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Grapevine Trellis Systems for Wine Grapes in Texas

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Trellis and training systems provide the architectural structure for the single vine and the entire vineyard. Beginning with a precise foundation advances the development of a uniform vineyard with balanced vines. Uniformity facilitates vineyard management calculations and decision making. If uniformity is overlooked when starting a vineyard, it will be sorely missed.

Trellis vs. Training Defined

The **trellis** consists of the physical hardware of posts, wires, anchors, and brackets that support the grapevines. **Training** is the arrangement and management of the parts of the vine to form a structure that facilitates consistent yields of quality grapes. Training is an art-meets-science discipline in vineyard management. Proper training utilizes and relies upon the integrity and precision of the trellis system for foundational support. Poorly trained grapevines tend to be less productive and more difficult to manage.

In hand-planted vineyards, the end posts, line posts, and irrigation system should be in place prior to planting. Additional wires and brackets can be installed during the following dormant season. Conversely, mechanically planted vines need to be in the ground before the trellis is installed (Fig. 1). Changes or improvements can be made to an existing trellis system, but changes can be costly when it comes to trellis hardware, labor, and time. Changes to the trellis system also have the potential to harm vines and decrease enthusiasm of the vineyard manager.

In young vines, the shoots are trained to form permanent trunks and cordons, also referred to as arms. The most intense training takes place early in the season in the period of rapid growth. Usually five full growing seasons are needed to develop permanent, self-standing trunks. After this period, support posts and wires are required to help mature vines carry the weight of their crop, especially through times of extreme soil moisture conditions or high winds.

Types of Trellis and Training System

Training facilitates the growth habit of the shoot into forming the permanent vine structure supported by the trellis system. The growth habit of

Figure 1. Planting before trellis and irrigation installment (left) and planting after trellis and irrigation installation (right).

each variety—whether the shoots grow upwards, downwards, or intermediate (in between)—typically determines the placement and heights of the wires. The vigor potential of the variety, rootstock, and vineyard site determine vine spacing and if additional hardware is needed for support.

Growth Habit

A. Upright Growth Habit

Vitis vinifera varieties and some French American hybrids' shoots naturally grow upright (vertically).

Low to moderately vigorous vines are trained with a single canopy of vertically growing shoots. High vigor and high producing vines are trained to have two vertical canopies of shoots.

A.1. Single Canopy, or Non-Divided Canopy, with Bilateral Cordons: VSP (Vertical Shoot Position)

A VSP training system is recommended for low to moderate vigor potential vines. A VSP trained vine has a single permanent trunk with permanent cordons. A cordon is a permanent arm extending from opposing sides of a grapevine trunk, Fig. 2. The fruiting zone is just above the cordon. Shoots are grown from spurs. Optimal spur density is two and a half spurs per foot of cordon (Fig. 2). A VSP trellis system can be adapted for mechanization depending on the number and height of catch wires used and the width of cross arms used. Any hardware—such as catch wires or brackets—that becomes dislodged during mechanical harvesting can potentially damage winery equipment during wine processing.

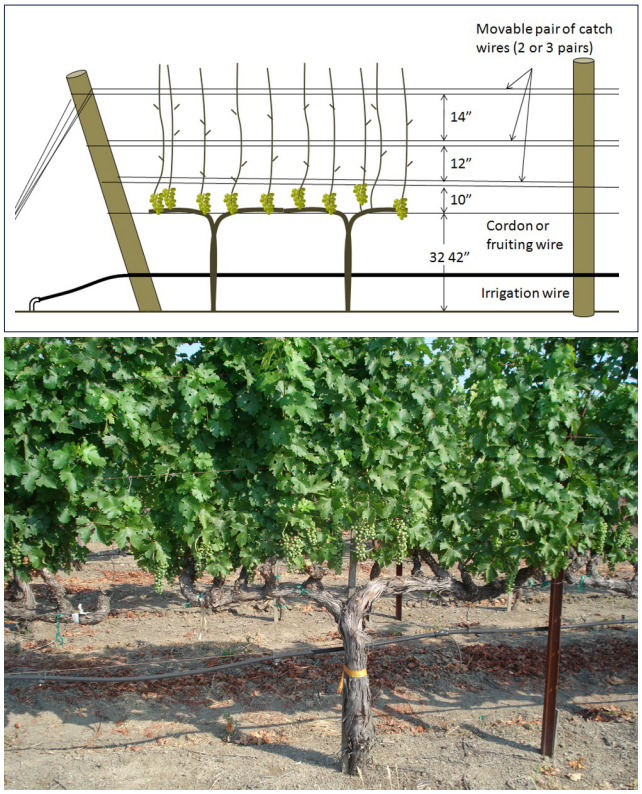

Figure 2. VSP trained vines.

A.2. Divided or Double Canopy – Quadrilateral Cordons: Lyre Training System –

High vigor potential grapevines can be trained as a single permanent trunk. There should be adequate trellis space to accommodate more shoots, which could potentially double the production area. The canopy of the Lyre system consists of a single trunk with the cordon divided horizontally to produce four (quadrilateral) cordons of vertically growing canopies (Fig. 3). When the fruiting capacity is doubled so is the yield. Shoots that grow between the two horizontally divided cordons are removed to promote light penetration and increase airflow to the fruiting zones.

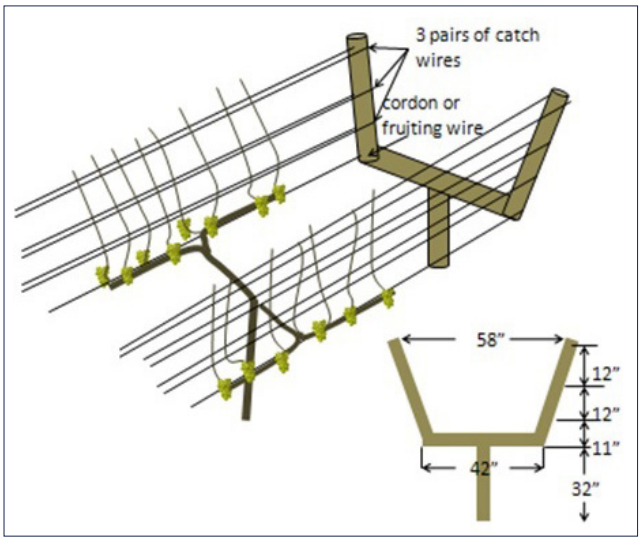

Figure 3. Vines with Lyre training system.

B. Downward Growth Habit

The shoots and canes of some hybrid varieties—such as Blanc Du Bois, muscadines, and native *Vitis* species—tend to droop and have a downward growth habit. The trellis system is designed so that the cordon and subsequent fruiting zone is higher off the ground.

B.1. Single Canopy, Bilateral Cordon: High Bilateral Cordon

The high bilateral cordon is a simple and relatively inexpensive design with a cordon that accommodates downward growth (procumbent) for hybrid varieties with a low to moderate vigor potential as well as muscadines. The shoots are trained to grow downward allowing sun exposure to the fruiting zone, increasing vine fruitfulness (Fig. 4).

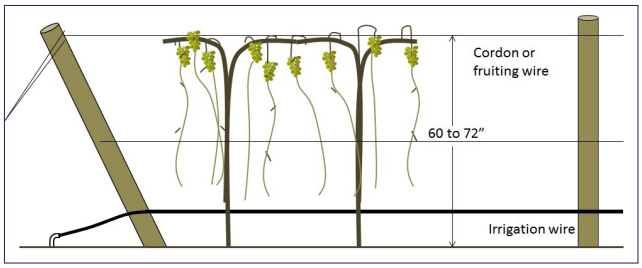

Figure 4. Vines trained using the high cordon system.

B.2. Divided or Double Canopy – Bilateral Cordon: Wye or Watson System

This type of system is commonly used for high vigor varieties and vineyard sites because it allows for a higher density of shoot growth. Canes are pruned to two to five spurs per linear foot which produce shoots trained in alternating directions toward the two opposing cordons (Fig. 5). This system is designed to allow for increased sun exposure to the fruiting zone to increase production.

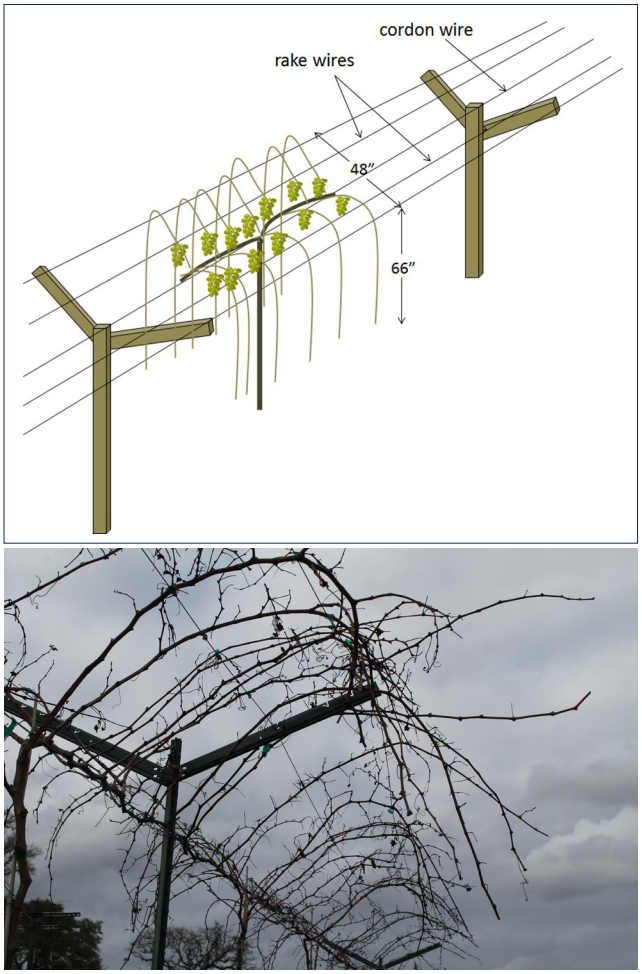

Figure 5. Watson system trained vines.

B.3. Divided Canopy – Bilateral Cordon: Geneva Double Curtain System

The Geneva Double Curtain is designed to accommodate vigorous vine growth and increased fruit production. There are two variations of the Geneva Double Curtain: a quadrilateral cordon and a bilateral curtain. The quadrilateral cordon is similar to a Lyre system except its shoots droop downward (Fig. 6). A bilateral curtain allows for increased production by allowing extended cordons to grow on parallel sides of the trellis. Training and shoot positioning are somewhat labor intensive using this system.

Vitis vinifera varieties generally have an upward growth habit and require a trellis that encourages vertical training. Some of the hybrid varieties have downward (procumbent) growth habits. The most common hybrid white grape (Blanc Du Bois) has an intermediate shoot growth habit—neither strongly upright nor procumbent. Due to its high vigor however, Blanc Du Bois most commonly utilizes a Watson Training System with a bilateral cordon at approximately 66 inches in height.

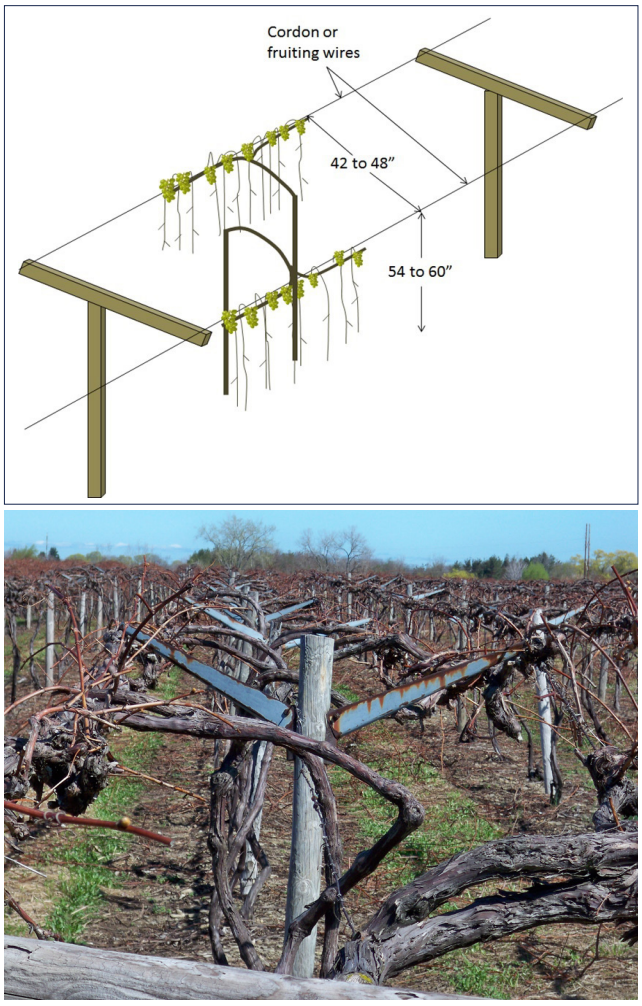

Figure 6. Vines trained using the Geneva Double Curtain system with quadrilateral cordon.

The shoots are spread horizontally and allowed to cascade downward. Lenoir (Black Spanish)—the most common hybrid variety in Texas—can be successfully adapted to any trellis system.

Scott Henry—a vertically divided canopy system—has not yet proven to be advantageous for use in Texas.

Notes Regarding Mechanization

Mechanization or future mechanization plays a significant role in vineyard design. Straight rows are necessary to allow for the passage of vineyard equipment. If mechanical harvesting is planned, the width of the training system and grapevine canopy must allow space for equipment to pass through. Vineyards planning to mechanize should consider the measurements and components of their trellis system to ensure they can accommodate the equipment.

Basic Trellis Requirements

Grapevines are planted along rows spaced from 4 to 6 feet apart. Decisions in vine spacing are dictated by potential vigor. A single canopy system, used in vineyards of low to moderate vigor, requires less space between the vines and rows than other systems. The horizontally divided canopy systems described in this article – with additional hardware measuring 4 feet in width – usually need 12 feet between vine rows. Vineyard management proves to be most efficient when vine rows are 8 to 10 feet apart. This distance allows for full sun exposure with minimum passes to mow or cultivate the row middles.

Each row is anywhere from 200 to 1,000 feet long with adequate space at the end of each row (30 feet) for a tractor with implements to make turns.

Trellis Materials

The trellis is the most expensive component of a new vineyard planting and should be built to last. The type of trellis to be used should be chosen based on a series of characteristics specific to the vineyard site and the varieties and rootstocks that will be cultivated. The trellis chosen will support the vines in a manner that promotes productive vines and efficient vineyard management.

End Posts and Line Posts

Every system needs strong posts at each end to brace the weight of the vine row. The strength of the end posts and their anchorage in the soil determine the overall endurance of the trellis system. The end posts must be able to withstand the tremendous weight of the grapevines and their crop.

Most commercial vineyards utilize either CCA (Chromium Copper Arsenate) pressure treated round posts, steel posts, or drill stem pipe for their end post assemblies.

If wood posts (10 feet by 5 to 6 inches) are used for the end post assembly, round posts are most common. Steel posts (7 to 9 gauge) may also be used, and drill stem pipe (2⅞ inches) is a popular option. Wood posts should be augured or pounded into the ground 4 feet deep. Similarly, steel posts may be pounded or augured and set in concrete. The deeper the post is set, the more it will resist the inward force placed on it by the grapevines.

The most common end post assemblies include a post with: a tie back to an anchor, an H-brace, or a dead man assembly (Fig. 7). Tie back systems' strength may vary depending on the anchoring used, but they generally have less strength than

Table 1. Number of vines per acre by differing vine spacings.

Between vines	Number of feet between rows									
	3	4	5	6	7	8	9	10	11	12
4	3630	2723	2178	1815	1556	1360	1210	1089	990	908
6	2420	1815	1452	1210	1037	908	807	726	660	605

H-brace and dead man assemblies. One disadvantage of tie back systems is that the anchor wire results in wasted trellis space and may get in the way of equipment. However, tie back systems generally require less material and labor for installation.

Line posts commonly use CCA treated round posts of 3 to 4 inches, T-Posts, or other metal post designs. Landscape timbers and 4 by 4-foot wooden posts should not be used as they have a short useable life and a low breaking strength. A grapevine canopy can act as a sail when wind blows perpendicular to vineyard rows. Line posts must be strong enough to withstand the weather. Line posts are most commonly spaced from 12 to 21 feet apart depending on the vine spacing and training system. Some growers choose to place a post at each vine for additional vine support and training, but this practice adds significant cost to the trellis. Line posts are typically 8 feet in length with 2 feet buried in the ground.

Figure 7. End post assemblies from top to bottom are Tie Back; H-Brace; and Dead man.

Wood posts must be aged and treated. Vine support stakes must be able to reach higher than the cordon when buried in the soil. Support stakes must withstand more abuse than would be expected. Rebar and T-Posts are good choices for windy or mechanically harvested sites.

Trellis Hardware

High tensile wire should be used for load bearing wires. Most commonly 12.5-gauge high tensile wire is used because of its high breaking strength and wide availability. Soft wires stretch when over-tensioned, resulting in sagging and eventual breakage. In comparison, 12.5-gauge high tensile wire has a similar breaking point (1,540 psi) similar to 9-gauge soft wire (1,324 psi) but is less likely to sag. Load bearing wires are often tensioned to 250 to 300 psi to prevent sagging and over-tensioning. A large number of connectors, brackets, and tools for installation are available through orchard and vineyard trellis suppliers (Fig. 8).

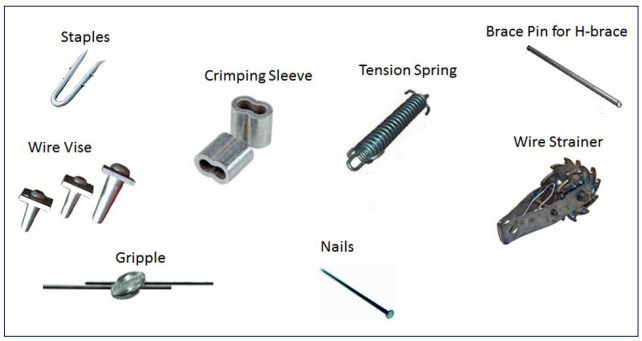

Figure 8. Vineyard trellis hardware.

There are many options in trellis assembly and materials—wood or steel; H-brace, Tie-Back or dead man. Whatever the option, the construction must suit the site, soil, and training system and meet the basic material specifications. The minimum specifications are:

Wood End posts – diameter of 5 to 6 inches, height 10 feet, buried 4 feet

Steel End posts – T-Posts: 12 to 14-gauge, T-Posts: 1.25 pounds

Line posts – diameter: 4 to 6 inches, height: 9 feet, buried: 2 feet

Wire – Catch and cordon wires: 12.5-gauge wire; anchor and irrigation: 9-gauge wire.

Growers should research which tools and hardware will best suit their needs.

Every system needs strong posts at each end to brace the weight of the vine row. The strength of the end posts and their anchorage in the soil determine the overall endurance of the trellis system.

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