Vine Balance and the Role of Vineyard Design

GRAPES 101

Grapes 101 is a series of brief articles highlighting the fundamentals of cool climate grape and wine production.

By James Wolpert

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Figure 1. Balanced vines have adequate growth to properly ripen the crop, but avoid excessive vegetative growth. Photo by Jim Wolpert.

"Vine balance" can be defined as the condition in which 1) vine shoot growth provides enough leaf area to properly ripen the crop and 2) crop per hectare meets a grower's or vintner's goals.

Vine growth is the complex interaction of soil, climate, rootstock capacity, scion capacity, vine density, trellis system, shoot density, and cultural practices. The first six factors are chosen at planting and cannot be easily changed without significant inputs. The last two are ones over which the grower has input.

Optimum shoot density. Recent research has suggested that shoot density (shoot number/meter), controlled at pruning, is a critical component. The often recommended range in shoot density is about 12 to 15 shoots/meter of undivided canopy. If shoots are too dense, light in the fruiting zone is reduced, leading to

reduced fruit quantity and/or quality. But if shoots are too sparse, fruit bearing surface (shoot number per hectare) is reduced, and therefore potential yield is lost.

Another critical interaction is that shoot number per vine affects shoot length. If shoot number exceeds vine capacity, then shoots will be too short and will not have enough leaf area (12 cm^2/g) to ripen the clusters on the shoot. However, if shoot number is too few for vine capacity then shoot length will be too long, with excessive leaf area per shoot and encouraging lateral leaf development in the fruiting zone.

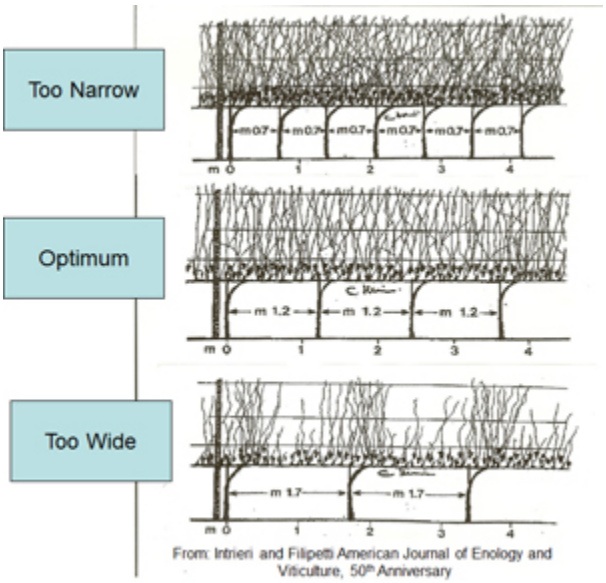


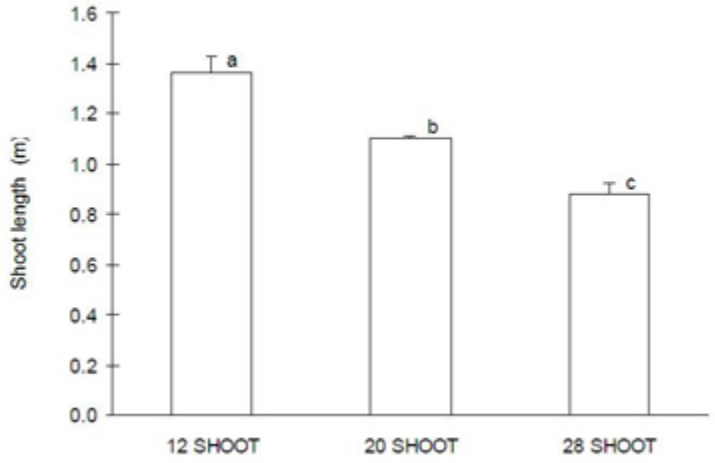
Figure 2. In-row vine spacing provides the backdrop for regulating individual shoot growth. When vines are spaced too closely, the canopy will be excessively shaded or (if thinned) individual shoots will grow too fast. If the vine spacing is too wide, canopy fill will be uneven, and yield will be sacrificed. Optimum vine spacing will produce a balanced canopy without excessive growth or gaps.

Vine spacing and shoot growth. Therefore, at a given shoot density (say, 12 to 15 shoots/m), shoot length depends on vine spacing, particularly in-row vine spacing. Or, to say it differently, to control shoot length in any given site/rootstock/scion combination, you must vary vine spacing. Increasing vine spacing increases shoot number per vine and shortens shoots, while decreasing vine spacing decreases shoots per vine and lengthens shoots. This is an unusual way to think about vine spacing but it illustrates the importance of planting time decision-making that growers must consider.

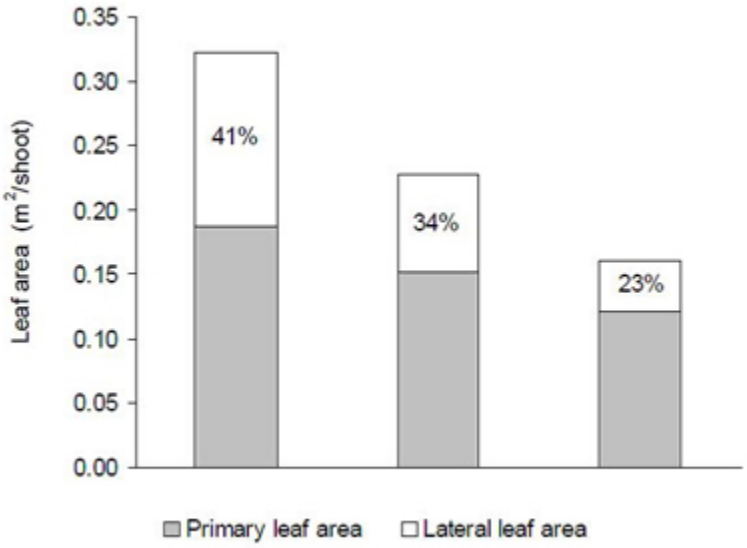
The difficulty, of course, is that a grower must have *a priori* knowledge of the successful integration of those complex factors to be assured of the proper amount of growth, meaning not too much or not too little. While growers in California have a great deal of experience making these decisions, it is safe to say that more information would be valuable.

Example: Sangiovese in Napa. Data from a Sangiovese vineyard in Napa, California, illustrates common relationships between shoot number and shoot growth in a five year-old vineyard. (*Myers et al*, 2008, *American Journal of Enology and Viticulture* 59:422-424). In this study, shoot numbers were adjusted to 12, 20 or 28 shoots per vine. Here's how the vines responded:

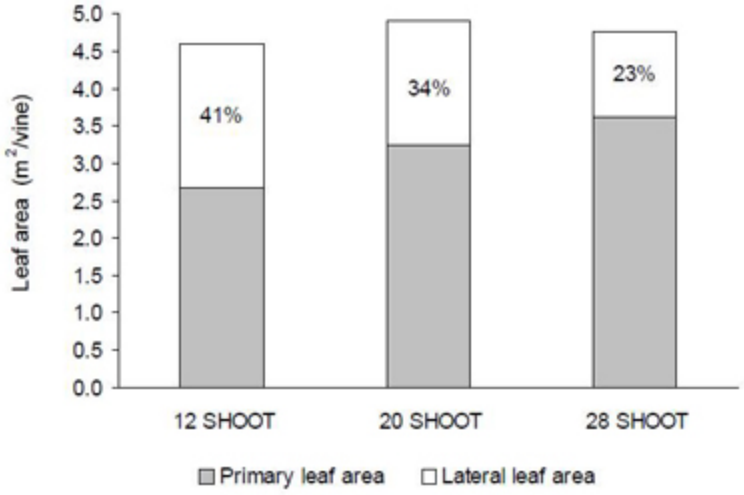
A. *Shoot number affected shoot length. Leaving more shoots per vine resulted in shorter shoots.*



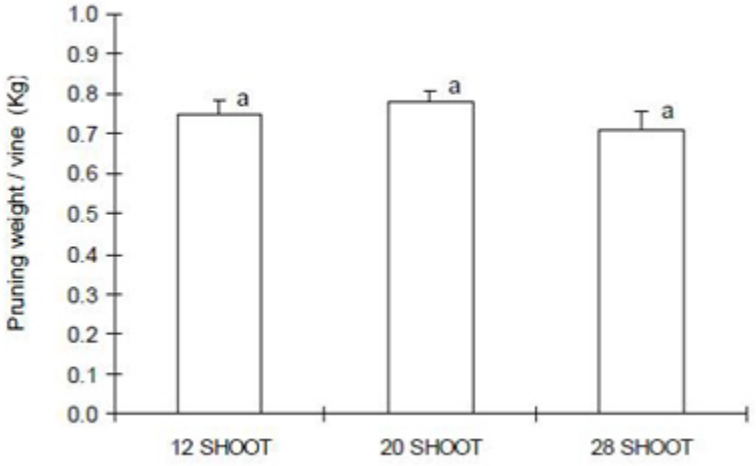
B. *Longer shoots had more leaf area and a greater percentage of leaf area as laterals.*



C. *Manipulating shoot number per vine did not change leaf area per vine, but changed percentage of primary versus lateral leaf area.*



D. *Pruning weight was unaffected by shoot number.*



In other words, leaving fewer shoots did not affect overall vine growth, it merely channeled the same amount of growth into fewer shoots.

In-row spacing, between-row spacing and vine growth. In a recent review, Italian researchers, Intrieri and Filippetti, laid out an excellent case supported by ample research, that in-row vine spacing is a more critical decision than between-row vine spacing in terms of the resulting vine growth. In California, in my opinion, there are more instances of mistakes where vines are spaced too close than too far apart. VSP trellising and narrow-wheel-base farming equipment have allowed vine rows to be reduced from the traditional distance of 12 feet to as close as 6 feet. As row spacing decreased, the tendency was for vine spacing to decrease as well, despite the fact these are, for the most part, two entirely independent decisions.

The philosophy for closely spaced vines (in-row) is the belief that vines will compete for nutrients and water and that competition will regulate growth. While this notion has some research support in cases where soils are shallow or infertile, close spacing has also been advocated on deep (>2m rooting), fertile, clay-loam, valley-floor soils. Experience to date has been that growers in this latter case of fertile soils struggle to control growth. Thus, care must be exercised when choosing which rootstock and vine spacing to use, after site selection and desired scion are taken into account. Closer is not always better.

Managing existing vineyards. Where vineyards are already established and decisions have already been made, growers are dealing with the consequences. When growth is less than desired, remedies are relatively straight-forward. As mentioned above, shoot number could be regulated down by pruning, even lower than12 shoots/meter in order to increase the length per shoot. However, this is not ideal because it will reduce shoot number per hectare and hence reduce cluster number per hectare (i.e., crop), not a good first choice. Cultural practices such as irrigation and fertilization are excellent drivers of growth and should increase growth potential and allow shoot number to remain at the ideal density. However, these inputs are costly and usually come with some inefficiencies.

In the converse situation, where shoot growth is too great, limited options are available to the grower. Obviously In sites where early irrigation and fertilization are practiced, those regimes should be moderated to reduce growth. However, often soils are naturally very fertile and winter rains completely fill the soil profile. Thus shoot growth can be excessive before irrigation and fertilization have begun, effectively removing them as growth control tools. Cover crops have been shown to compete sufficiently well to slow down vine growth and can be effective in fertile sites.

In conclusion, shoot growth and vine balance are ideal when a vineyard is designed in such a way that integrates the important drivers of growth: site, rootstock, scion, vine spacing and cultural practices.

Relevant Literature

- Intrieri, C. and I. Fillipetti. 2000. Planting density and physiological balance: Comparing approaches to European viticulture in the 21st century. *In:* Proceedings of the ASEV 50th Anniversary Annual Meeting, pp 296-308, American Society for Enology and Viticulture, Davis, CA.
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- Myers, J.K., J.A. Wolpert, G.S. Howell. 2008. Effect of shoot number on shoot growth and leaf area of young Sangiovese grapevines. American Journal for Enology and Viticulture 59:422-424
- Wolpert, J. A. 2013. Vine balance and the role of vineyard design. Posted at www.extension.org , accessed on December 12, 2013.

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