

# FINGER LAKES

## Vineyard Notes



Cornell University  
Cooperative Extension

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## Fruit Thinning in Wine Grape Varieties

Hans Walter-Peterson, Finger Lakes Grape Program

Cluster thinning is often employed in wine varieties to help achieve a certain crop load and quality level. The amount of fruit to remove from a given vine is a function of many individual factors, including vine vigor, variety and rootstock, growing season conditions, and even the contract with the buyer. Because conditions in eastern North America can vary greatly from year to year, the need for cluster thinning and the amount to be removed can also change every season. The goal of cluster thinning, then, is to achieve both the quality *and* quantity parameters that will satisfy both the grower and their buyers.

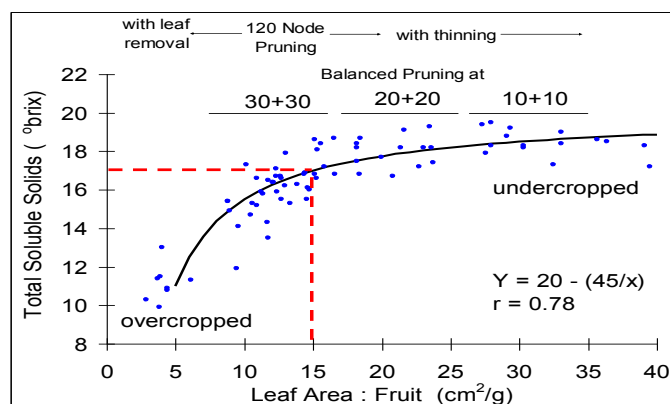
When clusters are removed from the vine, we are altering its *crop load* – the balance of exposed leaf area and fruit. Cluster thinning will have the greatest impact on vines that are over cropped, meaning they have more fruit than the vine can get to the desired level of maturity. By removing clusters, we decrease the number of berries that receive nutrients and

photosynthates from the vine, which ends up improving the overall quality of the remaining crop.

The graph shown here is based on Concord growth and development, but it illustrates the point quite well (similar curves have been found in other grape varieties). Vines that are over cropped have a low leaf area to fruit ratio, and would be located on the left end of the graph (Figure 1). By removing some of the clusters, we increase the ratio of leaf area to fruit (moving to the right on the curve), approaching the point where the curve starts to level off. The goal of everything we do in the vineyard is to maintain the vines as close to that “shoulder” of the curve as possible. That is where vineyard production is most efficient – achieving optimum quality while producing a full crop.

On the other hand, when vines are vigorous and produce large canopies (as many vineyards are this year), they can be under cropped, which would put them to the right side of the curve. By removing clusters, we push the vines even further to the right on the graph, which shows that we wouldn’t expect to see any further improvement in fruit quality – soluble solids, in this case. In other words, thinning fruit in this situation provides no quality benefit, but penalizes the grower by reducing the yields that they would otherwise get paid for.

Notice also that nowhere on this graph is the phrase “tons per acre” used. The ability to ripen fruit is not determined by an acre of land, but by the individual vines within that acre, and how they are managed by the grower. The measure of pounds/vine is somewhat of an improvement when discussing a relationship between yield and quality, but even that is not adequate because it does not take into consideration the size of the vine, i.e., how much leaf area it is capable of producing.



**Figure 1. Relationship between leaf area to fruit weight ratio and soluble solids in Concord. Similar relationships have been found in studies with other grape varieties. Source: Dr. Terry Bates, Cornell University**

### *Putting It Into Practice*

The impact that cluster thinning will have on the final crop will be influenced by just how much is removed and when the clusters are removed.

#### Timing

Clusters can be removed from the vines anytime during the growing season, but the impacts to the remaining fruit and the vine will vary depending on when it is done. Most fruit thinning is done between fruit set and near the end of veraison. One potential impact of thinning closer to fruit set is that the vine will compensate for the removed crop by producing larger berries on the remaining clusters. By removing competing sinks from the vine, more energy is directed to the growing berries that are undergoing cell division, which will create larger berries. Waiting to thin until lag phase or the ripening phase of berry development generally will not result in larger berries. This is not always the case, however. If vines are vigorous and the rate of cell division is not limited by the larger crop already, cluster thinning would not impact final berry size and weight.

Another question that gets asked in relation to timing is how long to let “extra” fruit hang on the vine if it is being used to slow down shoot growth. To answer this, we go back to the concept of competing sinks for nutrients and photosynthates. During the vegetative stage of development (before veraison), shoot tips and clusters compete for the vine’s resources. Reducing the strength of the sink that competes with shoot growth, by removing clusters, will enable more resources to be devoted to shoot development. In other words, the longer that fruit hangs on the vine, the longer it competes with the shoots as a sink for resources from the vine. So in this case, fruit should be removed once the vines reach veraison.

Thinning fruit after veraison is a game of diminishing returns as it gets later in the season. Both average temperature and day length are declining at this point in the season, so thinning later means that there is less opportunity for the vine to take advantage of the reduced crop load. To maximize the potential impact to ripening, fruit should be thinned at or prior to veraison.

#### How Much to Remove

This is one of those areas where our standard Extension answer really applies – “It depends.” And it depends on a lot of things – the growing season, the variety and rootstock, characteristics of the site, and the buyer’s quality and quantity expectations. But it all leads back to the idea of having a balance of adequate leaf area to ripen a given amount of fruit.

Part of the struggle with this question is the over-hanging myth that lower yields automatically result in better grape and wine quality. This can be true to a certain point, as illustrated by the crop load figure discussed earlier in this article. But at

some point, there is no further benefit gained from reducing crop below a certain level. Vines that are under cropped are capable of producing fruit with negative characteristics similar to over cropped vines.

The only real way to know how much to remove is through experimentation and trials on your own vineyard, and with detailed record keeping. By understanding how a vineyard block behaves under different types of conditions, and how that impacts the fruit that comes from it, a grower can start to get a sense of how much fruit those vines can adequately ripen under a given set of circumstances.

The other consideration that must be made is how the grower will be compensated for thinning their crop if it is required by their buyers. Not only is there a direct loss of yield, but the practice itself costs money as well, and growers and wineries should be having conversations about how that will be handled. Trent Preszler, Todd Schmit and Justine Vanden Heuvel did some very nice work on this, developing a model for how to calculate the minimum price needed to compensate growers for a particular level of cluster removal (a summary of the paper is reproduced at the end of this article). Whether this particular model or other means are used, it is important the economic impact of the practice to the grower be given adequate consideration.

#### Resources:

Hellman, E.W. and T. Casteel. “Crop Estimation and Thinning” in *Oregon Viticulture*, ed. Edward Hellman. Oregon State University Press, 2003. <http://winegrapes.tamu.edu/grow/tentative%20pdf/thinning.pdf>

Kliwer, M. and N. Dokoozlian. 2005. Leaf Area/Crop Weight Ratios of Grapevines: Influence of Fruit Composition and Wine Quality. *Am. J. of Enol. and Vit.* 56(2): 170-181.

Pool, R. 2001. Estimating and adjusting crop weight in Finger Lakes vineyards. <http://www.fruit.cornell.edu/grape/pool/cropsizes.html>

Preszler, T., T. Schmit and J. Vanden Heuvel. 2010. A model to establish economically sustainable cluster thinning practices. <http://agribusiness.dyson.cornell.edu/docs/pub/trade/RIPE-Econ-Cluster-Rem.pdf>

Preszler, T., T. Schmit and J. Vanden Heuvel. 2010. A model to establish economically sustainable cluster thinning practices. *Am. J. of Enol. and Vit.* 61(1): 140-146.

Sun, Q., G. Sacks, S. Lerch and J. Vanden Heuvel. 2012. Impact of Shoot and Cluster Thinning on Yield, Fruit Composition and Wine Quality in Corot Noir. *Am. J. of Enol. and Vit.* 63(1): 49-56.

Skinkis, Patty. “Crop Thinning: Cluster Thinning or Cluster Removal”. <http://www.extension.org/pages/31767/crop-thinning-cluster-thinning-or-cluster-removal>

# Concord Crop Estimation & Fruit Thinning in 2013

*Dr. Terry Bates, Viticulture Research Associate Cornell University*

Crop estimation for many Concord growers has become a common annual practice to observe crop potential and prepare for harvest decisions in different vineyard sections. It has been several seasons, however, since we have needed to address crop adjustment. For a summary of Concord crop estimation and adjustment procedures, please read the attached 2003 Vineyard Notes article: **Concord Crop Adjustment: Theory, Research, and Practice**. The article addresses crop load and vine balance, our research on fruit thinning, and details on how to do these procedures in your vineyard. In addition, the crop estimation chart based on Concord berry weight is also included in this newsletter.

## Crop Estimating in 2013

We take several factors into consideration when estimating crop potential in any given year. Crop load and weather conditions in the previous season impact vine size and initial bud fruitfulness. The number of nodes retained during winter pruning will influence yield components. In the Lake Erie region, the accumulation of heat in Lake Erie influences air temperature, bloom date, and floret development. Weather conditions around bloom affect percent set and initial berry growth.

## What is the situation for 2013?

Widespread freeze damage in 2012 led to relatively low crop load in most vineyards combined with good 2012 growing season conditions resulted in above average bud fruitfulness going into the 2013 season (Fig 1, right). As a very general observation, many growers retained higher than average fruiting nodes over the winter in an effort to insure good crop potential in 2013 after the 2012 freeze. Spring heat accumulation measured in Lake Erie was relatively average (Fig 1, left) which led to an average bloom date prediction... and this prediction held up with bloom being average to a few days early in most Concord vineyards. Floret and berry counts by Kelly Link on the standard phenology vines at CLEREL and Fredonia indicated higher than average floret counts but lower than average percent set resulting in an overall 10-15% increase in berries per cluster (Table 1). For the current growing season, the air growing degree day accumulation has been somewhat average but the precipitation, especially in June, has been well above average (Fig 2, left). As a result of adequate heat and vine water status through berry cell division, we are recording higher than average fresh berry weight 20-30 days after bloom (Fig 2, right). High bud

fruitfulness, increased retained nodes, more berries per cluster, and larger berries all point to one obvious outcome – a big crop potential.

## How Big is Big?

Whether or not crop adjustment is part of your management plan or not, performing crop estimation procedures throughout vineyard blocks is a good idea to know the potential yield and where it is located. As outlined in the 2003 article, crop estimation can be done by hand or machine picking and weighing. Stripping whole vines eliminates the need to measure all the yield components discussed in the previous paragraph. Simply weigh the fruit in a vineyard sub-sample and multiply it by some factor to predict the final harvest weight. The multiplication “factor” can be aided by the berry curve and the attached crop estimation table. Our ongoing project in precision viticulture is looking at a procedure to stratify and improve vineyard sampling for more accurate crop estimates.

We are currently crop estimating in our research plots both on and off station and are recording 30 day after bloom berry weights between 1.5-1.7 grams which should result in 3.0-3.4 grams at harvest. These values seem reasonable given the crop size and amount of precipitation this season. Current crop estimates range between 8-14 tons/acre across a wide range of sites with most of the estimates falling in the 10-12 ton/acre range.

## To thin or not to thin – that is the question:

Bloom in most vineyards this season was average to three days early indicating veraison would also be average to slightly early and predicting that vines will be able to ripen an extra ton/acre than normal to the same brix level. The ambiguous word here is “normal.” If all our vineyards were uniform then we could place a number on “normal” ripening potential. We all know; however, that different vineyard blocks because of soil and vine growth differences have different ripening potentials (i.e. 5 tons/acre vineyards, 8 ton/acre vineyards, etc.). If you have a solid 7-8 ton/acre vineyard then you should be comfortable with an 8-9 ton/acre crop in 2013. Hanging a 12 ton/acre crop in the same vineyard will lead to delayed sugar accumulation from veraison to harvest and lower crop potential for 2014.

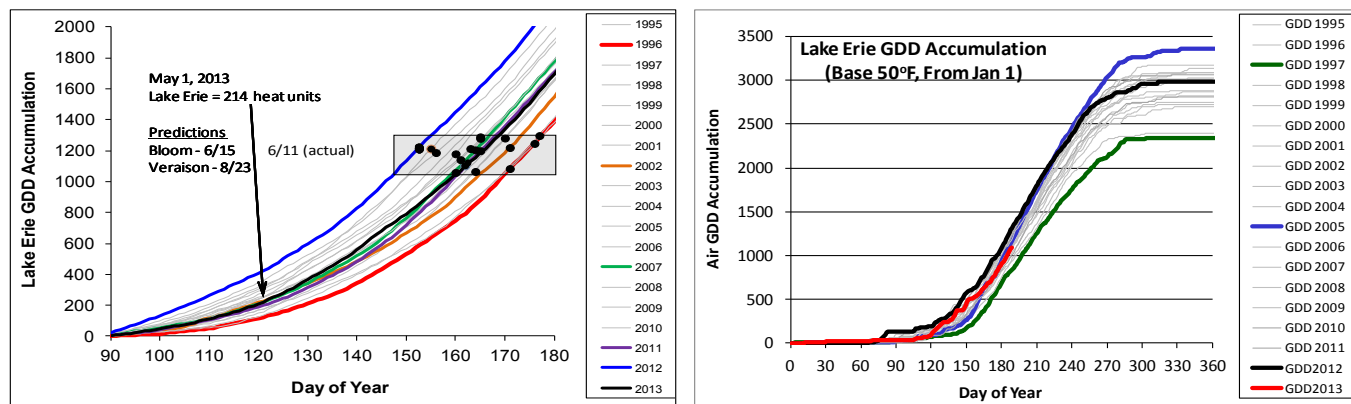


Figure 1: Lake Erie Water and Air Heat GDD Accumulation: (Left) Lake Erie degree day accumulation based on average surface water temperature with the 2013 bloom prediction. The spring lake heat tracked similar to 2011 with a similar bloom date. Veraison should occur on or near Aug 19th. In 2011, veraison was recorded on 8/18 in Portland and 8/20 in Fredonia. (Right) Air growing degree accumulation in the Lake Erie region. 2013 (red line) is tracking close to the 18-year mean GDD accumulation.

Location	Stock	Pruning	Historical Berries/cluster	2013 Berries/cluster	Historical % Set	2013 % Set
Fredonia	Own	Balanced (20+20)	42	49	35	33
Fredonia	C3309	Balanced (20+20)	37	40	37	33
Portland	Own	Balanced (20+20)	30	35	33	31
Portland	Own	90		34		33
Portland	Own	120	34	47	34	29
Portland	Own	Min		35		32
<b>Mean</b>			<b>36</b>	<b>40</b>	<b>35</b>	<b>32</b>

Table 1: 2013 Concord Berries/Cluster and %Set. There is a 10-15% increase in berries per cluster this season.

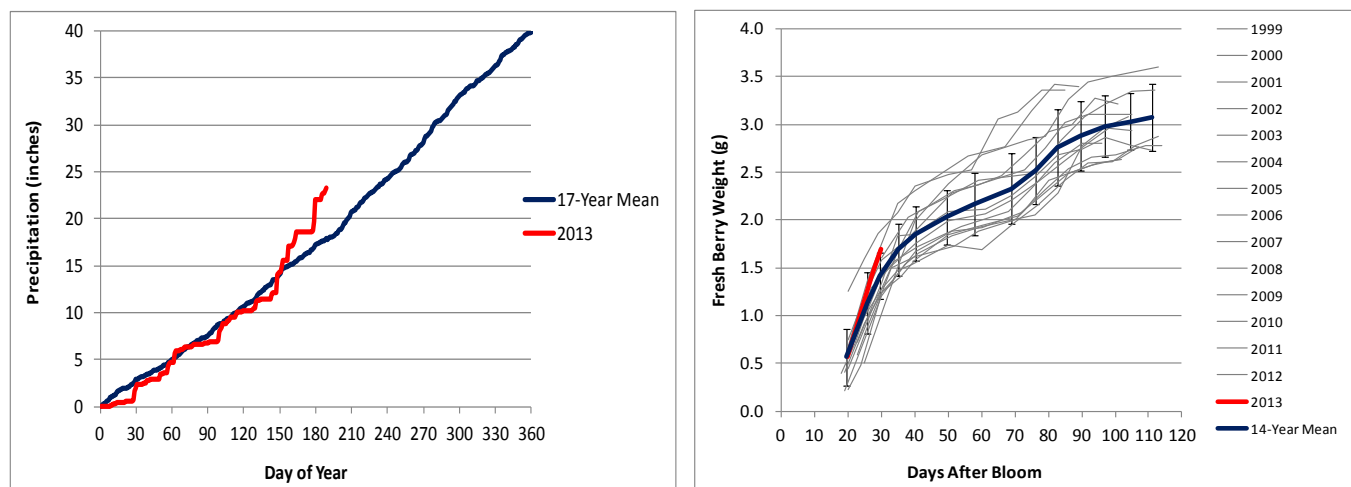


Figure 2: Precipitation and Berry Growth: (Left) 2013 and 17-year mean precipitation accumulation in the Lake Erie region. Note the above average precipitation during the first phase of berry development which is contributing to higher than average berry weight. (Right) 2013 and mean Concord fresh berry weight.



# Crop Estimation & Thinning Table—7/16/2003

Dr. Terry Bates

Dr. Terry Bates: Crop Estimation and Thinning Table: 7/16/2003

Pounds of Fruit Removed in 1/100th of an Acre	Time of Season															
	20DAB		25DAB		30DAB		40DAB		50DAB		Veraison			Harvest		
	% of Final Berry Weight															
	20	25	30	35	40	45	50	55	60	65	70	75	80	90	100	
10	2.5	2.0	1.7	1.4	1.3	1.1	1.0	0.9	0.8	0.8	0.7	0.7	0.6	0.6	0.5	
20	5.0	4.0	3.3	2.9	2.5	2.2	2.0	1.8	1.7	1.5	1.4	1.3	1.3	1.1	1.0	
30	7.5	6.0	5.0	4.3	3.8	3.3	3.0	2.7	2.5	2.3	2.1	2.0	1.9	1.7	1.5	
40	10.0	8.0	6.7	5.7	5.0	4.4	4.0	3.6	3.3	3.1	2.9	2.7	2.5	2.2	2.0	
50	12.5	10.0	8.3	7.1	6.3	5.6	5.0	4.5	4.2	3.8	3.6	3.3	3.1	2.8	2.5	
60	15.0	12.0	10.0	8.6	7.5	6.7	6.0	5.5	5.0	4.6	4.3	4.0	3.8	3.3	3.0	
70	17.5	14.0	11.7	10.0	8.8	7.8	7.0	6.4	5.8	5.4	5.0	4.7	4.4	3.9	3.5	
80	20.0	16.0	13.3	11.4	10.0	8.9	8.0	7.3	6.7	6.2	5.7	5.3	5.0	4.4	4.0	
90	22.5	18.0	15.0	12.9	11.3	10.0	9.0	8.2	7.5	6.9	6.4	6.0	5.6	5.0	4.5	
100	25.0	20.0	16.7	14.3	12.5	11.1	10.0	9.1	8.3	7.7	7.1	6.7	6.3	5.6	5.0	
110	27.5	22.0	18.3	15.7	13.8	12.2	11.0	10.0	9.2	8.5	7.9	7.3	6.9	6.1	5.5	
120	30.0	24.0	20.0	17.1	15.0	13.3	12.0	10.9	10.0	9.2	8.6	8.0	7.5	6.7	6.0	
130	32.5	26.0	21.7	18.6	16.3	14.4	13.0	11.8	10.8	10.0	9.3	8.7	8.1	7.2	6.5	
140	35.0	28.0	23.3	20.0	17.5	15.6	14.0	12.7	11.7	10.8	10.0	9.3	8.8	7.8	7.0	
150	37.5	30.0	25.0	21.4	18.8	16.7	15.0	13.6	12.5	11.5	10.7	10.0	9.4	8.3	7.5	
160	40.0	32.0	26.7	22.9	20.0	17.8	16.0	14.5	13.3	12.3	11.4	10.7	10.0	8.9	8.0	
170	42.5	34.0	28.3	24.3	21.3	18.9	17.0	15.5	14.2	13.1	12.1	11.3	10.6	9.4	8.5	
180	45.0	36.0	30.0	25.7	22.5	20.0	18.0	16.4	15.0	13.8	12.9	12.0	11.3	10.0	9.0	
190	47.5	38.0	31.7	27.1	23.8	21.1	19.0	17.3	15.8	14.6	13.6	12.7	11.9	10.6	9.5	
200	50.0	40.0	33.3	28.6	25.0	22.2	20.0	18.2	16.7	15.4	14.3	13.3	12.5	11.1	10.0	

Row Spacing determines length of 1/100th of an acre  
 10.0 feet row spacing = 43.5 feet = 1/100th of an acre  
 9.5 feet = 45.9 feet = 1/100th of an acre  
 9.0 feet = 48.4 feet = 1/100th of an acre  
 8.5 feet = 51.2 feet = 1/100th of an acre  
 8.0 feet = 54.45 feet = 1/100th of an acre  
 7.5 feet = 58.1 feet = 1/100th of an acre

#### Calculation

43, 560 square feet per acre  
 Divide by row spacing and then  
 divide by 100 to get 1/100th of an acre

#### Example:

A grower has 9 foot row spacing and clean picks 48.4 feet at 25 days after bloom.  
 The fruit weighs 80 pounds and the grower estimates that the berries are between 35% and 40% of final berry weight. According to the table, the crop estimate is between 10.0 and 11.4 tons per acre.

#### Disclaimer:

This table gives the relationship between time of season and % final berry weight on an average year. Year to year variability in weather related berry growth adds error to this table. Information on current year berry growth can be obtained from the Fredonia Vineyard Lab (or) it is strongly suggested that individual growers start collecting berry weight information from their own individual vineyard blocks.

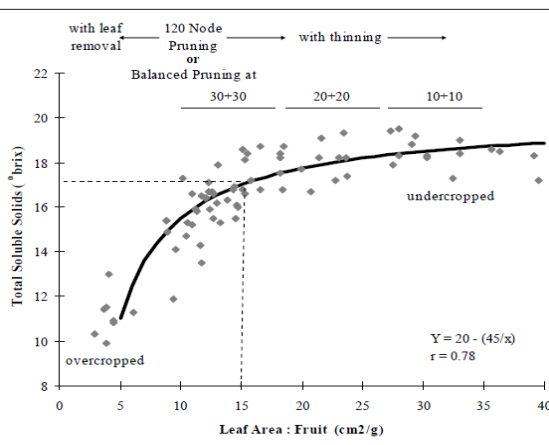
# Concord Crop Adjustment: Theory, Research & Practice

Dr. Terry Bates, Viticulture Research Associate Cornell University

Mechanical crop adjustment or “thinning” of Concord fruit has gained popularity in the past decade for various reasons, one being the integration of mechanical crop load management into mechanical pruning. In the past five years, we have conducted several research projects at the Cornell Vineyard Laboratory in Fredonia and in cooperating grower vineyards investigating the physiological and practical aspects of mechanical crop adjustment. Many area growers have tried thinning for themselves with varying degrees of success. The following article covers the theory behind crop adjustment, the information we have learned from our Concord research projects, and the practical method for in-the-field mechanical crop adjustment.

## Theory

Sustainable productivity of both ripe fruit and mature wood depends on the appropriate ratio of exposed leaves to retained fruit, otherwise known as crop load. An under cropped vine (one with a lot of exposed leaf area to retained fruit) will have ripe fruit and excess vegetative growth. An over cropped vine (one with little exposed leaf area relative to retained fruit) will have delayed fruit and wood maturity leading to a decrease in vine size and future fruiting potential. There have been extensive arguments over the definition of vine balance. Most likely because the definition is different depending on the individual grower, processor, winery, grape variety, intended purpose for the fruit, or maturity characteristic being measured. For the purposes of this article, let's assume that a “balanced” vine reaches a desired Concord fruit maturity of 16obrix by the middle of a typical harvest season while maintaining 2.5 to 3.0 pounds of cane pruning weight.



**Figure 1. The effect of crop load (exposed leaf area to fruit ratio) on juice soluble solids in Concord.**

Since we can measure exposed leaf area, fruit weight, and juice soluble solids, we can determine the effect of crop load on fruit maturation in Concord (Figure 1). We conducted a series of crop and leaf thinning experiments to create a range of leaf area to fruit ratios in Concord vines pruned to 120 nodes. The vines were harvested during the middle of a normal harvest season and the crop load / obrix curve shows that desired fruit maturity was achieved when there was 15 square centimeters of exposed leaf area per gram of retained fruit. Under cropped vines (on the right side of the curve) did not have greater fruit maturity but tended to Vineyard Notes #6 Page 2 of 13; June 13, 2003 rease in pruning weight. Over cropped vines (on the left side of the curve) had lower fruit maturity and tended to have decreased pruning weight.

For reference sake, in this particular vineyard block and growing season, 120 node unthinned vines yielded between 11 and 12 tons/acre, had a leaf area to fruit ratio of 10 and a fruit maturity of about 14.5-15.0obrix. Therefore the unthinned vines were slightly over cropped and either needed to be crop adjusted or needed an extended growing season to reach our desired fruit maturity of 16obrix. Thinning the vines down to 8-9 tons/acre increased the leaf area to fruit ratio to 15 and fruit maturity to 16-17obrix.

When I went back and looked at some of the old balanced pruning experiments by Dr. Nelson Shaulis and recalculated the leaf area to fruit ratio based on pruning weight data, I could illustrate why 20+20 pruning was so popular with Dr. Shaulis. Going back to figure 1, 10+10 balanced pruning had high leaf area to fruit ratios, were well under cropped, and tended to be over vigorous. In contrast, 30+30 pruning put the vines on the shoulder of the crop load / obrix curve. In good growing seasons, 30+30 vines were ideal with high yield, good fruit maturity, and adequate vegetative growth. However, in poor years, 30+30 pruning ran the risk of over cropping. A good option would be to crop adjust the 30+30 vines in poor years to increase the leaf area to fruit ratio and more appropriately match the crop load with the growing season. Dr. Shaulis used 20+20 pruning in many of his experiments and we still used 20+20 pruning in many of our current experiments that we do not intend to crop adjust. We do this because 20+20 pruning keeps us on the “safe” side of the crop load / obrix curve. In good years, the vines tend to be under cropped and will gain pruning weight and in poor years the vines will be balanced without going off the crop load cliff.

(Continued from page 6)

## Research

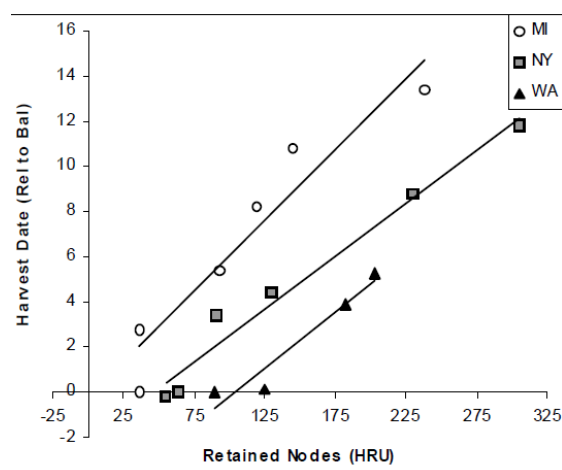
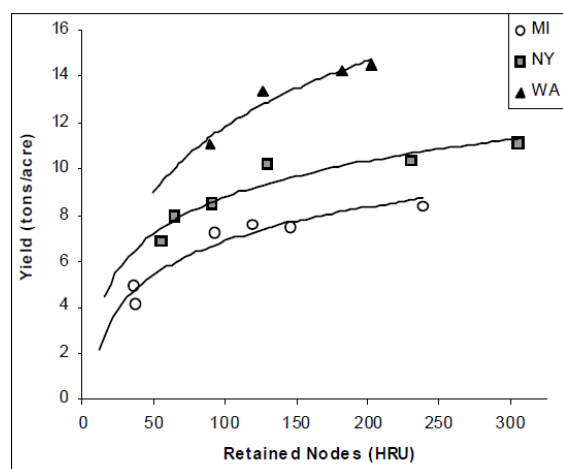
The data from Figure 1 indicated that balanced pruning and fixed node pruning with crop adjustment can both be used to manipulate crop load in Concord vineyards. Research over the past five years has attempted to address issues that put that theory into practice. Balanced pruning (especially to 20+20) is rare in commercial Concord vineyards because it can be labor intensive and it does not take advantage of the good growing seasons where a larger crop can be harvested without sacrificing wood maturity. Fixed node pruning is more common but can easily create an over crop situation, especially where crop adjustment is not being considered. Machine assisted pruning with or without hand pruning follow-up also lends itself to fixed node pruning but again raises questions about appropriate node number and crop adjustment. Following our crop load theory and the goals of the Concord industry, efficient crop load management requires pruning for maximum crop for the best possible growing seasons and then crop adjusting down to match the vineyard potential with the particular growing season.

Surprisingly, pruning for maximum crop does not mean not

pruning at all and it also does not mean leaving the same number of buds on all the vines in a particular vineyard. In a cooperative research project between NY, MI, and WA, Concord vines were pruned to a range of bud numbers and harvested at a pre-determined fruit maturity level.

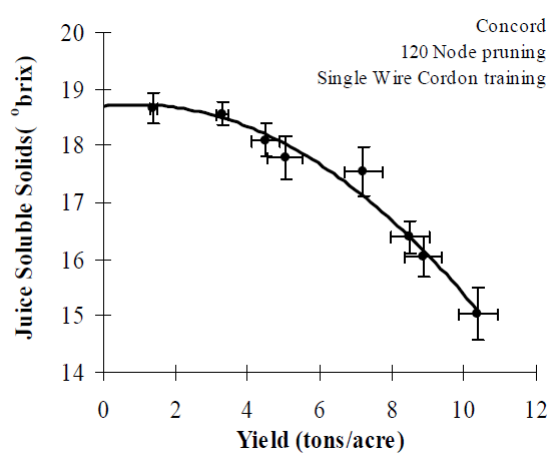
Interestingly, the plot in MI tended to have small vine size, the one in NY had medium vine size, and the one in WA had large vines (1.5, 2.5, and 3.5 pounds/vine, respectively). In each state, yield increased with increasing retained nodes to a point which I refer to as the yield plateau. The small vines reached a yield plateau at approximately 90 buds, medium vines at 120 buds, and large vines at 150 buds (Figure 2A).

Pruning to a lower bud number decreased yield and increased the rate of fruit maturity – this simply follows our crop load discussion. Leaving more buds with hedge pruning or minimal pruning did not increase yield further because of yield compensating factors such as lower cluster and berry weights; however, excess buds further delayed fruit maturity presumably because of canopy inefficiency (Figure 2B). Therefore, when pruning for maximum crop it is important to prune to a bud number that gives maximum crop potential for a given vine size level but not to prune beyond that number.



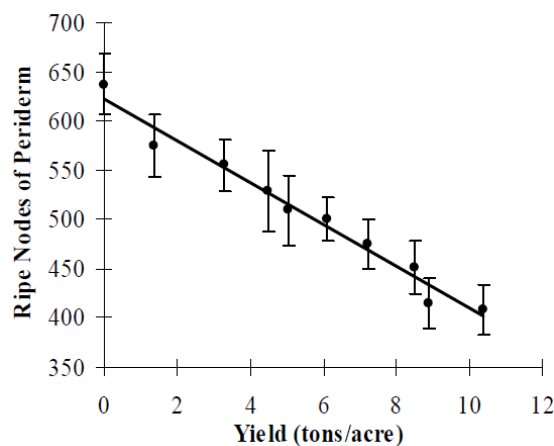
**Figure 2A and B.** The effect of retained nodes on yield (A) and relative harvest date (B) of small (circles), medium (squares), and large (triangle) vines. Data are from the three-state Concord juice quality project on single wire trained vines. Harvest date in (B) is the number of days it took a treatment to reach 16obrix relative to balanced (20+20) pruned vines

At the Fredonia Vineyard Laboratory, we have been researching the physiological effect of crop adjustment on 120 node pruned vines at 30 days after bloom. We prune to 120 nodes because we target 2.5-3.0 pound vines and our node number experiment (from figure 2) indicates that the yield plateau is reached at approximately 120 nodes. Each year we have recorded an inverse relationship between yield and obrix (figure 3A).



Other studies have shown that increasing vine size increases crop potential; therefore, thinning in year one not only influences fruit maturity in year one but also influences crop potential in year two by increasing vine pruning weight.

In the specific example in figure 3A and B, our goal was to harvest between 16 and 17obrix and maintain the vines between 450 and 500 ripe nodes of periderm (roughly 2.5 pounds of pruning weight) – our own specific vineyard



**Figure 3A and B. The effect of yield on juice soluble solids (A) and ripe nodes of periderm (B) on 120 node pruned vines at the Cornell Vineyard Laboratory in Fredonia. Each point is the mean of 10 vines, bars=standard error.**

Below 5 tons/acre, the vines are undercropped and there is no further increase in juice soluble solids with further fruit thinning (i.e. the vines are on the top of the crop load / brix curve in figure 1). From 5 to 11 tons/acre, juice soluble solids decrease as yield increases. Although growing season conditions will influence the slope of this curve from year to year, the general trend is that for every 2 to 3 ton/acre increase in yield there is a decrease in one degree brix. In practical terms, if you have a 10 ton/acre crop that is going to be 15obrix at harvest and you thin the crop down to 7-8 tons/acre, the crop will reach 16obrix at harvest.

In addition to, and probably more important than, the increase in juice soluble solids with thinning is the response of wood maturity to thinning. There is a direct inverse relationship between yield and ripe nodes of periderm (figure 3B). Periderm counts are a mature bud measurement that is proportional to pruning weight. In our experiment, as the crop decreased from 11 tons/acre down to 0 tons/acre the number of mature buds increased (and the pruning weight increased).

balance definition. At 11 tons/acre, the fruit was harvested at 15obrix and periderm counts were around 400. Fruit thinning down to 7-8 tons/acre increased the fruit to 16.5obrix and 475 ripe nodes of periderm, thus achieving our goal for vineyard balance. Thinning below 7 tons/acre turned out to be excessive thinning in that particular vineyard and growing season.

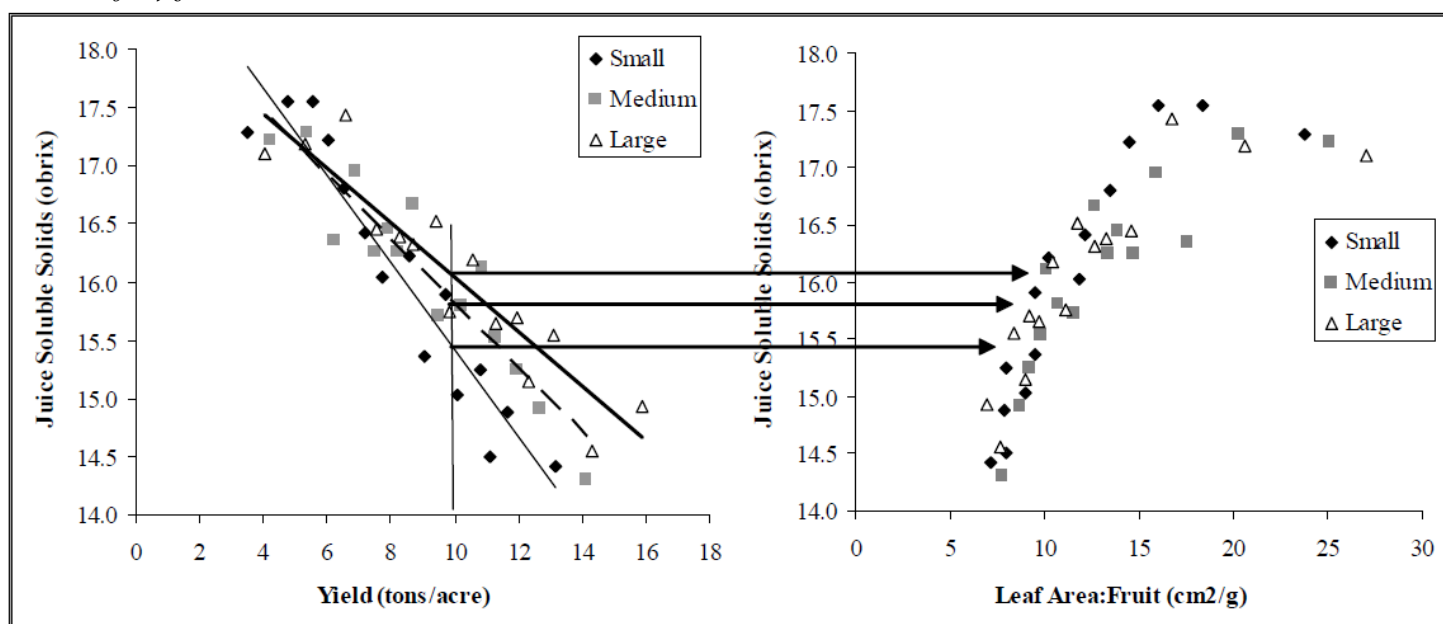
I am always drilling home the importance of vine size on Concord productivity. It is no surprise that vine size also influences the thinning response in Concord. In 2002, we repeated the 120 node thinning experiment on small, medium, and large vines.

The yield/brix regression lines in figure 4A show that small vines were more responsive to thinning than medium or large vines. Calculated exposed leaf area to fruit ratios (Figure 4B) also show that the crop load / obrix curve is the same for all vine size categories; however, at a given yield level the vines will be at a different points on the crop load / obrix curve. Or, the vines will reach similar leaf area to fruit ratios at different crop levels.

What about timing? Typically, commercial Concord



(Continued from page 8)



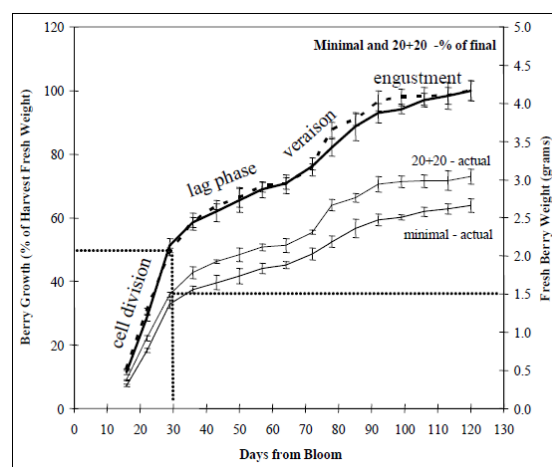
**Figure 4 A and B.** The effect of crop level (yield-A) and crop load (exposed leaf area to fruit ratio-B) on juice soluble solids of small, medium, and large Concord vines pruned to 120 nodes.

vineyards are mechanically crop adjust at 30 days after bloom; however, other thinning times have been tested or considered. Dr. Shaulis used manual flower cluster thinning in the West Tier back in the 1960's. Unfortunately, thinning prior to fruit set can increase the percent of florets that set fruit leading to some degree of yield compensation. In theory, the earliest that the crop can be adjusted after fruit set, the more efficient the vine response will be because the vines have invested few resources into the crop. In practice, the berries have little mass right after fruit set and it is difficult to accurately fruit thin with a machine when the berries are that small.

Dr. Pool investigated Concord berry growth in relationship to both calendar days after bloom and growing degree days. His research showed that Concord berries reached 50% of final fresh berry weight approximately 30 days after bloom and more specifically at 1200 growing degree days. The "50% final berry weight/30 day after bloom" timing has been adopted by several growers as a convenient time to both estimate the crop and mechanically crop adjust.

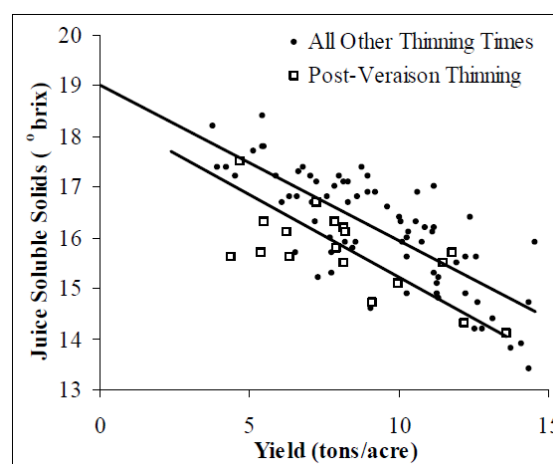
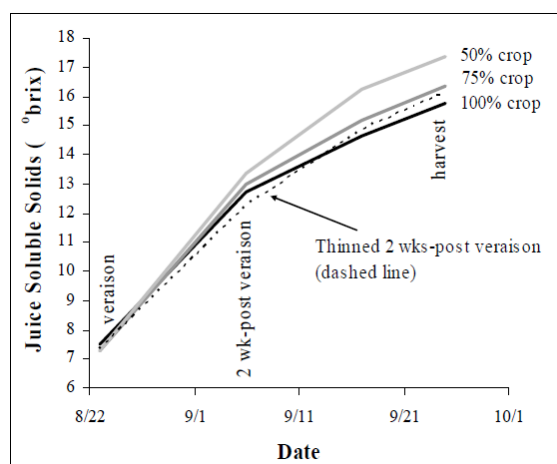
Growers have also asked about thinning later in the season (50 days after bloom) when berry growth slows down during the lag growth phase (Figure 5). At 30 days after bloom, fresh berry weight is rapidly changing and a few days in either direction can cause large errors crop estimation. At 50 days after bloom, the rate of fresh berry weight change is smaller when compared to the rate of change at 30 days after bloom, potentially providing added flexibility and accuracy to crop estimation. However, there should also be a resource cost associated with leaving an excessively large crop on the vine

for an extended time period.



**Figure 5.** Typical Concord berry growth curve showing both actual and % of final berry weight for balanced (20+20) and minimal pruned vines.

In 2002, we conducted another thinning experiment in 120 node vines at the Fredonia Lab where we manually crop adjusted at 20, 30, 50 days after bloom, immediate pre-veraison, and 2 weeks post-veraison. In terms of juice soluble solids accumulation, all of the pre-veraison thinning times led to a similar increase in obrix at a given crop level. Fruit from all treatments in the experiment started at approximately 7obrix at veraison (figure 6). The rate of soluble solids accumulation in vines with 50% crop was greater after



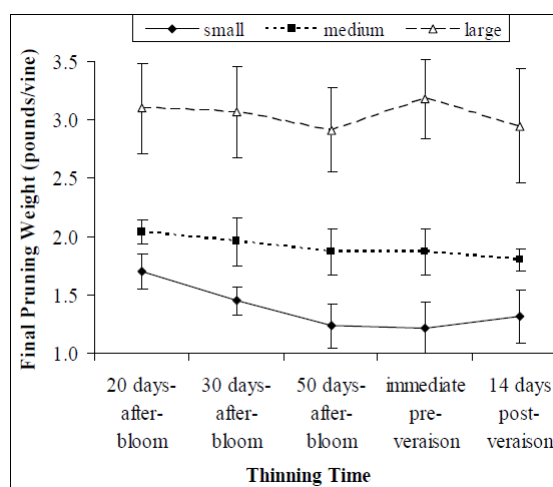
**Figure 6A and B.** Juice soluble solids accumulation from veraison to harvest on vines with different crop levels prior to veraison and on vines thinned 2 weeks post-veraison (A). The effect of yield on final harvest juice soluble solids of vines thinned at various times pre-veraison and 2 weeks post-veraison.

veraison than on vines with 75% or 100% crop. Vines thinned two weeks after veraison had a slow initial rate of soluble solids accumulation (similar to vines with 100% crop). After thinning 2 weeks post-veraison, the rate of soluble solids accumulation increased until harvest (similar to vines with 50% or 75% crop). The post-veraison thinned vines were unable to catch up to the earlier thinned vines by the selected harvest date (figure 6B). In theory, all data curves in figure 6A would eventually merge into one line if the growing season were long enough. The practical problem is that an extended harvest season is a rare luxury in the Lake Erie grape belt.

As discussed earlier, crop adjustment is important for both fruit maturation and wood development. Concord growth analysis research that we have done shows that perennial grapevine tissues accumulate starch approximately one month after bloom until the end of the growing season. It could be argued that delaying crop adjustment later than 30 days after bloom would infringe upon early wood development through the partitioning of resources, such as carbon and nitrogen, into the crop.

Pruning weight data from different sized vines thinned to 75% crop level at five different timings during the growing season brings our whole discussion of crop adjustment together. On already large vines, thinning time did not have an effect on final vine size (figure 7).

**Figure 7.** The effect of thinning time on final vine pruning weight of small, medium, and large vines.



The large vines had a relatively high leaf area to fruit ratio at a given crop level when compared to medium or small vines (as seen in figure 4); therefore, the large vines in our experiment could mature both the fruit and wood well within the limit of the growing season. In contrast, small vines with relatively low leaf area to fruit ratios (higher crop load) at a given crop level had lower juice soluble solids accumulation rates (figure 4) and were affected by thinning time (figure 7). In general, delaying crop adjustment decreased vine pruning weight and this response was measured as early as 30 days after bloom.

Conclusions:

1) Vine response to crop load is the same whether crop load

(Continued from page 10)

is manipulated by pruning, thinning, or a combination of the two.

2) In an average growing season with average vine size, Concord vines require 15 square centimeters of exposed leaf area per gram of fruit fresh weight for balanced production. Vines with a lower leaf area to fruit ratio need crop adjustment or an extended growing season to maintain a balance between vegetative and reproductive growth.

3) In overcropped vines, thinning increases both juice soluble solids and vine pruning weight. The response is more pronounced on small vines than on large vines because small vines have a higher crop load than large vines at a given crop level. On small vines, thinning approximately 2 tons/acre leads to an increase in one degree brix. On large vines, thinning approximately 3 tons/acre leads to an increase in one degree brix. On undercropped vines (below 5 tons/acre), there is no effect of thinning on juice soluble solids.

4) In terms of thinning time, thinning can be done any time before veraison to increase the juice soluble solids accumulation rate in the remaining fruit. In terms of wood maturation, thinning time impacts small vines more so than large vines. In commercial vineyards with lower than optimum vine size and/or with a variety of biotic and abiotic stresses, crop adjustment should be done as early as practically possible so that the crop load change can have a larger increase on wood development. On large healthy vines, thinning time did not impact the resultant vine size (although I question if this statement remains true if the same vines are pushed and thinned late for several years in a row).

### Practice

Everyone is always asking me how our research translates to commercial vineyards. In-the-field mechanical thinning research has been going on in the Lake Erie region since the early 1990's. I have been involved with several growers, especially Bob and Dawn Betts, Joel Rammelt, and Dave Vercant, for the past five years evaluating on-farm mechanical thinning.

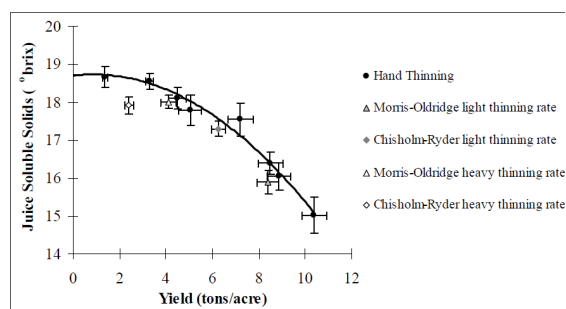
Our research shows that mechanical crop adjustment, if done correctly, gives the same results as thinning at the Fredonia Lab (figure 8). We have used different harvesters and thinning heads with straight rods and bow rods and at different thinning speeds.

Many growers have reported that they have beat up their vines with mechanical thinning and it is certainly possible to cause significant canopy damage when thinning. However, we have

found that with some common sense and a little machine operation experience that this damage can be avoided. Some useful tips are. . .

1) Bring your common sense. If it looks like you are taking off more leaves than fruit or causing significant canopy damage, you probably are. Adjust your thinning machine.

2) Avoid having to thin off more than 3-4 tons. If you have a vineyard that can yield 8 tons/acre in an average year, use dormant pruning to target 10 tons/acre in the prospect of a good growing season. Then thin off a few tons if the year is less than perfect. Avoid hanging 15 tons/acre and then having to thin off 7 tons/acre – it always leads to poor results.



*Figure 8. The effect of yield on juice soluble solids of hand thinned 120 node vines (same as figure 3A) compared with two thinning machines at two thinning rates. Canopy damage only impacted fruit maturity when we tried to thin approximately 8 tons/acre.*

3) Shake - don't slap! Machines that grip and shake the canopy tend to cause less canopy damage than those that slap the foliage and break shoots. Floating picking heads and bow rods are nice features to some new machines but they are not mandatory. We have had excellent results with the correct set up of old machines and straight harvester rods.

4) Some like it Hot! We have found much

less shoot breakage on Concord when thinning is done during a warm afternoon. First thing in the morning, the shoots are pumped up with water and tend to break during thinning. At 30 days after bloom in mid-July, the warm afternoon temperatures cause the shoots to relax and become more flexible later in the day resulting in less shoot breakage.

5) Talk to your fellow growers that have thinned successfully. They are a wealth of practical information.

### How to Mechanically Crop Adjust: The Easy Method

The following method considers mechanically crop adjusting at 30 days after bloom with "playing all the averages." The easy method takes less thought but can also be less accurate because it takes into account several assumptions.

To successfully crop adjust; a grower needs to know what the

balanced cropping potential is for a particular vineyard block in an average growing season. For example, a grower knows that Block A is in a poor spot and can only handle 5 tons/acre and that Block B is in a good spot and can run 8 tons/acre in an average growing season without losing significant pruning weight. Next, all the grower needs to do is measure what crop is hanging in the vineyard and adjust the harvester to take off the excess crop to reach the target crop level.

To crop estimate using the easy method, 1% of an acre is clean picked and weighed at 30 days after bloom. At 9 foot row and 8 foot vine spacing, there are 605 vines in one acre. A row of 605 vines at 8 foot spacing would be 4840 feet long. 1/100th or 1% of that row would be 48.4 feet. An easy way to pick 1/100th of an acre is to measure and cut a piece of rope 48 feet long, lay it down on the vineyard floor, and clean pick the vines in that rope length with a harvester.

The picked green berries are then sent across the harvester shoot to a barrel on a scale (many growers use a milk scale on a trailer). Weight the picked fruit. In the easy method, simply read the weight of the fruit picked off of 1/100th of an acre (in pounds) and move the decimal point over one place to the left to get the harvest estimate in tons/acre.

For example, in Block X, Bob lays out his 48 foot crop estimation rope (roughly two post lengths) and clean picks it. Dawn, on a trailer in an adjacent row, places a barrel on a milk scale, tares (or zero's) the scale, collects the berries from the harvester shoot into the barrel, and weighs the green fruit. The scale reads 100 pounds. Dawn moves the decimal point one place to the left and estimates that the block will have 10 tons/acre at harvest. Bob and Dawn repeat the procedure in a Block Y and the scale reads 50 pounds. They estimate that they will harvest 5 tons/acre from Block Y.

Bob and Dawn decide that Block Y with the 5 tons/acre estimate does not need thinning and they leave it alone. Block X, on the other hand, has a 10 tons/acre estimate and they want to thin it down to 8 tons/acre by taking off a harvest equivalent of 2 tons/acre. Working backwards and moving the decimal point one place to the right, Bob and Dawn must set up their harvester to remove 20 pounds of fruit in the same 1/100th of an acre (48 feet). After a couple trial runs at different beater speeds, they are comfortable that they are taking an average of 20 pounds of fruit off of a 48 foot section. Bob then runs over the rest of the block with the determined machine set-up.

#### How to Mechanically Crop Adjust: The Advanced Method

The easy crop adjustment method assumes that thinning is done at 30 days after bloom, that the berries are at 50% of final berry weight at 30 days after bloom, and that there is an average growing season. The actual physical activity in the

vineyard between the easy and advanced methods is the same – pick 1/100th of an acre and make some decisions about thinning. However, the advanced method takes into account actual berry weight and growing season conditions to make more educated decisions in the vineyard and to decrease error in the thinning process.

The way I like to calculate % final berry weight in crop estimation is to weigh a berry sample at the time I am thinning and make a prediction on what the final berry weight is going to be. I do this for three reasons: 1) the berry weight at 30 days after bloom and at the end of the season is different every year (is there such a thing as an average year?); 2) the berry weight is changing very fast in the 30 day after bloom / 1200 GDD period (see figure 5); 3) I am not always crop adjusting at exactly 50% of final berry weight in any one vineyard or any one area in the Lake Erie Belt.

1. Clean pick 1/100th of an acre (as in the easy method) and weight it.

Example: 142 pounds of green fruit is picked from 48 feet.

2. Measure average fresh berry weight at thinning time. Typically I weigh a couple different 100 berry samples to get a reliable average berry weight at thinning time.

Example: Average berry weight measured at 1.8g.

3. Predict what you think the final berry weight will be at the end of the season. This can be tricky but I feel that it is more accurate than automatically assuming that the berries are at 50% final berry weight.

Rules of thumb: Final berry weight changes with crop level, pruning method, and growing season. Balanced pruned vines with relatively light crops average 3.0g berries at harvest. 120 node vines average 2.75 g berries and Minimal pruned vines average 2.5 g berries at harvest (see figure 5). Excellent growing conditions with adequate water during the cell division phase of berry growth lead to larger than average berries. Lack of water post-veraison can lower final predicted berry weight. Predicting final berry weight is a guess at best and will always add error to the crop estimation (however, cluster and berry counts are old crop estimation errors that are now removed from the procedure).

4. Calculate % final berry weight.

Example: If average berry weight is 1.8g when I am going to thin and I predict that the final berry weight is going to be 2.75g then I calculate that I am at 65.4% of final berry weight ( $1.8/2.75 = 0.654$  or 65.4%).

5. Calculate the multiplication factor for crop estimation.



(Continued from page 12)

Example: If I am at 65.4% of final berry weight then I should multiply my 1/100th of an acre sample by 1.53 ( $100/65.4 = 1.53$ ) to get what the sample will weigh at harvest.

6. Calculate the per acre crop estimate.

Example: 142 pounds of green fruit multiplied by 1.53 = 217.3 pounds of fruit in 1/100th of an acre at harvest. This is equal to 21730 pounds of fruit per acre at harvest ( $217.3 \times 100 = 21730$ ) or 10.87 tons/acre ( $21730 / 2000$  pounds per ton).

7. Determine the desired crop level for the vineyard block. As in the easy method, if the grower knows a vineyard block is balanced at 8 tons/acre then that yield can be targeted each year. However, at the vineyard lab we look at the growing degree days at thinning time and make a judgment on how much crop to leave based on how many days we are ahead or behind average. The rule of thumb: For every three days ahead of average we are at thinning time we can ripen one ton/acre more than average. This “3 day per ton” rule comes from a Concord pruning experiment where vines with a range of crop levels were harvested based on juice soluble solids and not on a single date.

Example: If a vineyard can ripen 8 tons/acre on an average year and we are a week ahead of average at 30 days after bloom then we would predict that the same block can potentially ripen 10 tons/acre. In contrast, if we are a week behind average at 30 days after bloom then we would predict that the same vineyard block may be better balanced at 6 tons/acre. The only downfall to this rule of thumb is if the weather drastically changes between thinning time and harvest. However, I am more comfortable making weather related crop load decisions one month after bloom than I am in the middle of January when crop load is being decided with pruning alone.

8. Work backwards to determine the machine set up for thinning.

Example: To shake off 2 tons/acre harvest equivalent when the berries at 65.4% of final berry weight. ( $2 \text{ tons/acre} \times 2000 \text{ pounds/ton} = 4000 \text{ pounds/acre} = 40 \text{ pounds}$  in 1/100th of an acre at harvest.  $40 \text{ pounds} / 1.53 \text{ berry weight multiplication factor} = 26.14 \text{ pounds of green fruit}$  to remove from 1/100th of an acre at thinning time).

9. Set-up machine to take off desired amount of fruit.

Unfortunately, with all the different machines and harvester configurations out there, this is still a trial and error process. The set-up with a Chisholm-Ryder with straight rods is different than a Morris-Oldridge thinning head or a Korvan with bow rods.

## MANAGING WINTER INJURY THIS SEASON

*Hans Walter-Peterson*

As many growers have noticed by now, many vineyards in the Lake Erie region are showing signs of winter injury. While our temperature readings here at the Vineyard Lab got down to “only” -9°F, other growers have told us that they had temperatures in the teens below zero. Growers in certain portions of the “banana belt” of Niagara County, the Lake Ontario escarpment, experienced the benefits of that body of water this winter, with reports of the coldest temperatures from that area of about six to eight degrees below zero.

When cold weather of this magnitude hits, the first victim in the vine is usually the phloem tissue. This tissue is mainly responsible for transporting carbohydrates and nutrients throughout the structure of the vine. It is located just under the bark layer of the trunk or one-year-old canes. In a cane that is properly hardened off and survives the winter, the phloem will appear as a greenish ring just under the mahogany-colored bark of the cane. If the phloem has been injured, that layer will appear very dark green or brown (see the May 29th Crop Update at our website for pictures of these).

The death of this portion of the vascular structure prevents nutrients from being directed from the main storage organs (trunks, cordons, canes and roots) to the emerging buds for early season growth. If the phloem has experienced 100% injury, there will be very little shoot growth, if any, and a good chance that the vine will collapse later in the season. If only portions of the phloem are injured, shoot growth may be slow and uneven throughout the season, and cropping levels may be significantly reduced from normal. If the cambium layer, a layer of cells within the vine that creates both phloem and xylem (water-carrying) vessels survives, it is possible that the vascular connections can be restored over time, but these vines are generally not as productive as they once were.

So what should growers do in response to this latest ‘challenge’ from Mother Nature? While it may be tempting to get out there and hack out vines that don’t look like they’re doing anything, *I would wait until after this season before moving ahead with any vine removal.*

The recommendation that I’ve seen made to growers in the Finger Lakes, and makes sense to me, is to wait until later in the season (at least until bloom, probably even later), and evaluate your vines based on these four possible situations:

**Situation 1.** *There is strong growth of shoots on the top of the vine. Growth at the base of the vine consists of a few shoots whose development is similar to the upper shoots. You can assume there has been little phloem or cambium injury. Manage these vines like you normally would.*

**Situation 2.** *There is some shoot growth on the upper part of the vine, but there are many shoots growing near the soil line or graft union. Growth of these lower shoots seems much more vigorous than growth in the upper part of the vine.* You can assume there has been phloem injury. You can verify this by cutting the bark near the ground. The phloem may be discolored. If the bark slips, the cambium is active, and provided there is enough shoot growth in the upper part of the vine, the cambium may recover. If the bark does not slip, then the cambium is dead, and most likely the shoots in the upper part of the vine may die before the summer is over.

In either case it is important to train up one or more replacement trunks. Do not retain more trunks than you can manage. Bundling up a bunch of shoots only results in disease and poor replacement trunks.

**Situation 3.** *There is no growth in the upper part of the vine, but there is strong shoot growth at the soil line or near the graft union.* Tie up as many of the suckers as you can. If the vines are very vigorous, consider leaving some of the suckers to sprawl. They will help reduce vigor, but they won't compete for light or spray coverage.

**Situation 4.** *There is no growth on the vine.* Look for good canes on neighboring vines to use as layers, or order replants.

Vines that appear as described in #2 may survive to the end of the season, and perhaps even carry a small crop, but will very likely produce poorly from then on. Vines described by #3 above may very well collapse during the season, if there's any growth at all. **In situations 2 or 3, the vines should be flagged and removed this winter.**

There are a couple of reasons to keep your trunks in place this season, even if they don't look like they will be doing much of anything for you:

#### *Get Whatever Crop You Can*

One thing that we learned from last year's frost damage was just how resilient our grapevines can be. Many growers who thought that they would have no crop to harvest after losing many shoots to frost damage got "caught" at the end of the season with a crop that was worth harvesting. Unfortunately, many of these areas were left alone last year when it came to pest and disease management, and these grapes tended to be rejected at the processing plants more often.

Given that "lesson" from last year, it would make sense to keep your vines in place through this season, to try to get whatever crop you can from these vines.

#### *Reducing the vigor of suckers*

A mature vine's root system is able to supply all of the water and nutrients to support full vegetative (shoot) and reproductive (fruit) growth of the vine. If most of the fruit and shoot growth is gone due to winter injury, all of that supplying capacity is being pushed into a relatively small number of shoots, the suckers. Without some kind of control, these suckers will grow very vigorously during the season. Much like bull wood along the wire, these very vigorous suckers will have very poor winter hardiness because of their rapid growth and incomplete development. With another cold winter, you would be right back where you started – having to retrain another set of suckers.

Retaining your trunks, even if shoot growth collapses during the year, will help to tame this growth. Other things that have been discussed before to reduce vigor include maintaining vegetation in the row middles, and reducing nitrogen applications (for example, eliminating the second application if you do split applications).

In summary, be prepared to take a hard look at just what kind of injury you might be dealing with and to begin the process of replacing trunks, but hold off on beginning that process until after this season.

*Portions of this article were based on 'Strategies for Managing Cold Injured Grapevines' by Dr. Robert Pool (Finger Lakes Vineyard Notes, June 3, 2003).*

*Further information on grapevine winter injury, including illustrations, can be found at Dr. Pool's website, [www.nysaes.cornell.edu/hort/faculty/Pool/GrapePagesIndex.html](http://www.nysaes.cornell.edu/hort/faculty/Pool/GrapePagesIndex.html).*

# Using IRAC Number

Tim Weigle and Andy Muza

Over the years we have discussed the importance of rotating insecticides to reduce the risk of resistance development. Along with that, the introduction of the new Phenology-based Degree Day model for grape berry moth has brought a new importance to the knowledge of whether a material works through ingestion or contact so they can be appropriately timed. This information is often times difficult to find on a pesticide label, if it can be found at all. Table 1 is an adaptation of a table first produced by Rufus Isaacs, Michigan State University that brings all this information together into an easy to use resource.

The straight forward way to use this table for resistance management would be to look at the IRAC number when choosing an insecticide, and rotate between IRAC numbers during the growing season.

For those who would like a deeper understanding of how this works, a common question is, “What is an IRAC number?” IRAC is short for the Insecticide Resistance Action

Committee. This committee has looked at the active ingredients of insecticides and miticides and grouped them by chemical sub-group and mode of action.

By rotating between IRAC numbers you will be rotating between modes of action. With each new mode of action that is used, you have the opportunity to remove individuals in the population that are resistant to other modes of action.

When purchasing insecticides, know the IRAC number of the material you have used so far this season. You can make sure you are rotating modes of action by checking the label (most now have the IRAC number on the front – for example, Leverage 360 has a small box that tells it is a Group 3, 4A Insecticide) or ask your dealer what the IRAC number of the insecticide they are recommending is. If you run into an insecticide where you are having difficulty determining the IRAC number, please get in touch either Andy or me. We would be happy to do what we can to come up with an answer for you.

**Table 2. IRAC Mode of Action Classification and Chemical Sub-Group for Commonly Used Insecticides in the Lake Erie Region.**

Mode of Action	Chemical Sub-Group
1. Acetylcholinesterase inhibitors	1A. Carbamates
	1B. Organophosphates
3. Sodium channel modulator	3A. Pyrethroids, Pyrethrins
4. Nicotinic acetylcholine receptor agonists	4A. Neonicotinoids
5. Nicotinic acetylcholine receptor allosteric activators	5. Spinosyns
11. Microbial disruptors of insect midgut membranes	11. <i>Bacillus thuringiensis</i> and the insecticidal proteins it produces.
16. Inhibitors of chitin biosynthesis, type 1, Homopteran	16. Buprofezin
18. Ecdysone receptor antagonists	18. Diacylhydrazines
22. Voltage-dependant sodium channel blockers	22A. Indoxacarb
23. Inhibitors of acetyl CoA carboxylase	23. Tetrone and tetramic acid derivatives
27A. Synergists	27A. P450-dependent monooxygenase inhibitors
28. Ryanodine receptor modulators	28. Diamides

**Table 1. Insecticides for use in New York and Pennsylvania Vineyards**

Insecticide	IRAC Number	Control method	Longevity	GBM	Leafhopper	Japanese Beetle	Toxic to Natural Enemies
Delegate	5	C, I	**	***	*	*	Moderate
Spintor/Entrust	5	C, I	**	**	*	-	Moderate
Biobit, Dipel	11	I	*	**	-	-	Safe
Movento	23	S, C, I	***	Phyloxera control only			Moderate
Altacor	28	C, I	***	***	*	***	Moderate
Belt	28	C, I	***	***	-	-	Moderate
Voliam Flexi	28	S, C, I	****	***	***	***	Moderate
Intrepid <sup>^</sup>	18	I	****	***	-	-	Safe
Sevin	1A	C	**	**	***	***	Toxic
Imidan	1B	C	***	***	**	***	Moderate
Avaunt	22A	C, I	**	**	*	**	Moderate
Tourismo	28 + 16	C, I	****	***	-	-	Moderate
Evergreen	27A + 3A	C	*	*	*	***	Moderate
Baythroid	3A	C	***	***	****	***	Toxic
Brigade/Capture	3A	C	***	***	****	***	Toxic
Danitol	3A	C	***	***	****	***	Toxic
Leverage 360	3A	S, C, I	****	***	***	***	Moderate
Mustang Max	3A	C	***	***	****	***	Toxic
Provado	3A	S, C, I	****	-	****	***	Moderate
Pyganic	3A	C	*	*	*	**	Moderate
Actara	4A	S, C, I	****	**	***	***	Moderate
Admire Pro	4A	S, I	****	-	***	**	Safe
Assail	4A	S, C, I	***	-	***	***	Moderate
Venom, Scorpion	4A	S, C, I	****	**	****	***	Moderate
Brigadier	4A + 3A	S, C, I	****	***	***	***	Toxic

<sup>^</sup> = not registered for use in New York

**Control Method**

S = systemic locally or through vine

C = Contact activity

I = ingestion required

**Longevity Rating**

\* = 3-5 days

\*\* = 7 days

\*\*\* = 7-10 days

\*\*\*\* = 10 - 14 days

IRAC Number indicates Mode of Action and Chemical sub-group for the insecticide. Rotating mode of actions will decrease the chance of resistance development.



# Crop Thinning: Costs, Benefits & Decision-Making

Kevin Martin

Balancing the costs and benefits of crop adjustment is entirely dependent on crop size and production history. Knowing what a block has and what a block is capable of is an essential part of the decision-making process. Fortunately, it is relatively inexpensive to gather that data. Increasing the number of panels cleanly harvested 30 – 40 days post bloom may increase the accuracy of an estimate. Large growers may spend a full day hand or machine harvesting between 4 – 16 panels per block.

## Estimation

If crop estimation takes more than one day or the grower has already concluded some crop adjustment is unavoidable, it makes sense to estimate mechanically. If crop size might fall in an acceptable area and samples can be gathered and weighed with about 16 labor hours, hand harvest is likely less expensive. Crop adjustment decisions dramatically change the expected value of a crop. Relative to the value of this information, the \$25 cost per block is minimal. If nothing else, annual crop estimation can provide a positive return on investment by altering pest management programs.

## Fuel and Maintenance

Costs will vary by machine. These estimates could be off by 20%. Newer self-propelled machines should see fuel and maintenance costs in the area of \$14.25 per acre. This would be lower than harvest costs due to conditions and practices. Lower engine RPMs, less fruit weight and higher ground speed all contribute to a modest decrease in cost per acre. Older pull-types, such as Mecca, represent the opposite end of the spectrum. Maintenance costs should be slightly lower because these harvesters have less equipment to maintain. Along with less equipment comes a lower fuel cost, with one operator using just a 75hp tractor. Costs are still above \$10 per acre, with the effectiveness of crop adjustment somewhat questionable.

## Depreciation

A typical harvester sees more than \$10,000 in depreciation per year. Often this is expensed over 200 acres, or \$50 per acre. While currency fluctuations complicate the situation, the important take away is that a lack of use results in inefficient depreciation. Use cost for thinning purposes is fairly low. For some growers it could be as low as \$13 per acre.

## Reduced Crop

The reduction in crop is the large cost that makes many growers nervous. It is important to think of this practice as analogous to pruning. The willingness to reduce crop later allows for aggressive pruning practices that allow for higher yields in poor years. The expected value of the crop

removed from the vine can be illustrated as:

$$E(X) = x_1 * p_1 + x_2 * p_2 + x_3 * p_3$$

Each x represents a possible outcome and ranges of outcomes have been simplified for this illustration into three primary categories. These outcomes include ripening the current crop load to your market standards, ripening the current crop load to any available market standards and not ripening the current crop. The higher the current level of crop, relative to your average full crop, the lower the probability of ripening to your market standards. For example, the probability of ripening a 22-ton crop to 15.5 brix is very close to zero. On the other hand, ripening an 11-ton crop to 15.5 brix might have a probability of .5. A second possible outcome would be selling this 11-ton crop in a different market. Perhaps the probability of the grapes reaching an acceptable level of quality AND that market actually being available is .2. The final outcome, not ripening or selling the crop has a probability of .3.

To calculate expected value it is distributed across the outcomes according to probability. In this case the price of grapes is multiplied by the tons and the probability of ripening for each of the three outcomes. The prices are then discounted, as higher yields have a high probability of reducing crop the following year. In this case, we assume a 50% chance of a 2-ton reduction, 25% chance of a 1-ton reduction, and a 25% chance that next years crop will not be reduced.

As an alternative, crop size could be reduced by 2-ton per acre. If the probability of achieving a ripe crop increases to .8, the expected value of this year's crop increases by \$176. It is also assumed the probability for a reduced crop next year is significantly reduced. See figure 1 for a detailed illustration.

## Unadjusted Crop

Outcome	Yield	Probability	Price	Revenue
Ripe	9	0.5	270	1215
Secondary Market	9	0.2	190	342
No Market	9	0.3	0	0
Expected Value				1647

1321

## Adjusted Crop

Outcome	Yield	Probability	Price	Revenue
Ripe	7	0.8	290	1624
Secondary Market	7	0.15	190	199.5
No Market	7	0.05	0	0
Expected Value				1823.5

1783

Figure 1: Hypothetical Outcomes and Expected Value of Crop

The value and economics of mid-season crop load management are directly related to probability. In this case, probability is both weather and market dependent. The role of the secondary market will also be dependent on the weather and crop size. An overabundance of low brix grapes during harvest could depress secondary market prices or eliminate demand for some acreage all together.

#### Market Impact on Outcomes

Current markets and the adjustments made to brix should also weigh in the decision-making process. In some markets the incentive to produce maximum tonnage at minimum quality has been reduced substantially. Alternations in standards and release practices may also change the practicality of field releases and access to secondary markets. Incentives to produce higher brix have not impacted the entire Concord market. Increases in wine production, for those with established contracts, may allow flexibility in heavily cropped vineyards. However, even those with access to specific markets have to be mindful of the potential to significantly decrease the expected value of the 2014 crop. Economically speaking, it would be important to avoid cropping vines so heavily that vine mortality increases. Even in the wine market quality standards may justify thinning as well. The secondary market is a bit of a wild card. It has been very strong recently. It has allowed over-cropped vineyards a fairly profitable outcome. With the size of the total crop as large as it is, it is possible this secondary market could weaken considerably. Much like financial markets, we can analyze, but nobody really knows for sure. Even if the bulk market remains strong, tank space could also become an issue.

#### Risk Seeking Decision Making

Once you have completed your crop estimation the next step is to use your experience. With the experience you have on an individual block, you are in the best position to think about what the probability of ripening that crop is. The grower is also in the best position to determine the impact on return crop. Finally, thinking about your financial situation and crop insurance program, the grower can determine how much risk they're willing to take. While the above example shows thinning to have a higher expected value, there is a 50% chance not thinning would substantially increase revenue this year. In this hypothetical situation, I would think this is too much risk for any grower. Most growers have a risk-seeking decision making strategy. With that in mind, it may be acceptable to seek a riskier path. It is just important not to get carried away.

in 2014. Since 2010 health insurance regulations and programs have been slowly evolving to prepare individuals and business to access health insurance and enable the mandate. In addition, incentives and regulations are evolving through 2018 in an attempt to reduce the cost of health care.

#### 2010

Tax credit for small employers providing health care insurance for workers with modest salaries. Many additional benefits for health care insurance became required, thereby increasing the cost of insurance but theoretically lowering overall health insurance costs. An example is the requirement of dependent care coverage for children age 26 and younger.

#### 2011

Employers will be reporting the cost of health insurance on employees' W2 to prepare for the so-called "luxury tax". Small businesses were also eligible for grant funded wellness programs in an effort to improve health and reduce health care costs.

#### 2012

Insurance companies must report a uniform coverage summary. If you provide health insurance to your employees you should have received this report. This report must be given to employees, to allow them to compare it with other health insurance plans.

#### 2013

While not important to your agricultural business, Medicare Part D will begin closing the "donut hole". Personally growers over the age of 65 will see an increase in their Part D benefit.

#### 2014

This is where the meat of the law starts. Large employer mandate for employees with more than 50 employees begins on January 1<sup>st</sup>. The small employer tax credit for providing insurance increases as well. Plans that employers offer are required to meet a number of minimum benefits. These plans can be offered in the private insurance market. They can also be purchased through a state organized health care exchange. Both PA and NY are continuing to work through their exchange offerings and make that information publically available.

Individuals must report the status of health insurance coverage on income tax in 2014 for both themselves and dependents. Verification of employer provided coverage would be included on the W2. Individuals without insurance pay \$95 in 2014, phasing upward to \$750 in 2017. If the cost of coverage exceeds 9.5% of household income, the penalty would be waived.

Low-income individuals, those below 400% of the federal poverty level, are eligible for subsidized insurance. This benefit will apply to most agricultural employees in addition to many small-farm owners. Individual income below \$40,000 (\$80,000 family of four) would be eligible for some subsidies. The amount of subsidies increases as income

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## Health Care Reform

*Kevin Martin*

### Compliance With the Mandate

The individual and large employer (50 FTE) mandate begins

(Continued from page 18)

decreases.

The employer mandate only applies to large employees that do not offer adequate or affordable coverage and their employees receive the individual subsidy available to “low-income” individuals.

A large employer is defined as 50+ full-time employees. Based on the 30-hour formula a business with less than 78,000 hours will not be subject to the mandate. The hours of some seasonal employees are not counted toward the total. Employees that work less than 120 days per year would be considered seasonal.

## Upcoming Events

### Vineyard Tailgate Meetings

*Tuesday, July 23, 2013 5:00 – 6:30 PM*

*Vine Country Farms (Roy and Gordon Taft)*

*Intersection of Main Street and Stone Road, Pulteney NY*  
[\(click here for map\)](#)

These are a series of informal meetings held with growers in different locations around the Finger Lakes during the growing season. Meetings are held every other Tuesday afternoon, starting at 5:00 PM and usually ending around 6:30 PM. During the day of each meeting, Mike and I visit a few growers and vineyards near the meeting location to get a sense of what has been happening in the area, and give us some ideas about some potential topics for the meeting later that day. There will also be ample time to discuss any questions or issues that others want to bring up as well. There is no need to register ahead of time – just show up when you can, and leave when you have to.

There will be 0.75 pesticide recertification credits available for each meeting. As with other events where credits are available, you need to be present at the beginning of the meeting to sign the meeting roster – make sure to have your card with you - and stay until the end to receive your certificate.

Date	Address
August 6	Hermann J. Wiemer Winery 3962 State Route 14, Dundee NY 14837
August 20	Goose Watch Winery 5480 Route 89, Romulus NY 14541

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### Field Meeting on Soils & Compaction

*Tuesday, July 30 4:00 – 6:00 PM*

*Doyle Vineyard Management - Dresden Farm*

*1255 Ridge Road, Penn Yan NY*

This field meeting will be focused on soil management, including a demonstration of several different pieces of equipment that could be used to deal with compaction in vineyard soils. Our guest speaker will be Dr. Ian Merwin from Cornell University, who will talk about how some different aspects of soil management can influence production in perennial crop systems like vineyards.

There is no cost for those who have subscribed to the FLGP in 2013, and a \$10 fee for those who are not enrolled. To register, please contact Karen in our office at [kag255@cornell.edu](mailto:kag255@cornell.edu) or 315-536-5134

\*\*\*\*\*

### 2013 Fruit Field Day

*Thursday, August 1, 2013 8:00 am – 5:00 pm*

*New York State Agricultural Experiment Station, Research Farm South*

*1097 County Road 4, Geneva NY*

Register now to learn about Cornell’s latest research and extension efforts in tree fruits, grapes, hops, and small fruits at the Fruit Field Day, August 1<sup>st</sup>, from 8:00 a.m. to 5:00 p.m. at the New York State Agricultural Experiment Station in Geneva, NY. Attendees will travel by bus to the research plots to hear presentations by researchers; for a complete list of talks, [click here](#). The cost of registration is \$30 per person

(\$40 for walk-ins). Lunch will be provided. Pre-registration is required for the \$30 rate; register on-line at: <http://is.gd/ffd2013>. The event will be held at the Fruit and Vegetable Research Farm South, 1097 County Road No. 4, one mile west of Pre-emption Road in Geneva, NY. Signs will be posted.

\*\*\*\*\*

### **CULTIVAR X REGION: An NE 1020 Variety Trial Tasting**

*Thursday, August 15 2013 8:30 AM – 5:00 PM*

*Ramada Geneva Lakefront, 41 Lakefront Drive*  
[\(http://www.genevaramada.com/\)](http://www.genevaramada.com/)

A small block of rooms has been reserved at a discounted rate under the name “Cornell.” Reservations must be made by August 1<sup>st</sup>.

Curious about new cultivars? Interested in the effects of terroir on varietal character? Then join us for a cross-regional tasting of varietal trial wines!

The multistate NE 1020 project was designed to test the performance of interesting grape cultivars, both new and existing, at various sites across the US. Over the past two years, collaborative work between Cornell, Penn State, and

the Connecticut Agricultural Experiment Station have resulted in a collection of wines produced from NE 1020 sites spanning the region. Join us for a guided sensory evaluation of these wines, which represent a range of cool-climate varieties, both hybrid and *V. vinifera*. Your participation and feedback will help guide future variety trial activities, and provide you with first-hand experience of varietal and regional expression in these cultivars. This day-long program is free, and will include short presentations by project scientists, a tour of Cornell’s vineyard blocks, and lunch.

### **THIS EVENT IS FREE, BUT SPACE IS LIMITED AND REGISTRATION IS REQUIRED!**

To reserve your seat, please contact Sarah Lincoln at [sjl38@cornell.edu](mailto:sjl38@cornell.edu) or 315.787.2255 and provide the following information:

Name:

Affiliation:

Address:

Phone number:

E-mail address:

We look forward to seeing you!





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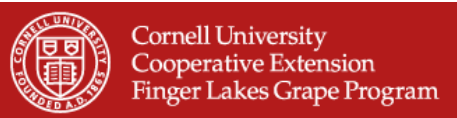
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