

Bud Fruitfulness and Yield

GRAPES 101

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

By Tim Martinson, Alan Lakso, and Terry Bates



Bud fruitfulness is the first measure of yield potential and training systems are designed to maximize bud fruitfulness in canes we select for retention at pruning time. Pictured is an abnormally fruitful 'Cayuga White' shoot photographed during the 2011 growing season. Most shoots have a maximum of three to four clusters.

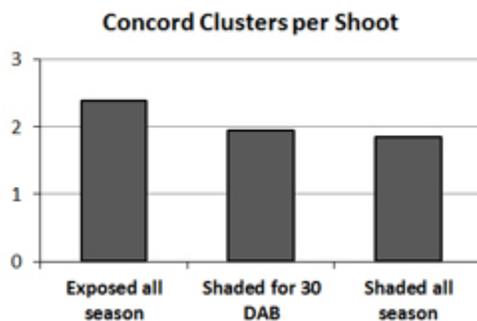
As grapes enter dormancy, the maximum crop potential for the next growing season has already been determined. Each compound bud has the potential to produce three shoots from the primary, secondary, and tertiary buds, and each of the individual buds has a fixed number of cluster primordia. We remove much of this crop potential during dormant pruning, retaining a specific number of buds. Each of these buds has a set number of grape clusters –normally ranging from zero to three –that was determined during the previous growing season in the month following bloom. While events after bud swell also influence crop size (floret development, fruit set), the number of clusters is set by bud development the previous year.



Fruitful primary (l) and non-fruitful secondary (r) 'Concord' shoot emerging from a single compound bud.

Fruitful buds

Buds are said to be fruitful if they have at least one developing cluster. But many buds have two or more clusters, so bud fruitfulness is often expressed as the average number of clusters per shoot. Clusters are initiated during the previous year's growing season before bloom, and the final number of clusters on the first six to ten nodes that are likely to be retained after pruning is determined by approximately a month after bloom. In California's Central Valley, bud fruitfulness (clusters per shoot) can vary by about 25% from year to year, and growers can get a first estimate of yield potential by dissecting buds and counting cluster primordia during the dormant season.



Effect of shaded buds on following season's bud fruitfulness. Shading for 30 days after bloom reduced fruitfulness from 2.5 to less than 2 clusters per shoot, but additional shading had no additional effect. Data from Alan Lakso.

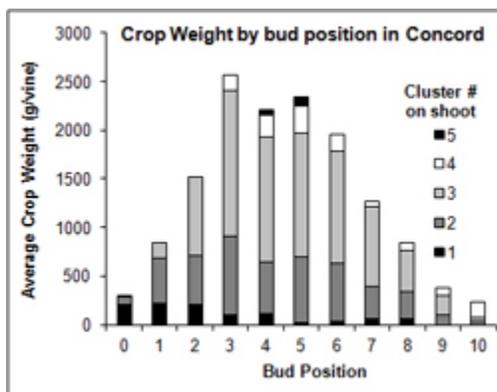
Light exposure and bud fruitfulness

During bud development, the tissue within the bud can form either a tendril or a cluster during the process of differentiation. Whether they form tendrils or clusters depends heavily on the light environment. Exposure of the buds to sunlight increases fruitfulness, and shading or low light intensity reduces it because the developing bud forms tendrils instead of clusters. Shading experiments have shown that this process is largely complete by about a month after bloom. A detailed study of several varieties in California (Sanchez and Dokoozlian, 2005) showed that bud

fruitfulness generally increases with increasing shoot light exposure with at least one-third to one-half of the available sun. In a recent experiment on Concord in New York (see figure), shading for the first month after bloom resulted in a reduction from 2.5 to 2.0 clusters per shoot. Buds exposed to sunlight also had a higher tendency to push more than one shoot (i.e., primary and secondary shoots both grew), resulting in more clusters per retained node.

Weather and fruitfulness

In the cool and often cloudy climate of New York, sunlight intensity and temperature varies widely among years. Years with sunshine and heat around and after bloom result in higher bud fruitfulness, while cool, cloudy years tend to lower bud fruitfulness in the following year. Variation in bud fruitfulness is one of the most important factors explaining year to year differences in yield.



'Concord' yield by bud position (on retained nodes) and cluster number, counting from base of the shoot (each cluster position indicated by shading). Data collected in 2004 from 100-node 'Concord' at Fredonia, NY.

Bud position and fruitfulness

In some grape varieties, the first few nodes at the base of the shoot tend to be less fruitful than nodes in the mid-cane region. This is one reason why some varieties are cane-pruned rather than spur-pruned. 'Thompson Seedless' is notable for low bud fruitfulness in the first four nodes. Concord on high cordon is often pruned to 6-bud spurs because the first two to three nodes are less fruitful. This is illustrated by data from western New York, in which the weight of grapes harvested was separated out by shoot and cluster position. The greatest yield per node was obtained from nodes three to six, with crop weight declining at both lower and higher bud positions.

Many other wine grape varieties have more uniform bud fruitfulness across nodes and can be pruned to short two to three bud spurs without reducing potential yield.

Primaries, secondaries and tertiaries

Within the compound bud, the primary bud reaches the most advanced stage of development and initiates more clusters than the secondary bud. Secondary buds are less fruitful than primary buds and rarely produce more than one or two clusters. Clusters from secondary buds typically have fewer flowers and berries than basal primary clusters. Secondary buds often remain dormant, but they can contribute to fruitfulness when double shoots – a primary and a secondary – emerge from the same node. However, secondary buds most often emerge only when the primary bud is damaged or winter-killed. The tertiary bud most often is not fruitful.

Yield per node

Bud fruitfulness is only one component of yield. The other factors that vary are flower number, berry number and berry weight. The main branches of flower clusters (inflorescence meristems) are formed by the time vines enter dormancy, but additional branching occurs during bud swell in the spring. By budburst, flower number is set. Fruit set following bloom varies from 20 to 70%, and is influenced by many factors such as variety and weather around bloom. Some nodes push out both a primary and secondary shoot, increasing potential yield per node. Final yield is determined by the number of clusters, berries per cluster, and berry weight.

Pruning and fruitfulness

Shading and its impact on bud fruitfulness is the reason why it's important to select well-exposed, moderate diameter canes for retention at pruning. Cane diameter is a good indicator of shoot vigor. Both low-vigor (small diameter) and high-vigor (large diameter) canes tend to have lower bud fruitfulness. Training systems that work with the vine's growth habit are designed to provide adequate sunlight exposure to the renewal zone (area retained for next year's crop).



Fruitful shoots emerging from base buds on older trunk wood. 'Noncount' buds on some cultivars have the potential to add significantly to the crop on retained 'count' nodes.

Frost injury and crop potential

Secondary shoots tend to have one-third to one-half as many clusters as primary shoots – and have fewer flowers per cluster – particularly if primary shoots start to grow in the spring before a frost event. If primaries freeze in midwinter, then the developing clusters in secondaries can produce more branches at budswell – but their development is inhibited when an actively-growing primary shoot is present.

Hard information about yield potential of secondary buds that push when primary shoots get frosted is scarce – and fruitfulness of secondaries and ‘non-count’ base buds (latent buds emerging from trunks and cordons) varies greatly by cultivar. Some hybrid varieties (eg. Dechaunac) tend to have fruitful base buds, while others (notably Concord and most *vinifera*) are not fruitful. But a common rule of thumb is that secondary buds will produce about 30% of the crop that primaries are capable of producing.

Implications for management

Understanding what bud fruitfulness is and how it varies is a key concept for grape growers. Growers can maximize bud fruitfulness by choosing appropriate buds and canes that received the most sunlight exposure during the critical bud development period following bloom. It’s also important to manage your vineyard to avoid excess vigor and shoot density. Following frost injury to primary shoots, it’s important to realize that the vines are likely to be able to produce a lower, but not insignificant yield from secondary buds. Finally, some varieties with fruitful ‘noncount’ base buds have the potential to produce a significant crop in addition to the crop potential present on ‘count’ buds. These varieties will often require additional shoot or cluster thinning to avoid overcropping.

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