SWMREC Special Report #24
revised 6/4/10

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

Yield/acre = (vines/acre) x (clusters/vine) x (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.:

Variety	Cluster wt (g)		
	mean	max	min
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

Yield/acre = (vines/acre) x (clusters/vine) x (berries/cluster) x (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 in Table 1 in the Appendix 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.

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

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

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:

$$\text{Clusters/vine} = \frac{\text{(4 tons/acre) x (2000 lbs/ton) x (454 g/lb)}}{\text{(807 vines/acre) x (64 berries/cluster) x (1.54 g/berry)}}$$

$$= 45.66 = 46 \text{ clusters/vine}$$

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 - After you have calculated the desired number of clusters per vine, precisely thin six vines to that number of clusters. Then look at those vines to get a mental image of what that crop level looks like. Thin other vines without making counts to achieve the appearance of crop level similar to those vines precisely thinned. I usually add about 8 clusters/vine to the calculated number so I don't over-thin and so I can remove occasional clusters that are lagging in maturity at veraison. Periodically check your eye against the precisely-thinned six vines.

Strategy 2 - 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 3 - Make a count to determine the average number of clusters on vines as in Strategy 2. Then calculate the percentage of clusters to be removed. For example, if you 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.

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

Table 1 - Average Berry Weights

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)	_____
(2)	_____	(2)	_____	(2)	_____	(2)	_____	(2)	_____	(2)	_____
(3)	_____	(3)	_____	(3)	_____	(3)	_____	(3)	_____	(3)	_____
(4)	_____	(4)	_____	(4)	_____	(4)	_____	(4)	_____	(4)	_____
(5)	_____	(5)	_____	(5)	_____	(5)	_____	(5)	_____	(5)	_____
(6)	_____	(6)	_____	(6)	_____	(6)	_____	(6)	_____	(6)	_____
(7)	_____	(7)	_____	(7)	_____	(7)	_____	(7)	_____	(7)	_____
(8)	_____	(8)	_____	(8)	_____	(8)	_____	(8)	_____	(8)	_____
(9)	_____	(9)	_____	(9)	_____	(9)	_____	(9)	_____	(9)	_____
(10)	_____	(10)	_____	(10)	_____	(10)	_____	(10)	_____	(10)	_____
(11)	_____	(11)	_____	(11)	_____	(11)	_____	(11)	_____	(11)	_____
(12)	_____	(12)	_____	(12)	_____	(12)	_____	(12)	_____	(12)	_____
(13)	_____	(13)	_____	(13)	_____	(13)	_____	(13)	_____	(13)	_____
(14)	_____	(14)	_____	(14)	_____	(14)	_____	(14)	_____	(14)	_____
(15)	_____	(15)	_____	(15)	_____	(15)	_____	(15)	_____	(15)	_____
(16)	_____	(16)	_____	(16)	_____	(16)	_____	(16)	_____	(16)	_____
(17)	_____	(17)	_____	(17)	_____	(17)	_____	(17)	_____	(17)	_____
(18)	_____	(18)	_____	(18)	_____	(18)	_____	(18)	_____	(18)	_____
(19)	_____	(19)	_____	(19)	_____	(19)	_____	(19)	_____	(19)	_____
(20)	_____	(20)	_____	(20)	_____	(20)	_____	(20)	_____	(20)	_____
(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

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 ________

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(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 ___________

Clusters/vine = _______ (tons/acre) x 2000 (lbs/ton) x 454 (g/lb) = ____________

_______ (vines/acre) x ________ (berries/cluster) x _______ (g/berry)

Variety _______________ Location ________________ Year ___________

Clusters/vine = _______ (tons/acre) x 2000 (lbs/ton) x 454 (g/lb) = ____________

_______ (vines/acre) x ________ (berries/cluster) x _______ (g/berry)

Variety _______________ Location ________________ Year ___________

Clusters/vine = _______ (tons/acre) x 2000 (lbs/ton) x 454 (g/lb) = ____________

_______ (vines/acre) x ________ (berries/cluster) x _______ (g/berry)

Variety _______________ Location ________________ Year ___________

Clusters/vine = _______ (tons/acre) x 2000 (lbs/ton) x 454 (g/lb) = ____________

_______ (vines/acre) x ________ (berries/cluster) x _______ (g/berry)

Variety _______________ Location ________________ Year ___________

Clusters/vine = _______ (tons/acre) x 2000 (lbs/ton) x 454 (g/lb) = ____________

_______ (vines/acre) x ________ (berries/cluster) x _______ (g/berry)

Variety _______________ Location ________________ Year ___________

Clusters/vine = _______ (tons/acre) x 2000 (lbs/ton) x 454 (g/lb) = ____________

_______ (vines/acre) x ________ (berries/cluster) x _______ (g/berry)

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Table 1. Berry weight data for several wine grape varieties. Data are from vines at the MSU Southwest Michigan Research and Extension Center, Benton Harbor, MI unless otherwise noted.

Variety	# of years of data	Yearly high berry wt[1] (g)	Yearly low berry wt[1] (g)	Average berry wt (g)
Albarino	1	.95	0	.95
Aurora[2]	--	1.96	2.08	2.02
Barbera	2	2.73	0	2.73
Brianna	0	0	0	0
Cabernet franc	2	1.74	1.52	1.63
Cabernet franc[2]	--	1.63	1.46	1.54
Cabernet Sauvignon UCD8	2	1.57	1.53	1.55
Cayuga White[2]	--	2.84	2.84	2.84
Chambourcin[2]	--	2.46	2.46	2.46
Chancellor[2]	--	2.17	1.75	1.95
Chardonel	2	2.18	2.04	2.11
Chardonnay	2	1.74	1.53	1.64
Dechaunac[2]	--	1.58	1.97	1.82
Delaware[2]	--	1.80	1.80	1.80
Dolcetto	2	1.90	1.60	1.75
Foch[2]	--	1.39	1.25	1.31
Gewurtz	2	1.86	1.77	1.82
GM311	1	1.29	0	1.29
GM318	1	1.42	0	1.42
GR7	1	1.34	0	1.34
Gruener Veltliner	1	1.88	0	1.88
Hibernal GM322-38	2	1.96	1.80	1.88
Kerner	2	2.12	1.95	2.04
Lagrein 03/09	0	0	0	0
Malbec	2	2.04	1.93	1.99
Marquette	1	.94	0	.94
Marsanne	1	1.42	0	1.42
Merlot	1	1.80	0	1.80
Muller Thurg	2	1.60	1.59	1.60
Muscat (seedless)	1	1.53	0	1.53
Muscat blanc	0	0	0	0
Muscat Ott	2	2.36	1.92	2.14
Noiret	2	1.75	1.45	1.60
NY760844.24	1	1.24	0	1.24
P. Meunier	2	1.68	1.62	1.65
Petite Sirah	1	1.94	0	1.94
Phoenix	2	2.25	2.11	2.18

Variety	# of years of data	Yearly high berry wt[1] (g)	Yearly low berry wt[1] (g)	Average berry wt (g)
Pinot blanc (152)	2	1.66	1.63	1.65
Pinot gris (3309)	2	1.37	1.29	1.33
Pinot noir (777)	2	1.40	1.35	1.38
Regent	2	1.78	1.67	1.73
Riesling[2]	--	1.64	1.74	1.69
Rousanne	1	1.43	0	1.43
Sauv. blanc	0	0	0	0
Sauv. blanc musque	1	1.47	0	1.47
Sauv gris	1	1.84	0	1.84
Semillion	0	0	0	0
Seyval (C3309)	2	1.43	1.37	1.40
Shiraz	2	1.86	1.76	1.81
Tempranillo	0	0	0	0
Teroldego Clendenon	1	1.59	0	1.59
Tocai Fruilano/09	1	1.15	0	1.15
Traminette	2	1.92	1.78	1.85
Valvin Muscat	1	2.07	0	2.07
Vignoles[2]	--	1.78	1.90	1.86
Viognier	2	1.65	1.46	1.56
Zweigelt	0	0	0	0

[1] Each year of data reports the average of 6 100-berry samples.
[2] Data courtesy of St. Julian Wine Company

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updated 6/2/10