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Vine Spacing: Is the Trend Toward High-Density Planting Going to End?

Planting density is one of the most important factors in vineyard design. Some considerations and how one vineyard manager deals with it.

by Mark Greenspan



A Russian River Chardonnay vineyard planted with variable spacing according to soil conditions. Vines were widely spaced on heavier soils (foreground) and narrowly spaced on coarser, gravelly soils (background).

When one thinks of the primary consideration when planting a new vineyard, besides varietal choice, one usually thinks about rootstock choice. I don't doubt that rootstock choice is crucial, and I have seen some vineyards fail to produce adequately because the rootstock used was not appropriate for the soil in which it was planted. However, when one designs a vineyard to achieve the highest wine quality that the site can deliver, one must design for "vine balance."

What is vine balance? Often, it is defined as the ratio of fruit to some other aspect of vegetative canopy. There are many indices

that attempt to describe vine balance—for example, the Ravaz index (weight of fruit to weight of dormant pruning wood), fruit weight to leaf area, and leaf layer number (exterior to the fruit zone). One might also consider yield per acre to be an indicator of balance. These are all well and good and are very useful as measured variables in research experiments. However, their ranges of acceptability seem to be too wide, rendering them relatively useless as an absolute indicator.

For me, I know balance when I see it. Vine balance for a premium winegrape vineyard includes the following: 1) I can see some of the clusters through the leaves but not all of them, 2) I can see most of the other clusters if I shift my viewing angle slightly, 3) clusters are not clumped together anywhere, 4) there are few, if any, laterals (some may be removed), 5) shoots grow to plus or minus 4.5 feet, then stop, 6) no more than one trimming pass is needed, if at all. There are allowances about these optima, based on site climate and especially with regard to fruit exposure. To me, this is the goal of good viticulture, and there is some art to it—I don't want to assign a number to it and change something just because the index is outside of a published range.

That brings me to the subject of vine spacing or vine density. Probably nothing can have as much of an influence on vine balance as vine spacing can. And by this, I refer primarily to intra-row spacing, not inter-row spacing. The trend, it seems quite clearly, has been

towards tight vine spacing (higher vine densities), probably in an effort to mimic the noble European vineyards (those being on poorer soils and without irrigation, I might add). The concept here locally is that the vines will compete with one another when planted in close proximity. This concept is complete hogwash in most field situations.

Intra-row Spacing May be More Influential Than Rootstock Selection

Jim Wolpert, Extension Specialist in Viticulture at **UC Davis**, gave a talk at the **ASEV Rootstock Symposium** on June 23, 2009. It was the best talk I've ever heard from Wolpert, where he described the relative importance of intra-row spacing to that of rootstocks and found that, while both were important, spacing seemed to have the more profound effect. In his talk, he showed data from Archer and Strauss (S. Afr. J. Enol. Vitic. 6:25-30, 1985) with rooting density data from several different vine density plantings. I took the liberty to graph these data as root density (root length per unit soil volume) against vine density. It is interesting to see that root density continues to increase with vine density, even up to a density of 8,000 vines per acre! If competition were occurring, the curve would flatten out at higher vine densities. It does seem to level off slightly above 2,000 vines per acre but continues to increase over the entire range. This tends to shoot down the argument about vine-to-vine competition, but there are likely soils where competition would be evident.

In reality, the tighter the intra-row vine spacing, the more vigorous the shoots. Wolpert showed that a vine has a fixed capacity to produce biomass. If vines are pruned to fewer buds, the shoots will be more vigorous and vice versa. In other words, pruning weight remains nearly constant for varying amounts of shoot density (shoots per unit length of canopy), but shoot weight does not remain constant. Therefore, it is important to leave sufficient bud numbers per vine at pruning such that the shoots are long enough but not excessively long. Longer shoots tend to produce more lateral growth, which is generally undesirable. Leaf area tends to be similar, regardless of pruning level for a given vine, but at lower bud numbers, the percentage of leaf area on laterals increases.

Well then, with tighter vine spacing, can't we just compensate by leaving more buds per vine? No, we cannot simply adjust pruning level (i.e., more or less buds per vine) at will. To achieve the balanced vine, we need to provide proper shoot density. If we have a given distance between vines, we cannot just cram in more shoots. Ideal shoot density depends upon whom you talk to. I know some ultra-high-end Pinot Noir vineyards that use a guideline of 10 shoots per meter while it is more common to find target levels of 15 shoots per meter, also for premium-quality winegrape vineyards. Whatever the case, it is clear that we cannot easily compensate for bad decisions made during the vineyard design phase by varying our cultural practices. As Wolpert stated: "Pruning severity is not one of the practices to achieve balance." I agree with him on that point.

Another way to think of "vine balance" is this: the relative biomass of the above-ground portion to that of the root system. Since we have seen that vines do not really compete against one another, their root systems are nearly constant, no matter how close they are to another vine (within limits). So, vine density does not really have anything to do with root systems but everything to do with how much above-ground vine there is. The root system stores carbohydrates and nutrients over the winter which, along with carbohydrates and nutrients stored in the trunk, cordon and canes, are used to provide energy for the initial bud push in the spring. A given root system can support a given number of buds/shoots. Cramming vines too close together has little to do with the root system but

everything to do with the number of buds that can be shoved into that vine's linear space without overcrowding.

Wider Spacing is Less "Risky"

Wolpert indicated that we are at greater risk in planting our vines too close together than in planting them too far apart. He alluded to a paper by Intrieri and Fillipetti (2000¹). This paper was summarized by **Bibiana Guerra** in *Wine Business Monthly* in April 2007. In it, the authors describe in a hypothetical manner based on scientific observation how the vine balance changes away from its optimum at a given vine spacing, which they indicated to be four feet. Obviously, that vine spacing is not ideal for all vineyard site, soils and rootstock combinations, but it is a reasonable guideline for modern vineyards on relatively "low-vigor" soils.

Why did Wolpert claim that there is lower risk for planting at wider vine spacings? Because at wider spacings we can, through educated guesses and trial and error, adjust the bud numbers to match the site vigor potential. This may mean that we need to cut the cordons or canes shorter to achieve balance. The downside there is that a portion of the vine row will not be productive which, though economically damaging, is not harmful from a viticultural or wine quality standpoint. On the other hand, vines spaced too closely will either need to be 1) of excessively high shoot density detrimental to wine quality, 2) of ideal shoot density but requiring multiple trimming passes, or 3) a candidate for either horizontal or vertical canopy division, if that is even possible.

I mentioned canes just now. Cane pruning imposes additional limits on how far apart vines can be in the row. While cordons may be extended to as long as necessary to fill the gap between vines, canes cannot be extended out very long. Shorter canes tend to provide more even bud break and shoot growth. One generally does not want to leave canes longer than three feet (often shorter) and with the bend in the cane that restricts intra-row vine spacing to not much over five feet.

Not much has been said about inter-row spacing. Well, there's not much that needs to be said. As discussed above, the issue is not so much the spacing but the amount of buds that can be retained per vine after pruning. The inter-row spacing has no effect on that parameter. Row width is more a manner of functionality than physiology. As tractors and implements have gotten narrower over the years, row spacing has eagerly shrunk to accommodate them (really a chicken and egg situation). Besides ease of movement in the vine rows, the other limitation to vine spacing is mutual shading from one row to the adjacent row. Generally, the rule of thumb has been to make the inter-row space equivalent to the canopy height. However, in sun-drenched climates such as much of California, closer spacings than 1:1 are easily allowable. Some mutual shading of the fruit zone in the afternoon can be a good thing in hotter climates. This depends also on the row orientation so that the shade is cast during the hottest time of the day (mid to late afternoon). Because closer spacing has little impact on vine balance, it is usually beneficial to space rows closely to improve yield on a land area basis.

Bevill Vineyard Management Using Variable Vine Spacing

Choosing the proper vine spacing is not easy, considering all of the inputs into the decision-making process (soil, climate, variety, rootstock, trellis, pruning system, potential wine quality/grape price). But, what about the real world, where soil conditions are not uniform across a given piece of land? Variability in soil conditions is a fact of life. In some cases,

variability is minimal and may be ignored, especially if the target market is not of the ultra-premium market and its associated grape pricing structure. However, oftentimes soil variability is not so subtle and must be dealt with.

I visited with Healdsburg-based **Bevill Vineyard Management**, headed by **Duff Bevill**. Bevill was eager to tell me about his company's installations of vineyards with variable intra-row vine spacing. He said that recently he had been moving away from changing rootstocks within blocks to satisfy soil variability and has been going with the variable spacing concept in numerous vineyards.

After a soil survey is conducted using soil backhoe pits, zones of similar soils are delineated. Sometimes the variability can be managed by creating blocks within each soil type, but that can often lead to small, odd-shaped blocks that are inefficient to operate. The problem with using different rootstocks to manage vigor zones like this is that, besides vigor, rootstocks have other properties that may not be a good match within the same block. Some of these properties could be earliness of bud break and/or vegetative cycle, drought tolerance, nematode tolerance, etc. So, it is better to use the same rootstock to satisfy the general soil condition. Balance and uniformity can be achieved by accommodating weaker soils (i.e., those with less water and nutrient holding capacity) with narrower vine spacing and stronger soils with wider vine spacing. Bevill will often use three spacings within a vineyard, such as four, five and six feet. This works well for cordon-trained vines, but cane-pruned vines may be treated this way as well but with generally closer spacing than for cordons.

Bevill sometimes creates different irrigation zones for different soil conditions. This may also be handled by installing two drip lines in each row (and two submains to feed them). The weaker soils usually require irrigation earlier than the heavier ones, so the second line can be used to irrigate those zones first before switching over to the whole-row irrigation line. It is important that the irrigation spacing does not change, despite the changes in vine spacing. Ideally, we want to apply the same amount of water per unit ground area regardless of whether the vines are tightly or widely spaced.

The downsides to variable spacing are minimal, in my opinion, compared to the potential benefits and headache savings down the road. Aesthetically, the crystalline perfection of a uniformly-spaced vineyard is destroyed when some vines in the center of the block have a different grid spacing. Too bad. The only time this will matter is during the dormant season, when you can actually see the stakes. Aside from aesthetics, there are additional costs for stakes, pencil rods or re-bar, and vines. There is potentially extra expense for the irrigation system, but I think that most new vineyards should be installed with two parallel irrigation lines anyway, which will benefit variable vine-spaced vineyards as well as uniform vine-spaced ones. Regardless, the end result is a vineyard that has a uniform canopy down the row and for which fruit matures uniformly over time and space. **wbm**

i 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.