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Shoot Positioning Native American (Concord-type) Grapevines

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Introduction

There has been research on machine shoot positioning at Cornell's Vineyard Laboratory in Fredonia, NY since 1979. Progress has been difficult, but recent developments have resulted in a mechanical shoot positioning system which many growers find satisfactory. This fact sheet is designed to answer questions that have been asked about hand and mechanical shoot positioning. The system is still under development; growers should consulttheir Cornell Cooperative Extension grape extension specialist for recent developments.

What is shoot positioning?

Shoot positioning consists of moving all upward or horizontally growing shoots which originate above or within about 24 inches of the cordon into a downward orientation and **a** location below the 24 inch zone. It was developed for vines which are trained to top wire cordons (Hudson River Umbrella, Geneva Double Curtain). It is done to insure that the leaves of basal nodes or canes which originate just below the cordon are not shaded by leaves on shoots originating above or below this zone. It also insuresthatwhen some mechanical pruning methods are used, sufficient node numbers develop in the pruning zone of the vine to produce a full crop of grapes.

Why shoot position?

For GDC vine training. Shoot positioning was developed by Dr. Nelson Shaulis to facilitate Geneva Double Curtain (GDC) training. Initially it was done to insure separation of the two canopies of foliage originating on each cordon of GDC trained vines. Later experience showed that yield benefits could sometimes be obtained when large, non-divided vines were shoot positioned (Fig. 1).

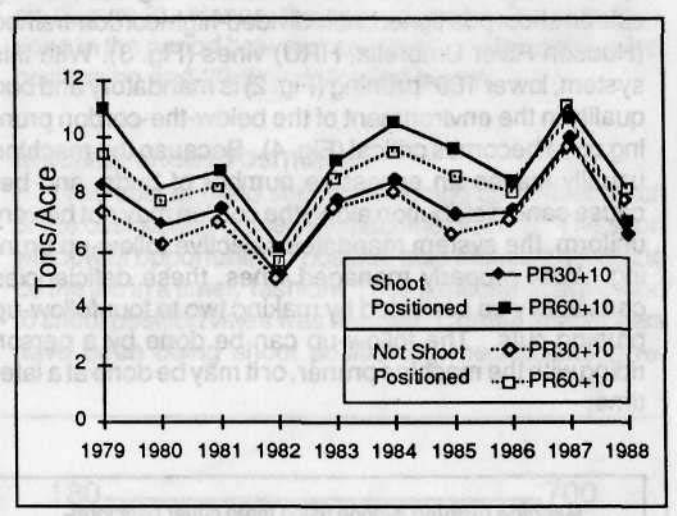

Figure 1. Effect of shoot positioning and pruning severity (30 + 10vs60+ 10 pruning) on yield of HRU trained Concord grapevines for the 10 year period, 1979 - 1988.
(Vineyard Laboratory, Fredonia, NY)

The yield increase was the result of enhanced fruitfulness of buds retained at pruning. The region where these buds develop is called the **renewal zone,** because that is where the growth which renews the vine canopy in the spring originates. Shoot positioning, by moving any foliage which might shade the renewal zone, assures that it is well illuminated.

For non-divided training systems. Until recently, shoot positioning was rarely done to non-divided canopy vines because, unlike GDC trained vines, all well exposed, highly fruitful canes whether growing above the cordon (360° pruning, Fig. 2) or below the cordon (180° pruning, Fig. 2) can be retained for fruiting on non-divided vines.

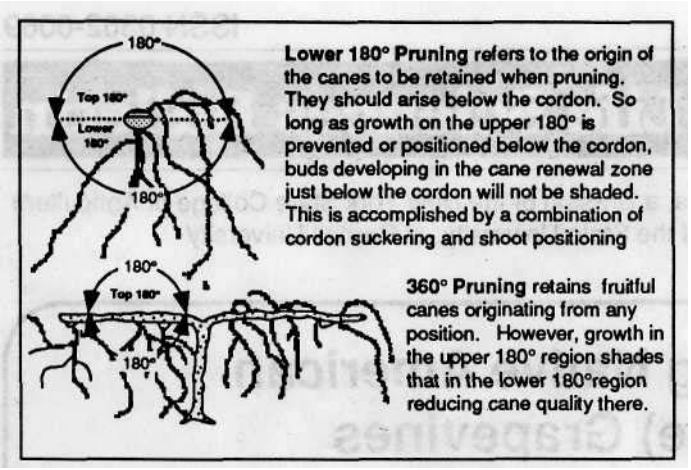

Figure 2. The concept of 180° and 360° pruning.

The development of the Cornell machine pruning system changed that situation. The machine pruning system uses cutter bars to make blocking out pruning cuts on shoot positioned, non-divided-high-cordon-trained (Hudson River Umbrella, HRU) vines (Fig. 3). With this system, lower 180° pruning (Fig. 2) is mandatory and bud quality in the environment of the below-the-cordon pruning zone becomes critical (Fig. 4). Because the machine usually leaves an excessive number of buds, and because cane distribution along the cordon may not be very uniform, the system mandates selective follow-up pruning. With properly managed vines, these deficiencies can usually be corrected by making two to four follow-up pruning cuts. The follow-up can be done by a person riding with the machine pruner, or it may be done at a later time.

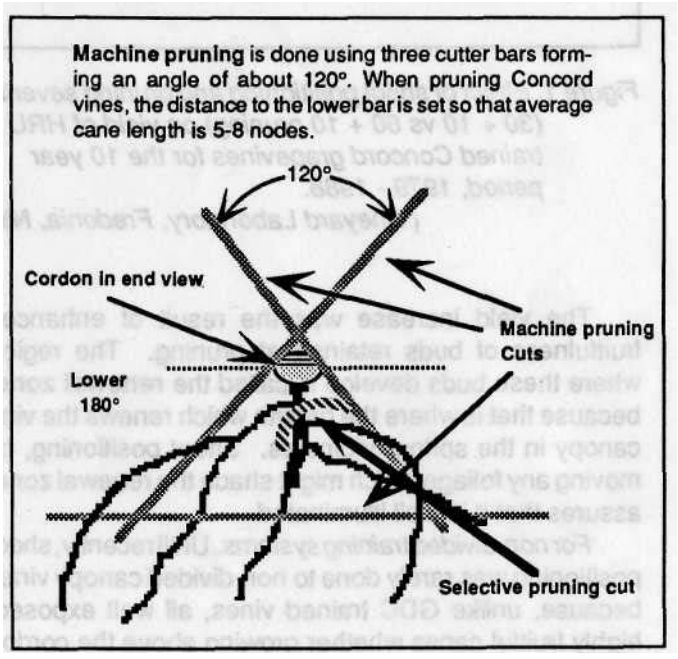

Figure 3. Machine Pruning using the Cornell system. 2

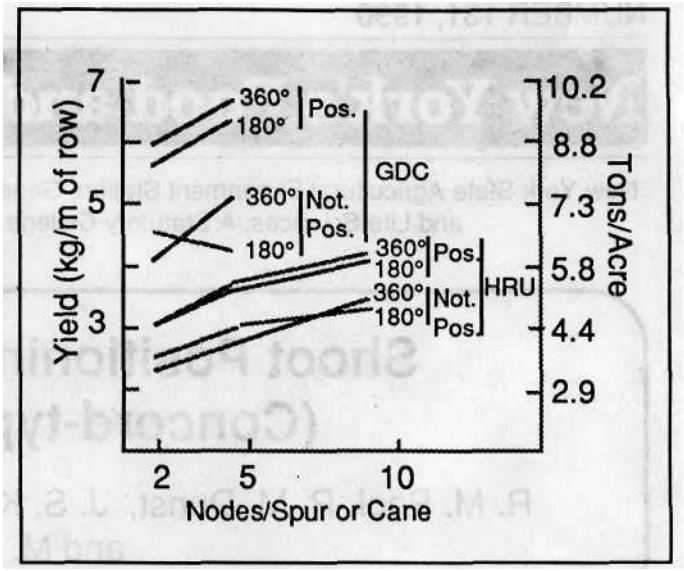

Figure 4. Effect of bearing unit length, shoot positioning and 180° vs 360° pruning on yield of Concord grapevines.

(Source: N. J. Shaulis)

The person doing the follow-up pruning does not have time to distinguish high quality buds from lesser quality. The sole tasks are to reduce bud number and insures distribution. Forthat reason, all buds developing in the lower 180° pruning zone must be highly fruitful. Maintaining illumination of the lower 180° renewal zone is critical if buds are to become highly fruitful. With the Cornell pruning system, illumination of the region is assured by removing all shoots which are growing on the upper 180° portion of the cordon (sprouting, cordon scrubbing) and shoot positioning to insure that no leaves develop which will shade the renewal zone. It is especially critical that a well illuminated lower 180° renewal zone is established before vines are machine pruned the first time. The decision to convert to machine pruning must be made at least one year before using the machine. Growersshouldtakeadvantageofthisconversion year to make sure that the trellis and cordons are suitable for large, productive vines and for mechanization.

Why use the Cornell machine pruning system?

ADVANTAGES

1. Node number, vine growth, and yields are similar to those obtained using traditional balance pruning.
2. Total labor requirement for pruning is reduced.
3. Skilled pruners are only needed for the follow-up adjustment allowing the most skilled workers to prune many more acres per year than they could do using traditional pruning methods.
4. The system lends itself to the utilization of power equipment for follow-up pruning, reducing pruner fatigue and improving quality of follow-up pruning.

DISADVANTAGES

1. An investment in machinery is required.
2. Two additional operations, cordon scrubbing and shoot positioning, should be done.

How do I shoot position?

HAND SHOOT POSITIONING

The goals. Excessive positioning of shoots is not desirable, because it can significantly reduce vine size. The goal of shoot positioning is to place and re-orient the tips of upright or horizontally growing shoots (or any other tissues which will cause shade in the renewal zone) into a downward orientation and into a location below the renewal zone. When vines are excessively shoot positioned, they look as if they had been raked with a comb. All shoots on such vines point downward in a more or less parallel fashion. In such cases, vegetative growth is drastically reduced and long term vine size (and hence productivity) is reduced.

The timing. Shoot positioning should only start after the tender young shoots have become strongly enough attached to the vine to withstand movement, but before the renewal zone has been shaded long enough that the buds and foliage are affected by the low light. Shoots also need to be long and heavy enough to remain in place after positioning. Positioning should be done before tendrils start to become attached to other shoots or to trellis wires. Once tendrils become attached, they lock the shoots into place requiring workers to carry shears to cut them apart. This greatly increases the time and cost of shoot positioning.

These goals are to some extent incompatible. Figures 5 and 6 show that total number of tendrils and number of attached tendrils begins to increase a little before grape bloom begins. This indicates that shoots would benefit from positioning before the beginning of bloom. However, the data in Figure 7 also show that the shoots are easily detached at that time and their short length (Fig. 5) allows them to spring back into place after being moved.

The answer to these conflicting goals is to position twice. The first positioning should be around the beginning of bloom. The goal is to separate potentially attached tendrils so they do not lock shoots into place. The second positioning should be done at least one week later, at which time the shoots are moved to a permanent location below the renewal zone. Data show that if the second positioning is delayed until 30 days after bloom, shade will have irreversibly damaged the developing buds and reduced the ability of leaves to do photosynthesis (Figure 8). Hence, the second positioning should be done in the period between seven days following the first positioning and 20 days following bloom.

MACHINE SHOOT POSITIONING

The cost of hand shoot positioning can offset much of the cost saving gained by machine pruning. The short window of opportunity to position also makes it difficult to do the job in a timely fashion. Thus a mechanical method to shoot position vines was needed. Cornell researchers have been doing shoot positioning mechanization re-

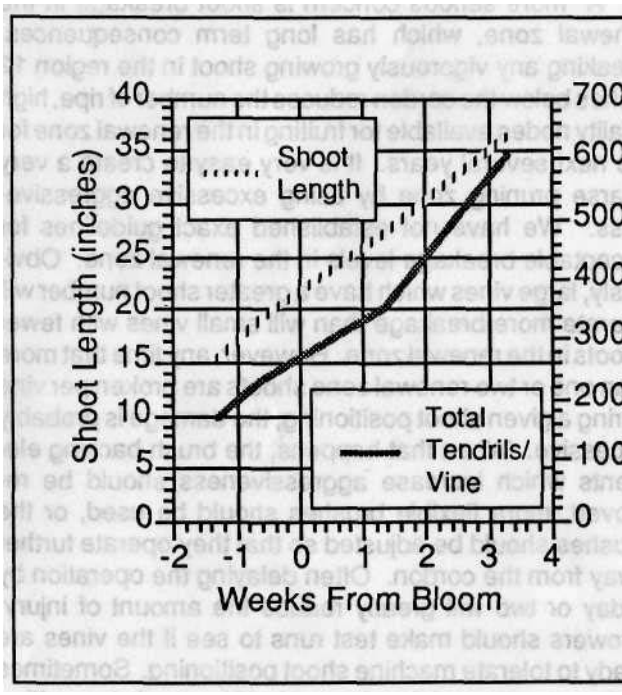

Figure 5. Growth of shoots and formation of tendrils on Concord grapevines.

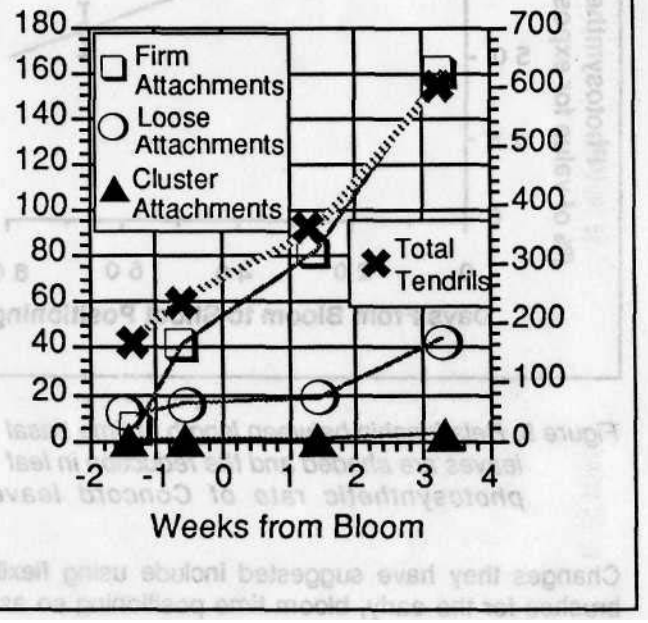

Figure 6. Increase in number of firmly and loosely attached tendrils of Concord grapevines.

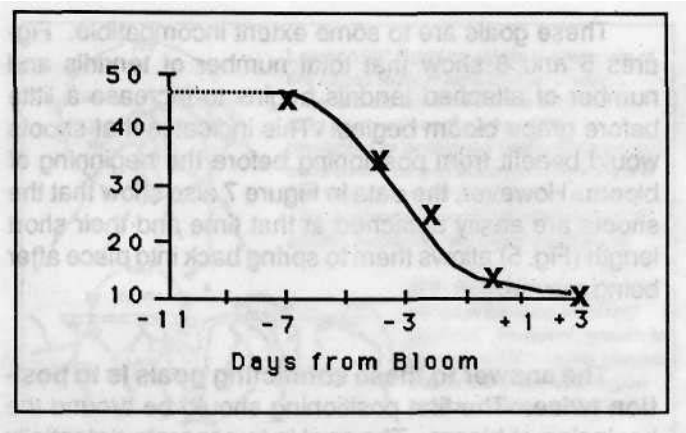

Figure 7. Percentage Concord shoots broken by application of 25 lbs. force at different times.

search since 1979. They have shown that machines which will position both sides of the vine at once are much more efficient than those which do only one side at a time. This requires over-the-row equipment. Presently the only available over-the-row machines utilize rotating brushes to position the shoots.

In the last three years, improvements to these brush type shoot positioners have been made by Dr. Wes Gunkel and his associates from the Department of Agricultural and Biological Engineering of Cornell University.

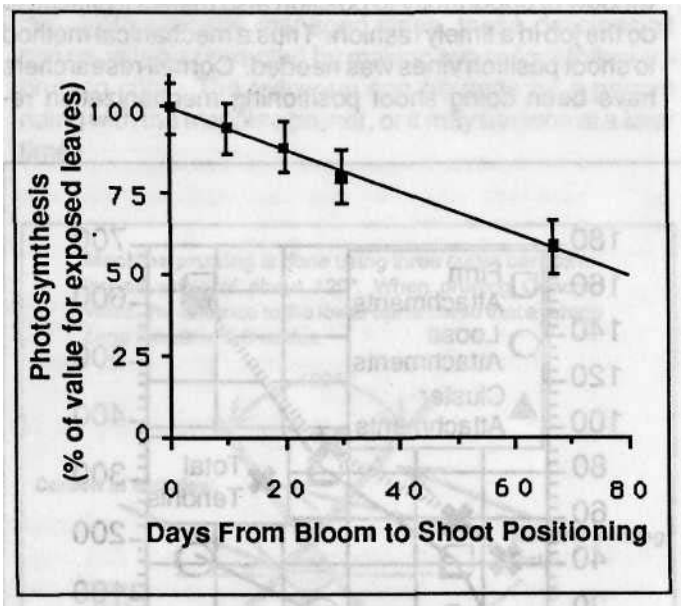

Figure 8. Relationship between length of time basal leaves are shaded and the reduction in leaf photosynthetic rate of Concord leaves.

Changes they have suggested include using flexible brushes for the early, bloom time positioning so as to decrease machine aggressiveness and reduce shoot breakage and using stiffer brushes backed by rubber fingers to increase aggressiveness at later times. The number and position of brushes have also been modified to help move shoots growing horizontally along the cordon. A manufacturer of these machines has made "Cornell Kits" available with which older units may be converted. Studies to date indicate a dramatic improvement in efficacy and reduced damage as a result in the changes in the machine. Research indicates that optimal timing of shoot positioning is the same, regardless of whether vines are positioned by hand or by machine. Growers should be aware that careful adjustment of the unit must be done to insure that there is sufficient aggressiveness to move the shoots but not so much as to cause excessive injury.

What are acceptable levels of breakage?

The first thing to remember is that injury is minimal on vines which have been properly trained in previous years. Secondly, one should remember that any shoot breakage in the upper 180° region of the cordon is not damage, but desirable removal of unwanted shoots. In addition, the grower needs to understand that shoot breakage has both short and long term consequences. The short term effect is direct crop loss, primarily due to cluster loss. As long as the unit is operated in a normal manner, this direct injury is not likely to be serious because the vine can compensate to some extent for reduced cluster number by increasing berry set. There can also be a limited compensating increase in berry size. Direct losses from breakage of two to three clusters per foot of canopy are not likely to be economically serious.

A more serious concern is shoot breakage in the renewal zone, which has long term consequences. Breaking any vigorously growing shoot in the region 12 inches below thecordon reduces the numberof ripe, high quality nodes available forfruiting in the renewal zone for the next several years. It is very easy to create a very sparse pruning zone by using excessive aggressiveness. We have not established exact guidelines for acceptable breakage levels in the renewal zone. Obviously, large vines which have a greater shoot number will tolerate more breakage than will small vines with fewer shootsinthe renewal zone. However, any time that more than one or two renewal zone shoots are broken per vine during a given shoot positioning, the damage is probably excessive. When that happens, the brush backing elements which increase aggressiveness should be removed, more flexible brushes should be used, or the brushes should be adjusted so that they operate further away from the cordon. Often delaying the operation by a day or two will greatly reduce the amount of injury. Growers should make test runs to see if the vines are ready to tolerate machine shoot positioning. Sometimes various portions of the vineyard will be ready to position at different times. Once a grower knows his vineyard, he

can schedule his time to cover the most acres of grapes at an optimal time.

How do I judge adequacy of positioning?

Research has shown that a single leaf layer will absorb about 90 per cent of the sunlight which is useful for photosynthesis. It takes many leaves on a vine to create the effect a single layer of leaves spread evenly over a whole canopy. In our research, we estimate the number of layers of leaves above the canopy and the renewal zone. Our goal is to have less than two layers of leaves.

We reiterate, training, cordon shoot scrubbing, and shoot positioning must all be optimized in order to obtain best results. Well trained vines which have had all growth removed from above the cordon, and which have been properly positioned in previous years, are more easily machine shoot positioned and suffer less injury than will conversion year vines. The consequence of a inadequate positioning or excessive shoot loss in the renewal zone is reduced yields for at least two years. Because of that, it may be wise to hand rather than machine shoot positioning during conversion years, and the operator of a machine positioner should be vigilant to avoid excessive shoot breakage.

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