of the seed coat. Flowers per cluster, berries per flower or fruit set, and seeds per berry (which greatly affects berry weight) have all been determined by this stage, and their effects can be measured by a sample cluster weight. This sample weight correlates well with final cluster weight. Simply, large clusters at the lag stage are large at harvest and small clusters at the lag phase are small at harvest.

A random sample of 200-400 clusters per block is usually adequate. This is weighed and divided by the number of clusters in the sample to calculate average cluster weight. Individual clusters do not have to be weighed. Timing the sample is more difficult. Mid-lag phase was 55 days after first bloom in the three years we ran our trials. This corresponded to seed hardening (when 75% of the seeds tips were too hard to cut with a knife without crushing the berry). Since seed hardening is usually associated with the lag phase of growth, 75% hard seed tips would be a good guess for a lag phase sample on any seeded variety. This summer, lag phase and seed hardening on several cultivars will be compared.

Pinot noir was used in this study because it is the most widely planted grape in Oregon. Other varieties have much more variation in cluster weight. Chardonnay and Sauvignon blanc will vary due to differences in bud fertility and Merlot and Gewurztraminer will vary due to large differences in fruit set. Both lag and harvest sample sizes should be increased for these varieties. Obviously, seed hardening cannot be used to time sampling for seedless varieties. Seedless varieties do not have a distinct lag in growth rate. However, a midseason sample could still be useful for these varieties.

CLUSTER WEIGHTS AT HARVEST

Cluster weights at harvest are a key part in a yield prediction program. The main point of the harvest sample is not for predicting yield that year, but to provide records for yield prediction in subsequent years. Long term harvest cluster weight records show the importance of cluster size variation on yield variation. This average can be used with early cluster counts for a prediction of yield. In addition, the lag phase sample can be used with the average harvest cluster weight to predict harvest cluster weight, as will be shown below.

A harvest cluster sample can be taken from the picking bins or off the vines. It is much easier to sample out of the bins, but a random sample taken off the vines has several advantages. It correlates better with the lag sample and is probably closer to the true cluster weight than a bin sample. Bin samples can be misleading because it is difficuIt to distinguish whole clusters frorn partial clusters and cluster wings. Usually 200-400 clusters is an adequate sample. Individual cluster weights are not necessary, only an average weight for the sample.

PREDICTION YIELD

Yearly information on vines per block, clusters per vine, lag phase cluster weight, and harvest cluster weight provides a grower with enough information for an effective yield prediction program. The first prediction can be made after the vine counts and estimates of clusters per vine, preferably just before bloom. Vines per block are multiplied by clusters per vine to estimate clusters per block. Then average harvest cluster weight is multiplied by clusters per block for an initial estimate of tons per block.

The first estimate can be revised after the lag phase cluster sample is taken (about 55 days after full bloom for Pinot noir). This sample is compared to the average lag phase cluster weight for an estimate of harvest cluster weight. For example, if the lag phase sample is 20% larger than the average lag phase cluster weight then harvest cluster weights can be estimated to be 20% larger than average harvest cluster weight. This revised cluster weight is then multiplied by clusters per block for a revised estimate of tons per block. These two predictions can be put in formula form as follows:

For the first prediction:

$V \times C \times H =$ estimated yield

where V = vines/block, C = clusters/vine, and H = average harvest cluster weight.

For the second prediction:

$V \times C \left(\frac{S}{A} \times H\right) =$ estimated yield

where S = lag stage cluster weight and A = average lag stage cluster weight.

Final cluster weight will depend on environmental effects on berry size. During the final part of the season, growers should be aware of these effects and adjust their estimates accordingly. A hot, dry season will result in berry size less than the average and the crop estimate should be reduced. Alternatively, late rain will increase berry size and the yield estimate should be increased. Other factors can also affect cluster size. Bird damage, botrytis, and mildew have profound effects on cluster size and yield, so these predictions should not be considered final. At best they are only predictions of yield potential.

CONCLUSION

Accurate yield prediction requires longterm records and an understanding of the causes of yield variation. The system described here works well with Pinot noir in the Willamette Valley. However, the concepts and procedures should work elsewhere and with other varieties. Knowledge of the components that cause yield variation and estimates of those components will allow the grower to anticipate and predict yield variation. This information will eliminate confusion in vineyard and winery planning.