



By Dr. Richard Smart

## Two golden rules of viticulture

In my travels around the world consulting to clients of different backgrounds and beliefs, I have learned the value of trying to distil some rather complex biology of the grapevine into simple, but hopefully, universal rules.

I want to explain the two rules I feel are most important for vineyard owners to follow. These are the "Two Golden Rules of Viticulture."

If I thought they were original, I would call them 'Smart's Laws,' but it seems that many of my good ideas are not original; most of them I learned from Professor Nelson Shaulis while a graduate student at Cornell University in New York.

I have had the opportunity to learn many other good ideas from friends and colleagues around the world, and I count commercial grapegrowers as a valuable source of viticultural wisdom.

These golden rules are particularly applicable to modern vineyards, which are often excessively vigorous, out of balance and shaded, as I have discussed in previous columns. Why are modern vineyards more likely to suffer these problems?

The modern viticulturist is able to avoid stresses to the vine due to shortages of water and nutrients, and is also able to avoid the effects of most weeds, pests, and diseases. But he or she is apparently rewarded for this good effort by the sight of a vineyard full of leaves.

It seems that we have been more successful in growing leaves and canes than fruit! Put another way, I say our canopy management practices have yet to improve to the same level as those of irrigation, fertilizer, pest, disease, and weed management.

### Importance of vineyard balance

For vineyards to produce sufficient quantities of quality fruit, shoot growth needs to be balanced with fruit yield. If there is not enough shoot growth relative to the yield, we say the vineyard is 'over cropped' but perhaps more appropriately we should say 'under leafed.' Such vineyards are typically of low vigor, which in turn, is due to some stress such as pests, weeds, disease or perhaps a soil environment which hinders root growth.

The more common condition, however, is when the vines are 'under cropped' or 'over leafed.' I must say that this condition is so common that many folks regard it as normal. The appearance of vigorous shoots is symptomatic of this condition.

In spring, shoots grow quickly and the stems are thick, with large leaves and often many active lateral or side shoots. By midsummer, the shoots can be easily six feet or more in length,

and because they can no longer support their own weight, they overlap and fall across the canopy. Of course, such canopies are heavily shaded unless some form of canopy management is used.

There is an important relationship between the above and below ground portion of the vine, which is not always appreciated. Vines growing in a deep fertile soil, or with a vigorous rootstock, or those well-supplied with water and nitrogen have a large root system. The root tips are the site of important hormone production which regulate fruit and shoot growth. The root system is also an important reservoir of stored foods for the vine. In other words, the bigger the root system, the bigger the vine's potential for fruit and shoot growth.

There are several indicators of the size of the root system. Both the amount of shoot and fruit growth and the trunk diameter are two such indicators. Probably the easiest way to quantify this, however, is by weighing the prunings in winter. The one-year-old wood is simply collected from a vine at pruning and weighed. Studies have shown that this weight is proportional to the vine's leaf area the previous year.

Golden Rule #1 relates to creating a desirable vine balance. If a vineyard has a large root system and a high potential for growth, then more buds must be left at pruning in order to balance the vine, otherwise, the individual shoots will be too vigorous as described above.

However, leaving too many buds at winter pruning will cause the growth of individual shoots to be restricted, and perhaps delayed ripening through 'over-cropping' or 'under-leafing' as well. Rule #1 relates the number of buds to be left at winter pruning to an estimate of the root system size, estimated by pruning weight.

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**GOLDEN RULE #1:  
LEAVE ABOUT 12 TO 16 BUDS PER POUND  
PRUNING WEIGHT.**

Experience will teach you how to modify this rule of thumb for your particular vineyard. If you are in a cool region, leave 12 rather than 16 buds per pound. For Pinot noir, which requires a larger leaf area to fruit weight ratio for good table wine quality, leave 12 rather than 16 buds. Similarly, leave 12 buds per pound for varieties with larger than normal bunches.

**Importance of open canopies**

Rule #2 tells how to produce open canopies, and can also be used as a guide for winter pruning and shoot thinning. If shoots in a canopy are too close together, there will be too much shading, and yield and quality will be less than the potential.

If, on the other hand, the shoots are too far apart, then sunlight will be wasted as it falls on the vineyard floor. For vertically shoot-positioned canopies where the vines are in balance, studies have shown that about five shoots per foot gives a canopy with sufficient gaps so there is not too much shoot and fruit shading, and little sunlight is wasted.

It is more difficult to develop a rule of thumb for the typical California or Australian sprawling canopies, because once the shoots grow more than about three to four feet in length, they cannot support themselves and fall down to create shaded canopies.

**GOLDEN RULE #2:  
PRUNE OR THIN THE CANOPY TO ABOUT  
FIVE BUDS OR SHOOTS PER FOOT OF  
CANOPY LENGTH.**

With time, your local experience will allow you to modify this rule to suit your own vineyard and varieties. For example, non shoot-positioned canopies can have more than five buds per foot without necessarily being shaded, and high vigor shoots should be spaced further apart, say three or four per foot.

**Simultaneously applying rules #1 and #2: the tricky part**

The observant reader will have already started to think: *Wait a minute.* How can there be two rules to apply? Both of which are to be used at winter pruning? What if they conflict? Or what if it is impossible to satisfy both rules?

That happens all the time. Consider a typical moderate to high vigor Cabernet Sauvignon vineyard in the Napa Valley, with vines spaced 8x12. In early winter, we measure a few vines and find the average pruning weight to be about six pounds. Applying Rule #1, we will want to leave 16 buds per pound (Cabernet being a vigorous variety), so that means 96 buds.

Applying Rule #2 suggests we want to leave five buds per foot of canopy, or about 40 buds. So Rule #1 says leave 96 buds, Rule #2 says leave 40 buds. They cannot both be right, or can they?

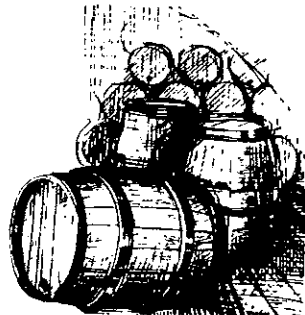
Let us think about the implications of following one rule, and

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disobeying the other. Leaving 96 buds as suggested by Rule #1 means that if there were 100% bud break, then there will be 96 shoots on the vine, or 12 per foot. This value is more than twice the value indicated by Rule #2, and we can expect the canopy to be dense and shaded.

What will happen if we follow Rule #2? Pruning to only 40 buds means that individual shoots will be too vigorous and out of balance, and the canopy will be shaded anyway because of long shoots, large leaves, and plenty of lateral growth.

Interestingly, different countries and regions have developed different approaches to this dilemma. In California, the tendency is to follow Rule #2 at both pruning and desuckering; while the resulting spur and shoot spacing are good, the shoots are typically over vigorous. These shoots become so long they cannot support themselves, overlap each other and create a dense, shaded canopy.

In Australia, the common attitude is to follow Rule #1. The vines are pruned to many buds 'to control vigor, mate.' The resulting bud and shoot density is high, and there may be, for example, 15 to 20 shoots per foot, so again the canopy is shaded.

#### **Solution to the dilemma**

The solution to the above problem is to divide the canopy; that is to make two feet of canopy for each foot of vine row length. One can use any one of several trellis systems, for example, Scott Henry, Smart-Dyson (to be described in the next PWV Nov/Dec'93 column), 'U' or lyre trellis, Geneva Double

Curtain (GDC), etc.

Whether vertically divided in the Scott Henry or Smart-Dyson, or horizontally divided with the 'U' or GDC, the result produces two feet of canopy for each foot of vine spacing.

This means that we can now apply Rule #1 and prune to the required 96 buds per vine which should give more balanced shoot growth. Dividing this figure by the doubled canopy length (now 16 ft.) gives six buds per foot, almost the desired value of five. One would install the new trellis and presume that as the shading is decreased, the pruning weight will be reduced and the crop will improve. It may be that the vine can be pruned to the desired value of five shoots per foot in future years.

#### **Conclusion**

The tricky part about the Golden Rules of Viticulture is to apply them simultaneously, like a pair of algebraic equations. Their application will quickly highlight problems of vines being out of balance, or shoots being so close together as to cause shading. Solutions to the problem are found by dividing canopies, but sometimes we also have to do vine removal. More of that in later columns.

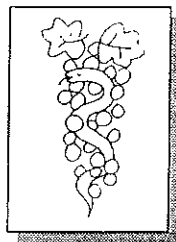
Future columns will also deal with the question: Which trellis system should I use? and the related issues of the ease of construction and management of different systems. The next column will introduce a new training system known as the Smart-Dyson system. This trellis is a joint Australian-American collaboration, with some ideas from Portugal! ■

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## GENTISIC ACID: an aspirin-like constituent of wine

Since the French Paradox became public,<sup>10</sup> a flurry of reports has dealt with various aspects of the apparent protective effect of wine against cardiovascular damage.<sup>12,15</sup>

Many recent reports have centered around the phenolic constituents of wine and in particular resveratrol, which seems to act by interfering with prostaglandin formation (prostaglandins are compounds involved in inflammatory response by tissues). Specifically, by preventing the conversion of prostaglandin precursors into thromboxane as catalyzed by the enzyme cyclooxygenase, thus preventing the crucial hydroxylation (oxidation) step.<sup>5,6,15</sup> Thromboxane, in turn, is the compound immediately responsible for the formation of blood clots.<sup>3,6</sup>

It appears then, that both inhibition of cyclooxygenase and general antioxidant activity are crucial in providing cardiovascular wellness. A similar action has been suggested for other phenolics, both simple and complex, present in wine. Thus, it has been suggested that compounds such as anthocyanidins, flavanols, flavanolols, flavanones and flavones, including the ubiquitous epicatechin and quercetin, might be implicated.<sup>16</sup>

Upon review of the phenolic constituents reported in wine, it

appears that, in addition to those mentioned, a very likely candidate for the prevention of blood clots and anti-inflammatory response, might be gentisic acid [490-79-9] or 2,5-dihydroxybenzoic acid (Fig.I). This compound is ubiquitous in plants including grapes, and has been reported repeatedly in wine.<sup>1,4,7,8,11,13,14</sup> One such report indicates that it is found at levels of about 2.25 mg/L in white wine.<sup>17</sup> It also is present, at slightly higher concentration, in red wines. In addition, it has been shown that when a person takes aspirin, the body produces gentisic acid.<sup>2</sup>

What is strikingly unusual about gentisic acid, is its structural similarity with the active principle of aspirin, salicylic acid or 2-hydroxybenzoic acid (Fig.II). Thus, it is expected that gentisic acid would exert a pharmacological action similar to aspirin's (Fig.III). This includes the repeatedly proven ability of aspirin to increase capillarity and thus blood flow, as well as the anti-inflammatory action which results from its ability to block cyclooxygenase activity. Indeed, gentisic acid has been postulated and prescribed at one time or another as a substitute for aspirin in medicines.<sup>9</sup>

Furthermore, gentisic acid is a better antioxidant than aspirin due to its chemical structure (specifically, the fact that it has two phenolic hydroxyls in positions *para*- to each other). Antioxidant activity of this type of compounds has been amply demonstrated.<sup>2,3,6,18</sup>

Thus, gentisic acid seems to be better suited than aspirin to perform the cardiovascular protective duties for which aspirin is widely prescribed. Furthermore, due to its antioxidant activity and its ability to inactivate harmful compounds, such as hydroxyl free radicals,<sup>2,3</sup> gentisic acid might also help prevent, as has been suggested for aspirin, the development of some forms of cancer.<sup>2</sup>

What this means to those who choose to include wine in their daily diet, is wine has an impressive array of compounds that may contribute to health as well as the flavor of the meal. Consumption of one-half liter of wine/day, either white or red, might provide, in terms of gentisic acid alone, similar cardiovascular protective action as half of the commonly prescribed dose of 5-mg of aspirin every other day, with the added benefit of modest protection against certain forms of cancer. ■

Figures 1, 2, 3, 4

