



Shiloh Estate

SHILOH VINES & WINES KNOWLEDGE BASE SERIES

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Part II: Winegrowing

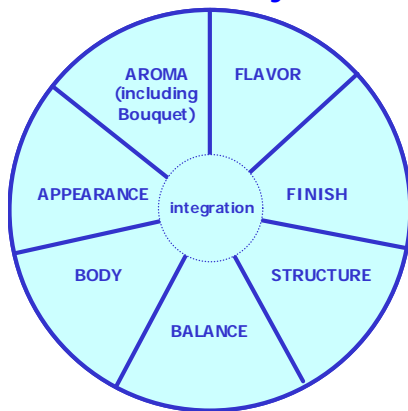
by

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Coordination Draft
Comments Welcome

Toward Quality Wine



Quality—This paper is the second of a series of five dealing with winegrowing and winemaking. The lead paper "Part I: Toward Quality Wine" suggests a pathway to wine quality and quality wine where *quality* embraces the wine's *sensory components* depicted above.

Each stage comprising this pathway toward quality involves numerous influences impacting wine type (e.g., still red wine), style (e.g., dinner wine), and sensory components (e.g., *flavor*).

The three winegrowing stages that occur prior to "Harvest & Crush"—with emphasis on decisions and practices that have an impact on the sensory components—are briefly (and somewhat superficially) discussed within the context of: (a) strategic decisions related to Vineyard Establishment and (b) cultural practices related to Vine & Crop Management and Vineyard Floor Management. Finally, major impacts on sensory components attributable to key strategic decisions and operational practices are summarized.

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PLANNING & MANAGEMENT

VINEYARD ESTABLISHMENT (or Vineyard Selection)

- Site preparation
- Infrastructure
- Planting & replanting
- Other (e.g., cover crops)

VINE & CROP MANAGEMENT

- Pruning
- Frost protection
- Irrigation
- Fertilization
- Canopy management
- Cluster thinning
- Pest-disease control
- Other (e.g., training)

VINEYARD FLOOR MANAGEMENT

- Till or no-till
- Cover crop mowing
- Weed control
- Other (e.g., compost)

HARVEST & CRUSH

FERMENTATION & MACERATION

MAINTENANCE & MATURATION

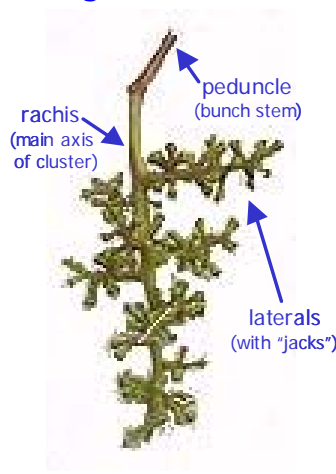
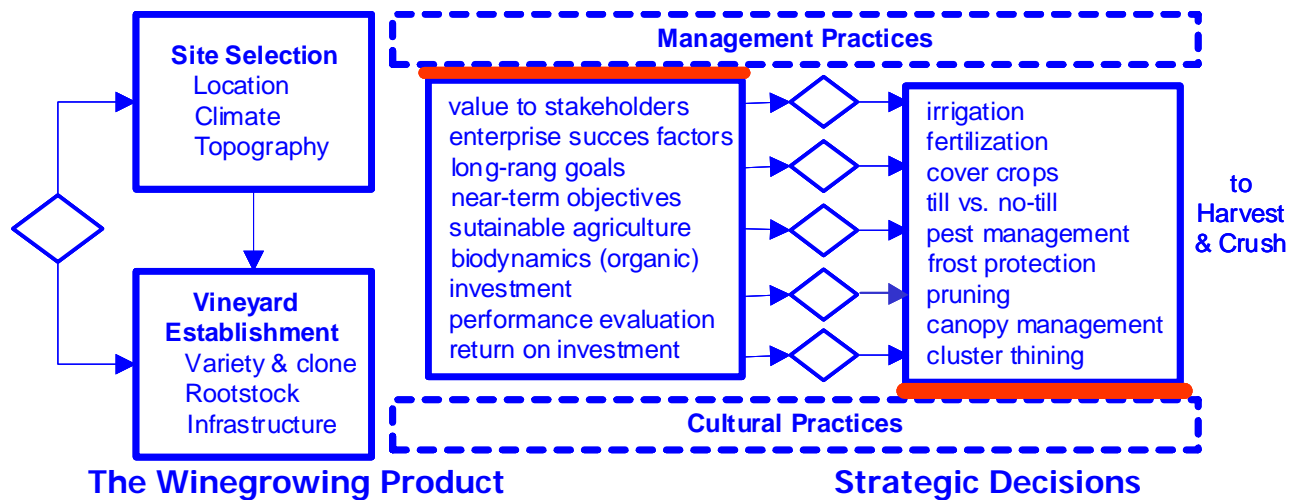
EVALUATION & IMPROVEMENT

Related Papers—Papers comprising this series are available at:

<http://www.shilohestate.com/>

Other winegrowing papers of potential interest that are available on this web site include:

- "Strategic Management"
- "Establishing a Small Vineyard"
- "Rootstocks"
- "Cover Crops"



The Cluster—The long-range goals and near-term objectives of a winegrower are to produce—vintage-after-vintage—a grape crop that meets the needs of the winemaker. At bottom, this equates to the quality of grape clusters that are harvested and delivered to the winery. Although the cluster develops within a life support system that includes the vine itself, *terroir*, etc., it is ultimately the *berries*—and a small amount of material other than grapes or MOG—that are transformed into wine. The berries provide the fundamental *essence* of the vintage and the resulting wine.

The aroma and flavor components intrinsic to the berry represent the most important contribution of the winegrower to the wine with the other sensory components represented to a lesser degree.

MOG—This includes such non-berry items as the peduncle, rachis, and laterals (with "jacks") as well as leaves and lizards.

Note that the berry includes pulp, skin, and seeds. Most wineries attempt to minimize MOG—but some MOG usually makes into the crush.

Long-Range Decisions—The most important strategic decisions are related to site selection and vineyard establishment. Once implemented, these decisions cannot be easily undone.

Site Selection—Location along with site-specific factors such as soil, mesoclimate, and topography provide the setting for success. Certain locations facilitate certain varieties of *Vitis vinifera*. Areas can be categorized by heat summation (HS) days:ⁱ

Climatic Region Locations by Region (HS Days)
Region I Locations (< 2,500)
Carneros (South Napa/Sonoma), Yountville, Burgundy
Region II Locations (2,500-3,000)
Oakville, St. Helena, San Luis Obispo, Bordeaux
Region III Locations (3,000-3,500)
Calistoga, Livermore, Milan (Italy), Adelaide (Australia)
Region IV Locations (3,500-4,000)
Sacramento, Florence (Italy), Capetown (South Africa)
Region V Locations (> 4,000)
Modesto, Bakersfield, Algeria, Perth (Australia), Palermo

For best development, *V. vinifera* requires long, warm-to-hot, dry summers and cool winters. Regions I and II are generally considered ideal.

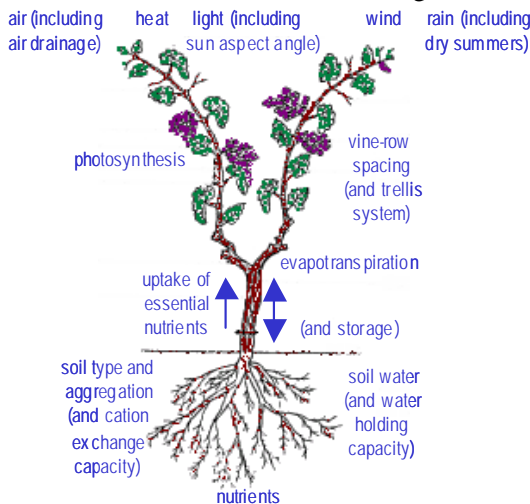
Vineyard Establishment—Given an appropriate site, the "right" varieties, clones, and rootstocks must be matched to the specific setting along with vine-row spacing and the trellis system. Many vineyards planted (or re-planted) in recent years combine vertical shoot positioning trellis systems with high vine densities. Robert Mondavi Winery has introduced narrow spacing (e.g., 4' x 4') to increase competition and stress among vines. Although this reduces yield per acre, "the grapes are smaller and highly concentrated with aromas and flavors that are deeper, more intense, and more expressive of the climate, soil, and character of the particular vineyard and particular vine."ⁱⁱ

Annual Growth Cycle of Vine (from Dormancy to Dormancy)			
Buds go through stages (dormant, swelling, green tip, first leaf) with nutrients directed mostly to cell division.	Vegetative growth is dominant with transition to fruit growth as veraison (berry ripening) begins.	Fruit growth is dominant with nutrients directed to cell enlargement. Berry °Brix (sugar) and pH increase, acid decreases.	After harvest, storage is dominant with starch (CHO) and nitrogen stored in the root system via the vine's phloem.
Bud Break & Grand Period of Growth		Berry Growth, Ripening & Over-ripening	
Each bud surviving pruning contains a primary growing point with four primordia: (i) shoot (ii) leaf (iii) flower clusters (iv) tendril The grand period of growth begins.	Each shoot, its leaves, and tendrils grow along with its flower clusters (usually two) and their berry sets (that self-pollinate), and the clusters and berries (including their green skin, seeds, and pulp) gradually enlarge.	Grape Transformations during Ripening* <ol style="list-style-type: none"> 1 Cell enlargement: skin, pulp, seeds 2 Ripening: sugars increase, acids decrease (e.g. tartaric, malic, amino), tannins increase (more in stems and seeds than skin) 3 Sucrose → glucose + fructose 4 Aromas and pigmentation: odor compounds, polyphenols, and anthocyanins all increase 5 Over-ripening after maximum size and sugar 	
Bud Break	Bloom	Veraison	Maturity (Harvest)
Leaf Fall			

Sources: WVT 132 Soils, Fertilization, Irrigation, Viticulture and Winery Technology Program, Napa Valley College (Spring 1998)
 * Emile Peynaud, *Knowing and Making Wine*, John Wiley & Sons (1981, English Edition 1984)

Cultural Practices

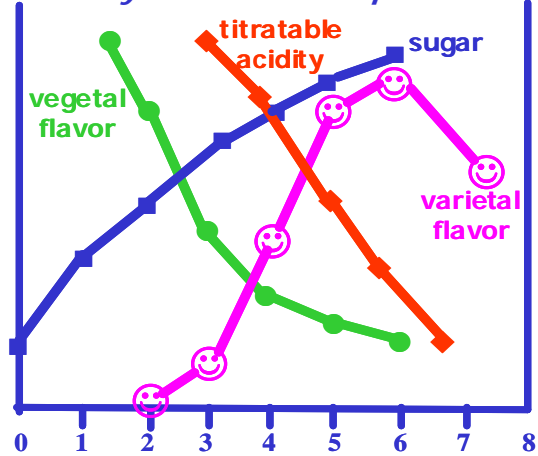
General Discussion—Vines go through a growth cycle that is influenced by a complex array of factors that may or may not be subject to the direct or indirect control of the winegrower.



Near-term operational objectives relate to the production of grapes with high varietal flavors, low vegetal flavors, high (but not too high) sugar, and moderate (but not too low) acid.

It is said that five to 20 aromas characterize a variety. However, many aromas and flavors intrinsic to the berry—and the intensity of these aromas and flavors—are not detectable by the

Berry Flavor Development



Source: WVT 180 Fundamentals of Enology
 Napa Valley College (Fall 2002)

senses in the vineyard. This is because molecules of the monoterpene family—the source of floral and citrus aromas—are chemically-bound to one or two sugar molecules and in the bound form are non volatile. These potentially volatile terpenes (PVTs) may (or may not) realize their full potential during the winemaking process.ⁱⁱⁱ

The winegrower must employ "best cultural practices" to produce a crop that matures properly without contracting disease, and winegrower and winemaker must work in concert to harvest an optimal crop at the time of optimal berry maturity.

Pruning & Vine Training—There are three major approaches to the structure of the vine:

- Cordon-trained, spur-pruned (with bilateral cordons most popular; some quadrilaterals)
- Head-trained, cane-pruned (most flavorful)
- Head-trained, spur-pruned (older style)

Proper training and pruning creates a balanced vine and avoids *undercropping* (that can lead to vegetative properties) and *overcropping* (that can delay harvest and deny berries sugars and acids that depend on photosynthesis and hang-time).

A balanced vine can produce berries with good *aroma*, *flavor*, and (in reds) color potential.

Vine training and pruning operations also include the objective of optimizing sun and light exposure vis-à-vis leaves and berries, respectively.

Irrigation & Fertilization—A recent study at UC-Davis suggests that the sensory characteristics of wine are affected by irrigation strategies:^{iv}

Sensory Attribute	Irrigation Strategy		
	None	Once/Week	Twice/Week
<i>Aroma</i>	Low veg High fruit	High veg Low fruit	Medium veg Medium fruit
<i>Flavor</i>	Low veg High fruit	High veg Low fruit	Medium veg Medium fruit

Many great wines come from cooler winegrowing regions that support a long hang time. Attention is being placed on irrigation methods and technologies that can help control berry growth and quality. Deficit managed irrigation is now finding wider use to manage post-veraison stress (used to decrease berry size, increase the potential intensity of berry *aromas*, *flavors*, and color).

Needed nutrients can be applied with irrigation, directly to the soil or foliage, or through cover crops (that can also be planted to control vigor).

Canopy Management—The canopy determines the microclimate of vines (as site determines the mesoclimate). Given a proper trellis system, vine-row spacing, training and pruning, this step includes tipping, topping (hedging) and especially leaf removal (basal leaves) to maintain vine balance, expose leaves to sunlight, and optimize cluster exposure to light and air. Berries in shaded canopies have low sugars, high acids, elevated pH, low proline, high arginine, low total phenols, low anthocyanins in reds, and high chlorophyll in whites.^v Sun, light, and air equate to quality.

Cluster Thinning—Quality wines come from vineyards with low to moderate yields (3 to 6 tons per acre) and where potentially volatile terpenes (PVTs) are high. Although yield should not be lowered below the level required for high quality wine, some of the most expensive cult wines come from vineyards where crops have been thinned to achieve yields as low as 1.0 ton per acre.

Protective Factors—Pest and disease control are essential and can be aided by application of sulfur (for powdery mildew), canopy management, and cover crops. Frost protection can be aided by site selection (e.g., air drainage on hillsides) and overhead sprinkler systems (can also be used on extremely hot days to reduce berry temperatures).

Summary of Potential Contributions

Winegrowing	Wine Components						
Potential contribution of cultural practice or step to component:	A	A	F	F	B	S	B
	P	R	L	I	O	T	A
	P	O	A	N	D	R	L
	E	M	V	I	Y	U	A
Strong	A	A	O	S		C	N
	R		R	H		T	A
Moderate	A					U	N
	N					R	C
Weak	C					E	E
	E						
Site selection	M	S	S	M	W	W	M
High-density plantings	M	S	S	M	W	W	M
Pruning and Training	W	M	M	W	M	M	S
Irrigation & Fertilization	W	S	S	M	W	W	M
Canopy Management	S	S	S	M	W	W	M
Cluster Thinning	S	S	S	M	W	W	M
Protective Factors	W	W	W	W	W	W	M

Effective winegrowing protects *aroma* and *flavor potential* while avoiding problems that could detract from this potential. Other components are achieved or enhanced during the winemaking process.

It is difficult to generalize the contributions of various strategic decisions and cultural practices to sensory components (as we have attempted above) due to the high number of variables involved and interactions among these variables.

ⁱ VWT 130 General Viticulture, Napa Valley College (1997)
ⁱⁱ "The Robert Mondavi 2002 Annual Report" p. 9.
ⁱⁱⁱ Erica Winter, "Grape Bunch Exposure and Aroma Development," *Practical Winery & Vineyard* (September/October 2002)
^{iv} "Trellis Talk," Bayer Crop Science (September 2002)
^v Bruce Zoecklein, *et al*, *Wine Analysis and Production*, Aspen Publishers (1999); p. 56