Vineyard canopy management series: Shoot thinning

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Introduction

The "Vineyard canopy management series" of extension circulars will review each canopy management practice individually. Each circular will advise how to effectively implement each canopy management practice and why it is important to do so. The practices collectively known as "canopy management" aim to maximize canopy leaf exposure and efficiency, maintain crop quantity and quality, decrease disease incidence and severity, and improve vineyard health and sustainability. Though labor-intensive, canopy management is not optional if the goal is annual production of high quality grapes and wines.

Shoot thinning is the first seasonal canopy management practice. Shoot thinning is practiced in winegrape vineyards, but not in muscadine vineyards. Failure to shoot thin results in a highly congested canopy characterized by reduced air flow, high humidity, and extended damp periods. Muscadines can generally tolerate such conditions without adverse effects. Winegrapes grown in crowded fruit zones, however, will experience excessive disease incidence and severity – especially in the humid southeastern US. Shoot thinning is thus a necessary canopy management practice in winegrape vineyards in Georgia and other southeastern US states.

Why thin shoots

Dormant pruning is the first step in crop regulation (Hickey and Hatch 2018; enter link HERE for pruning pub anticipated to be published this fall). Please reference that bulletin if clarification is needed on vine anatomy; most anatomical terms should be clarified in figure captions below. Clusters are borne on shoots that emerge from the count buds retained during pruning. Shoot thinning is thus the second opportunity to regulate crop yield. Shoot thinning is particularly important when cordon/spur are the chosen combination of training/pruning method. Basal buds are left at the base of retained spurs. Less fruitful, or unfruitful, shoots will emerge from the basal and latent buds located at the junction of the spur and cordon; the net effect is often excessive shoot density without a tandem increase in crop. Relative to spur pruning, cane pruning limits the number of latent and basal, non-count shoots (Table 1; Figure 1). Less shoot thinning is therefore required when practicing cane relative to spur pruning. This is of particular importance if the availability of vineyard labor is limited in the springtime as opposed to the dormant period. Unwanted increases in shoot density can be further compounded if vines are pruned to excessive count bud numbers (greater than three to five per linear foot of cordon) when aiming to offset the threat of cold injury or spring frost. If neither cold injury nor frost damage occurs, then shoot numbers will be too excessive for desirable canopy and crop health.

Table 1. Training and pruning effect on shoot numbers.			
Treatment	Total shoot count (# / vine)*	Total shoot count (# / vine)**	Count shoot % (of total shoot # / vine)**
Cordon training and *spur* pruning	45	47	56
Head training and *cane* pruning	22	27	71

*Hatch (2015); data averaged across 2013 and 2014 seasons in Cabernet Sauvignon.

**White and Hickey (2018); data averaged across 2017 and 2018 seasons in Petit Manseng.

Figure 1. Developing buds will become shoots in spur- (left) and cane- (right) pruned systems. Note the excessive non-count/latent (green arrow) bud number in the right photo; buds will develop into shoots and will need thinned out to maintain canopy porosity. For more information on shoot thinning requirement as related to pruning method, see Hickey and Hatch (2018).

It is important to thin shoots because excessive shoot density will increase the incidence of cluster touching and bunch rot. Canopy and cluster congestion will increase the amount of time it takes for tissues to dry and will further limit fungicide spray penetration. We do not need help promoting fungal diseases in our humid climate. Therefore, shoots should be thinned in the spring to optimize canopy porosity, maintain cluster health, and produce a balanced crop yield. The right photo in Figure 2 was the result of two factors: (1) excessive bud number retention at pruning, and (2) failure to shoot thin in the spring. The shaded parts of the several touching/overlapping clusters will be prone to bunch rot and have poor color and varietal character development (Fiola 2017). The left photo in Figure 2 shows an optimal shoot and cluster density that allows good fungicide coverage and sunlight penetration into the fruit zone.

Figure 2. An optimal cluster and shoot density in Cabernet Sauvignon at veraison (color change and sugar accumulation) (left) and an overly-congested Merlot fruit zone at bunch closure (right). Note: the pictures show vines that are trained to cordons (blue arrows) and are spur-pruned.

When to thin shoots

Shoots grow fast early in the season. This early period of rapid shoot growth often coincides with the period of frost threat. There is therefore a very short window of opportunity to efficiently shoot thin (Fiola 2017, Smith and Centinari 2017), which is roughly between the 3 to 12" growth stage (Figure 3). It is hoped that this window of opportunity occurs *after* the threat of frost has passed, leaving the lone decision of when to start thinning based on shoot growth. Bets must be hedged if the threat of frost remains and labor is short (unfortunate, but often the case). Should shoot thinning start before the threat of frost has passed to increase the chances of finishing the task efficiently? Or, should shoot thinning commence after the threat of frost has passed but potentially beyond the growth stage when it is most efficiently conducted? A solution to this problem may be to start thinning as soon as fruitful vs. non-fruitful shoots can be identified (3 to 5") and use active frost protection (Hickey et al. 2018 enter link to vineyard frost pub HERE) to protect the retained shoots.

Fruitful shoots are valuable. However, they may be accidentally thinned if shoot thinning is conducted before clusters are visualized. On the other hand, if shoot thinning is conducted too late, shoot tendrils will become attached to neighboring shoots and lignification will begin at the base of the shoot; such phenomena will greatly reduce shoot thinning efficiency. Hybrid cultivars tend to have more fruitful secondary shoots than *vinifera* cultivars. This "crop insurance" might serve as impetus to thin hybrids first, particularly in vineyards subject to frequent, late spring frosts that kill primary shoots. On the other hand, it would be logical to shoot thin early-bud breaking cultivars (e.g. Chardonnay, Merlot, Blanc du Bois, Lomanto) before late-breaking cultivars (e.g. Petit Verdot, Cabernet Sauvignon, Chambourcin, Traminette) due to shoot growth differences on a given calendar date.

Figure 3. The earliest stage to begin shoot thinning (left; approx. 3”), an ideal stage to shoot thin (center; approx. 5 to 7”), and the latest stage to efficiently shoot thin before shoots lignify at base and tendrils grab neighboring shoots (right; approx. 10 to 12”).

How to thin shoots

Basal, diseased, unfruitful, and otherwise short or malformed shoots are good candidates for thinning. Fruitful shoots that emerge from count bud positions on the spur should be retained (Figure 4). Saving basal/unfruitful shoots is advised when a spur renewal is needed to improve productivity on a region of the cordon. If implemented within the above-recommended window of shoot growth (3 to 12”), shoots can be easily snapped off by hand. A pair of hand shears will aid in separation of shoots by cutting tendrils if shoots are thinned much after they are 16 to 20” in height. Further, hand shears will be necessary if shoots start to become lignified at the junction of the shoot and one-year old spur, which begins to occur at roughly 24” shoot height. Hand shears may also be necessary to thin shoots if excessive bud numbers were retained on spurs to compensate for potential frost or cold injury (Figure 4). It is advised to first cut shoots away from the apical (top) portion of the spur to maintain lower renewal positions for next year. Mechanical, tractor-mounted shoot thinning equipment is primarily used in large-acreage, wine and juice grape production systems.

Figure 4. A spur with three count buds (blue arrows) that should be cut at the blue dotted line(s) if excessive bud numbers already exist in the cordon region. An unfruitful shoot may emerge from the basal/latent bud (green arrow) and thus may need to be thinned.

Shoot number

In the above text, the rather subjective terms “optimal” and “excessive” have been used to describe shoot density. Shoot density should be adjusted to roughly three to five shoots per linear foot of cordon or cane (Fiola 2017, Smith and Centinari 2017; Figure 5). On a per vine basis, those densities equate to roughly 15 to 25 shoots if between-vine spacing is five feet, and 18 to 30 shoots if between-vine spacing is six feet [see Hickey and Hatch (2018) for a table of target bud densities per vine in popular training systems and vine spacings enter link for pruning pub anticipated to be published this fall]. Assuming no incurred losses to pests, crop yield would be roughly 3.8 tons per acre if: (1) rows were spaced nine feet apart, (2) four shoots per linear foot of cordon were retained on a single-cordon training system, (3) average cluster weight was 120 grams, and (4) average shoot fruitfulness was 1.5 clusters per shoot. Crop yield would be roughly 4.8 tons per acre using the previous example but increasing shoot density to five shoots per linear foot of cordon. Those examples show how much shoot density can affect crop yield. However, as stated above, being too greedy with high shoot densities can increase fungal disease prevalence and reduce wine quality potential. Higher shoot densities can be retained in hybrid relative to *vinifera* cultivars, and in cultivars that are generally rot tolerant (Petit Verdot, Petit Manseng, Villard blanc) compared to those that are not (Chardonnay, Sauvignon blanc, Riesling, Vignoles, Blanc du Bois, Pinot noir).

Figure 5. An optimal shoot density of roughly four shoots per linear foot of cordon in Merlot at the pre-bloom stage; shoots were thinned roughly one week before the photo was taken.

Excessive crop may fail to reach commercial maturity in a timely manner when an increase in shoot number does not equate to increased exposed leaf area. Note that crop can increase with shoot number, but high shoot density does not necessarily equate to greater light interception in the ubiquitous vertical-shoot-positioned (VSP) system (Figure 6). The "ceiling" for light interception in the VSP system is a function of foliar self-shading that occurs as a result of the space limitations of 6 to 8"-spaced catch wires. On the other hand, greater shoot numbers can increase *both* crop *and* light interception in training systems that have one fruit zone and a divided canopy (Figure 6). The increased space in the fruit zone and canopy in such systems may permit the retention of greater shoot densities while maintaining crop health and quality. Thus, greater shoot densities may be retained in divided relative, single-cordon training systems (e.g. Watson, Ballerina, "Y", or "split" VSP trellis, and Smart-Dyson) relative to non-divided systems (e.g. VSP; single high wire). The UGA Extension Viticulture Team is currently evaluating the effect of various shoot densities and pruning methods on crop quantity and quality in both divided and non-divided, VSP canopies.

Figure 6. The most popular winegrape training system in the world, a vertical-shoot-positioned (VSP) system (left); a VSP system that has been retro-fitted with several trellis cross arms to divide the canopy and increase light interception and porosity (right).

Summary

Shoot thinning should not be thought of as an optional practice in winegrape vineyards. Relatively less shoot thinning will be required when the retained bud number during dormant pruning matches that of the desired shoot number, and when cane pruning is chosen over spur pruning. Shoot thinning is perhaps the most time sensitive of all canopy management practices; there is a very short window of opportunity to thin shoots before there is an exponential increase in the labor required to complete this task. It is therefore highly advised that shoot thinning be started in a timely fashion and as soon as shoot fruitfulness can be determined. Starting shoot thinning as early as possible during the growing season will optimize the potential for retaining only the desired number of fruit-bearing shoots. Shoot thinning sets the stage for successful production of a healthy canopy and high-quality crop that are less prone to fungal diseases.

References and additional reading

Fiola J. 2017. Canopy Management – Shoot Thinning and Positioning. Timely Viticulture Newsletter Series, University of Maryland Extension. https://extension.umd.edu/learn/canopy-management-shoot-thinning-and-positioning

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