

Crop Adjustment in Wine Grapes

by
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Many growers are quite willing to limit crop levels of wine grapes to ensure maximum fruit quality. However, the steps required to achieve a desired crop level are more involved than one might imagine. The simplest calculation of yield for an acre of vineyard is:

Formula 1

$$\text{Yield/acre} = (\text{vines/acre}) \times (\text{clusters/vine}) \times (\text{weight/cluster})$$

When using this formula, values for the number of vines per acre and clusters per vine can be obtained relatively easily. The problem is determining what value to use for average cluster weight. It is possible to get values for average cluster weights from several sources of published cluster weight data. For example, here are varieties from a Cornell University publication by Pool et. al.:

<u>Variety</u>	<u>Cluster wt (g)</u>		
	<u>mean</u>	<u>max</u>	<u>min</u>
Cabernet Sauvignon	74	114	50
Cabernet franc	106	150	84
Chardonnay	150	205	120
Gewurztraminer	91	138	70
Merlot	100	136	76
Pinot gris	101	153	67
Pinot noir	75	101	50
White Riesling	83	103	53

These values may be a starting point. However, as evident from the maximum and minimum values reported above, differences in the weight of clusters within a variety can be highly variable from vineyard to vineyard and from year to year. For example, measurements of Cabernet franc clusters at SWMREC for vines managed with five training systems over a period of six years have resulted in up to a 33% difference in average cluster weight. In years with extensive winter injury a high percentage of the crop developed from secondary buds and the average cluster weight dropped to only 59% of the average cluster weight in normal years. In summary, cluster weight data can be a very large source of error when estimating crop level.

A more reliable crop estimation equation for an acre of vineyard is:

Formula 2

$$\text{Yield/acre} = (\text{vines/acre}) \times (\text{clusters/vine}) \times (\text{berries/cluster}) \times (\text{weight/berry})$$

In this equation the variability of the weight of a cluster is divided into two factors, i.e., the number of berries per cluster and the weight per berry. The number of berries per cluster often varies considerably from year to year and is the major cause of variability in the weight of clusters. For example, the number of berries per cluster in 2001 and 2002 for White Riesling vines at SWMREC was 55 and 84, respectively, or a 53% difference. The variability in berries per cluster can be managed in the estimation of crop level by counting the number of berries per cluster after fruit set.

The final weight of berries for a particular crop won't be known until harvest. Fortunately, this value deviates only moderately from year to year. Therefore, the difference in berry weight between a specific year and the long term average for a particular vineyard is a relatively small source of crop estimation error.

We have devised the following systematic process to assist growers in creating databases for their own vineyards in regard to the average number of berries per cluster and the long term average berry weight:

Step 1 - After fruit set, when berries are pea-sized, gather data on the number of berries per cluster for 25 clusters in a particular vineyard. Use Form 1 to record these data and keep them organized from year to year.

Step 2 - Determine a value to be used for average berry weight. Until you have developed your own database of berry weights, use the values below to make a calculation for the desired clusters per vine. The maximum and minimum values will give you some idea of how much error you might expect from this factor in the equation.

To build your own database, use Form 2 at harvest to record the weight of six 100-berry samples and then update your multi-year average of these data each year. Those samples should be from uniform blocks which are no larger than 10 acres. The measurement of these samples requires a scale capable of measuring with an accuracy of one gram. Because most growers don't have that capability, we will gladly assist in making those measurements. Place each 100-berry sample in a separate, sealed zip-locked plastic bag.

Variety	Berry wt (g)			Source of data
	average	max	min	
Cabernet Franc	1.62	1.70	1.51	Zabadal
Chardonnay	1.62	1.67	1.57	Zabadal
White Riesling	1.56	1.58	1.54	Zabadal
Aurora	2.02	2.08	1.96	St. Julian
Foch	1.31	1.39	1.25	St. Julian
Cabernet Franc	1.54	1.63	1.46	St. Julian
Chambourcin	2.46	2.46	2.46	St. Julian
Chancellor	1.95	2.17	1.75	St. Julian
Chardonnay	1.73	1.78	1.69	St. Julian
Chardonel	2.46	2.50	2.40	St. Julian
Cayuga White	2.84	2.84	2.84	St. Julian
Dechaunac	1.82	1.97	1.58	St. Julian
Delaware	1.80	1.80	1.80	St. Julian
Merlot	1.80	1.85	1.74	St. Julian
Pinot Gris	1.48	1.52	1.42	St. Julian
Riesling	1.69	1.74	1.64	St. Julian
Seyval	1.95	2.05	1.85	St. Julian
Vignoles	1.86	1.90	1.78	St. Julian

Step 3 - Calculate the desired number of clusters

Formula #2 can be rearranged to calculate the number of clusters per vine required for a desired crop level. The equation will then look like this:

Formula #3

$$\text{Clusters/vine} = \frac{(\text{Desired yield (tons/acre)}) \times (2000 \text{ lbs/ton}) \times (454 \text{ g/lb})}{(\text{vines/acre}) \times (\text{berries/cluster}) \times (\text{wt/berry (g)})}$$

Example: A grower has a Chardonnay vineyard planted on row and vine spacings of 9' x 6' which gives 807 vines per acre. He wants to thin his crop to 4 tons/acre. He has collected this information: (a) his sampling after fruit set indicates that his vines average 64 berries/cluster, (b) his berry weights from previous years average 1.54 g/berry. He can calculate how many clusters/vine to retain for cropping as follows:

$$\begin{aligned} \text{Clusters/vine} &= \frac{(4 \text{ tons/acre}) \times (2000 \text{ lbs/ton}) \times (454 \text{ g/lb})}{(807 \text{ vines/acre}) \times (64 \text{ berries/cluster}) \times (1.54 \text{ g/berry})} \\ &= 45.66 = 46 \text{ clusters/vine} \end{aligned}$$

Use Form 3 to make your own calculations.

Step 4 - Making the Actual Crop Adjustment

After the berry sampling has been done and the crop adjustment calculation has been made, the actual adjustment of crop should be performed before the start of veraison. In the example above, the grower determined that 46 clusters per vine should be retained. Various strategies can be used to reduce the number of clusters per vine. For example, if the training system is a mid-wire bilateral cordon (VSP), then aim to retain 23 clusters on each side of the vine with as much uniformity in distribution as possible. If your estimate of berries/cluster included all clusters on the vine, then randomly choose among all the clusters on the vine for those you will retain. That is, do not retain just the larger, basal clusters.

For another example, I recommend that when using the Scott Henry training system that 2/3 of the crop be placed on the upper fruiting wire and 1/3 on the lower fruiting wire. This is because the upper wire has greater shoot vigor and a slight fruit ripening advantage over the lower fruiting wire. Using the example of 46 clusters per vine, this would translate to about 31 clusters on the upper fruiting wire and 15 clusters on the lower fruiting wire.

As a final adjustment to a crop of high premium wine grapes, some growers have inspected their vines during veraison and removed clusters that are lagging in color development as a way of promoting more uniformity in ripening.

Thinning the number of clusters on a vine may be performed in several ways. The cost and availability of labor often prevents precise counting of clusters. Less precise but more rapid strategies include:

Strategy 1 - Count the number of clusters on several vines to determine "on average" how many clusters are on the vines. You can then calculate how many clusters need to be removed from each vine rather than precisely counting the number of clusters retained on each vine..

Strategy 2 - Make a count to determine the average number of clusters on vines as in Strategy 1. Then calculate the percentage of clusters to be removed. For example, if we counted 69 clusters per vine and wanted to retain 46, that would be 66% or 2/3. Then thin by removing one out of three clusters. (Leave two, remove one, etc.)

When doing rapid cluster thinning the tendency is to under-thin so as to leave more crop than desired. After deciding on a thinning strategy, apply it to a dozen vines. Then count the clusters remaining on several of those vines to see how close you are to the desired number of clusters per vine.

Thin to achieve good distribution of clusters throughout the fruiting zone of the vine. Finally, severely thin small vines to leave little or no crop to promote the development of increased vine size.

References:

Pool., R.M., G.E. Howard, R. Dunst, J. Dyson, T. Henick-Kling, J. Freer, L. Fuller-Perrine, W. Smith and A. Wise. Undated. Growing Vitis Vinifera Grapes in New York State I. Performance of New and Interesting Varieties. doc2678a

Appendix

Forms to be used in crop estimation are as follows:

Form 1 - Yearly Data for Berries Per Cluster

Form 2 - Yearly Berry Weight Data

Form 3 - Crop Estimation Worksheet

Form 1 - Yearly Data For Berries Per Cluster

Variety _____ Location _____

Use this form to record over a period of several years for one variety in one location. After fruit set, randomly pick 25 clusters from the vineyard, making sure that the clusters represent the population of clusters you will retain for fruiting. Record the data below. The multiple-year average for berries/cluster will give you an indication of average cluster size over many years. However, you will use the current year's average for berries per cluster to estimate crop size.

Year _____	Year _____	Year _____	Year _____	Year _____	Year _____						
Clus #	Ber/ clus*	Clus #	Ber/ clus*	Clus #	Ber/ clus*	Clus #	Ber/ clus*	Clus #	Ber/ clus*	Clus #	Ber/ clus*
(1) _____	(1) _____	_____	(1) _____	_____	(1) _____	_____	(1) _____	_____	(1) _____	_____	(1) _____
(1) _____	(1) _____	_____	(1) _____	_____	(1) _____	_____	(1) _____	_____	(1) _____	_____	(1) _____
(2) _____	(2) _____	_____	(2) _____	_____	(2) _____	_____	(2) _____	_____	(2) _____	_____	(2) _____
(2) _____	(2) _____	_____	(2) _____	_____	(2) _____	_____	(2) _____	_____	(2) _____	_____	(2) _____
(3) _____	(3) _____	_____	(3) _____	_____	(3) _____	_____	(3) _____	_____	(3) _____	_____	(3) _____
(3) _____	(3) _____	_____	(3) _____	_____	(3) _____	_____	(3) _____	_____	(3) _____	_____	(3) _____
(4) _____	(4) _____	_____	(4) _____	_____	(4) _____	_____	(4) _____	_____	(4) _____	_____	(4) _____
(4) _____	(4) _____	_____	(4) _____	_____	(4) _____	_____	(4) _____	_____	(4) _____	_____	(4) _____
(5) _____	(5) _____	_____	(5) _____	_____	(5) _____	_____	(5) _____	_____	(5) _____	_____	(5) _____
(5) _____	(5) _____	_____	(5) _____	_____	(5) _____	_____	(5) _____	_____	(5) _____	_____	(5) _____
(6) _____	(6) _____	_____	(6) _____	_____	(6) _____	_____	(6) _____	_____	(6) _____	_____	(6) _____
(6) _____	(6) _____	_____	(6) _____	_____	(6) _____	_____	(6) _____	_____	(6) _____	_____	(6) _____
(7) _____	(7) _____	_____	(7) _____	_____	(7) _____	_____	(7) _____	_____	(7) _____	_____	(7) _____
(7) _____	(7) _____	_____	(7) _____	_____	(7) _____	_____	(7) _____	_____	(7) _____	_____	(7) _____
(8) _____	(8) _____	_____	(8) _____	_____	(8) _____	_____	(8) _____	_____	(8) _____	_____	(8) _____
(8) _____	(8) _____	_____	(8) _____	_____	(8) _____	_____	(8) _____	_____	(8) _____	_____	(8) _____
(9) _____	(9) _____	_____	(9) _____	_____	(9) _____	_____	(9) _____	_____	(9) _____	_____	(9) _____
(9) _____	(9) _____	_____	(9) _____	_____	(9) _____	_____	(9) _____	_____	(9) _____	_____	(9) _____
(10) _____	(10) _____	(10) _____	(10) _____	(10) _____	(10) _____	(10) _____	(10) _____	(10) _____	(10) _____	(10) _____	(10) _____
(11) _____	(11) _____	(11) _____	(11) _____	(11) _____	(11) _____	(11) _____	(11) _____	(11) _____	(11) _____	(11) _____	(11) _____
(12) _____	(12) _____	(12) _____	(12) _____	(12) _____	(12) _____	(12) _____	(12) _____	(12) _____	(12) _____	(12) _____	(12) _____
(13) _____	(13) _____	(13) _____	(13) _____	(13) _____	(13) _____	(13) _____	(13) _____	(13) _____	(13) _____	(13) _____	(13) _____
(14) _____	(14) _____	(14) _____	(14) _____	(14) _____	(14) _____	(14) _____	(14) _____	(14) _____	(14) _____	(14) _____	(14) _____
(15) _____	(15) _____	(15) _____	(15) _____	(15) _____	(15) _____	(15) _____	(15) _____	(15) _____	(15) _____	(15) _____	(15) _____
(16) _____	(16) _____	(16) _____	(16) _____	(16) _____	(16) _____	(16) _____	(16) _____	(16) _____	(16) _____	(16) _____	(16) _____
(17) _____	(17) _____	(17) _____	(17) _____	(17) _____	(17) _____	(17) _____	(17) _____	(17) _____	(17) _____	(17) _____	(17) _____
(18) _____	(18) _____	(18) _____	(18) _____	(18) _____	(18) _____	(18) _____	(18) _____	(18) _____	(18) _____	(18) _____	(18) _____
(19) _____	(19) _____	(19) _____	(19) _____	(19) _____	(19) _____	(19) _____	(19) _____	(19) _____	(19) _____	(19) _____	(19) _____
(20) _____	(20) _____	(20) _____	(20) _____	(20) _____	(20) _____	(20) _____	(20) _____	(20) _____	(20) _____	(20) _____	(20) _____
(21) _____	(21) _____	(21) _____	(21) _____	(21) _____	(21) _____	(21) _____	(21) _____	(21) _____	(21) _____	(21) _____	(21) _____

(22) _____	(22) _____	(22) _____	(22) _____	(22) _____	(22) _____
(23) _____	(23) _____	(23) _____	(23) _____	(23) _____	(23) _____
(24) _____	(24) _____	(24) _____	(24) _____	(24) _____	(24) _____
(25) _____	(25) _____	(25) _____	(25) _____	(25) _____	(25) _____
Avg _____	Avg _____	Avg _____	Avg _____	Avg _____	Avg _____

(over)

*Ber/Clus = number of berries per cluster

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Form 1 - Yearly Summary For Berries Per Cluster

Year

Berries/cluster

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Average

_____ (in pencil)

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Form 2 - Yearly Berry Weight Data

Variety _____ Location _____

Use this form to record over a period of several years information for one variety in one location. Enter below the weight of 100-berry samples. Then calculate the average of those samples, divide by 100 to get the individual berry weight and record that on the back of this sheet. The multiple-year berry weight average on the back of this sheet will be the value you use each year to estimate crop size.

Year _____
Sample
(1) _____
(2) _____
(3) _____
(4) _____
(5) _____
(6) _____
Average _____

Year _____
Sample
(1) _____
(2) _____
(3) _____
(4) _____
(5) _____
(6) _____
Average _____

Year _____
Sample
(1) _____
(2) _____
(3) _____
(4) _____
(5) _____
(6) _____
Average _____

Year _____
Sample
(1) _____
(2) _____
(3) _____
(4) _____
(5) _____
(6) _____
Average _____

Year _____
Sample
(1) _____
(2) _____
(3) _____
(4) _____
(5) _____
(6) _____
Average _____

Year _____
Sample
(1) _____
(2) _____
(3) _____
(4) _____
(5) _____
(6) _____
Average _____

Year _____
Sample
(1) _____
(2) _____
(3) _____
(4) _____
(5) _____
(6) _____
Average _____

Year _____
Sample
(1) _____
(2) _____
(3) _____
(4) _____
(5) _____
(6) _____
Average _____

Year _____
Sample
(1) _____
(2) _____
(3) _____
(4) _____
(5) _____
(6) _____
Average _____

Year _____
Sample
(1) _____
(2) _____
(3) _____
(4) _____
(5) _____
(6) _____
Average _____

Year _____
Sample
(1) _____
(2) _____
(3) _____
(4) _____
(5) _____
(6) _____
Average _____

Year _____
Sample
(1) _____
(2) _____
(3) _____
(4) _____
(5) _____
(6) _____
Average _____

(Enter yearly averages on back of this sheet)

Form 2 - Yearly Berry Weight Data

Year

Average berry wt (g)

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Multi year average _____ (write in pencil to update each year)

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Form 3 - Crop Estimation Worksheet

This worksheet provides the formula for estimating the clusters to retain per vine with blanks to be filled in. Then make the calculation to determine the clusters to retain/vine.

Variety _____ Location _____ Year _____

$$\text{Clusters/vine} = \frac{\text{_____ (tons/acre)} \times 2000 \text{ (lbs/ton)} \times 454 \text{ (g/lb)}}{\text{_____ (vines/acre)} \times \text{_____ (berries/cluster)} \times \text{_____ (g/berry)}}$$

Variety _____ Location _____ Year _____

$$\text{Clusters/vine} = \frac{\text{_____ (tons/acre)} \times 2000 \text{ (lbs/ton)} \times 454 \text{ (g/lb)}}{\text{_____ (vines/acre)} \times \text{_____ (berries/cluster)} \times \text{_____ (g/berry)}}$$

Variety _____ Location _____ Year _____

$$\text{Clusters/vine} = \frac{\text{_____ (tons/acre)} \times 2000 \text{ (lbs/ton)} \times 454 \text{ (g/lb)}}{\text{_____ (vines/acre)} \times \text{_____ (berries/cluster)} \times \text{_____ (g/berry)}}$$

Variety _____ Location _____ Year _____

$$\text{Clusters/vine} = \frac{\text{_____ (tons/acre)} \times 2000 \text{ (lbs/ton)} \times 454 \text{ (g/lb)}}{\text{_____ (vines/acre)} \times \text{_____ (berries/cluster)} \times \text{_____ (g/berry)}}$$

Variety _____ Location _____ Year _____

$$\text{Clusters/vine} = \frac{\text{_____ (tons/acre)} \times 2000 \text{ (lbs/ton)} \times 454 \text{ (g/lb)}}{\text{_____ (vines/acre)} \times \text{_____ (berries/cluster)} \times \text{_____ (g/berry)}}$$

Variety _____ Location _____ Year _____

$$\text{Clusters/vine} = \frac{\text{_____ (tons/acre)} \times 2000 \text{ (lbs/ton)} \times 454 \text{ (g/lb)}}{\text{_____ (vines/acre)} \times \text{_____ (berries/cluster)} \times \text{_____ (g/berry)}}$$
