Shiloh Estate LLC

SHILOH VINES & WINES KNOWLEDGE BASE SERIES

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Vine Balance

by

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Coordination Draft
Comments Welcome

"Low yields on a balanced vine tend to make kick-ass wine."

Wes Hagen
Vineyard Manager/Winemaker
Clos Pepe Vineyards

Toward Quality Wine

Vineyard factors that affect wine quality, in order from most to least important: (1) variety, (2) variety and region (climate) interaction, (3) vine balance, (4) canopy microclimate, (5) vine water status, (6) yield, (7) clone, (8) rootstock. Soil interacts with most of these factors.

Richard Smart (**PWV** Jul/Aug 2000 pp. 86-87)[i]

Strategic Decisions—That quality wine originates in the vineyard is widely acknowledged. Quality grapes represent a necessary—but not necessarily sufficient—condition for quality wine. Vineyard site selection determines climate, terroir, topography, water availability, exposure, and other realities important to winegrowing. Other factors having a long-range impact on grape and wine quality include varieties, clones, rootstocks, trellis system architecture, row-vine spacing, and vine training and pruning systems matched to the site.

Cultural Practices—A wide and complex array of winegrowing practices impact the quality of each vintage: pruning, irrigation, fertilization, pest management, cover cropping, canopy and crop management, grape maturity assessment, harvest timing and techniques, and so on.

Vine Balance—Given a particular vineyard site location (e.g., climate) and grapevines (e.g., variety), the major factors affecting vine balance include pruning, canopy and crop management, and irrigation. Situational factors such as rainfall or late frost also have impact.

Balance Defined

In the world of winemaking, there is a universal truth about the quality of the vintage: It is directly correlated with optimal grape maturity. What would constitute the ideal, optimally ripe vineyard would be uniformly ripe clusters with small berries chock-a-block with flavor.

James Kennedy (**PWV** Jul/Aug 2002 p. 14)

Balance in Wines—In "Part I: Toward Quality Wine," balance was defined as:

Integration of acidity, sweetness, and flavor in pleasing proportions.

See: http://www.shilohestate.com article.

Balance in Vines—A balanced vine may be able to produce high-quality clusters comprising berries that may be healthy, that may be harvested at their optimal maturity and carefully transported to the winery where they may be transformed in high-quality wine. Lots of "maybes."

Most definitions of vine balance relate to the capacity of vine in terms of foliage versus fruit. One definition is the ratio of: (a) weight of fruit harvested divided by (b) weight of wood pruned months later—a ratio in the neighborhood of seven. Another definition is based on the number of leaves (or total leaf area) per shoot versus clusters, e.g., eight leaves for every cluster. The strategic and cultural variables need to manage vine *vigor* to yield an optimally mature harvest.

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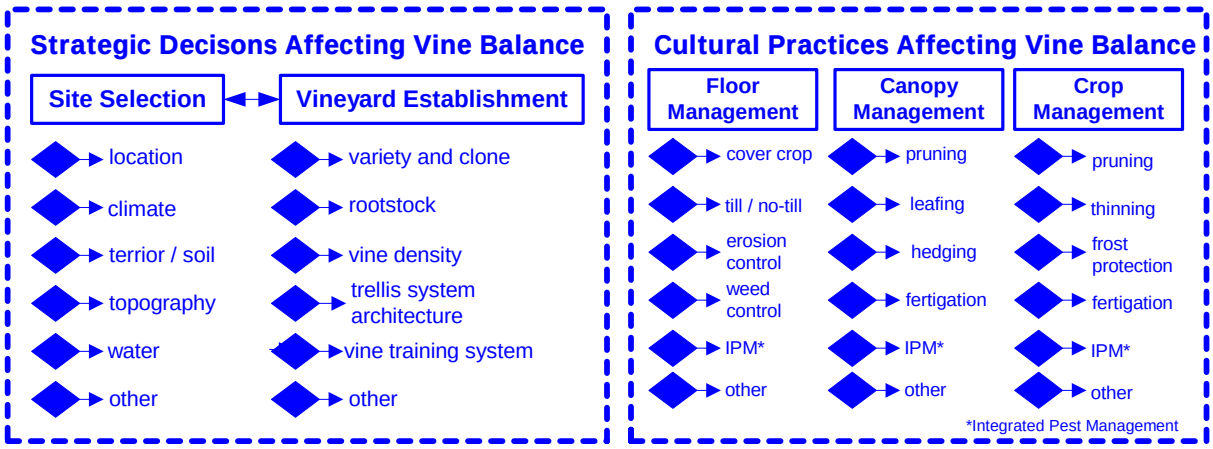


Balanced Shoots

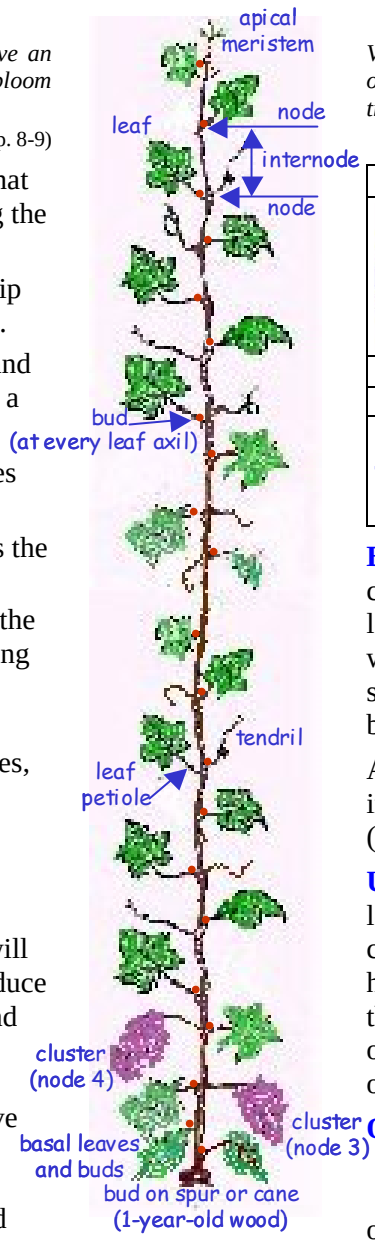
During bloom, shoots of Vitus vinifera *have an average of 16-19 leaves. Four weeks after bloom there are 25-27 leaves.*

Vasconcelos & Castagnoli (**PWV** Sep/Oct 2001 pp. 8-9)

Shoot Typology—A typical shoot that emerges from an eye (or bud) during the growing season has several parts:

- Apical meristem or active shoot tip that leads the growth of the shoot.
- Nodes with leaves (and petioles and buds at axils), grape clusters, and a shoot tip (or apical meristem).
- Leaves that produce carbohydrates via photosythesis.
- Leaf petiole or stem that connects the leaf to the node on the shoot.
- Buds (or, more correctly, eyes at the leaf axil) that contain three growing positions for next year's crop.
- Tendrils that help the shoot to support itself by attaching to stakes, foliage wires, etc.
- Clusters (or bunches) of grape berries that often occupy nodal positions 3 and 4.

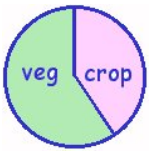
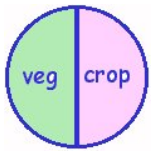
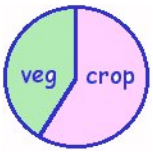
Optimal Shoot—A balanced vine will have the capacity (i.e., vigor) to produce shoots that have at least 16 leaves and two clusters. The vigor of the vine should produce a shoot from each bud that is of sufficient length to have sufficient nodes to have sufficient leaf surface area to support two clusters. This *sufficiency* is achieved through strategic and cultural factors.



Balanced Vines

Vine balance is defined as the relative proportions of crop, leaves, and perennial structure (such as trunk and roots).

Winter & Osmond (**PWV** Sep/Oct 2002 p. 8)

Undercrop	Balance	Overcrop
		
Ratio ≅ 5/1	Ratio ≅ 7.5/1	Ratio ≅ 10/1
Potential Impact on °Brix, TA, and pH		
°B ↓ suboptimal TA ↓ suboptimal pH ↑ suboptimal	°B ↑ optimal TA ↑ optimal pH ↓ optimal	°B ↓ suboptimal TA ↓ suboptimal pH ↑ suboptimal

Balance—A balanced vine has the correct ratio of vegetative growth to crop load—about 7.5 lbs fruit to 1 lb pruning wood—as well as balance between structure above ground (trunk, arms) and below ground (roots).[ii]

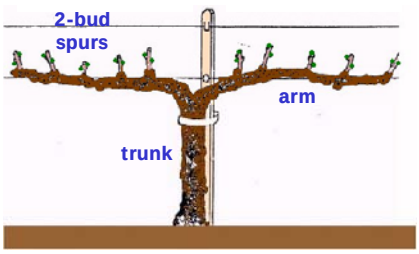
All strategic decisions have significant impact along with most cultural practices (especially pruning and irrigation).

Undercropping—Shoots are excessively long and thick with underdeveloped clusters; this condition tends to delay the harvest. Too much shoot vigor may be the result of sever pruning, over thinning of crop, early frost that reduces crop, over-irrigation, or under-fertilization.

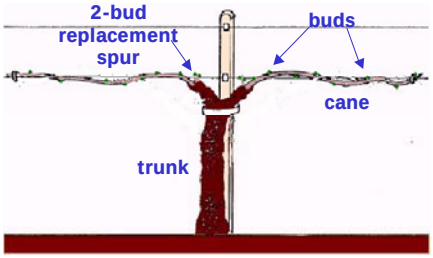
Overcropping—Excessive buds result in excessive (short) shoots and clusters.

Lack of shoot vigor may be the result of poor pruning, lack of water, poor soil, or disease or insect injury.

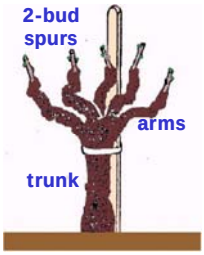
Popular Vine Training & Pruning Systems



Cordon-Trained, Spur Pruned (CTSP)



Head-Trained, Cane Pruned (HTCP)



Head-Trained, Spur Pruned (HTSP)

Buds per Vine

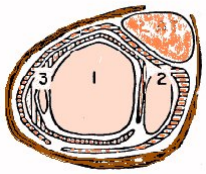
Cordon with spurs allows me to more readily control bud count per acre to between 16,000 and 18,000 buds.

Markus Bokisch (**PWV** Jan/Feb 2003 p. 18)

Pruning—In late winter or early spring, when the vines are still largely dormant, vines are pruned:

- Cordon-trained, spur-pruned—The one-year-old wood (i.e., shoots) is pruned back to two-bud spurs (i.e., the basal buds).
- Head-trained, cane-pruned—The old cane (now two-year-old wood) and its shoots are removed and one of the shoots (one-year-old wood) from the replacement spur becomes the new cane. Each node has a bud.
- Head-trained, spur-pruned—Usually trained as a "goblet" with short arms, spur-pruned.

Buds produce a shoots during the growing season.



The Bud—Each bud, called an eye, has three growing positions or shoot primordia; usually the largest one will push out. Each shoot primordial within a bud has all of the basic components of a shoot, e.g., leaves, clusters, apical meristem.

Shoots—The number of eyes (i.e., potential shoots) is: (a) the number of nodes on a cane or (b) two times the number of two-bud spurs. The number of shoots on a vine is a function of the number of nodes or two-bud spurs on a vine that, in turn, is a function of: (a) the internode or inter-spur spacing and (b) the number of canes or arms and their length. [Actually, shoots equal buds.]

Shoot length is a function of vigor that, in turn, is a function of many factors, e.g., vine density, rootstock and variety, soil, irrigation, and climate.

Bud removal can control the number of shoots and hedging (or tipping) can control shoot length.

Quality & Yield

High vine density equates to more vines per acre and, potentially, higher yield. Quality implications are less clear.

Jordan Ross (**PWV** Nov/Dec 1999 p. 20)

TPA—Yield of grapes harvested is measured in tons or pounds—often Tons Per Acre (or pounds per vine). The yield of a block is the weight of the clusters harvested. This weight divided by the plantable acres equals TPA, and divided by the number of vines equals average yield per vine.

Vine Density—The number of vines per acre is simply 43,560 divided by the product of the vine and row spacing. One plantable acre with 4' x 4' vine-row spacing, for example, equates to 2,722 vines. [43,560 ft^2 ÷ (4 ft x 4 ft) = 2,722]

Linear Row Feet—For 1 acre planted 4' x 4', the number of feet between the vines is approximately 2,722 vines times 4 or 10,890 linear row feet. This is a useful measure as for head-trained, cane-pruned and cordon-trained, spur-pruned vines; it represents the upper limit, respectively, of cumulative cane length or cordon-arm length per acres. Quadrilateral cordon, Geneva double curtain (GDC), and other more complex trellis systems require more complex calculations.

Potential Buds (or Shoots) per Acre—If the average internode spacing is 4" or the average inter-spur spacing is 8", this is 12 buds per vine or 2,722 x 12 = 32,664 buds per acre. (12 buds/vine divided by 4 linear feet/vine equals 3 buds/foot.)

Quality—The above is arithmetic, not quality. The challenge is to grow quality vines with quality clusters and berries, the hallmark of balanced and healthy vines whose variety and rootstock are matched to local site specifics.

Recent trends for high quality wines are to use high-density HTCP (including Guyot) or CTSP plantings on vertical shoot positioning.

Strategic Decisions and Cultural Practices to Achieve or Manage Vigor viz. Balanced Vines			
Variable	**Low Vigor Sites**	**Moderate Vigor Sites**	**High Vigor Sites**
Soil profile (depth)	Shallow (e.g., < 2 feet)	Moderate (e.g., 2 1/2 - 4 feet)	Deep (e.g., > 6 feet)
Soil type	Clay, gravel, stone, sand	Silt with some clay or loam	Mostly loam
Rootstock (geotropic angle)	Include *V. riperia* (80°)	Include *V. berlandieri* (45°)	Include *V. rupestris* (20°)
Vine density	High (e.g., 4' x 4' spacing)	Moderate (e.g., 6' x 8')	Low (e.g., 8' x 12')
Trellis system	VSP (including Guyot)	Lyre, Smart-Dyson, T	Quadrilateral cordon, GDC
Cover crop	Low vigor (non-competitive)	Moderate vigor	High vigor (competitive)
Irrigation / fertigation	Regulated deficit irrigation	Regulated deficit irrigation	Consider non-irrigation
Yield per acre	1.5 to 4.0 TPA	3.0 to 6.0 TPA	5.0 to 8.0 TPA

Strategic Decisions

Today, a site is evaluated for vigor prior to planting, and decisions such as rootstock, varietal, spacing and trellising are made that allow maximum quality to be achieved from the site.

Joel Aiken (**PWV** Mar/Apr 2001 p. 24)

Site Selection—This decision is the most strategic in the sense that once made it cannot be reversed (except by not using the site for a vineyard). But, larger sites are not necessarily homogeneous with respect to meso-climates, soils, topography, etc.

Vineyard Establishment—Given a site, many decisions are still considered strategic because once made they cannot be *easily* reversed. However, a site can vary in soil type, topography, etc.

The big variables vis-à-vis vine balance are:

Terroir, rootstock, variety, clone—The varieties and clones need to match the meso-climate and the wine type. The rootstock needs to match the soil. For example, Stags Leap Cellars uses different rootstocks—the soil from east to west of the vineyard goes from rock to loam to clay with their Cabernet Sauvignon sitting atop St. George, 110 R, 101-14, 3309C and 420 A rootstocks.[iii]

Trellis and training systems—These systems need to be compatible with the grape variety and (especially) site vigor with the vine-row spacing determining vine density (but not buds or shoots per vine). Spacing impacts vine balance and grape quality with high-density planting often favored:

"The premise, with which few disagree—is that competition between neighboring vines for available moisture and nutrients results in smaller vines, making it easier for each vine to fully ripen its smaller cropload …."

Andy Beckstoffer (**PWV** Nov/Dec 1999 p..22)

This impact is related to the root system:

"Size of the root system is an important factor in determining the growth of the above-ground portion of the vine and a certain balance between shoot and root growth …. Closer vine spacing resulted in a marked increase in root density …. Vine spacing [affects] quantity and quality of grapes …."

Eben Archer (**PWV** Mar/Apr 2000 pp. 24-28)

Cultural Practices

At 3 TPA, grapes have sugar but not flavor maturity. We're finding that we have to leave a little more crop out there and get vines balanced to achieve hang time that assures biological and physical maturity.

John Abbott (**PWV** Jul/Aug 1999 p. 63)

Vineyard Floor Management—Cover crops are used to regulate growth by reducing vine vigor through competition for nutrients that would aid vine growth and therefore delay fruit ripening (stressing the vines through regulated deficit irrigation can often achieve similar results). This strategy applies when excessive vigor is promoted by soils, rootstocks, or both.[iv]

Canopy Management—Numerous practices affect the canopy:

Pruning—This is the big one; controls shoot count.

Hedging, tipping, topping—Controls shoot length.

Leaf removal—Controls cluster sunlight and shade (and air circulation). An alternative is being tested by Remi Cohen, Bouchaine winegrower in the Carneros AVA. Given north-south rows, she is installing a VSP arm and foliage wires causing shoots to lean toward the hotter western sun thus balancing morning and afternoon sunlight.

Crop Management—The TPA can be controlled by pruning coupled with removal of buds, shoots (with buds), or clusters (i.e., green harvest).

"…canopy manipulation, weak shoot removal, leaf removal, and green thinning allow fruit to be harvested with uniform maturity…."

Joel Aiken (**PWV** Mar/Apr 2001 p. 24)

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[i] Several attributed (sometimes paraphrased) quotes from *Practical Winery & Vineyard* (**PWV**) along with issue and page(s) where the quote may be found.. Also see: http://practicalwinery.com

[ii] As always, NV College's Viticulture and Winery Technology Program is acknowledged.

[iii] See "Vineyard Rootstock Selection" at http://www.shilohestate.com/

[iv] See "Cover Crops" at http://www.shilohestate.com/