Constructing a Vineyard Trellis

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Vineyard Trellis Systems can be as simple as a single wire in a high cordon system (top) to as complex as this catch wire system being used for table grapes in California (bottom).
Function & Requirements of a Vineyard Trellis

Serves as a framework for training and supporting the vines.

- Must be strong enough to support large crops and withstand high winds.
- Must last 20 or more years with routine maintenance.
Major Trellis Components

- **Posts**: Wood (preferred), steel, or other material spaced 21, 24 or 28 ft apart
  - Dependent on vine spacing
- **Strong end-post design**
  - Anchored: earth anchor, tie-back post, or deadman for rows less than 600 ft.
  - Braced: H-brace or slant brace for rows over 600 ft.
- **High-tensile galvanized steel wire**
  - High cordon, or Kniffen: 1 to 3 wires
  - Vertical shoot positioning: 5 to 7 wires
  - Geneva Double Curtain: 3 or 4 wires
Anchored End Post System with an Earth Anchor

Suitable for rows up to 600 ft, but this is affected by soil texture and anchor’s helix diameter.

- 5” x 10’ end post
- 3-4” x 8’ line post
- 60° angle
- 2’ deep
- 3 - 4’ deep
- 6’ tall
- Brace wire
- Earth anchor 4-6” helix x 40”
Earth Anchor Requirements

Shaft:
Minimum: 1/2” x 36”
Preferred: ≥ 5/8” x ≥ 40”

Helix:
<table>
<thead>
<tr>
<th>Dia. (in.)</th>
<th>4</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area (sq. in.)</td>
<td>12.6</td>
<td>28.3</td>
</tr>
<tr>
<td>% of 6-inch</td>
<td>44.5</td>
<td>100</td>
</tr>
</tbody>
</table>

Suitable for rows up to (ft)* ~250 600

* Suitable row length decreases on lighter, sandy soils.
Anchored End Post System with an Earth Anchor
Anchored End Post System
with a Tie-back Post

Suitable for rows up to 600 ft. Cost of materials will often determine whether an earth anchor or tie-back post is used.

- 5” x 10’ end post
- 3 - 4’ deep
- 6’ tall
- 3 - 4’ deep
- 3-4” x 8’ line post
- 2’ deep
- 60°
- Brace wire
- Tie-back Post 5-6” x 5-6’
End Post System with a Tie-back Post
H-Brace End Post System
Required for rows over 600 ft

3-4” x 8’ line post
5-6” x 9-10’ end post

3-4’ deep
2’ deep
6’ tall

Brace post
Brace pin
Brace wire

Requires 4 additional posts per row to construct the braces.
**H-Brace End Post System**

Optional method that allows the use of a shorter end post

- 3-4” x 8’ line post
- Brace post
- Brace wire
- Brace pin
- 5-6” x 8-9’ end post
- 4 - 5’ tall
- 2’ deep
- 3-4’ deep
H-Brace End Post System
Slant Brace End Post System

- 3-4" x 8' line post
- 5-6" x 9-10' end post
- Brace wire
- Brace post
- 2' deep
- 6' tall
- 3-4' deep
Trellis Post Materials

Red, southern yellow, or lodgepole pine:
- Pressure-treated with chromated copper arsenate (CCA).
- Life expectancy of 20 to 30 years (suppliers should be able to provide a guarantee).

Steel stakes:
- Can be substituted for line posts.
- Subject to bending and leaning.
- Should be used in combination with wood posts.

Other alternatives:
- Native timber
- Fiberglass
- Recycled plastic
- Reinforced concrete
Using Untreated Native Timber *

| Native woods do not have useful natural resistance to termites. |

Charring the buried portion of a post may have merit. It reduces the availability of a food source, and generates wood tar that has some anti-microbial activity. There is no proof of benefit, but it might not hurt and may very well help to prolong the life of a post.

<table>
<thead>
<tr>
<th>Resistance to Decay</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Osage Orange</td>
<td>Exceptional</td>
</tr>
<tr>
<td>Black Locust</td>
<td>Exceptional</td>
</tr>
<tr>
<td>Red Mulberry</td>
<td>Exceptional</td>
</tr>
<tr>
<td>Eastern Red Cedar</td>
<td>Very resistant</td>
</tr>
<tr>
<td>Honey Locust</td>
<td>Moderate</td>
</tr>
</tbody>
</table>
8 ft Steel Stakes being used in combination with native timber posts

Mike White, ISU Extension
Recycled Plastic Post
### Vines Between Post

<table>
<thead>
<tr>
<th>Vine Spacing</th>
<th>Post Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>21 ft</td>
</tr>
<tr>
<td>6 ft</td>
<td>-</td>
</tr>
<tr>
<td>7 ft</td>
<td>3</td>
</tr>
<tr>
<td>8 ft</td>
<td>-</td>
</tr>
</tbody>
</table>

- Vine vigor determines vine spacing in the row, and thereby affects post spacing. Do not exceed 30 ft between post.
- Equipment size, degree of side slope & training system often determines the spacing between rows.
## Wood Trellis Post Comparison
### Size vs Strength

<table>
<thead>
<tr>
<th>Size * (Dia. (in))</th>
<th>Cross-sectional Area</th>
<th>Lateral Breaking Point</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sq. in.</td>
<td>% of 4&quot;Post</td>
</tr>
<tr>
<td>2.5</td>
<td>4.91</td>
<td>39</td>
</tr>
<tr>
<td>3</td>
<td>7.07</td>
<td>56</td>
</tr>
<tr>
<td>3.5</td>
<td>9.62</td>
<td>77</td>
</tr>
<tr>
<td>4</td>
<td>12.57</td>
<td>100</td>
</tr>
<tr>
<td>5</td>
<td>19.64</td>
<td>156</td>
</tr>
<tr>
<td>6</td>
<td>28.27</td>
<td>225</td>
</tr>
</tbody>
</table>

* Measured at narrow end

**Preferred Post Size:**
- **Line Post:** 3 to 4 inch diameter
- **End Post:** 5 to 6 inch diameter
Row Length at Different Line Post Spacings

- Row Length (feet):
  - 21 ft
  - 24 ft
  - 28 ft

- Number of Line Post per Row:
  - 3 to 25
As the row length increases, fewer end posts are required per acre. The jump in line posts occurs when row length exceeds 600 ft and 4 extra line posts per row are required to construct end post braces.
Cost of Trellis Posts per Acre

For rows spaced 9 feet apart with 3” x 8’ line post and 5” x 10’ end posts.

With the cost end posts being 3 or more times greater than line posts, longer rows cost less to establish on a per acre basis.
Trellising Hardware

12.5 ga High-tensile Wire & 9 ga Soft Wire

Wire Strainers

1 Strainer handle

Crimping Sleeves

Tension Indicator Spring (Optional)

3/8 x 9”

3/8 x 4”

Steel Brace Pins (for H-Brace)

Wire Vise (for Rows < 200 ft)
# Trellis Wire Characteristics

## Low Carbon vs High-tensile

<table>
<thead>
<tr>
<th>Gauge</th>
<th>Dia. (in)</th>
<th>Yield Point (lbs) *</th>
<th>Breaking Point (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Low Carbon</td>
<td>High-tensile</td>
</tr>
<tr>
<td>9</td>
<td>.148</td>
<td>1,119</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>.135</td>
<td>929</td>
<td>1,973</td>
</tr>
<tr>
<td>11</td>
<td>.121</td>
<td>747</td>
<td>1,587</td>
</tr>
<tr>
<td>12</td>
<td>.106</td>
<td>572</td>
<td>1,214</td>
</tr>
<tr>
<td>12.5</td>
<td>.099</td>
<td>-</td>
<td>1,063</td>
</tr>
</tbody>
</table>

* Tension at which the wire begins to stretch.
Preferred Wire for a Vineyard Trellis

**Line wire:** 12.5 gauge High-tensile

**Brace wire:** 9 gauge Low Carbon

- High-tensile wire cannot be twisted.
- Wires have similar yield and breaking points.
- Because high-tensile wire is not very subject to stretching, the tension on the wire should be reduced during the winter.

- Estimated that a temperature drop from 80° to -20° F can increase the tension on 500 ft of 12.5 gauge high-tensile wire by 130 pounds due to shrinkage.
- Tension indicator springs will absorb most of the additional tension.
Specialized Trellising Tools

Hydraulic Post Driver

Post Hole Auger

Wire Spinning Jenny

Chain-Grab Wire Puller

Crimping Tool
Other Tools & Materials

**Tools:**
- Hammer
- Fencing pliers
- Steel bar
- Tape measure
- 6 ft measuring stick
- Plumb bob
- Cordless Drill w/ 3/8” bit (for brace construction)

**Materials:**
- 1 3/4” or 2” Staples
- (Grounding rods, wire, & clamps)
- (Hardwood twitch sticks)
Lightning Damage

Risk can be reduced by grounding the wires to earth anchors or grounding rods.
# Materials for 1 Acre of Trellis

(11 Rows @ 9 ft apart w/ 2 wires)

<table>
<thead>
<tr>
<th>Line Post Spacing</th>
<th>21 ft</th>
<th>24 ft</th>
<th>28 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Row Length</td>
<td>441 ft</td>
<td>432 ft</td>
<td>448 ft</td>
</tr>
<tr>
<td>3” x 8’ Line Post</td>
<td>220</td>
<td>187</td>
<td>165</td>
</tr>
<tr>
<td>5” x 10’ End Post</td>
<td>22</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>Earth Anchors</td>
<td>22</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>12.5 ga High-tensile wire (4,000 ft rolls)</td>
<td>2.49</td>
<td>2.44</td>
<td>2.53</td>
</tr>
<tr>
<td>Wire strainers w/ tension springs</td>
<td>22</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>Crimping sleeves (2 / splice)</td>
<td>92</td>
<td>92</td>
<td>92</td>
</tr>
<tr>
<td>2” staples (lbs @ 53/lb)</td>
<td>17.0</td>
<td>16.2</td>
<td>14.5</td>
</tr>
<tr>
<td>#9 soft wire (ft)</td>
<td>308</td>
<td>308</td>
<td>308</td>
</tr>
</tbody>
</table>

The number of end post, anchors, strainers, crimping sleeves & feet of soft wire needed per row remains constant regardless of row length.
As row length increases, the cost of trellis materials per acre goes down because fewer end posts, anchors, strainers, etc. are needed. The amount of high-tensile wire required per acre will remain relatively constant, and is an inexpensive item in comparison to posts.
## Materials for 1 Acre of Trellis

(10 Rows @ 10 ft apart w/ 2 wires)

<table>
<thead>
<tr>
<th>Line Post Spacing</th>
<th>21 ft</th>
<th>24 ft</th>
<th>28 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Row Length</td>
<td>441 ft</td>
<td>432 ft</td>
<td>448 ft</td>
</tr>
<tr>
<td>3” x 8’ Line Post</td>
<td>200</td>
<td>170</td>
<td>150</td>
</tr>
<tr>
<td>5” x 10’ End Post</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Earth Anchors</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>12.5 ga High-tensile wire (4,000 ft rolls)</td>
<td>2.26</td>
<td>2.22</td>
<td>2.30</td>
</tr>
<tr>
<td>Wire strainers w/ tension springs</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Crimping sleeves (2 / splice)</td>
<td>84</td>
<td>84</td>
<td>84</td>
</tr>
<tr>
<td>2” staples (lbs @ 53/lb)</td>
<td>15.4</td>
<td>14.7</td>
<td>13.2</td>
</tr>
<tr>
<td>#9 soft wire (ft)</td>
<td>280</td>
<td>280</td>
<td>280</td>
</tr>
</tbody>
</table>

With wider rows, less material is required per acre. Row width is often determined by equipment size, the degree of side slope, and trellising system.
Trellis Materials Cost per Acre

Rows 10 ft apart w/ 2 wires

With few rows per acre, the cost of trellis material per acre is less.
Establishing a Trellis
Distribute and drive posts immediately after planting
Driving Posts

In proper position:
- Straight
- Narrow end down
- Correct depth

A pre-cut measuring stick provides a quick reference for gauging the proper depth.

Dr. Bruce Bordelon, Dept. of Horticulture, Purdue University
Line Post
Should be positioned between vines

3-4” x 8’ line post

2’ deep
Line Post
Driven vs setting in an Augered hole

3-4” x 8’ line post
2’ deep
Provide equivalent anchorage
Cost of line posts will be less.

3-4” x 9’ line post
3’ deep
Narrow End

3-4” x 9’ line post
3’ deep

Cost of line posts will be less.
Posts in Swales

Posts in swales are prone to being pulled out by the wire tension. Use longer posts, and drive them deeper.
Planting on a Contour

Straight rows are preferred for stretching wire, but rows can be planted on a contour if the sharpness of the curve does not exceed 5 degrees per 30 ft of span. Pivot posts should be at least 4” dia. x 9’ and driven 3’ deep.

A plywood template can be made to gauge a 5 degree curve.
Constructing an Anchored End Post System

Set the end post in an augered hole, or drive in at an angle.

- 3-4” x 8’ line post
- 5” x 10’ end post
- 6’ to point of top wire attachment
- 60°
- 3 - 4’ deep
- 12-18” wide
- 2’ deep
Install an Earth Anchor by screwing it into the soil at an angle that points to the spot of attachment for the brace wire.

Earth anchor
4-6” helix x 40”
Attach Brace Wire
by forming a loop & twist to tighten

Staple or notch the post to hold brace wire in position. Wire can also be wrapped around the post.

Steel bar or Twitch stick

Brace wire (#9 soft wire)

To tighten, twist the brace wire in same direction used to install the earth anchor.
String, Attach, & Tighten Wires

Wire tension should be set at about 250 lbs.

12.5 ga High-tensile wire

Wire Strainer

60°
Constructing an H-Brace End Post System
Set end and line post 8 ft apart

3-4” x 8’ line post

5-6” x 8-9’ end post

4 - 5’ tall

2’ deep

3-4’ deep
Drill 3/8” holes through the line post, into end post, and into both ends of the brace post.
Insert a brace pin in the end post
Place brace post between end and line posts
Insert brace pin to secure the brace post
Attach Brace Wire
forming a loop & twist to tighten

Staple to secure brace wire
String, Attach, & Tighten Wires

Wire tension should be set at about 250 lbs.

12.5 ga High-tensile wire

Wire Strainer

Staple to secure wire
Attaching Wires to the Posts

• Use at least 1 3/4” long staples w/ slash-cut points.
• Staples should never be driven vertically into the post. Rotate the staple 45° so that it straddles the grain of the wood.
• Position staple so that the points spread apart when driven into the post.
• Attach wire to the side of a post using 2 staples.
• When attaching wire to the top of a post, place the staple about 1/3 of the way from the center, and take measures to prevent the wire from cutting into the post (could be a staple placed under the wire).
Double Stapling
to attach wire to the side of a post
Running Wires Through Holes
Drilled in Posts

An alternative to stapling:
- Requires more construction time.
  - Drilling the holes.
  - Running the wire through the holes.
- Some risk of the wires cutting into the post, particularly on rises and in swales.
Alternate Tie-off Methods

- Wire Vice (cannot reduce tension)
  - For rows 200 ft or less
    - Wire Strainer at one end
  - Suitable for 200 ft to 500 ft rows
    - Wire Strainer in the middle
  - For rows 500 ft or longer

- Crimping Sleeve
Using Crimping Sleeves

to attach wires to end post. Staples are used to secure wires at the proper height.
Install Strainers to Tighten Wires to a tension of about 250 pounds
Attach the spring scale to the wire and pull the wire to the middle nail. Read the pounds tension required to pull the wire to the nail and multiply by 20 to determine the wire tension. For example, a pull of 12.5 lbs x 20 = 250 lbs tension on the wire.

From: How to Build Orchard and Vineyard Trellises, US Steel, Pittsburg, PA
**Method to Measure Wire Tension**

![Diagram of wire tension measurement](image)

*Fig. 31. A technique for tensioning wires to be used in conjunction with information in Table 8. (Figure reproduced courtesy of Washington State University Extension.)*

**Table 8.** The total test weight, in pounds, of a chain, bucket and its contents that will indicate 270 or 300 psi tension on wire for three post spacings when used as indicated in Fig. 31.

<table>
<thead>
<tr>
<th>Desired wire tension (lb)</th>
<th>Test weight (lb) for 6-inch sag for three post spacings (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>24</td>
</tr>
<tr>
<td>300</td>
<td>25.0</td>
</tr>
<tr>
<td>270</td>
<td>22.5</td>
</tr>
</tbody>
</table>

Vineyard Training Systems
High Cordon System
(“Single Curtain, Bi-lateral Cordon”)
Suited for American and many French-American hybrid cultivars with a trailing / drooping growth habit
6-Cane Kniffen System
with wires at 2.5, 4 and 6 feet
Suitable for low vigor cultivars
Umbrella Kniffen System

Suited for American cultivars requiring pruning to long canes. Requires extra labor to tie canes to lower wires.
Geneva Double Curtain System

Suitable for high vigor vines. Minimum row width for this system should be 10 feet.
Geneva Double Curtain

with metal post at each vine, or a mid-level cordon with catch wires for *V. vinifera* cultivars. Bottom wire supports a trickle irrigation line.
Catch Wire System
for Vertical Shoot Positioning

Catch wires spaced 10" apart

Cordon wire at 36 to 42"
Vertical Shoot Positioning
Suited for cultivars with an upright growth habit

Trailing / Drooping
Characteristic of American species

Upright
Characteristic of *V. vinifera* & some French-Amer. hybrids
<table>
<thead>
<tr>
<th>Semi-upright:</th>
<th>Upright:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chambourcin</td>
<td>Chelois</td>
</tr>
<tr>
<td>De Chaunac</td>
<td>Vignoles</td>
</tr>
<tr>
<td>La Crosse</td>
<td></td>
</tr>
<tr>
<td>Prairie Star</td>
<td></td>
</tr>
<tr>
<td>Seyval Blanc</td>
<td></td>
</tr>
</tbody>
</table>
Vertical Shoot Positioning
‘LaCrosse’ vines in an Iowa vineyard