Northern Grapes News

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Managing Winter-Injured Vines

Paolo Sabbatini, Michigan State University

The 2013-2014 winter in the Midwest and Eastern US was defined by the polar vortex; temperatures plunged into the sub-zero digits and the extended duration of the cold events severely affected grapevines. Many cultivars that normally survive our winters with little to no damage were severely injured by the extreme cold. The extent of the damage will depend mainly on cultivar and location. This winter will show dramatic differences among cultivars and the spring will reveal what type of damage (bud, trunk, and vine death) growers will have in different vineyard locations; once the damage is assessed, the challenge is to determine how to successfully manage vines during the 2014 growing season.

Damage reports. Reports of the extent of winter injury in vineyards across the Midwest and Eastern US are rolling in. In Ohio, almost 98% bud damage is reported on vinifera grapes, with hybrids at 60%, and American grapes at 30%; even cold-hardy grapes are extensively damaged. In New York, the average *V. vinifera* bud damage (as surveyed by the Cornell University Extension team) is 67%. However, the level of damage varies depending on vineyard location; for example, in Pinot noir, bud damage ranges from 18% to 100%.

Winter pruning. This year, the strategy for coping with the extensive winter injury should start with delaying pruning as long as possible during the dormant period. The delay should be used to assess the extent of winter injury and then adjust the pruning strategies in relation to bud and vine damage and mortality levels. Therefore, before pruning, grape growers should carefully evaluate each cultivar for bud damage. Each bud (or node) is a compound bud, or a complex of three primordia. The primary primordia (or "primary bud") is the largest meristematic tissue in the middle of the compound bud. The secondary bud is located towards the base of the cane, while the tertiary bud (which is generally not fruitful) is located towards the apical portion of the cane. For most of the varieties grown in the East and Midwest, the primary bud carries 70-75% of the cropping potential of the compound bud (primary + secondary + tertiary). Knowing this simple bud morphology and making cross-sectional cuts (with a sharp razor blade) through the bud, growers will be able to identify the health status of each bud. If the buds are alive and healthy, they should be green; brown or black color is unfortunately an indication of mortality (Fig. 1).

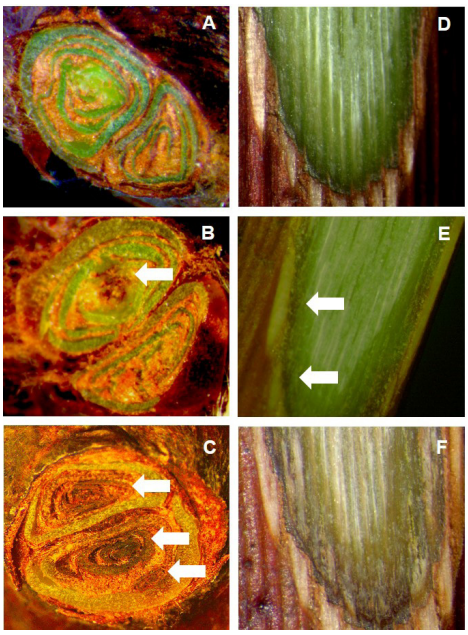


photo: Paolo Sabbatini, Michigan State University

Fig. 1. *Cold injury to grape buds and canes. A) Healthy compound bud; B) Discolored tissues indicating injury to primary bud; C) Compound bud with cold injury to primary, secondary and tertiary buds; D) Healthy cane tissues; E) Moderate cold injury to cane indicated by discolored cambium tissues; F) More advanced symptoms of cold injury to cane*

How many buds need to be assessed is related to the amount of damage that the vineyard suffered. Start by collecting a sample of 40-50 buds; if they are all dead (brown-dark), the chances of finding living buds is very slim and there is no need to continue the assessment. Contrarily, when the results are highly variable (alive and damaged buds in samples coming from the same cultivar and the same vineyard location) it's advisable to check about 100 buds to get a more accurate idea of the level of damage. If the vineyards are not uniform (different vine size, slope, soil), it is better to keep samples from vines/areas separated to evaluate the potential impact of those variables. Secondary bud mortality is usually similar to primary bud mortality, yet some indication of the amount of secondary bud damage is important, especially when over 60% of primary buds are dead. When the assessment of bud damage is complete, the next step is to adjust the pruning strategy for the 2014 season accordingly. General suggestions are reported in Table 1.

Table 1. Suggested pruning strategies in relation to different levels of bud mortality.

Bud mortality (%)	Suggsted strategy
10-15	No need to adjust your winter pruning.
20-50	Leave a higher number of buds (+20-30%) at winter pruning.
60	Double the number of buds left.
More than 60	No dormant purning or just reestablish the bearing structure of the vine.

Severe damage. When bud mortality is over 70%, pruning effort should be directed to reestablish the fruit-bearing zone of the vines and to balance the growth of the vines during the spring and the summer. When vines are severely damaged, base buds close to pruning cuts have the potential to break bud and grow. This physiological phenomenon is very useful for increasing the number of shoots per vine during the spring and consequently increasing the total leaf area. Having a higher number of shoots in established vines, which have large root systems and plenty of reserves in the permanent structures of the vine, will avoid excessive shoot growth (bull canes). Vigorous shoots tends to have long internodes and poor lignification, which makes them less resistant to winter injury and poor choices for next year's pruning (both cane and spur pruning).

Vine renewal. The extreme cold during this winter could also have permanently damaged cordons and trunks. Injured cambium tissues will be a brown to black color (Fig 1). When damage on permanent cordons is present, the pruning effort should be directed at reestablishing the structure of the vine. Renewal canes from the base of the trunks are the best option for replacing injured trunks and cordons. Severely injured trunks need to be replaced because in cold climate locations, they are very sensitive to crown gall disease (especially *V. vinifera* cultivars), and diseased portions of the vine needs to be removed and replaced with new healthy tissues.

Suckers. Severely winter-damaged vines often have shoots called suckers coming from the base of the vine. Sometimes, due to very extensive damage, suckers are the only resource for leaf area for the vines in the spring. Several extension bulletins and growers' experience suggest that the suckers should not be removed or even thinned to one or two per vine. Instead, it's best to leave at least five or six suckers and guide their growth to the trellis. Other suckers, if present, can be allowed to grow on the ground, because they are source of additional photosynthetic leaf area resulting in additional carbon production during the summer and they will help prevent excessively vigorous growth on the potential replacement canes. Again, overly vigorous growth during vine recovery from cold damages is not desirable.

Other strategies. Several other viticultural strategies can mitigate the impact of winter cold: (1) the use of multiple trunks, sometime defined as "spare-parts viticulture," (2) always having replacement canes (suckers) growing under the vine, which is fundamentally important for grafted cultivars and (3) covering the graft union with soil during the winter.

Graft unions. Covering (and uncovering) the graft union of the vines every year is very labor intensive, but is also the most efficient technique to guarantee that vines and fruiting canes will survive for the following season. Soil serves as an excellent method of insulation. A few inches below the soil surface, temperatures are rarely damaging, as they generally remain around the freezing point, with much colder air temperatures just above the soil surface. Commercial growers use a grape hoe to mound the soil in the fall and they remove the soil in the spring, before the vines restart their active growth (to prevent scion rooting; roots growing from the scion variety instead of the rootstock variety). Graft unions on grafted vines should be covered with few inches of soil for the winter months, protecting scion buds close to the grafting point that could be very important in the case of severe winters damaging or killing the buds above the mounted soil.

photo: Michigan State University Extension Bulletin E2930

Insulation of the graft union in V. vinifera vines with soil (or mulch) by hilling up above the graft union. This method is going to provide the best protection from cold injury especially to the graft union area and those viable scion buds above the union. Image from: Winter injury to grapevines and methods of protection.

In 2012, the USDA released a new plant hardiness zone map to be in line with the temperature increase around US. We are using the extra heat and the longer growing season to ripen cultivars that were impossible to grow only few decades ago in cool and cold climate ares. Unfortunately, this warming trend is also producing extreme winter cold temperatures and going back to the basic methods of vine protection during the winter is important for sustainable viticulture in the East and Midwest. This winter was a forceful reminder that cultivar choice and site selection are still the most important tools we have against low winter temperatures. While we need to prune vines to mitigate damage as best as possible for the 2014 growing season, we should also keep in mind the 2015 season and crop, and the effect our choices during pruning and training will have on it.

Zabadal, T, I. Dami, M. Goffinet, T. Martinson, & M. Chien. 2007. Winter Injury to Grapevines & Methods of Protection. Extension Bulletin E2930, Michigan State University Extesnsion, East Lansing, MI.

NGP Team Profile: Miguel Gomez

Miguel is an Assistant Professor of Economist at Cornell University, and specializes in marketing and food distribution, pricing and price analysis, and quantitative methods. As part of the Northern Grapes Project, he identified marketing strategies to help wineries succeed.

1. You grew up in Colombia in a family that was involved in the coffee industry. How do you use some of the knowledge you gained from that experience in your current research on the grape and wine industry?
From my past experience in Colombia I gained an appreciation for both production and marketing issues in agricultural production. I learned that being an excellent grower was necessary but not sufficient for business success. Likewise, marketers must understand that agricultural production cannot adjust immediately to market needs. It is the same in the grape and wine industry, our research needs to carefully balance producer and marketer needs.

2. As part of the *Northern Grapes Project*, you conducted research looking at the drivers of customer satisfaction in tasting rooms that sell cold-hardy wines, and you've conducted similar research at wineries in the Finger Lakes region of New York, that sell a great deal of *V. vinifera* wines. How did the findings of those two studies compare?
The two studies had very similar results. In both studies we found five principal drivers of customer satisfaction: service, ambience, tasting protocol and retail execution. Of these, ambience and service exerted the most influence on overall customer satisfaction. Furthermore, in both studies we found that customer satisfaction significantly influences purchase intentions, the amount of dollars spent, and quantity purchased. However, the difference between the two regions is that customer service played a much important role in the tasting rooms that participated in the *Northern Grapes Project* than in the Finger Lakes study.

3. You have also researched the drivers of customer satisfaction in grocery stores and restaurants in addition to wineries. What differences and similarities have you found?
In grocery stores and in restaurants we found three primary drivers of satisfaction: customer service, quality of products, and prices. However, in our tasting room studies, we find that price levels and product quality have a very modest influence on customer satisfaction. In the wine studies, we argue that this happens because wine is a much more complex product for the consumers to evaluate in comparison to the products that they typically buy in supermarkets and the food they buy in restaurants. In addition, the wine category is highly differentiated, making it difficult for the consumer to assess the relationship between quality and price. Another important difference is that excellence in service is much more important in the tasting room than in a supermarket or in a restaurant. In the tasting room, the interaction between tasting room staff and the customer is critical to have happy customers and increase sales.

4. Given that you work with a number of different industries under the umbrella of food marketing and distribution, you work with a diverse group of crops and commodities. What do you like most about working with the grape and wine industry?

Working with the wine and grape industry is like having the best of the two worlds. As an agricultural economist, studying the challenges and opportunities of growing wine grapes allows me to do research meaningful to farmers. My research in this area underscores that farmers' decisions (e.g. what to grow and what practices to use) must respond to consumer and winemaker demands and preferences. Conversely, while my research in wine marketing identifies effective strategies that enhance financial performance, I emphasize that it takes time and money to make changes in the production side to meet consumer expectations.

5. In your opinion, what is the most exciting research-based information that will come out of the *Northern Grapes Project*?

I think the most exciting research-based information that will come out of the *Northern Grapes Project* is to identify ways to effectively articulate viticulture, winemaking, marketing in nontraditional wine regions. The *Northern Grapes Project* is a unique opportunity to understand tradeoffs and synergies between these three critical aspects for the growing wine industry in cold climates.

2012 Michigan Wine Tasting Room Research - A Series
Issue #4, The Impact of Tasting Room Fees on Wine Purchases

Don Holecek and Dan McCole, Michigan State University

Charging visitors a fee to taste wines is a sometimes contentious issue that has many wineries seeking to find the right balance between responsible business practices and customer hospitality. Although 70% of North American wineries now charge a fee to taste wines, the practice in some regions is inconsistent, with some wineries believing that offering a free tasting can encourage wine sales, and others feeling as though charging a fee shows the consumer that the wine is of high quality and can't be given away for free.

Study Design: To obtain the information relating to wine purchase and consumption behavior, we surveyed visitors to Michigan wineries throughout the summer and fall of 2012. We worked with Michigan wineries to identify tasting room visitors willing to participate in the study, and then sent surveys to participants shortly after their visits either by mail or email.

The survey was developed following a series of interviews with Michigan wineries beginning in February 2012, which helped us accurately understand the research needs of wineries. Nearly 70 percent of the Michigan wineries with tasting rooms were contacted about what they would like to know about their customer base. These interviews also helped recruit potential research partners. In total, 1,552 questionnaires were gathered by U.S. mail and email with an overall response rate at about 40%. Although understanding the question of how a tasting fee might impact sales was not a primary objective of the *Northern Grapes Project,* some of the questions we asked allowed us to tease out some useful information on the topic.

This article is the fourth in a planned series of reports that will cover questions of a particular interest as they pertains to tasting room operators.

Tasting room fees: One question posed to everyone who took the survey was "Do you avoid tasting rooms that charge a fee?" Almost 71% of respondents said they don't avoid tasting rooms that charge a fee while 29% said they do. Each respondent was also asked about the number of bottles and average price per bottle they spent at the wineries they visited. The respondents who avoid tasting rooms that charge a fee purchased an average of 6.85 bottles of wine at an average price of $14.28 ($97.82 in total spending) over the course of their trip. However, the respondents that do not avoid tasting rooms that charge a fee purchased an average of 7.68 bottles of wine and spent an average of $17.55 ($134.78 in total spending) over the course of their trip.

Next we analyzed the data to see there was a difference in the amount spent on wine in the tasting rooms that charge a sampling fee compared with those that don't. Because this research question was not a primary objective of the *Northern Grapes Project*, we did not ask subjects to report their spending at each winery, but instead asked about the total amount of wine purchased from wineries throughout their trip. However, because many respondents had only visited one tasting room on their trip, we were able to analyze the data from these visitors to better understand the actual purchase behavior of visitors to tasting rooms that charged a fee vs. those that did not charge a fee (Table 1).

A total of 122 respondents visited wineries that charged a fee for their tasting, and bought an average of 4.73 bottles of wine at an average price of $15.52 per bottle ($73.41 total). The 216 respondents who visited tasting rooms that didn't charge indicated they bought an average of 3.68 bottles of wine at an average of $13.34 per bottle ($49.09 total). Although it is clear that visitors spent more at the wineries that charged a fee, it is possible that the difference in spending was the result of other factors. For example, wineries that do not charge a fee tended to draw more day visitors than overnight visitors. Results showed that those who went on a day trip bought an average of only 3.23 bottles of wine for an average of $13.80 ($44.57 total) while those who indicated it was an overnight trip bought 4.82 bottles of wine for an average of $14.40 ($69.41 total).

Table 1. *Difference in spending between tasting rooms that do/do not charge a fee.*

	Fee (N=122)	No fee (N=216)
Bottles	4.73	3.68
Avg. Price	$15.52	$13.34
Total spent	$73.41*	$49.09*

**T-test = significant (p=0.10)*

The purpose of the travel (Table 2) also seemed to have an impact on total spending at the winery. Those who were traveling for a getaway spent the most at $60.96 in total, while those who were traveling only to visit wineries spent a total of only $45.88 (many of these were day visitors). Additionally, when it comes to the purpose of the visit (Table 3), the highest amount spent at the wineries was by those looking to learn about wine ($73.74) and those looking to purchase wine ($69.99).

Table 2. Purpose of visit to the winery.

	Purchase wine (100)	Socialize (47)	Learn about wine (25)	Relaxing day out (65)	Unique experience (43)	Other (45)
Bottles	5.22	3.11	5.52	2.94	3.98	2.56
Avg. Price	$13.88	$14.36	$13.51	$13.65	$14.57	$15.11
Total spent	$69.99	$42.00	$73.74	$40.93	$53.95	$53.36

Table 3. Purpose of travel to the winery.

	Visiting friends & family (68)	Wineries (25)	Getaway (111)	Other (128)
Bottles	4.11	3.52	3.96	4.22
Avg. Price	$13.70	$12.52	$15.41	$13.64
Total spent	$52.11	$45.88	$60.96	$56.22

As it pertains to age, the highest spending totals were among the 51-60 and 61 and older age groups, followed by 31-40, 41-50 and 21-30.

Table 4. Age of winery visitors.

	21-31 (79)	31-40 (51)	41-50 (74)	51-60 (74)	61+ (51)
Bottles	2.7	4.6	4.0	4.8	4.8
Avg. Price	$13.5	$13.8	$14.3	$14.8	$14.2
Total spent	$33.7	$63.5	$53.7	$71.7	$69.0

To help determine which factors contributed the most to differences in spending, we used a statistical procedure called multiple regression analysis. In addition to whether or not a sampling fee was charged, we also considered purpose of travel, reason for visiting the winery, the gender of the respondents, the age of the respondents, the amount of time spent planning the trip, the region of the trip and the respondents' respective knowledge of wine. Overall, the model showed that these variables were not great predictors of total spending. In fact, all of these factors together (including whether a sampling fee was charged) only accounted for 10% of the difference in spending at the wineries, and whether the tasting room charged a fee was not even a significant factor. The other 90% of the spending difference is likely the result of variables not measured in this study (e.g., wine quality).

Conclusion: Although there was a large difference in the amount of wine purchased among those who visited tasting rooms that charged a sampling fee compared with those that did not charge a fee, that fact seems to be insignificant in explaining the difference in wine purchases. This is one of many cases where correlation does not equal causation. A famous example of this point refers to research from several years ago that showed that the murder rate in the U.S. is correlated with higher ice cream prices. Obviously in this case, some other variable is responsible for both the ice cream prices and increased murder rate. The same appears to be true of the correlation between tasting room fees and total wine purchases. Although there is a relationship between the two, whether a winery charges or doesn't charge for a tasting doesn't seem to impact sales either positively or negatively.

Northern Grapes Project Funding Update

The 2014 Farm Bill (or more formally, the Agricultural Act of 2014) was signed into law on February 7th. While the year-plus delay meant that we were not able to apply for a renewal grant "on time," we were granted a one-year no-cost extension, during which we are spending "leftover" funds from the original two-year, $2.3M Specialty Crops Research Initiative (SCRI) grant. We also received funds from the New York State Specialty Crops Block Grant program, and were therefore able to keep the Northern Grapes Project operational during the "gap" year in funding.

Beginning in 2014, the Request for Applications for the SCRI program included a new first step: the submission of a Stakeholder Relevance Statment. These statments were reviewed by an industry panel, and those projects that scored highly enough were invited to submit full proposals. We were fortunate to pass this first step, and our full proposal package was just submitted.

We received fantastic support from the Northern Grapes industry while preparing the renewal grant and were able to collect 23 letters of support from industry organizations and generate almost $142,000 of in-kind matching funds. Thanks to all of you for the incredible support!

We're hopeful the project's funding will be renewed so we can finish all of the work that we hope will ultimately benefit the Northern Grapes industry.

Equipment for Small Wineries

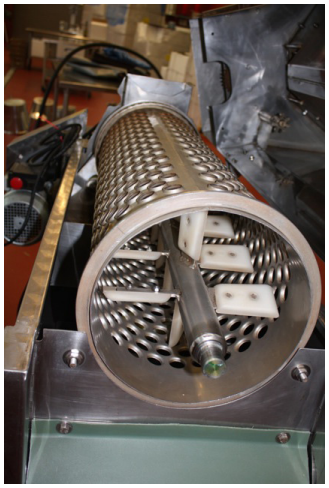
Chris Gerling, Cornell University

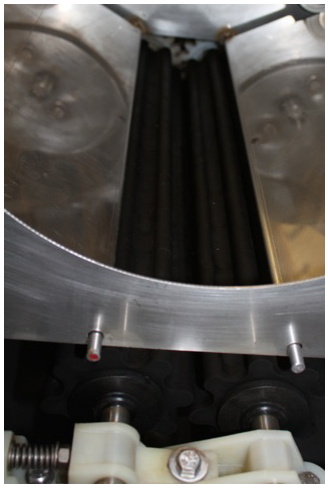
There are countless options when it comes to equipping a winery. Some wineries use state of the art, fully automated machinery, yet there are also high-end wineries that attempt to severely limit said machinery from touching the products. Some top-tier manufacturers are starting to produce versions of their elite equipment that are a fraction of the size (and perhaps 80% of the cost) of larger siblings. A boom in home fermentation has also prompted several of the brewing and winemaking suppliers to stock more "prosumer" equipment aimed at enthusiasts and people with the intent but not necessarily the budget to go pro. I am now charged with laying out some choices, some considerations and some advice, all while keeping this relatively brief. For this reason I am going to stick to de-stemmer/crushers, presses and filters.

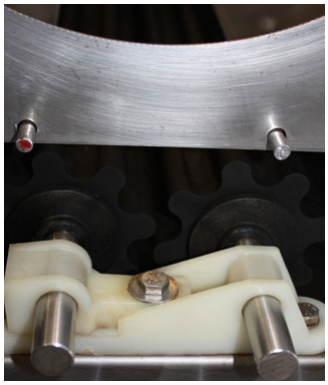
De-stemmer/crusher

Function: Remove rachis (stem) from clusters, break berries.

Mode of operation: Stem removal is usually accomplished by means of a set of paddles connected to a drive shaft that spin inside a circular stainless steel basket containing round holes (Photo 1, below, left). The grapes pass through the holes while the stems are pushed out of the end of the machine. Crushing generally happens between two gear-shaped rubber rollers (Photos 2 & 3, below right).







photos: Chris Gerling, Cornell University

Choices: Some pieces of equipment in this category can only remove stems from clusters, some can give you the option to only de-stem or de-stem and crush, while others will always do both. Higher-end models usually have adjustable speed and distance between the crushing rollers. Some models also include CIP (Clean In Place) spray nozzles. While these sound great and are undoubtedly useful in a machine that gets unbelievably sticky during use, don't think for a second they can save you from the daily routine of taking it apart to get at every nook and cranny.

Considerations and advice: While they come in many shapes and sizes, almost all employ the same basic design. The major differences come down to appropriate size, how well it actually does the job and ease of maintenance/ cleaning (especially cleaning). Other questions: what type of power does it need? What metals and food grade materials is it made of and what will touch the grapes? Can it accept bins or be upgraded to do so? Does it produce lots of "jacks" (broken pieces of stem that aren't removed)? What are the parts that wear out, and can replacements be sourced in the US?

Press

Function: Separate skins and seeds from juice before or after fermentation, depending on wine color and style.

Mode of operation: Physically squeezing the grapes.

Choices: Presses for small wineries come in two general flavors, basket and bladder/membrane. For most new presses sold to commercial wineries, the winemaker can program a press sequence and the press will run it. The winemaker can then see to other tasks while the program is running (think about this like cooking — walk away for a minute to check a valve: yes; leave for a doctor's appointment: no).

photo: Chris Gerling, Cornell University

Basket presses are composed of a wooden or stainless steel perforated cylinder sitting on a platform to hold the crushed grapes and then some type of ram that moves down the center of the cylinder (Photo 4, left).

A bladder press has a rubbery inner tube that inflates with air or water and squeezes the grapes against the walls of a stainless steel cylinder. A more advanced version of a bladder press is the membrane press, wherein the "inflatable" portion is mounted against the walls of the press and a non-elastic membrane pushes the grapes against perforated stainless steel cylinders (aka "channels") inside the press. Membrane presses are almost always air-powered (Photo 5, bleow).

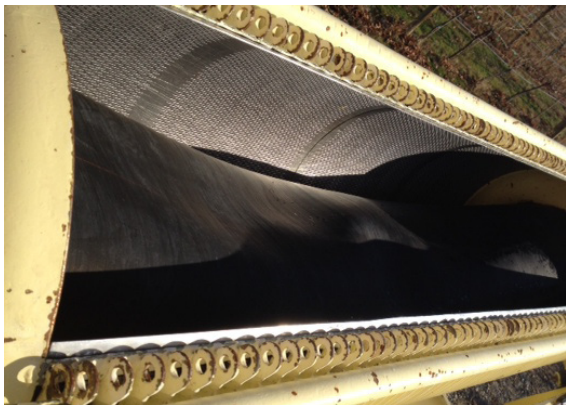


photo: Chris Gerling, Cornell University

Considerations and advice: What type of power does it need? How easy is it to clean? What metals and food grade materials is it made of and what will touch the grapes? How much air or water does the bladder/membrane require, and what type of compressor or water system will be required? What types of wine will you be producing? Basket presses are generally more effective for dessert and ice wine pressing, although many wineries use bladder presses quite successfully.

Filter

Function: Remove unwanted sediment and microbes from the wine to improve appearance and microbial stability.

Mode of operation: Various — there are four major types of filters that a small winery might consider which fall into two primary categories- surface and depth (Photo 6, below). As the illustration shows, surface filters simply provide a barrier with small openings that block particles too large to fit through (think a wall with a gate), while depth filters are more like a maze. Filtration systems usually have a rating regarding the size of particle they will exclude, and this can be a nominal or absolute rating. A nominal rating means that under certain operating conditions, most of the larger stuff (90-99% or so) will be excluded most of the time. An absolute rating means that (depending on manufacturer and rating) 99.9% of particles larger than the rated size will be excluded. Depth filtration is always nominal while surface filters can be nominal or absolute. Why would anyone ever spend time and money on nominal filters when given a choice? Because you spend far less time and money employing nominal systems, and get much greater throughput as well.

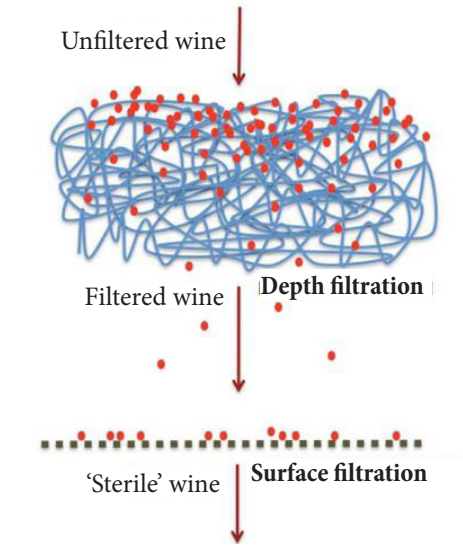


photo: Chris Gerling, Cornell University

Filtration is not strictly necessary in wine production; there are labels that tout the lack of filtration as a selling point. Most wineries choose to filter, however, and there are uses for filtration besides the usual bottling preparation, including increasing yield by filtering hard pressings, stopping fermentation (usually after lowering the temperature), removal of fining agents and making the wine visually "brilliant."

Surface Filters

Membrane Filter. The basic filtration idea- the membrane has small holes of a certain size, and everything larger is excluded. These membrane cartridges are also often used with bottling lines to make sure that no stray yeast or bacteria get through. Wineries only use these bottling line filters as a check, however, and the reason for this is the shortfall of the filter: they're expensive and pretty easy to plug up.

Pros: Relatively cheap overall system cost, integrity can be easily tested, can achieve "absolute" filtration.

Cons: Easily fouled, limiting throughput, especially with turbid liquids and/ or early in the production process. Membrane cartridges (Photo 7, below) are expensive to replace.

photo: Chris Gerling, Cornell University

Cross-flow. A cross-flow filter is an automated system where the liquid is pushed parallel to the filter media instead of straight at it, reducing surface-fouling. Part of the automation is a periodic back-flush that helps dislodge accumulated gunk. With these systems in place, a cross-flow filter can achieve both high throughput but also high-level (0.2 micron or less) filtration.

Pros: Can take a wine from unfiltered to final filtration level in one pass. Good throughput with relatively low labor and cost of operation.

Cons: While each year they get smaller and cheaper, cost of equipment is still an order of magnitude higher than other filters. Winemakers may not want all wines filtered to the extent cross-flows are usually set up for.

Depth Filters

Pad. A pad filter (Photo 8, below) uses filter sheets or pads loaded onto a plate and frame assembly that just means a bunch of the pads can be stacked in a row. Pad filtration works by the principle of the "torturous path," meaning the interwoven fibers in the pad create a labyrinth wherein large particles get stuck. The fiber arrangement means the rated pore size is an average.

Pros: A pad filter is relatively cheap and easy to set up, has good throughput, and is often the most-used in small wineries. Once a winemaker is comfortable with the system, there are options like using two filter grades in one pass or removing filter plates to minimize hold-up for small volumes.

Cons: Pad filters are labor intensive, and are prone to leak or fail if not set up correctly. Filtration is nominal, as opposed to absolute, so absolute will be required after. Cost of filter sheets adds up over time.

photo: Chris Gerling, Cornell University

DE. Diotomaceous earth (DE) is a powdered form of very soft rock. The rock is actually made of fossilized diatoms (hence the name), which are basically prehistoric algae. The powder is usually whitish, but more importantly it is always porous, making for useful filtration media. There are a few different types of filter systems that can employ DE, including plate and frame (like the pad filter above), vacuum precoat, and pressure leaf. The main principle all of these filters employ is the creation of one or more "cakes," or packed DE, that the wine must travel through. The cakes are formed by the powder combining with the juice or wine and then sticking to the filter surface.

Pros: DE is good for turbid liquids, especially unsettled juice, fermenting must, or dessert wines at any stage of the process. DE is usually the filter of choice for recovering wine from lees after fermentation (and usually what is meant when winemakers use the term "lees filter").

Cons: DE is labor intensive. These filters almost always require more "finesse" in their operation and often the judgment of the operator. Because it is a naturally occurring and therefore variable medium, DE filtration is almost always approximate and hard to quantify in terms of pore-size. DE is also considered a health hazard due to dangers associated with inhaling the dust.

So what do most wineries actually buy and use? Most small wineries that are going to be carrying out the entire production process from grapes to bottled wine have a crusher/destemmer, a bladder (or membrane) press, a pad filter and then some type of absolute membrane attached to their bottling system. These equipment choices seem to provide the best blend of flexibility and performance while also being among the most cost-effective. A winery needs to consider individual styles and goals before making these decisions, however. High-end red wine producers in the West are now using basket presses much more frequently. As I mentioned earlier, cross-flow filters are getting smaller and less expensive all the time. The most challenging part of the planning process may be anticipating growth. No one wants to buy equipment that won't do the job in two years, but the payments are the same no matter how many (or how few) grapes get squeezed.

Larger, more automated equipment makes for quicker operations when there is a large amount of one grape variety or wine lot to be handled. When the plan calls for frequent switches between short-runs that are headed to different tanks, however, it can actually be more effective to have a smaller crushing/pressing set-up that will make for faster turnover. At the Vinification & Brewing Lab, where we produce hundreds of small lots of wine for our research, it often takes longer to clean the de-stemmer between lots than to actually put the grapes through. A bigger, fancier machine,

which takes longer to clean, would only slow the process down. We are an extreme case, but you can see the idea. In most complex processes, the slowest step often determines the speed of the entire procedure. Chemists call this the "rate-limiting step." Basically it's what's slowing you down. For wineries producing white wines at harvest, the limiting factor is almost always the press. Loading, operating, emptying and readying the press for the next cycle almost always take far longer than continuous crusher operation would dictate, and this is why my advice is to look to invest more in press capacity (which could mean larger or even more than one) before looking at larger, faster crusher/de-stemmers.

When considering equipment options, be aware of how the machinery is taken apart for cleaning and maintenance. Visit a winery and watch the machinery in operation and also the set-up and clean up. Make sure the power needs of your equipment can be met by the winery electrical supply. Consider the styles of wine you will be making — is it more important to get higher yields or to treat the grapes more gently? Natives and certain hybrids can be more difficult to press and filter. This leads me to another option: outsourcing. Any step of the process can be hired out to a custom crush facility or better-equipped winery. There is also the option to rent certain equipment (cross-flow filters, for example) for a specified length of time. My final piece of advice is to visit a "gravity" winery — a winery that has been designed to minimize the use of pumps. You may not be interested in duplicating the set-up, but it can be really useful to see a facility that has been designed around the winemaking process. The more efficiently a winery can be thought out and equipped, the easier, cleaner and safer every operation will be.

Resources

Wine Business Monthly, especially recent articles about small bottling set-ups, pumps and sparking wine equipment:
http://www.winebusiness.com/wbm/index.cfm?go=getArticle&dataId=51566
http://www.winebusiness.com/wbm/?go=getArticle&dataId=81500

Wine Country Classifieds:
http://www.winerysite.com/images/pdf/classifieds.pdf

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