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INFORMATION Sheet

Defying Vintage: Predicting and Managing Annual Variability in the Vineyard

There is a very common axiom in viticulture and enology that, "the wine is made in the vineyard," and therefore "to make a great wine you need to start with great grapes." Most amateur wine makers have a particular wine making “style” that they try to maintain, however, in most locations in the Eastern U.S. it is a challenge to come up with great grapes every year to maintain that style due to the annual variability in weather. The cool, dry, "dream" growing season of 2001 contrasted with the wet, "difficult" season of 2000 is a classic example of the disparity of conditions commonly experienced from year to year.

Variables such as weather (precipitation, day/nite temperatures, and sunlight), pests (insect, disease, weed, deer, and bird), vegetative (canopy) development, crop load, and timing of harvest will produce a specific set of fruit quality parameters which will ultimately influence the wine quality. Grape pH, total acidity (TA), sugar content, organic acid profile, tannin maturity and especially varietal character vary considerably depending on conditions during the growing season. Some of these variables are beyond our control, but many can be adjusted, controlled, or compensated for through common viticultural management practices.

It is therefore important to be aware of site conditions during *each* growing season so one can *anticipate* potential problems and make the appropriate management, harvesting, and wine making decisions to produce the best quality grapes and wine possible. The good news for most amateurs is that the typical “backyard vineyard” is relatively small, and is amenable to more drastic management. The objective of this article is to discuss the various "uncontrollable" variables, how to predict their influence on grape quality, and the proper viticultural and/or enological adjustments to optimize quality.

The general theme is to take an *Integrated Viticultural Management (IVM)* approach to grape production and pest management practices, as opposed to treating each practice as a separate entity. An *IVM* approach emphasizes, “whole plant health care” comparable to what is recommended for optimal long-term human health maintenance. Practices of vine training, along with nutrition, canopy, crop, and pest management all interact and are critical for longterm productivity and short-term quality. All are important “links” in the *IVM* chain and any weakness can have a profound, and typically negative, effect. *IVM* includes both *preventive and reactive* viticultural and enological procedures that can be used to compensate for various idiosyncrasies of a particular growing season.

Many vineyard practices, such as vine training, nutrition, and pest management can be considered “preventative”, critical for setting a baseline and for “avoiding” potential problems. Since there is no way to control the temperature, precipitation, and sunshine, if one knows what to expect from a specific set of growing season conditions, *reactive* viticultural procedures can be used to correct potential problems cause by environmental conditions before they can negatively affect crop quality. Constant monitoring of the vineyard is needed in order to catch problems early and correct them before they have an adverse affect.

Vine training

The two most important long-term *preventive IVM* efforts include vine training and nutrition management. Overly vigorous vines tend to produce low yield and poor quality fruit. The best way to minimize annual variation in vegetative vigor is proper vine training and annual pruning. Sites (e.g., heavy, fertile soils) and varieties (e.g.. Cabernet Sauvignon) that are prone to high vegetative vigor and overcrowded canopies need to be planted at wide spacing on “split” training systems that help manage the vigor (e.g. open lyre or Geneva Double Curtain).

When a vine is trained to the appropriate trellis system, the desired seasonal canopy management is more easily achieved. Proper annual balanced pruning will keep crop loads in balance with vegetative vigor, resulting in better grape quality. To maintain good vegetative/ reproductive balance in the vineyard, you are typically pruning for a baseline of about four to six shoots per linear foot of trellis (vertical trained two armed Kniffen).

Nutrition management

Vineyard nutrition is an most important component as it affects all others. Excess Nitrogen (N) will encourage high vegetative vigor and the associated canopy management and wine quality difficulties. If vegetative vigor tens to be too high, decrease annual N application rates, and wait until *after fruit set* to apply if needed.

It is convenient to go out each year and just use a 10-10-10 (N-P-K) for the nitrogen, but long-term use of this practice will lead to deleteriously high level of potassium (K) . Adequate K is necessary, but high K will promote high pH/ high TA fruit, resulting in difficult to manage, less stable wines. Boron (B) and zinc (Zn) are critical for good fruit set and quality and deficiencies should be corrected immediately. Viticulturists must monitor nutrition through regular annual soil and tissue (petiole) testing, coupled with observations and assessment of vigor and yield in the vineyard. Based on the recommendations from bloom petiole samples, appropriate amendments can be made *within the same growing season* to keep the vineyard in the proper vegetative and reproductive balance.

Canopy management

Many factors interact to control vegetative growth during in the season. If the previous winter was severe and bud count is lower that desired (based on balanced pruning calculations) expect greater than normal shoot vigor that will need reactive management. Cool wet springs (prior to bloom) also tend to promote high vegetative vigor and dense canopies, as opposed to hot dry weather that will keep vigor in check. High levels of N applied early in the spring will exacerbate a vigor problem.

Dense canopies resulting from too many shoots reduce light, air, and pesticide penetration to the clusters leading to multiple problems. Shaded fruit is prone to high pH/high TA, reduced pigment content (poor color), increased disease pressure (especially *Botrytis*), delayed ripening, and is typically characterized by an undesirable "vegetative" character. Shoot positioning is always an important practice to optimize quality, but when vegetative vigor is excessive, additional *reactive* canopy management techniques such as shoot thinning, fruit-zone leaf pulling,

and summer shoot shearing can alleviate the fruit quality problems associated with a dense canopy. Again, applying minimal N, and only when needed *after* fruit set (as opposed to early spring) will tend to reduce shoot vigor.

Crop management

It is imperative to maintain the proper interactive balance between fruit load and vegetative vigor. The first step is proper balanced pruning. A heavy fruit load (leaving many buds) will keep vine growth in check but too stringent control of fruit load (leaving too few buds) will result in increased vigor and complicate canopy management.

Grapes on an over-cropped vine will not ripen evenly, will have poor color (uneven ripening), will not accumulate high sugar content, and will have less varietal character. Again, four to six shoots per linear foot of trellis with one cluster per shoot is a good baseline. If the crop is higher than desired, as is often the case with French Hybrid varieties, thinning just *after* fruit set will reduce cluster compactness. This is especially critical and effective for varieties prone to *Botrytis* due to tight clusters (e.g. Riesling!). If vegetative vigor is high due to spring weather, delay the thinning as leaving the "extra" clusters will reduce subsequent growth; thin the extra clusters at veraison to insure proper ripening of remaining crop.

Direct effects of weather

Organic acids are very critical for flavor, balance, and stability in wine. The content and types of acid are greatly affected by many factors, from nutrition to climate. In general, fruit produced in hot dry seasons is typically lower in TA and specifically lower in tartaric and (especially) malic acid, compared fruit developing under cool wet conditions.

The color (anthocyanin pigment content) of red grapes is critical, since darker red color is usually associated with higher quality. Long hot growing seasons tend to produce fruit with low-pigment content. For example, ‘Pinot Noir’, a typically low pigment grape/wine to start with, has even less color under the typical hot summers in the Northeast. Conditions favoring high pH are also deleterious to color. As fruit pH rises, anthocyanin pigment hues change from the desired red to the more undesirable brownish-purple, so harvesting grapes and producing wine within the optimum pH range is also critical for color stability.

Mature or ripe tannins are necessary for “softer” red wines that are of high quality and good aging potential. Therefore in cool wet growing seasons when fruit and tannin ripening is delayed, it is critical to reduce the crop even more (cluster thin) and increase sun penetration to clusters (leaf pulling) to promote more even and rapid ripening.

The presence of pest damage will greatly diminish grape quality. Bunch Rot (*Botrytis*) and other infections can decrease color and aromatics, and increase oxidation, off flavors, and volatile acidity (acetic). These negative characteristics follow through the fermentation and persist in the finished wine. It is therefore imperative to avoid *Botrytis* and other pest damage in the vineyard. Maintain an open canopy (shoot positioning/leaf pulling) that promotes rapid drying of morning dew and precipitation on leaves and clusters, and improved fungicide penetration and cluster contact.

Harvest adjustments

Adjusting time of harvest is a way of compensating for specific fruit characteristics for a specific growing season. As previously discussed, in a hot and dry season, the grapes will typically be lower in acid (tartrate and malate), so the crop may need to be harvested earlier before the acids decrease below the desired range for microbial stability. In contrast, for red grapes in a cool wet year, harvest should be delayed as late as possible to promote proper tannin maturity. In general, harvesting early tend to reduce varietal character,

which may be desirable for some varieties and some wine styles, especially sparkling.

The enologist has many tools, such as utilizing diverse yeast strains, malolactic fermentation, fermentation temperature, blending, and oak aging to compensate for or take advantage of specific quality parameters, but that is an extensive topic for another issue. In summary, since it is not possible or practical to alter climatic conditions, grape crops in the northeast will vary in quality parameters from year to year. However, with an understanding of how specific growing conditions will affect that crop, one can adjust viticultural practices to produce high quality grapes each year regardless of conditions.

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