

## **Vine Training Systems:**

### **What Purposes Do They Serve and What Attributes Are Most Important?**

Thomas J. Zabadal, MSU Dept. of Horticulture

The growth form of a vine profoundly influences its overall performance as well as many aspects of a grower's vine management. Therefore, I place the choice of a vine training system fourth in importance when establishing a new vineyard after: (1) whether or not to plant a vineyard, (2) the site for the vineyard, and (3) the variety/rootstock combination to be planted. The increasing recognition of the importance of vine training systems has generated a dramatic increase in discussion and written material about this topic in recent years. This activity stems from an improving understanding of vine function and efforts to translate that understanding into improved vine performance. The phrases "canopy management", "leaf removal", "shoot positioning", "fruit exposure", etc., all have their beginnings in the vineyard with the choice of a vine training system. New vine training systems are appearing with great frequency. If one were to plot the number of new vine training systems per year on a graph, the trend would suggest that by the year 2010 we will have many hundreds of vine training systems from which to choose! Many of these new vine training systems are conceptually exciting because they hold the prospect of improved vine performance over many of the traditional vine training systems. Nevertheless, this rapidly expanding topic can certainly bewilder even the veteran grower. Therefore, before one weighs the positive and negative attributes of several specific vine training systems, it may be useful to reflect on the basic purposes of vine training, to resolve one's priorities among those purposes and to recognize possible compromising factors in one's choice of a vine training system. The following discussion is intended to guide that process.

### **What Is A Vine Training System?**

A vine training system is a sustainable growth form of a vine. This distinguishes it from the engineering involved in the construction of a vineyard trellis which will be used to support that growth form and from pruning, which is the actual task of creating and maintaining that growth form. A vine training system begins with a conceptualized ideal form or shape of a vine, which we then attempt to apply to every vine in a specific vineyard. No two vines are identical. Therefore, when managing individual vines, it will be necessary at times to compromise aspects of their chosen ideal form. Nevertheless, the goal is always to come as close as possible to the ideal growth form of the vine for a specific vine training system.

### **What Are The Attributes Of A Vine Training System?**

1) Sustainability of the Growth Form. A vine training system should provide a sustainable and often stable form to grapevines for an indefinite period of time. However, one's choice of a vine training system may be a poor choice for providing such stable, sustainable vine structure. For example, when planting slight-moderately hardy varieties in cool climate vineyards it may be helpful to look upon vine training systems from the vantage point of the semi-permanent vine parts they utilize. Semi-permanent vine parts are those portions of the vine that we intend to utilize for a period of several years to include trunks, arms and specialized horizontal arms called cordons. The more of these semi-permanent vine parts, the greater the effort required to establish the mature growth form of the vine training system. This is especially true in the use of cordons. Some growers have labored for many years in an effort to fully establish cordons with slight-moderately hardy varieties in cool climate vineyards because the cordons are periodically winter killed. In such instances one can at times feel as though he/she is working towards a

training system that never becomes fully established. When frequent winter injury is a problem the fan training system (Fig. 1) illustrates a vine training system that can be implemented with no semi-permanent vine parts. Therefore, it can be established from suckers in one step. In that sense it provides a stable, sustainable vine training system in an unstable environment.

Another example of the failure of a vine training system to maintain a sustainable growth form can be cited from trials of the Scott Henry training system with *Vitis vinifera* varieties in Michigan. The very positive attributes of this training system to include excellent fruit exposure and a display of a large, functional leaf area excite our interest. Nevertheless, we have found that under Michigan growing conditions, fruit on the lower fruiting wire matures significantly less than that on the top fruiting wire. We are undertaking trials to see if we can minimize this difference with lower crop loads on the lower fruiting wire. Traditional Scott Henry training involves training vines alternately on upper and lower fruiting wires (Fig. 2A). Yet another difficulty with this training system in our Michigan trials is the precipitous decline of vine size for those vines trained to the lower fruiting wire. Such alternating large and small vine sizes in a vineyard are not desirable or even sustainable because the small, weakened vines represent an increased winter injury hazard. Therefore, to take advantage of the positive aspects of the Scott Henry training system it is being evaluated in ways so that each vine contributes to the fruiting of both the upper and lower fruiting wires. This is being done by using up to four trunks per vine with fruiting within the vine's own vine space (Fig. 2B) or using a two-trunk system with one trunk servicing the upper fruiting wire and the other the lower (Fig. 2C). In this way the Scott Henry training system may provide a sustainable growth form in Michigan.

A final example of the lack of a vine training system to provide a sustainable growth form involves the 'Niagara' variety when it is trained to Hudson River Umbrella (top wire cordon) in Michigan. This combination frequently results in very sparse growth towards the middle of the vine and excessive apically dominant growth at the ends of cordons, which can be difficult to manage. Therefore, several growers have abandoned this variety/vine training system combination.

(2) Influence of the Pruning Process. Meaningful pruning of a grapevine can proceed only when the pruner understands the desired form of the vine, i.e., the vine training system. On the other hand, one's choice of a vine training system is often heavily influenced by the strategy for pruning. Vine training systems which utilize cordons and short cane or spur pruning lend themselves to unskilled pruning labor and/or mechanical pruning. Training systems which utilize long cane pruning, require more skilled pruning labor and are not mechanizable. Nevertheless, training systems which utilize long cane pruning should not automatically be discarded from consideration because they actually may be the best approach in particular vineyard situations. For example, in table grape production the desirable cluster configuration from nodes on long canes is often superior to that obtained from spur pruning. Another example relates to long cane pruning for 'Chardonnay' production in Michigan, which is superior to spur pruned vines utilizing mid-wire cordon training in regard to yield and fruit quality. As a third example, the basic approach to Scott Henry training utilizes long canes, which can then be rotated to achieve the downward positioning of shoots on the lower fruiting wire. At times the attraction for cost and labor effectiveness in the pruning process may cause growers to select vine training systems which are viticulturally inferior to other possible choices. If this is done, at least it should be with full awareness.

(3) Influencing Fruit Exposure to Sunlight. Fruit exposed to sunlight will be lower in acid, higher in soluble solids and less susceptible to disease infections than shaded fruit. Therefore, increasing the exposure of fruit to sunlight to promote fruit maturity is often desirable. Some vine training systems, i.e., those that lend themselves to some form of leaf removal or shoot positioning, are better than others for enhancing fruit exposure. On occasion, there may be reason to promote shading of fruit. For example, in hot climates excessive fruit exposure may lead to overripe table fruit as indicated by amber coloring of white varieties, excessively high sugar/acid ratios and/or scalding of berries. Heavy bird depredation pressure may also reluctantly favor shading of fruit.

(4) Facilitate Harvesting. Vine training systems which systematically place clusters in predictable locations can be advantageous for hand harvesting. With mechanical harvesting, vine training systems must situate fruit high enough on the trellis so that it can be caught by the catching plates of the harvester. Good distribution of fruit on the trellis promotes more gentle, less destructive mechanical harvesting contact with vines.

(5) Canopy Management. By first or second grade most kids have learned that leaves make sugar in the presence of sunlight. Over the past quarter of a century we have restated that understanding in viticultural terms to say that functional leaves are those exposed to sunlight and that those in the shade are not! Vine training systems vary greatly in their ability to distribute functional leaf area on the trellis. The best vine training systems in this regard have an extensive canopy surface with only 1-2 leaf layers to intercept and utilize sunlight. When used to full advantage, such increased functional leaf area may translate into increased vineyard productivity as well as fruit quality. Of course, less dense canopies also contribute to fruit exposure and disease control.

(6) Node Quality in the Renewal Zone. The renewal zone is the portion of the vine from which nodes are retained at the time of pruning for fruiting. Thirty years ago node quality in the renewal zone of a vine was a universal concern. With approaches to vine management such as minimal pruning or even light hedging, there is less dependence on individual node fruitfulness when determining the fruiting capacity of the vine. Nevertheless, traditional severe pruning is still the dominant approach to vine management in many viticultural areas and individual node function is important. A vine training system may promote a shaded renewal zone to the extent that there is difficulty in obtaining the desired cropping level on a vine. For example, spur pruning of large vines on a mid-wire cordon training system (when practiced without leaf removal or shoot positioning as discussed below) can cause this condition. At times long "kicker canes" have been added to this system to increase the fruiting capacity to the vine. Nevertheless, the fundamental problem may be the use of a vine training system in a condition which promotes an excessively shaded renewal zone. The use of Umbrella Kniffin training produces another example of a shaded renewal zone. William Kniffin originally designed this system with the renewal zone at the very top of the trellis (Figure 3A). However, much of the use of this system has evolved to situate the renewal zone in the mid-portion of the trellis (Figure 3B) which will be highly shaded on large vines.

(7) Compatibility with Canopy Management Practices. Leaf removal to enhance exposure of clusters to sunlight is difficult and inefficient when a vine training system places clusters in a random orientation on the trellis. Therefore, vine training systems that will place fruit in a well defined zone are more compatible with the use of leaf removal. Similarly, shoot positioning,

whether it be upwards, downwards or horizontally is suited to those training systems that have shoots which originate in a structured, predictable location on the trellis. In fact, the effectiveness of some vine training systems depends upon their being used in conjunction with such practices. For example, shoot positioning is essential to obtain the full benefit of Geneva Double Curtain training. As another example, the new Smart-Dyson-Ballerina training system (Vineyard and Winery Management, January/February, 1996) is an innovative mid-wire cordon training system which is compatible with and uses 360 ° pruning (above and below the cordon) in conjunction with shoot positioning.

The interrelationship between a vine training system and an associated canopy management strategy should be questioned at times. For example, does spur pruning of a mid-wire bilateral cordon training system facilitate a target for leaf removal in a well-defined fruit zone or does it necessitate leaf removal on large vines because this training system creates a congested, shaded fruit zone in the first place?

(8) Cost Effective Management. The economics of several aspects of vine management already mentioned are influenced by one's choice of a vine training system. Pruning efficiencies, whether manual or mechanical, harvesting, whether manual or mechanical, disease and insect control are all heavily influenced by one's choice of a vine training system.

### **Setting Priorities Among Training System Attributes**

Growers who are not challenged by winter injury to their vineyards may not give much thought to the sustainability of a vine structure. However, for the grower who is always mindful of the risk of severe winter injury to his vines, vine training systems that contribute to vine survival and reliable productivity are paramount. For this reason we are currently researching several vine training systems which may benefit from reliable snow cover to insulate them and thus avoid low temperature stress in the winter. In the cool climate vineyards of Michigan, fruit quality of winegrapes would often rank second after vine and crop survival on a list of grower concerns. Because fruit exposure and leaf area/crop relationships are important factors in maturation of fruit, those who place a high priority on fruit maturation should look at vine training systems for their ability to expose fruit while displaying a large functional leaf area. The availability and cost of vineyard labor vary greatly, even over relatively short distances within a viticultural region. Therefore, some growers may be forced to look at mechanical pruning compatibility as a high priority for a vine training system even though current mechanical pruning technologies may not provide ideal vine management. The choice of a vine training system should be based on identifying priority needs such as those illustrated above and not merely on tradition or the aesthetically pleasing appearance of a particular vine structure.

### **Recognizing Deficiencies In A Training System**

As a viticultural advisor, I have concluded at times that happiness is more important than being horticulturally correct! If a grower is happy with his/her vineyard condition, then it seems inappropriate for me to harass individuals with my "viticultural wisdom"! However, if a grower desires to pursue improved vine performance, then some changes in vine management may be warranted. Signals that might suggest a deficiency of a vine training system in a mature vineyard include: (a) difficulty in maintaining or fully establishing the desired growth form of vines, (b) poor fruit maturity especially as it is related to its development in the shade, (c) disease and insect

pressures that are excessive given the pesticide spray program for the vineyard, (d) poor fruiting capacity of the vine as related to inferior node quality in the renewal zone, (e) the development of dense canopies with deteriorating interior leaves, (f) confusion at the time of pruning about the chosen ideal growth form of the vine and the steps needed in the pruning process to achieve that growth form and (g) inability to efficiently employ desirable canopy management practices.

If any of these conditions apply to a vineyard, then it may be time to look critically at the wide array of new, innovative vine training systems with regard to attributes which might improve those conditions. The cost of implementing a specific training system, especially if it involves three-dimensional trellis construction, will be a major factor in the final selection of a training system. However, before a grower becomes embroiled in the economics, mechanics and logistics of trellis construction to support a specific vine training system, he/she should evaluate his/her priorities for the attributes of a vine training system.