Summary 13

VITICULTURE & ENOLOGY
UNIVERSITY OF CALIFORNIA DAVIS

Title: **“Canopy management for fruitfulness”**

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In: Aus. J. Grape Wine Res. 6, 109-115. 2000

In his introduction, the author acknowledges there is a great amount of research on the effects of canopy management on fruit composition and resultant wine quality. But he sees little emphasis on the effects of canopy management on yield and various yield components. The objective of this article is to study the effect of canopy practices and canopy microclimate on bud fruitfulness and fruit yield per node.

- The author elaborated on why he chose to look at both **fruitfulness** and **fruit yield per node**. Both refer to yield, but they are slightly different. “Fruitfulness” is used here to mean observed fruitfulness, as opposed to potential fruitfulness, and is defined as the number of clusters per shoot. But this is a poor indicator of final yield, since shoot number per vine -even per node- varies widely. That is why the author prefers to use “fruit yield per node”, or node fertility, which is defined as the weight of all the clusters from a single node - regardless of the number of shoots in that node, and of whether those shoots arise from primary or secondary buds.

- Grape canopies can impact the following canopy microclimate factors: amount of photosynthetic photon flux density (PPFD), light quality, wind speed, evaporation, air temperature, and air humidity. The first four are the most readily affected, whereas the last two are much less attenuated. The article goes on to address the impact on node fertility of a series of canopy management parameters and practices that follow here.

- **1) Light.** Shading reduces the yield per node. Both clusters per shoot and shoots per node were affected. Another author observed that buds situated inside the canopy are less fruitful than those outside. Late spring seems to be the critical period when shading is the most detrimental to fruitfulness. When solar radiation is intercepted by the leaves in a grapevine canopy, the leaves change not only the quantity, but also the quality of light. For instance, the red to far red ratio (R:FR) decreases from aprox. 1.15 to 0.15-0.75. When the impact that this change had on fruitfulness was studied by yet another author, the results were mixed. In one case, there was no effect, whereas in another, lowering the R:FR reduced the number of clusters per shoot.

- **2) Temperature**. Often, the effects of temperature are difficult to separate from those of light. Some authors believe that the increased temperature resulting from better light exposure may contribute to increased fruitfulness. In general, higher temperatures promote cluster primordia initiation and development. It has been suggested that this effect occurs extremely early in development, well before inflorescence primordia are evident.

- **3) Trellis**. Yield per node is only affected when a change in trellis and training system occurs that involves physically dividing the canopy. The most clear example is the introduction of the Geneva Double Curtain (GDC) by Shaulis in the 1960’s, which increased budbreak and fruitfulness, and caused yield increases of 44-90% compared to the non-divided canopy. In a separate study, Richard Smart also found more shoots per node and more clusters per shoot in a Cabernet Franc trained to a Ruakura Twin Two Tier (RT2T), compared to a standard Vertical Shoot Positioning system (VSP). This translated into

80% higher yield. Finally, Kliewer and Smart observed more shoots per vine and more clusters per vine in divided trellis systems -such as U-trellis, V-trellis, and W-trellis-, in a study with Sauvignon Blanc at Davis, California. Yield increases were as much as 53-67%.

- **4) Renewal area location.** Location of renewal wood at the top of the canopy produced higher yield than when the renewal area was at the bottom, where sunshine was limited. Other authors found that yields doubled in Concord when renewal area was at the top on a GDC trellis, as compared to the bottom renewal of a single curtain. Another author compared renewal areas either on a higher or a lower tier in Cabernet Franc. The top tier produced five times the yield of the lower tier. Researchers believe that this effect is due to a modification of the light environment in the renewal area, which in turn increases budbreak, bud fruitfulness and overall yield. Whether the effect is due to the light conditions of the subtending leaf or the bud itself is not well known. *[*Note*: In a recent study, Dokoozlian et al showed that whole shoot light microclimate, rather than individual bud light interception, is the main factor determining bud fruitfulness].*

- **5) Shoot orientation**. One author had suggested that vertical shoots were more fruitful than horizontal shoots. Later, Kliewer showed that there is no effect of shoot orientation on bud fruitfulness.

- **6) Leaf removal**. Studies on whether or not leaf removal and lateral shoot removal in the fruiting zone might improve fruitfulness have had mixed results. In one case with Pinot Noir on a VSP, there was a lack of response. Similarly, another author found no effect with Riesling and Chardonnay. In contrast, others found that when they removed leaves from a dense Sauvignon Blanc canopy, shoots per node, clusters per shoot, and flowers per cluster all increased over a control. They were able to report a 4-fold increase of R:FR and a 5-fold increase of PPFD in the leaf removal treatment. Thus, the effect, or lack of effect, might be related to the vigor of the variety, as well as the severity of the leaf removal.

- **7) Shoot thinning**. In different studies with Riesling and Sultana, shoot thinning caused an increase in the number of clusters per shoot. However, severe shoot thinning (85% of shoots removed) had the opposite effect, causing an increase in shoot vigor, an increase of the ratio of primary to secondary shoots, and a decrease of clusters per shoot in several varieties.

- **8) Incidence of primary bud necrosis.** In the previous study, the severity of shoot thinning was correlated with the incidence of a disorder called Primary Bud Necrosis (PBN). In PBN, the primary shoot fails to push, and a secondary shoot pushes instead. Because a shoot is still visually present, the phenomenon goes undetected, but since secondary shoots are less fruitful than primary shoots, the resulting yields are always reduced. The current author believes that the presence of PBN in vigorous cultivars might actually be the reason for their infertile basal nodes. Varieties prone to PBN include: Sultana, Flame Seedless, Riesling and Syrah. Besides vigorous shoots, other factors that exacerbate PBN include: high soil nitrogen, canopy shading, and gibberellic acid application.

What are the practical implications of this study? When we manipulate leaf canopies, the parameter that we are most likely affecting is the number of shoots per node, which in turn affects yield. For this reason, node fertility –cluster number per node- is a better indicator of productivity than bud fruitfulness. When we open up the canopy, yields are likely to increase because the improved light conditions favor multiple shoots with better fruitfulness arising from the same node. On the other hand, situations like the presence of a frost, or the presence of bud necrosis, will decrease yields because primary fruitful shoots will be replaced by less fruitful secondary shoots. It is important to minimize situations that encourage bud necrosis, such as excessive vigor, nitrogen application, or shading.

Author: Bibiana Guerra, Editor: Kay Bogart. This summary series funded by J. Lohr Vineyards & Wines.