Welcome to the 2nd Viticulture Newsletter on the "Northwest Berry & Grape Information Network". The theme of crop prediction comes at a time when Oregon growers are making management decisions to achieve their desired 2002 tonnage. We hope this helps you reach your target.

Thank you to all individuals who have contributed to this newsletter. The work you are about to read was collected, summarized, and written by Jessie Howe and Jessica Cortell. Thank you to Oregon's former Viticulture Extension Agent Ed Hellman and his crew. Without this WEB site, our newsletter would not be possible. Thanks to Ben Exstrom for creating an interactive program that we can use to calculate an adequate sample size to predict yield (see Crop Prediction and Adjustment).

Our next newsletter will be posted to the Berry & Grape Infonet on December 1st. The newsletter will include a summary of the 2002 season and provide information on pruning strategies for the coming year.

We hope to see you at the August 22nd workshop on Vineyard Drip Irrigation! The workshop will be held at OSU's Woodhall III Research Vineyard in Alpine, Oregon.

Vineyard Drip Irrigation Workshop - August 22, 2002 10am - 3pm
RSVP: Lee Ann @ (541) 737-3464 by 5 pm – August 9th
Registration due by Aug. 12th — Make checks payable to: “Ag. Research Foundation” — Memo line: “irrigation workshop”
Mail to: Lee Ann Julson, OSU-Dept. of Horticulture, 4017 ALS Bldg., Corvallis, OR 97331-7304

Details about this workshop can be viewed by clicking here http://berrygrape.orst.edu/news/Dripsmnr.htm . For further information please contact myself or Jessie Howe at (541) 737-5453.
Thank you and good luck with harvest in 2002!
Annie Connelly

**Attention! Grape Disease Info:**
Anyone seeking current grape disease information should check out the WEB site [http://plant-disease.orst.edu/index.htm](http://plant-disease.orst.edu/index.htm). The site has been put together by OSU Botany Plant Pathology and OSU Extension. Search the *Plant Index* by "Grape" to view details about grape diseases.

---

**Managing Crop - an introduction**
The goal is to achieve quality. This is the trend for Oregon winegrape production and the reason the Oregon winegrape industry stands unique in the global market. Achieving quality involves all aspects of vineyard management (regardless of how vague and subjective the term "quality" is). This newsletter will focus on the role of crop management in achieving a desired quality and quantity (yield) of fruit.

Managing the crop in your vineyard does a few things. It allows you to achieve a desired tonnage at harvest. It also allows you to manipulate how the vine will utilize its energy during ripening. During the ripening period every cluster of every vine is a "sink". Each "sink" places a demand on the vine because it requires energy to ripen. Recently, Jim Kennedy, wine chemist at OSU, published a paper in *Practical Winery and Vineyard* that discusses berry development with respect to optimizing maturity (see recommended reading). Understanding berry development is critical in making crop management decisions. It helps us understand why timing is so important when estimating yields and thinning fruit. It also creates opportunities for us to achieve desired affects through strategic management practices.

Grape growers have the opportunity to manage their crop throughout the entire season. Pruning, shoot thinning, and fruit thinning are all management tools that can be used to manipulate yield. Shoot thinning and fruit thinning also help create a more open canopy, which is desirable for high quality fruit (more air movement and sunlight, less disease pressures). Other opportunities grape growers have to manage the quantity and quality of their crop are during both nutrient and water monitoring and management.

---

**Effects of Crop Level on Yield Components, Fruit and Wine Composition, and Wood Carbohydrate Reserves of Pinot noir Grapes**

The following is an abstract that was printed in the ASEV Technical Abstracts of the 53rd Annual Meeting held in Portland, Oregon. It describes a crop load study that was done in Oregon during the 1999 and 2000 growing seasons. Erik Brasher conducted the study in fulfillment of his Master of Science degree from Oregon State University. Erik worked under the guidance of Dr. Carmo Vasconcelos.
The effect of crop thinning on yield components, fruit and wine composition, vine vigor, and wood carbohydrate reserves of Pinot noir grapevines was studied during two seasons at two locations in the northern Willamette Valley of Oregon. At both sites, crop was reduced at véraison. At site 2, during the second season, vines were thinned at bloom or at véraison in a factorial design. Wine was made from both thinning dates from the highest and lowest crop load levels. Yields ranged from 2.2 to 6.6 tonnes/ha (0.98 to 2.95 tons/ac). Yield components at both sites that were significantly affected by crop level were those expected to be strongly correlated with cluster thinning such as yield per vine, clusters per shoot, and Ravaz Index. Berries per cluster and cluster weights were significantly decreased in response to cluster thinning at site 1 in the first season. At site 2 the grape cluster weights decreased with increasing crop levels during both seasons. In the same vineyard, the number of berries per cluster decreased with increasing yields. These changes in cluster weights and the number of berries per cluster are an artifact caused by selectively removing underdeveloped clusters, thus increasing the mean cluster with of the remaining clusters. Berry weights did not increase when clusters were thinned at véraison, indicating that yield compensation did not occur. At site 1 during the first season, juice pH decreased from 3.16 to 3.14, when yields increased from 2.8 to 6.2 tonnes/ha (1.25 to 2.77 tons/ac)(Table 1). During the second season at site 1, soluble solids decreased from 24 to 23.2 Brix when yields increased from 3.2 to 7.1 tonnes/ha (1.43 to 3.17 tons/ac)(Table 1). There was no response to cluster thinning on fruit composition at site 2. Despite the wide range of crop load, cluster thinning had no impact on vine vigor or wood carbohydrate reserves over the two-year period at both vineyards. There was an increase in total anthocyanins and color intensity in wine from fruit thinned at bloom as compared to véraison thinning. Within the cropping ranges represented by these two vineyards, which are typical of yield projections for vineyards in the northern Willamette Valley that grow Pinot noir, changes in juice and wine composition caused by cluster thinning were too modest to justify the losses in yield.

Table 1: (Site I) Juice and skin composition of Pinot noir vines submitted to cluster thinning at Willakenzie vineyard during the 1999 and 2000 seasons

<table>
<thead>
<tr>
<th>Clusters/vine</th>
<th>Yield (ton/a)</th>
<th>Soluble Solids degrees brix</th>
<th>pH</th>
<th>TA (mg/L)</th>
<th>Anthocyanins (mg/g berry)</th>
<th>Anthocyanins (mg/berry)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1999</td>
<td></td>
<td>2000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>n =</td>
<td></td>
<td>n =</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>16</td>
<td>1.27</td>
<td>14.2</td>
<td>3.33</td>
<td>7.9</td>
<td>0.96</td>
</tr>
<tr>
<td>15</td>
<td>16</td>
<td>1.79</td>
<td>23.5</td>
<td>3.27</td>
<td>7.6</td>
<td>0.91</td>
</tr>
<tr>
<td>20</td>
<td>16</td>
<td>2.44</td>
<td>23.2</td>
<td>3.11</td>
<td>8.3</td>
<td>0.91</td>
</tr>
<tr>
<td>25</td>
<td>16</td>
<td>2.68</td>
<td>23.2</td>
<td>3.12</td>
<td>7.9</td>
<td>0.91</td>
</tr>
<tr>
<td>Significant regression R²</td>
<td>n =</td>
<td></td>
<td>p</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td>0.7370</td>
<td></td>
<td>***</td>
<td>ns</td>
<td>0.0040</td>
<td>0.0630</td>
</tr>
<tr>
<td>2000</td>
<td>0.7440</td>
<td></td>
<td>***</td>
<td>ns</td>
<td>0.1410</td>
<td>0.0350</td>
</tr>
</tbody>
</table>

1 ns, *, **, and *** indicate not significant, and statistically significant at the 0.05, 0.01, and 0.001 levels of probability, respectively.
Crop Prediction and Adjustment
Recently, Steve Price of Price Research Service, Inc., was invited by the Rogue Chapter of the Oregon Winegrowers Association and the Southern Oregon Research and Extension Center (OSU) to deliver a presentation on Crop Prediction and Adjustment. The following is a summary of the presentation Steve gave on July 8th at Paschal Winery.

Predicting yield potential in Oregon Vineyards is not a new topic. Early work done by Steve Price and Porter Lombard during the 80's (see recommended reading) at OSU intended to develop an easy yield potential prediction system that Oregon growers could use. Price and Lombard recognized that a yield potential prediction program for Oregon needed to be adjustable for individual blocks of grapes due to the large swings in yield observed in Oregon vineyards. Yield variation within and between Oregon vineyard sites has been attributed to Oregon's unique environmental and climatic impacts and Pinot noir (the most widely planted grape variety), which is naturally sensitive to environmental effects on yield components.

A quick review: berry development
There are three distinct stages in berry development (See Fig. 1). Stage I occurs from first bloom to lag phase and is when cell division is occurring. Stage II (lag phase) is a short period between Stage I and Stage III when seed hardening occurs. Stage II usually occurs 50 days past first bloom. Stage II is referred to as "lag phase" because a lag in berry growth (weight and diameter) can be observed during this time. This lag is a result of vine energy being spent on seed development rather than berry (skin/pulp) development. Stage III occurs after lag phase until harvest. Stage III is when berry cells are enlarging.

Why predict yield potential?
Predicting yield is an extremely important exercise that grape growers participate in every growing season. Yield prediction is critical to making thinning decisions in the vineyard, planning processing and tank/barrel space in the winery, and meeting winery/vineyard contract obligations. Most importantly, yield affects quality. Thus, predicting yield accurately is of enormous value to both the grape grower and winemaker.

When to predict yield potential
Stage II of berry development (lag phase) has proven to be a good indicator that berries are half way to harvest and half way to their final weight. Thus, lag phase is an ideal time to predict yield potential because sample weights can simply be multiplied by two (on average, see Lag phase prediction) and there is still time to thin fruit. It is important to note that using sample weights at lag phase is only indicative of yield potential not actual yield. Depending on weather conditions (temperature and precipitation) yield can fluctuate above or below the estimated yield value at lag (See Fig. 2).

Determining lag phase
The best way to determine when lag phase is occurring is to measure seed hardness (See Fig. 3). Begin by making small cross section cuts with a razor into a sample berry. Continue making small cuts until you cut the base of the seeds. If the razor cuts through the seed easily, lag
phase has not begun. If resistance is met by trying to slice the seeds, then the seeds have started to harden and lag phase has begun.

Lag phase prediction
On average, a sample taken during lag phase can be weighed and then multiplied by 2 to predict yield potential. However, a range of 1.7 to 2.6 for multiplying factors has been observed. It is important to factor in block history, predicted harvest weather, bloom weather (how concentrated the bloom period was, ex: 3 days vs. 10 days), and % seed hardening when determining your multiplier value. Currently, there is not a formula to plug all of these factors in to achieve the perfect multiplier. The most accurate tool is your experience over many vintages.

Sampling Techniques
Fruit sampling is necessary to estimate yield potential. There are multiple ways one can choose to sample a vineyard. Berry samples, cluster samples, or whole vine samples are all techniques that can be used to estimate yield potential. Regardless of the sampling technique employed, it is critical to collect random and unbiased samples. This is extremely difficult to do.

Requirements for estimating yield potential with cluster sampling
The following values need to be determined in order to estimate yield potential with cluster samples:

1. producing vines per block (can be determined during dormant season)
2. clusters per vine (can be determined pre-bloom, bloom, or lag phase)
3. lag phase cluster weight (determined at lag phase)
4. multiplier value (start with 2 (adjust according to your knowledge of block); a more accurate (site specific) multiplier can be determined once historical block data has been created)
5. harvest cluster weight (determined at harvest; this value will help you determine how accurate your multiplier value was for the current season and help you determine a multiplier value for the following year)

Requirements for estimating yield potential by whole vine harvest
When using whole vine harvest to estimate yield potential, samples should be taken from trunk to trunk (i.e. 2 vines, 1/2 of each vine). The following values need to be determined in order to estimate yield potential by whole vine harvest:

1. producing vines per block (can be determined during dormant season)
2. yield per vine (determined during lag phase)
3. multiplier value (start with 2 (adjust according to your knowledge of block); a more accurate (site specific) multiplier can be determined once historical block data has been created)

4. yield per vine (determined during harvest)

A simple sample size formula
What is an adequate sample size? Vineyards and individual vineyard blocks will vary in the size of samples that should be taken. The following formula is a simple way to determine how large of a sample one needs to take to achieve a certain degree of accuracy. You can access a sample size calculator to help with your calculation by clicking here http://berrygrape.orst.edu/news/grapes/Vitnews1.htm.

\[ r = \frac{4(CV)^2}{U^2} \]

\( r = \text{sample size} \)
\( CV = \frac{\text{standard deviation/sample mean}}{} \times 100 \)
\( U\% = \text{desired level of accuracy} \)

1. Determine the mean yield/vine (lbs) within the vineyard or block. This can be done by sampling whole vines. The number of vines sampled should represent the size of the block. Be aware of outliers. If any sample is obviously different than others throw it out when determining the mean.

2. Calculate the standard deviation (SD) of the samples taken. Standard deviation can be calculated in the following steps (this is a standard function in any spreadsheet):
   a. calculate the difference of each value from the mean of all values.
   b. calculate the sum of all differences and square that value.
   c. divide this value (b.) by the total number of values minus one.
   d. take the square root of this value(c.) to determine the standard deviation.

3. Use these values (1. and 2.) to calculate CV.

4. Determine how accurate you want to be (what degree of error you can live with). Accuracy is described by U%.

An example of this formula is illustrated in Figure 2. Figure 5 illustrates the relationship between sample size (r) and desired accuracy (U%).

Crop Adjustment Strategy: viticulture practices used to manage crop load
There are a few management tools that can be used throughout the season to adjust crop load in the vineyard. Pruning determines how many potential clusters the vine will produce. Shoot
thinning is a tool that can be used to facilitate good canopy management and reduce the number of shoots that have potential to set fruit. Shoot thinning is a quick easy way to do an initial crop adjustment. Fruit thinning is yet another tool that can be used to manage crop load. There are many ways to thin fruit and many times at which fruit can be thinned. Whole clusters may be thinned or individual berries may thinned. Timing of fruit thinning varies depending on resources (labor and time) and goals.

In general, cluster thinning is slow. Waiting to cluster thin until just prior to véraison means that the canopy will be denser and it will take a thinning crew longer to locate clusters and remove them. Scheduling thinning practices before the vine achieves its full canopy is desirable, as it will be quicker. Thinning can be done prior to yield prediction at lag phase if you have some idea of potential yield within a given block. A key to successful thinning is providing clear instructions to your thinning crew. Some possible pre-prediction and post-prediction thinning instructions follow.

**pre-prediction thinning:**
- remove all short shoots
- remove any touching clusters
- remove all 3rd clusters
- remove wings

**post-prediction thinning:**
- thin to 1 cluster per shoot
- remove a set # of clusters per vine
- remove fruit to achieve a set number of clusters per linear foot
- remove all green fruit at véraison
- remove all damaged fruit

Although it is not very common, berry thinning is extremely attractive for it ability to produce a potentially smaller, looser cluster that is less susceptible to botrytis and gets better overall sun exposure. Berry thinning can be done either chemically (common practice in table grapes) or mechanically (combs, machine harvesters).

**Price Research Examples**
During the 1999, 2000, and 2001 growing seasons a handful of Oregon wineries took part in a crop removal study which sought to address the best time for cluster thinning and whether fruit quality is enhanced. This study also addressed whether compensation occurred due to early thinning. The thinning standard was one cluster per shoot for all treatments. The three cluster thinning treatments were thinned either at shatter, at seed hardening (lag phase), or at 50% color change (véraison).

During all three seasons, there was no evidence of fruit compensation due to early thinning. Additionally, there was little evidence of differences in fruit chemistry (brix, pH, and TA) between the thinning treatments. In 1999, there was a large difference in potassium levels between thinning treatments. Some effects on wine phenolics were observed from the thinning treatments. In 1999, there was a large difference in first color. Also in 1999, there appeared to
be a difference in seed maturity (catechin). These differences were not observed in 2000.
There was a general wine preference for the treatments that were thinned early (shatter and lag)
over the thinning that was done at véraison.

As a result, the wineries that participated in this study feel the thinning window is longer than
they used to assume. Therefore, they thin earlier.

Stage I = cell division
Stage II “lag phase” = seed development
Stage III = cell enlargement

Fig. 1: Berry growth curve
Fig. 2: Effects of weather conditions on cluster volume in 1985 (hot dry prior to harvest) and 1986 (rain prior to harvest). Cluster volume was determined using the water displacement method in a volumetric flask.

make small slices with a razor until contact with seeds is achieved

Fig. 3: Cross sectional slices to determine seed hardness and lag phase
Sample weights (lbs)
yield/vine

<table>
<thead>
<tr>
<th>Value</th>
<th>Mean</th>
<th>SD</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2</td>
<td>2.0</td>
<td>0.458</td>
<td>22.8</td>
</tr>
<tr>
<td>2.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ r = \frac{4(CV)^2}{U^2} \]

If \( U = 5\% \), \( r = 83 \)

If \( U = 10\% \), \( r = 21 \)

If \( U = 15\% \), \( r = 9 \)

\[ r = \text{sample size} \]

Fig 4. Sample calculation
Fig 5. Relationship between sample size ($r$) and desired accuracy ($U\%$).

Table 1: Cluster weights from 4 blocks of Pinot noir during lag phase and harvest in 1986.

<table>
<thead>
<tr>
<th>Block</th>
<th>lag phase cluster weight (g)</th>
<th>harvest cluster weight (g)</th>
<th>increase factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>29</td>
<td>74</td>
<td>2.6</td>
</tr>
<tr>
<td>2</td>
<td>35</td>
<td>89</td>
<td>2.5</td>
</tr>
<tr>
<td>3</td>
<td>36</td>
<td>89</td>
<td>2.5</td>
</tr>
<tr>
<td>4</td>
<td>67</td>
<td>131</td>
<td>2.0</td>
</tr>
</tbody>
</table>
At his Crop Prediction and Adjustment presentation, on July 8th at Pascal Winery, Steve Price commented, “Myself and others at OSU, came up with the idea of crop prediction in 1988 but it has been people in the industry that have run with it and applied it in many different ways.” This comment created an opportunity to interview a few people in the industry about how they are predicting yield and making crop adjustments. The results of the interviews are described in Table 1 and Table 2. Most of the individuals interviewed are managing several vineyards, growing grapes for high-end wines, and have many years of grape growing experience.

Numerous factors determine what thinning practices a grower will use. As Rick Ensminger stated, “The vineyards and wineries have to work hand in hand in order to grow the fruit to the wineries specifications”. Factors that affect crop load and thinning practices include growing region, site, variety, frost damage, trellis system, vine density and vine age. For example, some varieties grown in Southern Oregon, achieve the desired quality with higher yields due to the warmer climate. In the Willamette Valley, where it is cooler, lower yields have been found to result in better quality.

As with all vineyard practices, fruit thinning methods continue to evolve as growers and winemakers strive for the highest quality possible. Most of the people interviewed are using the lag phase cluster weight method of predicting yield. However, some people are able to use historical data and visual observation to make good predictions. Rick Ensminger says he uses historical data plus observations of fruit set and shoot length to help him determine the optimal crop load. Shoot length is an important indicator in his dryland-farming situation. Earl Jones experimented with doing green cluster weights but found it was very time consuming with 14 different varieties. Instead, Earl uses historical data on average cluster weights at harvest and # of clusters / vine.

A number of people are experimenting with leaving the second cluster (2°) instead of the bottom cluster (1°) because it is smaller. Stirling Fox said, “This year we are comparing average cluster weights of primary versus secondary clusters because if you are thinning off all the bottom clusters and they are consistently larger, you may reduce your crop by more than you had planned.” On the other hand, Dai Crisp prefers leaving the bottom cluster, at his cool high elevation site, because they ripen earlier.

Another technique people are using is wing and shoulder removal as part of their thinning procedure. Growers are doing this either soon after fruit set or during post-véraison removal of green fruit to tighten the maturity curve. “We have found that wings and shoulders are usually 2 °Brix behind the main part of the cluster at harvest”, Crisp stated. This year, Crisp removed wings and shoulders on cluster samples before weighing them in blocks where wings and shoulders are going to be thinned. By doing this, he can better predict the final average cluster weight and yield.

Most growers remove short shoots or clusters on short shoots, the third (3°) cluster, and green or pink fruit (at 75-80% véraison) for routine thinning procedures. The number of times a grower can afford to send a thinning crew through the vineyard is dependent on the price they will receive for the fruit. Other vineyard practices that were mentioned for producing high quality fruit are: good shoot positioning (no shoots crossing each other), fruit thinning so that clusters
don’t touch and can hang freely, leaf pulling on the east side, shoot thinning early, avoiding damage to the fruit, removing fruit damaged by sunburn, and paying attention to details. As Crisp said, “It is all about balance and light, you have to keep those photoreceptors receiving and have sunlight exposure on your fruit”.

Table 1. People interviewed production information and yield prediction method.

<table>
<thead>
<tr>
<th>Person interviewed</th>
<th>Title</th>
<th>Region</th>
<th>Acres</th>
<th># of contracts</th>
<th>Varieties &amp; crop levels (tons / ac)</th>
<th>Who makes decision on crop level?</th>
<th>Sold by the acre (A) or ton (T)?</th>
<th>Method for yield prediction</th>
<th>Accuracy level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dai Crisp</td>
<td>VM</td>
<td>W. V.</td>
<td>93</td>
<td>15</td>
<td>PN (1.8-2)</td>
<td>50 / 50 VM /WM</td>
<td>A</td>
<td>LPCW</td>
<td>90-95 %</td>
</tr>
<tr>
<td>Stirling Fox</td>
<td>VM</td>
<td>W. V.</td>
<td>260</td>
<td>4</td>
<td>PN (2-3), PG (2.75-3) CH (2.5), R (2), SB (2.5) MU (3) GN (3) **Mgmt. team (VM, WM &amp; O)</td>
<td>50 / 50 VM /WM</td>
<td>A</td>
<td>LPCW</td>
<td>Good</td>
</tr>
<tr>
<td>Randy Gold</td>
<td>VM</td>
<td>S. OR</td>
<td>125</td>
<td>4</td>
<td>PG &amp; CH (3.5-4.5) M, CAB, S, V, &amp; T (2.5-3.5), CF 2.5</td>
<td>50 / 50 VM /WM</td>
<td>T</td>
<td>LPCW, PH</td>
<td>Quite accurate</td>
</tr>
<tr>
<td>Rick Ensminger</td>
<td>VM</td>
<td>C.G.</td>
<td>70</td>
<td>6</td>
<td>PN, PG, CH, G, M &amp; L (2.5-4.5)</td>
<td>Primarily the WM</td>
<td>A</td>
<td>O</td>
<td>Fairly good</td>
</tr>
<tr>
<td>Allen Holstein</td>
<td>VM</td>
<td>W. V.</td>
<td>400</td>
<td>6</td>
<td>PN (2.5 –3.5), PG (3) R (3), CH (2.5 –4)</td>
<td>75% WM / 25% VM</td>
<td>_</td>
<td>LPCW</td>
<td>90-97%</td>
</tr>
<tr>
<td>Earl Jones</td>
<td>O, VM, WM</td>
<td>U.</td>
<td>55</td>
<td>4</td>
<td>T, S, &amp; M (3) &amp; 11 other varieties</td>
<td>Earl (VM, WM, O)</td>
<td>T</td>
<td>O, PH</td>
<td>65-75%</td>
</tr>
<tr>
<td>Michael McCauley</td>
<td>WM</td>
<td>S. OR, Ill. V.</td>
<td>_</td>
<td>7</td>
<td>PN, PG, PB &amp; G (2.5-4) CH (4)</td>
<td>50 / 50 VM /WM</td>
<td>T</td>
<td>LPCW</td>
<td>90-95%</td>
</tr>
<tr>
<td>Joel Myers</td>
<td>VM</td>
<td>W. V.</td>
<td>240</td>
<td>7</td>
<td>PN (2-2.2), PG (3-4) CH (-)</td>
<td>50 / 50 VM /WM</td>
<td>PN by A PG by T</td>
<td>LPCW</td>
<td>90 %</td>
</tr>
<tr>
<td>Bill Wendover</td>
<td>VM</td>
<td>Ill. V, A. V.</td>
<td>300 prior</td>
<td>20</td>
<td>PN (2-4), PG &amp; CH (4-5), R &amp; M (10), G (8-10)</td>
<td>Primarily the WM</td>
<td>_</td>
<td>O</td>
<td>90 %</td>
</tr>
</tbody>
</table>

VM = Vineyard Manage, WM = Winemaker, O = Owner
W. V. = Willamette Valley, S. OR = Southern Oregon, CG = Columbia Gorge, U = Umpqua, Ill V. = Illinois Valley, A. V. = Applegate Valley
PN = Pinot noir, PG = Pinot gris, PB = Pinot blanc, CH = Chardonnay, SB = Sauvignon blanc, M = Merlot, R = Riesling, CAB = Cabernet Sauvignon, CF = Cabernet franc, G = Gewuztraminer, V = Viognier, S = Syrah, T = Tempranillo, L = Limberger, G = Grenache, MU = Muscat, GN = Gamay noir
* = joint decision between the winemaker and vineyard manager, ** = mgmt team of winemaker, vineyard manager and owner.
Table 2. Timing, number of passes and methods of thinning used in vineyard management.

<table>
<thead>
<tr>
<th>Vineyard Name</th>
<th>Timing of main thinning</th>
<th>Average # of thinning passes</th>
<th>Removal of short shoots / clusters on short shoots?</th>
<th>Removal of third cluster per shoot (top 3°)</th>
<th>Removal of wings and shoulders</th>
<th>Which cluster(s) is/are preferentially left on the vine (1°, 2° or 3°)</th>
<th>Removal of green fruit post véraison</th>
<th>Thin to 1 cluster per shoot regardless</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dai Crisp</td>
<td>Lag phase - véraison</td>
<td>3-4</td>
<td>Yes</td>
<td>Yes, in high end blocks</td>
<td>1°</td>
<td>Yes</td>
<td>Sometimes on young vines</td>
<td></td>
</tr>
<tr>
<td>Stirling Fox</td>
<td>Lag phase - véraison</td>
<td>2-3</td>
<td>Yes</td>
<td>Yes, Some blocks</td>
<td>1° or 2°</td>
<td>Yes</td>
<td>Some vineyards</td>
<td></td>
</tr>
<tr>
<td>Randy Gold</td>
<td>Lag phase - véraison</td>
<td>2</td>
<td>Yes</td>
<td>No</td>
<td>2° on young vines</td>
<td>Yes</td>
<td>Yes, on young vines</td>
<td></td>
</tr>
<tr>
<td>Rick Ensminger</td>
<td>Set - véraison</td>
<td>1</td>
<td>Yes</td>
<td>No</td>
<td>Usually the 1°</td>
<td>Yes</td>
<td>_</td>
<td></td>
</tr>
<tr>
<td>Allen Holstein</td>
<td>Lag phase - 50% véraison</td>
<td>2</td>
<td>Not routine</td>
<td>Yes</td>
<td>Usually the 1°</td>
<td>Yes</td>
<td>Yes, rule of thumb</td>
<td></td>
</tr>
<tr>
<td>Earl Jones</td>
<td>Lag phase - véraison</td>
<td>1</td>
<td>Sometimes</td>
<td>Yes, (Syrah and Grenache)</td>
<td>Usually the 1°</td>
<td>No</td>
<td>Yes, rule of thumb</td>
<td></td>
</tr>
<tr>
<td>Michael McCauley</td>
<td>Lag phase - véraison</td>
<td>2-3</td>
<td>Yes</td>
<td>Yes, Sometimes</td>
<td>Usually the 1°</td>
<td>Yes</td>
<td>Some vineyards</td>
<td></td>
</tr>
<tr>
<td>Joel Myers</td>
<td>Lag phase - véraison</td>
<td>3+</td>
<td>Yes, if 16° or less</td>
<td>Yes</td>
<td>1°</td>
<td>Yes, at 75%</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Bill Wendover</td>
<td>Start of véraison for PN, after bloom for others</td>
<td>1</td>
<td>Yes</td>
<td>Depends on crop level</td>
<td>No</td>
<td>1° and 3° (if two clusters per shoot)</td>
<td>Yes, (PN)</td>
<td>Sometimes for higher end wine</td>
</tr>
</tbody>
</table>

* 1° = primary or bottom cluster on a shoot, 2° = secondary or second cluster up the shoot, 3° = tertiary or third cluster up the shoot.

**Recommended Reading**

The following scientific publications and trade journal articles are a small portion of numerous publications that discuss aspects of crop management and yield potential.


