Chapter 5

Vineyard Establishment

Vineyard establishment involves careful planning, thorough site preparation, vineyard design, planting, and trellis construction. Unlike dormant pruning or other annual activities, designing and establishing a vineyard must be done correctly the first time. In addition, the process must be tailored to the particular site and the grower's intentions. This chapter discusses the basic steps in establishing a vineyard and offers suggestions for practical methods and materials. There are many alternatives. Although this chapter may be used as the sole source of information for vineyard establishment, it is advisable to obtain and compare information from additional sources before beginning. References provided here include more detailed information on particular aspects of vineyard establishment, such as trellis construction. It is also helpful to visit existing vineyards to examine their design, compare trellising materials, and discuss plant and row spacing.

Preparing the Site

The first step is to prepare the vineyard site. The main objectives are to correct deficiencies in soil pH and nutrient availability and to prepare a level, clear surface on which to establish the cover crop, vines, and trellises. Some sites are wooded, in which case considerable effort will be needed to prepare for planting. In contrast, cultivated land or well-managed pastures can sometimes be planted to vines with very little preparation.

Soil Testing

Physical soil features should be evaluated in the site selection process. (See chapter 4.) Most important, the soil must meet minimum standards of depth and internal water drainage. Soil survey maps should be consulted to determine the agricultural suitability of any proposed site. The history of crop production at the site can provide some indication of its potential for grape production. Sites that have been cultivated recently are usually in better condition than pasture or abandoned farmland. Heavily wooded sites are the most difficult to bring into grape production, and grape growth often varies across the site because soil has not been mixed by cultivation. Wooded sites may be suited for little else because of their steepness, rockiness, or poor soil.

Detailed soil analyses must be made before a vineyard is established so that pH and fertility can be adjusted if necessary. Procedures for conducting soil tests and interpreting the results are discussed in chapter 9.

Brush and Rock Removal

The vineyard site must be cleared of any trees, brush, and loose rocks before cultivation. The removal of large trees should be followed by subsoiling 18 to 24 inches deep to remove large roots and incorporate lime if applied. It is generally more efficient to hire an experienced bulldozer or loader operator to clear trees and rocks from the site rather than trying to do this task by hand. During site preparation, any impediments to air movement into and out of the vineyard should

be removed, which might entail removing adjacent overgrown fencerows or pushing back the edge of shading woods. To avoid shading and root competition, do not plant vines close to adjacent woods or tree lines. As a rule, vines should be planted no closer to shading objects than the average height of these objects. Also enough land should be cleared to erect an electric deer exclusion fence if deer are known to use adjacent cover. The construction of deer fences is a specialized task; see the sources of information listed at the end of chapter 8.

Cultivation

In certain cases, existing pasture can be planted directly to vineyard rows without destroying the groundcover between the rows. This option is feasible if (1) soil tests demonstrate an acceptable pH for the intended grape species and (2) the existing vegetation is suitable as a vineyard cover crop. In this case, the vineyard rows are marked off (see "Marking Off the Vineyard") and a 24-inch sod strip in the row is killed with a postemergence herbicide, usually in the fall before planting. To foster root development, rows can be ripped with a 18- to 24-inch single-shank ripper before planting.

More frequently, the need for soil pH and nutrient adjustment or perennial weed eradication will require soil cultivation. Various schedules can be used in establishing a vineyard. One logical sequence for preparing and planting a partially wooded site is as follows:

Late winter: Complete the tree, brush, root, and rock removal process.

First spring: Adjust soil pH and fertility; plow and disk the site; plant a cereal crop, such as spring wheat or oats.

Summer: Spot treat residual perennial weeds with herbicides.

Late summer: Apply additional lime if necessary; plow in the cover crop residue; plant a perennial cover crop.

Second spring: Apply a postemergence herbicide to vine rows; auger holes and plant the vines.

Summer: Set posts and construct trellises.

Regardless of the time frame or approach followed, it is important to rid the site of persistent weeds, brambles, brushy trees, and other unwanted vegetation before setting vines. In some cases, weed eradication might require the planting and cultivation of cover crops for a period of two years rather than one as outlined above. Chisel plowing to a depth of 12 to 24 inches helps to incorporate lime and loosens compacted soil. It may be possible to reduce costs by employing the services of a local custom equipment operator. Operations such as plowing and disking may be needed only during the establishment phase and thus it may not be necessary to purchase specialized equipment.

In most North Carolina vineyards, perennial cover crops are planted between the rows. A perennial cover crop, as the name implies, is one that is retained from year to year. Grasses are preferred because they do not serve as alternative hosts for nematodes and because grass retains its foliage during the winter, reducing soil erosion. Nematodes are tiny worms that can damage vines by their feeding or by transmitting virus diseases. If the intended vineyard site has been used for grape or other fruit production within the last five years, the soil should be tested before planting to determine nematode populations. Instructions for nematode assays are available from county Cooperative Extension centers.

Cover crops offer several important advantages over clean cultivation (leaving the soil bare).

Soil erosion control: Cultivated agricultural acreage loses about 8 tons of soil per acre per year. This loss is greater on hilly terrain where vineyards are often located. Grass sod reduces

erosion by lessening the impact of rain and slowing the movement of surface water, thus allowing greater water infiltration.

Increased vineyard accessibility: A permanent cover crop makes it possible to enter the vineyard with equipment sooner after a rain than if the soil is bare. The sod increases the rate of soil moisture loss and provides greater traction for machinery.

Moderation of vine vigor: Cover crops can reduce vine growth rates, which can be either an asset or a liability, depending on available moisture, vine size, and vine vigor. Grapevines grown in our region — particularly grafted vines —often produce more leaf area than the trellis and training system can expose to sunlight. This situation is referred to as high vigor. The excess growth can lead to an undesirable degree of canopy shading, reducing fruit quality. Competition for water and nutrients by cover crops can reduce the vegetative growth of vines, thereby reducing canopy shading problems. Unfortunately, cover crops can adversely affect weak vines, particularly during droughts. Mowing and keeping a 3- to 4-foot-wide area in each vine row relatively weed-free is recommended. Please see in chapter 8, Pest Management, for new recommendations on specimen selection and management.

Most grasses will establish better if sown between mid-August and mid-September rather than during the spring. Most seed distributors can provide specific recommendations on seeding methods. Nitrogen fertilizer broadcast at 35 pounds of actual nitrogen per acre when grass is sown can stimulate growth.

If an existing vineyard is to be replanted, the old vineyard should be cleared and planted to grass or cereals (for example, oats or barley) for a minimum of two years. This fallow period will help reduce populations of grape root pests, perennial weeds, and concentrations of preemergence herbicides that might be present.

Designing the Vineyard

If all vineyard sites were level, clear parcels of land and had ideal soil conditions, vineyard establishment would be relatively straightforward. It would be necessary only to mark the rows (posts and vine locations) using suitable spacings, and then dig holes and plant the vines. Not all vineyard sites, of course, are equal. Proposed sites are commonly on slopes; sometimes they are partially or completely wooded and others are characterized by irregular knolls and depressions.

Vineyard design starts with evaluating how the vineyard will conform to existing topographic features and property boundaries. Vineyard planning should achieve these primary goals:

- ❑ prevent soil erosion (intentionally ranked highest in priority)
- ❑ use land area efficiently
- ❑ optimize vine performance
- ❑ facilitate vine management and equipment operation.

Partitioning the Vineyard into Blocks

Vineyards larger than several acres are generally partitioned into "blocks." A block might represent a single variety or, on uneven terrain, blocks might reflect the allowable planting area. Division of a large vineyard into blocks is also convenient for keeping records of inputs (such as pesticides and labor) and returns (fruit yields) for cost-accounting purposes. Figure 5.1A illustrates a vineyard partitioned into several blocks. The blocking pattern used was intended to keep most rows running perpendicular to the existing slopes. Dividing a vineyard into blocks might also be necessary because of existing fence lines, roads, or natural features like streams or rock outcroppings. In designing the vineyard, reserve the highest

locations of the site for varieties that are sensitive to winter cold and for those that break bud early in the spring (Figure 5.1B). Initial vineyard design should include sketches of the property with plantable areas drawn in or superimposed on clear plastic overlays.

Row Orientation

On level sites, orient rows to maximize length and minimize number. Such an orientation minimizes the number of expensive end-post assemblies. Most sites are not level, though. Rows should be oriented across, or perpendicular to, the predominant slope of the site to minimize soil erosion. Do not contour or curve rows around hills; the trellises of curved rows are structurally weak. In cases where the site is hilly, it is sometimes best to position the rows in a herringbone pattern. Low areas and gullies should be left open and sodded to serve as erosion barriers or traffic alleys. Some advantage can be gained by orienting rows parallel to prevailing summer breezes to aid vineyard ventilation. A further consideration is to maximize sunlight interception by the vine canopies. Field research and computer simulation studies have shown that rows oriented in a north-south direction receive more sunlight and produce slightly higher yields than those oriented east to west. Thus, if other factors are equal, it is desirable to align rows as closely as possible to a north-south axis. Generally, however, orientating the rows to minimize soil erosion should take precedence over other considerations.

Row Spacing

Maximum vineyard productivity is attained when most of the available sunlight is intercepted by grapevine leaves. Sunlight striking the ground can be thought of as wasted energy. Research shows that vineyard productivity and grape quality are maximized when grapes are grown in rows with their foliage trained to thin, vertical canopies. Row spacing in such a design (the distance between two adjacent rows) should be no less than the intended canopy height to minimize row-to-row shading of adjacent canopies.

Most trellises are constructed with 8-foot line posts set 2 feet into the ground, thus providing a 6-foot-high trellis supporting about 4 feet of canopy. Thus, for conventional nondivided canopy training systems, the row spacing should be no less than 4 feet. Conventional vineyard equipment widths, however, usually limit the minimal row spacing to 8 to 10 feet. Equipment availability and operation should be considered carefully before deciding on row spacing. A relatively wide spacing (10 to 12 feet) is advised on steeper terrain (5 to 15 percent slope) or where horizontally divided canopy training systems are planned. (See "Trellis Construction.")

Vine Spacing

Perhaps no other aspect of vineyard design leads to as much difference of opinion as vine spacing: the distance between adjacent vines along the same row. Vine spacing of 6 to 8 feet is most common in North Carolina. From an economic standpoint, close vine spacing (less than 4 feet) increases the yield per acre in the initial years of production. However, that accelerated return can be offset by higher costs for materials (vines and training stakes) and labor (planting and training). There is no evidence that close spacing improves vineyard yields or fruit quality, and there is ample evidence that it complicates canopy management. On the other extreme, wide vine spacing (greater than 10 feet) can result in poor trellis fill (the amount of trellis occupied by foliage), particularly with cane-pruned vines or after winter injury to trunks and cordons. Therefore, a planting distance of 6 to 10 feet between vines is generally recommended for nondivided canopy training systems. However, a 7-foot spacing is recommended for most situations and a 6-foot spacing is recommended for low vigor vines grown in poorer soils. The 8- to 10-foot spacing is recommended for

grafted vines in rich soils or where irrigation is used.

Headlands and Alleys

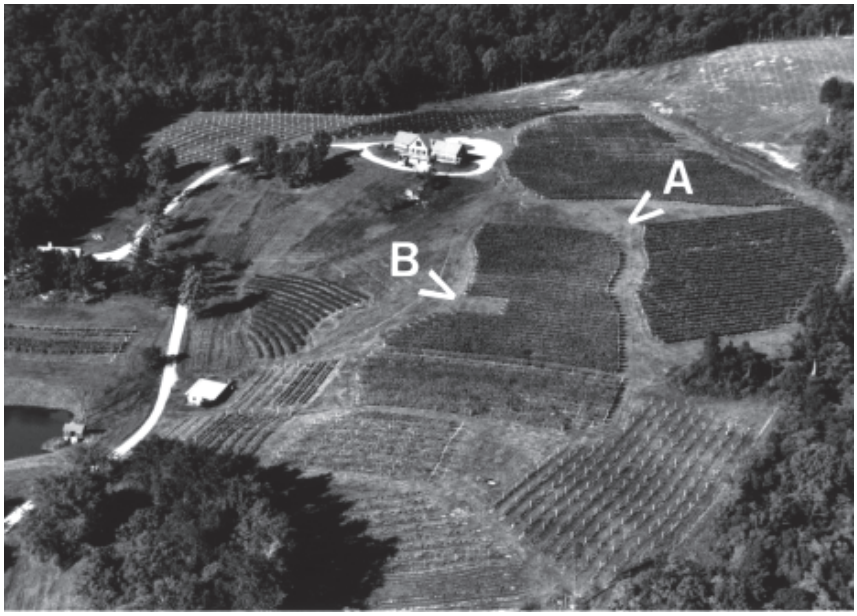
Ample room should be left at the end of vineyard rows (the *headland*) to provide space to turn equipment. Tractors with attached trailer-type air-blast sprayers require a minimum of 30 feet turning clearance (Figure 5.1a). Rows longer than 600 feet should be divided at the midpoint with a cross alley to facilitate movement of machinery and personnel.

Marking Off the Vineyard

Before vines are planted it is necessary to mark vine and post locations to ensure uniformly spaced vines and parallel rows. In the two methods described here, the vines are planted first in preaugered holes, followed soon afterward by pounding of posts and construction of trellises. Obviously, it is possible to reverse that order and pound or set posts before the vines are planted. In either case, it is extremely important to mark off straight and parallel rows. Figures 5.2a through 5.2c illustrate the basic steps involved in marking off an irregularly shaped vineyard block of about 4 acres.

The first step in marking the block is to choose a reference point—one corner of the vineyard block and one end of a reference row (point A in Figure 5.2a). The reference row is typically the first row in a block, but it can be any row. The reference point or corner is used to establish a grid upon which the vines and posts will be set. The reference point is also the location of the first vine of the first row. Therefore, leave an ample headland plus one-half a vine space behind the reference point to set an end post. The reference row is typically set parallel to an existing property boundary, fence line, ridgeline, or roadway. In Figure 5.2a, the reference row is set parallel to an existing fence line. On level land, the reference row can be oriented more arbitrarily or to a preferred compass direction (for example, north-south).

With a reference point chosen, the next step is to mark off a precise right angle. One leg of this angle is the reference row and the other leg



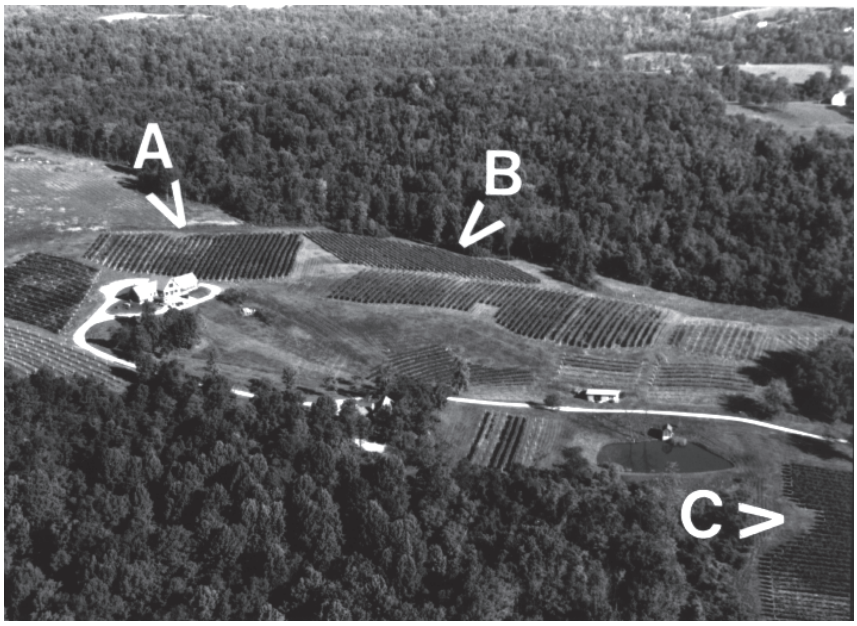


Figure 5.1a (top). The blocking pattern of this vineyard was designed to keep most rows running perpendicular to the prevailing slope. (A) Unplanted alley separates two blocks that have different row directions. (B) Inset area was considered too steep to plant.

Figure 5.1b (bottom). Varietal differences in time of bud break and cold hardiness were used to determine the relative elevation of vineyard blocks. The difference in elevation between highest (A) and lowest (C) blocks is approximately 100 feet. (A) Chardonnay: cold tender, early bud break. (B) Vidal blanc: cold hardy, late bud break. (C) Seyval: cold hardy, early bud break, good secondary crop potential.

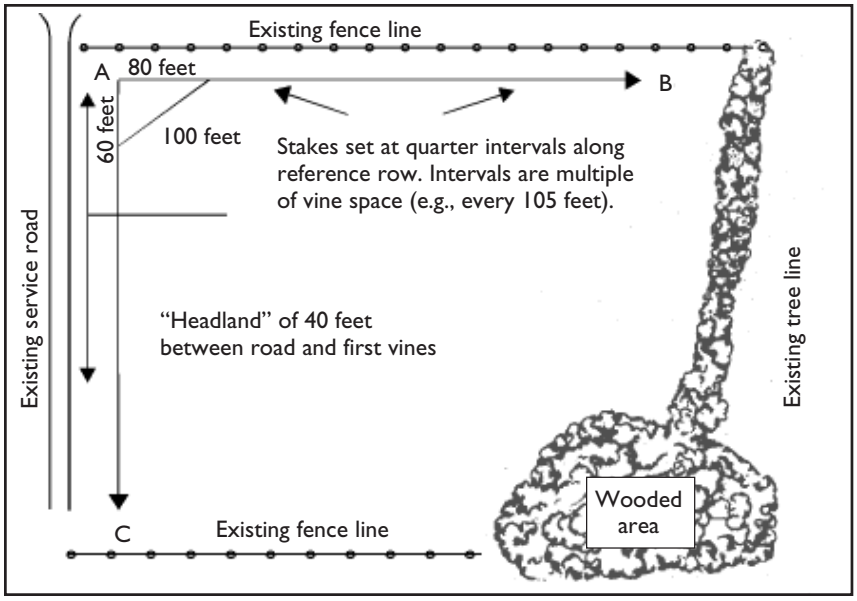


Figure 5.2a (top). Marking off vineyard: The reference point (A) is chosen to establish the first right angle corner of the vineyard.

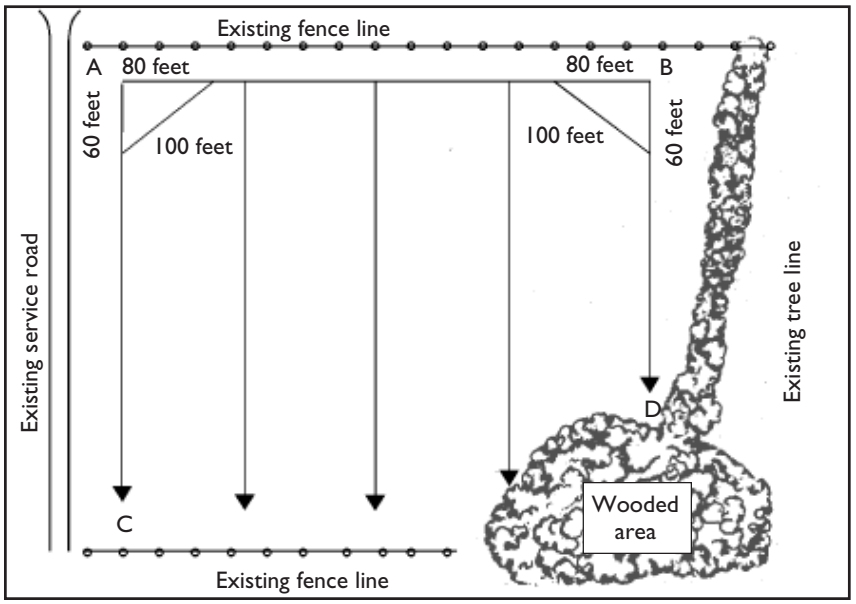


Figure 5.2b (center). The second corner (B) of the vineyard is established. Grid lines are staked to further ensure that vineyard rows will be parallel.

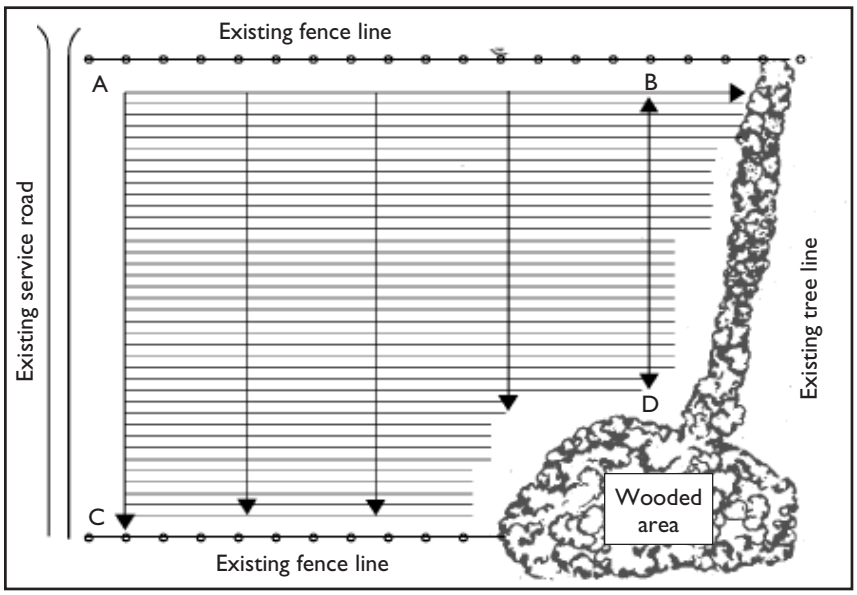


Figure 5.2c (bottom). Vine locations are marked in each row by stretching a pre-marked wire between corresponding row ends.

defines the first vines in each of the following rows. It is critical that this first corner of the vineyard be a true right angle to achieve a square or rectangular pattern to the vineyard rows. A surveyor's transit is useful for establishing right angles and straight rows. Position and level the transit over the corner reference stake (point A in Figure 5.2a). Aim the transit down the intended length of row 1. The point of aim could be another stake (B in Figure 5.2a) set to form a line parallel to an existing landmark (that is, the fence line), or the line could be arbitrary. Set the transit dial compass (if equipped) to 0°. Sighting through the transit, have an assistant with a range rod set stakes (use 18-inch surveyor's stakes) at quarter intervals down the length of row 1. The stake intervals should be some multiple of the vine space distance. In Figure 5.2a, the stakes were set every 105 feet (7 x 15). Be sure that the tape measure used to determine these intervals is pulled taut and that it is held close to the ground.

Having marked the reference row, turn the transit 90° and sight down the row ends to point C (Figure 5.2a). Have an assistant with a tape measure set stakes at intervals corresponding to end-post locations (for example, every 10 feet). At this point, check the trueness of this first corner of the vineyard. This can be done by ensuring that the dimensions of the corner correspond to the 3:4:5 ratio of the sides of an accurate right triangle. Place a stake in the reference row 80 feet (4 x 20) from the corner stake (point "A"). Place another stake 60 feet (3 x 20) (the sixth row if using 10-foot rows) in the line of row-ends. The diagonal line between these two stakes will be 100 feet (5 x 20) if a true right angle has been established (Figure 5.2a).

Move the transit to the opposite end of row 1 (point B) and level it. Rezero the transit by sighting back down row 1. Turn the transit 90° and sight across the rows (point D in Figure 5.2b). Note that in Figure 5.2b the north end of vineyard rows is staggered to maintain a 30- to 40-foot headland between the row ends and the tree line. Point B was chosen as a reference point common to all rows above the wooded area. Have an assistant with a tape measure mark row widths as before. Repeat the process of ensuring that this second corner is a true right angle. Repeat the cross-row staking at the quarter-interval stakes along row 1. Check the distance between these grid lines at both ends to ensure that they are parallel and their corners are true right angles. The quarter-interval grids need not be marked off in small plantings.

Once vineyard row widths have been established, mark all vine locations in all rows, starting with row 1 (Figure 5.2c). Use a length of trellis wire long enough to extend the length of the longest row. Mark the wire at intervals corresponding to vine spacing with white paint or adhesive tape (for example, every 7 feet). Stretch the wire tautly between the row end markers of row 1 and mark each vine location (Figure 5.2c). The wire should be kept close to the ground when traversing depressions in topography. A good steel tape measure can be used in lieu of premarked trellis wire. Vine locations can be marked by dropping 1/4 cup of lime at the desired spots or by spraying a spot of white paint on the ground.

Repeat the above process to mark vine locations in all remaining rows. Remember to leave one-half a vine space behind the first and last vine of each row to later place the end posts. Post locations can be determined in a similar fashion either before or after vines have been planted.

Planting

Vines are usually planted in the spring, generally between the first of April and the end of May. It is not necessary to delay planting until after the threat of spring frosts. Fall planting is also permissible if arrangements can be made to receive vines from the nursery during that period. Be sure that vines planted in the fall were recently dug and are in a dormant condition. Vines that have been in cold storage over the summer are apt to commence growth if planted in the fall and subsequently exposed to unseasonably warm weather. In that event, the vines would be susceptible to severe winter injury. It is also desirable to hill up soil around fall-planted vines to reduce heaving that can occur with repeated freezing and thawing of loosened soil.

Nursery Stock

The number of vines to order depends upon row and vine spacing. For small plantings, divide the row length by the vine spacing, round up to a whole number if necessary, and multiply by the number of rows. For larger plantings, first determine the area of the vineyard (multiply the length by the width) and divide that figure by the area occupied by a single vine (the row spacing multiplied by the vine spacing). Add 1 percent extra vines to allow for poor vines or loss during the first year. The extra vines can be planted closely in a nursery and used later as needed.

Vines should be purchased only from reputable nurseries that offer certified disease-free stock. Nurseries that specialize in grapes generally offer better prices and quality than nurseries that sell a variety of plant species. Vines should be ordered well before the intended planting date. For spring planting, order vines no later than October or November of the previous year. In some cases—for example, if a particular rootstock is desired—it might be necessary to order vines one to two years before planting. For unusual varieties, it may be preferable to order the budwood from a certified source, such as the Foundation Plant Materials Service (FPMS.ucdavis.edu) at Davis, California, and have

the budwood delivered to a reputable grafter or nurseryman for grafting or rooting.

Receiving Stock

Arrange to have stock delivered several days to a week before the intended planting date. Remember, there is no guarantee that planting conditions will be suitable at the time the vines are delivered. For that reason, provisions should be made to hold the vines in a cool, shady place upon delivery. Upon receiving stock, open the shipping containers and ensure that the roots are moist. Keep the vines cool and roots moist until planting time. It is critical that the roots of unplanted vines not be exposed to freezing temperatures. The vines should arrive in a dormant condition and, depending on temperature, should not break bud for one to three weeks.

Setting Vines

Holes for vines should be augered as an independent operation before the day of planting. Auger holes using a 9- to 12-inch-diameter auger. The holes should be about 12 to 18 inches deep. Holes augered in heavy clay soils often have glazed, impermeable sides, particularly if the soil was wet when drilled. The smooth surfaces of glazed holes can restrict root growth. The sides of auger holes should therefore be scored with a hoe or hand trowel before planting. The soil should be moist on the day of planting. Wet soil is apt to compact; dry soil can desiccate tender roots.

The roots of the young vines should not be trimmed; however, trimming the roots is better than twisting the roots to fit the hole. (The ideal way to accommodate large roots is to drill a larger hole.) The vine roots must be kept wet during planting. Even brief periods of drying can injure the roots. A convenient method of keeping roots wet while carrying vines in the field is to place 10 to 20 vines in a 5-gallon plastic pail half filled with water. Grafted grapevines should be set in the hole with the graft union several inches above the soil level (Figure 5.3). Soil settling should result in the graft union being an inch or so above the soil line. If set too deep, the scion, or fruiting, portion of grafted vines will develop roots that will be difficult to remove. Such vines can become susceptible to phylloxera attack. Nongrafted grapevines should be set with the crown (junction of older wood and newer canes) 1 or 2 inches above the soil line (Figure 5.3). Spread the roots in the hole and backfill with soil. Firm the soil but do not pack it. Water the vines thoroughly as soon as possible after planting. In this regard, a preestablished irrigation system offers a decided advantage.

Mechanical Planting

Planting by hand, as outlined above, is suitable for small (1- to 10-acre) plantings. For larger plantings, the speed of mechanical planting makes it more attractive. Mechanical tree planters can be rented for this purpose.

Initial Vine Training

Vines should be pruned back after the last threat of spring frost to a single cane of two to three buds. At that time it is desirable to place a 4- to 5-foot stake at each vine (Figure 5.3). Bamboo stakes are available for this purpose and are relatively inexpensive. Stakes serve two purposes: they clearly mark vine locations and they serve as a support to which developing shoots can be tied. The stakes should be set 10 to 12 inches deep and should be long enough to be tied to the first wire of the trellis system. First-year vine training is similar regardless of the intended training system. Training systems are discussed in chapter 6.

Constructing the Trellis

Research and experience have led to specialized methods and materials for trellis construction, many of which are adapted from modern fence-building concepts. Some excellent information is

commercially available on this subject. (See the sources listed at the end of this chapter.) The vineyard trellis must be strong enough to support large crops as well as to bear the force of occasional high winds. Consider that the trellis will represent a major investment and should serve for 20 or more years with routine maintenance. The following discussion pertains to the construction of a typical nondivided canopy training system with three to seven wires.

Posts

Pressure-preservative-treated yellow pine or other softwood posts are the most commonly used and recommended for vineyards in this region. Eight-foot posts are standard; when set 2 feet deep, they provide a 6 foot-high trellis. Longer posts are desirable only for deeper placement, as with end posts or brace assemblies. Round posts are preferred to square-cut posts; round posts have much greater shear strength than square-cut posts of comparable size.

Wood posts should be treated with a preservative for in-ground use and should last for up to 20 years. "Preservative" means any chemical used in treating wood to retard or prevent deterioration or destruction caused by insects, fungi, bacteria, or other-wood destroying organisms. The pressure-treating process results in a post with a lifespan 10 to 15 years greater than that of a post simply dipped in the same preservative. Most wood preservatives are highly toxic, and workers should wear gloves and protective eyewear when handling or cutting posts. It is inadvisable to use untreated posts in the vineyard. Locust or cedar posts, debarked and painted with a wood preservative on the ground-contact portion, can be used; however, the labor required to prepare these posts usually makes commercial posts more attractive.

Non-wood alternatives, such as metal posts, are increasing in popularity. Steel posts offer the following advantages:

- ❑ Easier to install than wood posts.
- ❑ Easier to use than wood posts.
- ❑ Ready to use once they are driven into the ground; just string your wires, making them more versatile than wood posts.
- ❑ Better for grounding lightening strikes than wood posts.
- ❑ Wire clips, staples, etc., are not needed.
- ❑ Quality is more consistent than wood posts.

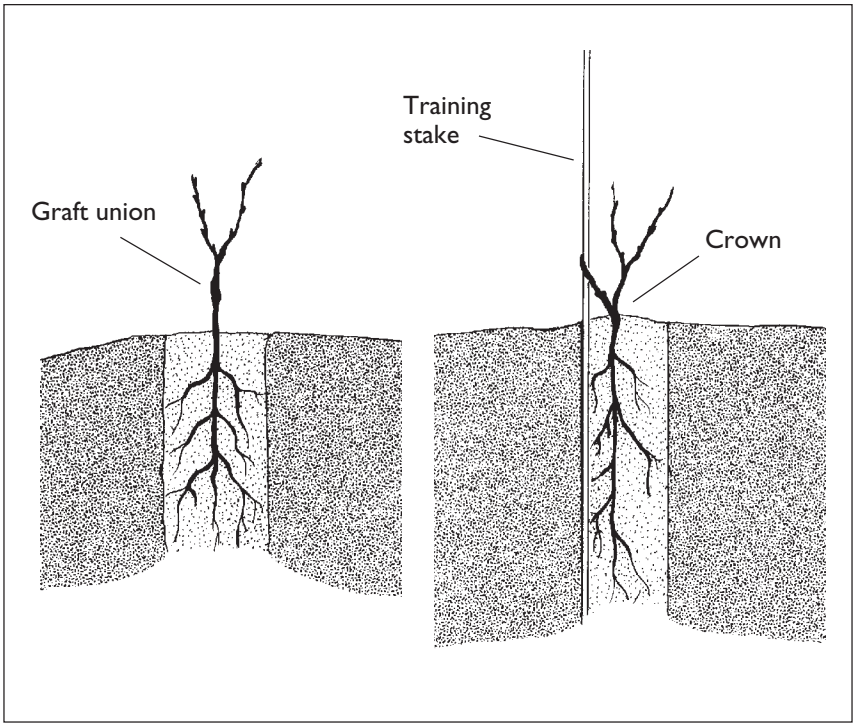


Figure 5.3 Correct planting depth for grafted (left) and nongrafted (right) grapevines.

Line posts (as opposed to row-end posts) should be at least 3 inches in diameter at their smaller end. End posts should be at least 5 inches in diameter and are often 1 or 2 feet longer than line posts so that they can be set deeper. Posts can be set in either of two ways: they can be driven with a post pounder or they can be set in augered holes and backfilled. Driving posts is much faster; by one estimate, two people can drive six posts in the time required to auger a hole and set one post. Furthermore, because the driving disturbs less soil, the driven post is more stable than a post set in an augered hole. Most posts have a slight taper. The smaller end should

Figure 5.4 (top). External end-post brace assembly suitable for non-divided canopy trellises with row lengths less than 600 feet.

Figure 5.5 (bottom). External end-post brace assembly used for divided canopy trellises and rows greater than 600 feet.

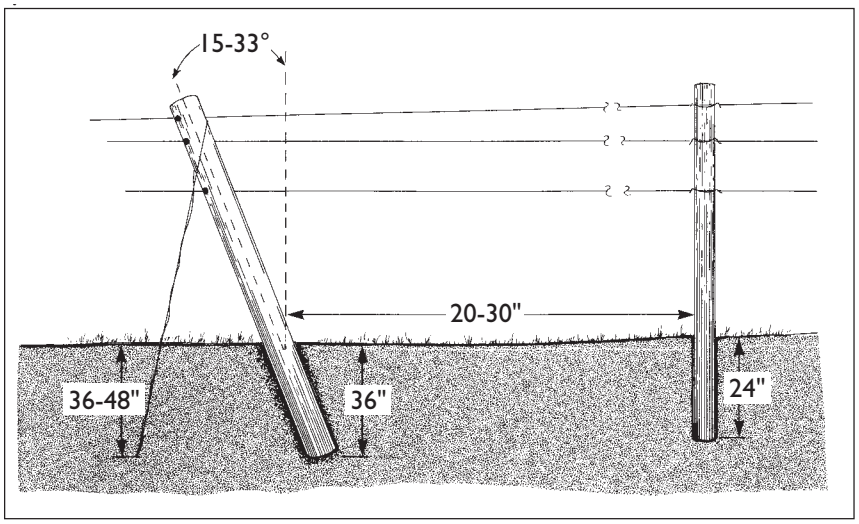
be driven into the ground. In heavy or stony soils, it might be necessary to saw a bevel on the end of the post to facilitate driving. Driving is also easier if the soil is moist. If posts are to be set in augered holes, the end of the post set in the ground is less important.

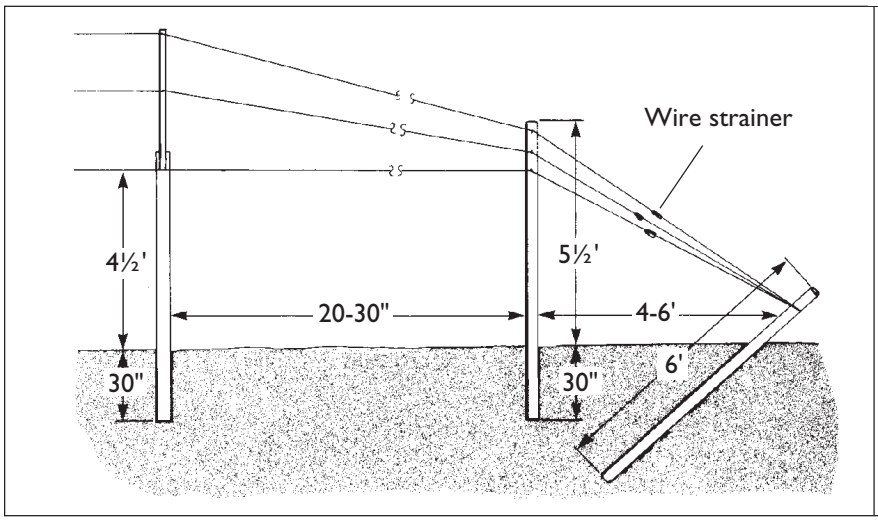
Wire

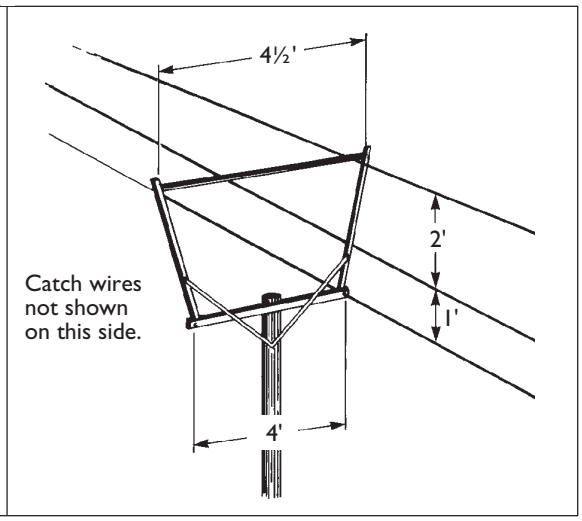
Many different types of wire have been used in grape trellises. Before about 1970, the most commonly used type was soft, galvanized 11- or 12-gauge wire. More recently, high-tensile (HT) galvanized steel wire has been preferred because of its greater strength and longevity. The HT wire should have class III galvanizing and possess a breaking strength of at least 170,000 pounds per square inch. Wire gauges of 11 to 12.5 are acceptable; 12.5 is the most common. HT wire, which can be stretched to 250 pounds of tension, is preferable to softer wire. At that tension, expansion and contraction with changes in temperature is minimized, reducing time spent in tightening loose trellis wires. The greater tension that can be applied to HT wire also permits a relatively wide post spacing (20 to 30 feet) without wire sagging. HT wire is hard and coiled under tension. Wear gloves, appropriate clothing, and eye protection when handling it. Hold the wire ends firmly when pulling, and stick loose ends into the ground until fastened to the trellis to prevent recoiling.

Brace Assemblies

Strong row-end braces are critical to the strength of a trellis. A common means of bracing the row end is an external brace, as shown in Figure 5.4. The external or tie-back brace is generally suitable for nondivided canopy trellises with row lengths up to 600 feet. The end post should be at least 5 inches in diameter and 9 feet long and should be set or driven 3 feet into the soil at 15 to 30° off vertical (away from the row). The post is then anchored with a "deadman." Steel screw-







type anchors (for example, 4- to 6-inch screw on a 5/8-inch by 48-inch galvanized shaft) are commonly used. The deadman anchor is braced to the end post with a double loop of 9-gauge bracing wire. Bracing wire is soft and can be twisted without breaking. A "twitch stick" placed in the loop and turned will take up the slack in the brace wire. Be sure to twist the brace wire in the same direction that was used to screw the anchor into the ground (clockwise). A variation of the external brace uses an 8-foot post driven 6 feet into the ground rather than a steel anchor (Figure 5.5). This stronger anchoring is recommended for divided canopy training systems to support the weight of heavier crops. One disadvantage of external bracing is the exposed brace wire or wires which can be hit by tractor tires or trip the unwary worker. An internal brace assembly (Figure 5.6) avoids this problem and is stronger than a steel-anchored brace. The internal brace is more expensive, however, because several posts are required for each assembly.

Construction

It is generally most efficient to construct the trellis in steps over the entire vineyard rather than completing the trellis row by row. The trellis posts, row-end braces, and at least one wire should be installed during the first growing season. Install end posts or end brace assemblies first. Then mark the line post locations (as was done earlier with vine locations) by stretching a premarked wire between the corresponding end posts of a given row and marking each post location with a stake, lime, or paint. The post spacing was determined when the vine spacing was measured. Use a multiple of the vine spacing distance for post intervals, but do not exceed 30 feet (20 to 30 feet is common). Remember that the first and last vines of a row are only one-half a vine space from their respective end posts. With post locations marked, drive posts by working across the rows. As an alternative, rows can be straddled with the tractor and posts pounded by row if the staking of vines is delayed until the posts are set. Use a builder's level to plumb the postdriver to ensure that each post is driven vertically.

Wires are strung and stapled after the posts have been installed. At least one wire, usually the lowest, should be strung in the first season to facilitate vine training. The wire heights can be marked on the post by using a notched or marked template with the desired wire locations. The number of wires and their locations varies with the intended training system. (See chapter 6.) Use a wire jenny or spool to dispense the coiled wire

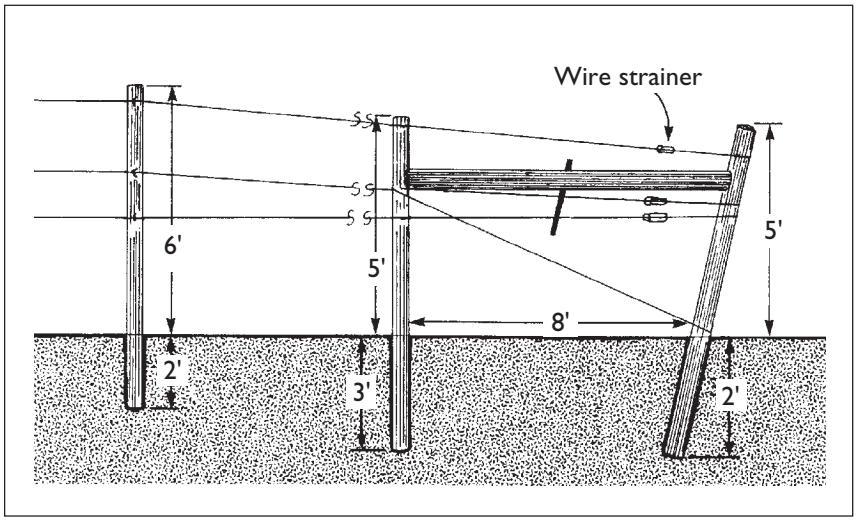


Figure 5.6 (above). Internal end-post brace assembly.

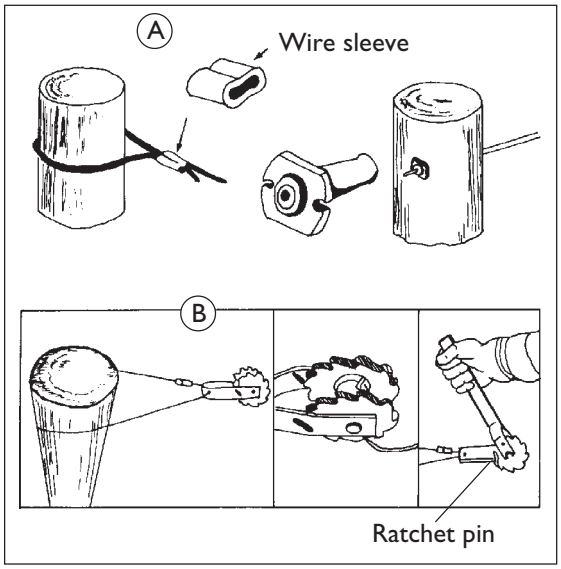


Figure 5.7 (left). Methods of fastening wire: compressible wire sleeves and "wire vise" (A) and in-line wire strainer (B).

and prevent tangles. Position the jenny at one end of the row and pull the loose end of the wire to the opposite end of the row on the windward side of the row to which it will be stapled. Attach the loose end of wire to the end post with two compressible wire sleeves (Figure 5.7) at the appropriate height. Cut the opposite end from the coil and attach it to the corresponding end post by one of three methods, depending on row length (Figure 5.8). The wire can be fitted with an in-line strainer, inserted in a wire vise, or tied off with wire sleeves (Figure 5.8). In the last case (for row lengths greater than 500 feet), an in-line strainer is mounted at the midpoint of the row. Do not completely take up the slack wire until the wire has been stapled to all posts. Wire vises are recommended only for rows less than 200 feet long and for foliage catch wires. In-line strainers should be used for cordon support wires in rows 200 to 500 feet long. For rows greater than 500 feet in length, splice in-line strainers in the middle of the row to tension the wire effectively over its entire length. Wires can be extended beyond the end post and tied to earth anchors (Figure 5.5).

For paired catch wires, pull the wire around the opposite end post and draw it back to the starting point to form a continuous loop. Secure the loop at the far end of the row with a loose staple. With this method, wire vises or another type of tensioner is needed only at one end of the row.

Wires should be stapled loosely to the line posts so that they can move freely through the staples. Hold the wire against the post with the body while using both hands to hold and drive the staple. Avoid denting or crimping the wire during stapling. Some prefer to place staples in the posts before stringing the wire. In this case, the wire is threaded through the staples as it is dispensed. Wires are tensioned after stapling is completed. If multiple wires are installed, tension the highest wire of the trellis first, followed by successively lower wires.

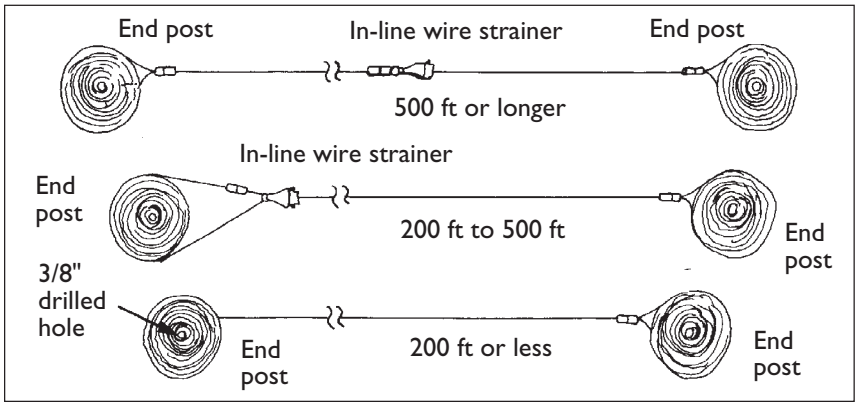


Figure 5.8 Three methods of fastening and tensioning trellis wire.

Divided Canopy Training

Grapevine canopies represent the three-dimensional arrangement of foliage on the grape trellis. Canopy division is a method of exposing more of the vine's foliage to sunlight and can be a beneficial means of improving yields and fruit quality with large vines. Canopy division is cost effective only if the vines are expected to be large and if the principles for management of divided canopy training are understood and recommended practices are followed.

Two divided canopy systems that could be used in North Carolina are the Geneva Double Curtain (GDC) and the open U, or *lyre*, system. Both systems are described in chapter 6. Specialized materials are available for these systems, which will probably be cost effective considering that less labor is required for construction and their longevity is greater. Row spacing should be increased to 12 feet with either of these divided canopy systems unless narrow vineyard equipment is used. More sophisticated end brace assemblies are recommended for divided canopy systems to support the greater crop loads possible with those systems (Figures 5.5 or 5.6).

Summary

This chapter has presented practical techniques and materials for vineyard establishment. These techniques and materials may be further refined, and other alternatives are available. Prospective growers should visit existing vineyards and review vineyard design and construction techniques. Some questions to address in those visits are:

- ❑ Is there evidence of soil erosion resulting from row orientation?
- ❑ Is land efficiently used?
- ❑ Does the vineyard design facilitate equipment and personnel movement?
- ❑ Are row end brace assemblies secure?
- ❑ Are trellis components in good repair?

Most established growers can comment on at least one or two items that they would do differently if they were to re-establish their vineyards. Once vines and posts are in the ground, it is difficult to correct design flaws.

Publications on Trellis Construction

- ❑ *How to Build Orchard and Vineyard Trellises*
  Available from:
  Kiwi Fence Systems, Inc.
  RD 2 Box 51-A
  Waynesburg, PA 15370
- ❑ *Directory of Vineyard and Winery Products Suppliers* Available from:
  Vineyard and Winery Management
  103 Third St., P.O. Box 231
  Watkins Glen, NY 14891
- ❑ *Sunlight into Wine*
  Available from:
  Practical Winery and Vineyard Magazine
  15 Grande Paseo
  San Rafael, CA 94903
- ❑ *Oregon Viticulture (2003)*
  Available from:
  Oregon State University Press
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  1-800-426-3797; fax 541-737-3170
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