Choosing Between a Wooden Pole or a Galvanized Steel Post Design-
A Decision to Make When Designing a Hop Yard Trellis System for Growing Plants in a V-Bine Configuration

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There are many factors to consider when planning a hop yard. Land dimensions, wind direction, size of equipment that will be used at harvest time, cost, and more recently- what type of poles (wooden vs steel) to use, are just some of those factors.

This article will focus on the design differences and considerations of installing a conventional wooden pole trellis system vs a galvanized steel post trellis system. The topics covered are:

- Pole Type and Size
- Pole Spacing and Installation in the Field
- Cabling Requirements
- How to Anchor Poles
- Longevity and Maintenance of Wood vs Steel

This article will not venture into what variety of plants to grow nor fertilizers, pesticides or irrigation requirements.
WOODEN Pole Type and Size: A conventional wooden pole trellis system may use many different types of wood, depending on regional availability, cost, and personal preference. Some of the more common types include old telephone poles, black locust, cedar, larch, and tamarack. Usually, two different size poles are needed. The end of row and perimeter poles are usually 6-7 inches in diameter and 23 feet in length- installed at a 65 degree angle away from the hop yard. See image and diagram below.

The line poles are 4-5 inches in diameter and 22 feet long- installed perpendicular (straight up) to the ground. All poles are set four feet in the ground (depending on frost level) using an auger and back-fill technique, leaving 18 feet of pole above ground. The diameter of the holes are usually twice the diameter of the poles.
STEEL Post Type and Size: The galvanized steel post system consists of three parts.

**Part 1** is the ground stake. It is a 4” square x 6’ long piece with a 6” swag on one end. It is installed 4’ feet in the ground leaving the swaged end exposed 2’ feet above ground level. See image at left.

The best method for installing this 6’ ground piece is to auger a hole 4-6” deep, approximately 8-10 inches in diameter. Fill the bottom 6” with gravel to aid in drainage. Set the post in the hole so that 2’ of the post will remain above ground level, and fill the hole with concrete up to 6” from the top. This remaining 6” can be back-filled with soil.

**Part 2** is a 4” square x 17’ long piece with a 2” square hole laser cut 6” from top end. This piece fits over the swaged portion of the ground stake that is exposed 2’ above the ground. This creates a post that is approximately 18’-6” tall (above the ground).

**Part 3** is a galvanized steel cross piece (or “T”) that is 6’ long and has holes on all four sides. It is slipped through the laser cut square hole at the top of the upright post. See image at left. When properly installed, this cross piece will be at 18’ above ground level- a common height most hop varieties will achieve each season.

The holes in the cross piece are used for attaching hardware (U-bolts) to run the cabling from one post to the next down the entire length of the row. The cable can be attached over the cross piece, or under. The image at the left shows the cable running over the cross piece.
Unlike a conventional wooden pole trellis systems, all steel posts are installed perpendicular to the ground. There is no need to angle the end posts or perimeter posts.

See the image below.

WOODEN Pole Spacing: Line pole spacing on wooden poles varies from 28’ to 56’ depending on the design used. For commercial v-bine planting the plants are normally planted at 3’-6” spacing down the row. For more details see www.schmidthiops.com

STEEL Post Spacing: Line spacing on steel posts can be a maximum of 90’ between posts. Note-Because of the extended spacing between line posts, the steel posts system requires a 3/8” diameter 1:7 design cable and pre-formed cable connectors or cable tensioners. This proprietary cabling system allows for 1/2 less posts to be installed vs a wooden pole system- resulting in reduced labor and an increase in the number of plants that can be planted in each row. (i.e. if you’re not installing a pole, you can put an extra plant in that spot).

With either system, the width between rows is dependent on the type of equipment used during crop maintenance and harvest. Usually 14’.
Cabling System for WOOD: The most common cables recommended for use in wooden pole trellis system are both a 3/16” and 5/16” diameter in a 1 x 7 design. However, many times a 7 x 19 design is used for easier installation. See image below.

In addition to lower cost, the 7 x 19 cable doesn’t require preform connectors (as with the steel post system), and is easier to work with than the 1:7 cable. One disadvantage is that where the V bine cables (or row cables) are suspended from cross-cables, they rub on one another and fray. Failure may occur in 5 to 7 years.

Therefore, a 3/16” diameter 1:7 cable is recommended for stringing from pole to pole, and the 5/16” diameter 1:7 cable for the cross cabling. This eliminates the fraying problem. Since the 1:7 cable is much less pliable it requires preformed cable connectors or cable tensioners (just like in the steel posts system). The 5/16” 1:7 cable has a tensile strength of 10,000psi.

Cable (3/16”) is run the width of the field by attaching it to the top of the wooden poles- from one row to the other. Additional cabling (5/16”) is then run the length of the field (down the rows) by attaching it the cabling previously installed. See image at above.
**Cabling System for STEEL:** The cabling system for steel posts utilizes 3/8” diameter 1:7 design cable. See image below. This type of cable is much more resistant to failure from rubbing and fraying, and has a tensile strength of 15,400psi (54% higher than the 5/16” 1:7 sometimes used in wooden trellis systems).

The cable for the rows is hung utilizing the cross piece (or “T”) installed at the 18’ level (above ground) of the posts. This “T” is formed by installing a 2” square galvanized piece that is 6’ long through a laser cut square hole near the top of the 4” square post. One cable is run from each end of the “T” down the entire length of the row through U-bolts on all intermediate row posts. In a steel post trellis system there is no cross-cabling. See images at left.
Similar to a wooden trellis system, there are two options for cabling the end-of-row posts.

**Option 1** utilizes turnbuckles (see image at left) which enables tensioning of the cable after installation. In addition to the turnbuckle, a pre-formed cable slice, thimble, and sleeve clamp are also required. See the image at the left.

**Option 2** uses a cable tensioning device that allows for the cable to inserted in one end and pulled tight. The tensioner does not allow the cable to come back out. The cable can be tightened at any time by continuing to pull the cable through the tensioner. See the image at the left.

See the diagram on following page for an illustration of both of these options, side-by-side.
Cabling System for STEEL (con't):

The right side of the diagram below shows the cabling Option 1, utilizing turnbuckles and pre-formed cable connectors that must be assembled in the field. The left side of the diagram shows Option 2, which uses the cable tensioners at the end-of-row posts, and greatly reduces the amount of labor and time needed for installation.
Anchoring System for WOOD: There are many options available for anchoring systems for wooden pole trellis yards. Everything from rebar and sign posts to spade-shaped to helix auger anchors. See image below of helix auger. All anchors should be installed per manufacturer’s specification.

Each pole at the end of a row, as well as, each side pole around the perimeter of the field uses one anchor. These end of row and perimeter poles should be notched about ½” deep approximately 6” from the top of the pole, to prevent the anchor cable from slipping. See image below.

Because all of the row end and perimeter poles are set at a 65 degree angle away from the field, the anchor cable to the ground anchor extends 22 plus feet beyond the growing field, vs only 17 feet with the steel post system.
**Anchoring System for STEEL**: The steel post system utilizes two anchors for each row end post. This may seem like a lot of anchors vs a wooden pole trellis field, but with the steel posts system the perimeter posts are not anchored. So in essence, the number of anchors needed can be greatly reduce. The recommendation is to use 10” spade-shaped anchors. See image below.

The spade anchor is installed perpendicular to the ground approximately 15-17 feet from the end row post. This should create a 45 degree angle from the top of the end row post down to the anchor. See image below.

The anchors include a 6’ length of stainless steel or galvanized cable attached to the 10” spade on one end and a preform cable connector or cable tensioner at the other. Once the anchor is driven into the ground, it “seats” itself when upward tension is applied. See part 3 of image above.
Anchoring System for STEEL (con’t):

The anchor assembly is attached to the cross piece (T) of the end-of-row posts using a preform cable connector or cable tensioner and 3/8” 1:7 cable. The image below shows the proper positioning of the anchors and angle away from the end-of-row post approximately 15-17 feet from the base of the end post.

The cable from the ground anchor to the top of the end posts should be attached about 12” to 18” in from the ends of the “T” piece on either side. See the image below. The cable running the length of the row can then be attached closer to the end of the “T” piece (outside of the anchor cable attachment.

The diagram on following page shows the anchor cabling details. Again, using Option 2 cable tensioners eliminates the need for the turnbuckles and pre-form cable connectors shown on the next page.
Hops Anchoring System for Galvanized Steel Post Trellis

10" Arrowhead Anchor

6' of Stainless Steel Cable

3/4" x 12" Turnbuckle

Pre-form 3/8" Cable Connector

Preform Connection Directly to Cross-Piece U-Bolt (no turnbuckle)

Turnbuckle to Start
Anchoring System for STEEL (con’t):

Note: Since the end row posts are set perpendicular to the ground (not at a 65 degree angle away from the field as with wooden poles), the anchors only extends 15 to 17 feet beyond the row. This actually reduces the total acreage required vs a wooden trellis system. Remember, because the end-of-row poles in a wooden system are angle away from the field (not perpendicular as with steel) and then the anchoring system is angled even further away- the resulting space beyond the field increases to 22+ feet.

Longevity and Maintenance of a WOODEN Trellis System:

There are better resources on this topic than this paper. However, here are some things to consider in reference to maintaining a wooden trellis system to achieve optimal service life.

Wooden trellis poles are susceptible to rot and insect damage if proper precautions are not taken. Most resources recommend striping the bark off at least the bottom 4 foot of the pole (the portion that will be in the ground). This area can then be treated with a wood preservative, although this is optional. Another option (instead of striping the bark) is to treat this same bottom 4 feet of the pole with a special tar product or rubberized wrap. This will create a barrier, preventing both moisture and insect penetration- without harmful effects to the soil. When properly treated, many wooden pole varieties can last up to 20 years.

Longevity and Maintenance of a STEEL Trellis System:

Protecting the galvanized steel posts requires no additional labor beyond installation. The galvanizing on the exterior of the steel is 99.99% pure zinc, and the uniform coating is applied to the steel substrate at the production mill in a continuous in-line process. Galvanized steel has a service life exceeding 40 years- double the average service life of a wooden pole trellis system. This factor must be taken into consideration when doing a cost evaluation of wood vs steel.
Comparative Analysis for Installing One Acre of a
Galvanized Steel Trellis System
Vs
A Conventional Wooden Trellis System

<table>
<thead>
<tr>
<th></th>
<th>Wooden</th>
<th>Galvanized Steel</th>
</tr>
</thead>
<tbody>
<tr>
<td># of Rows per Acre</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td># of Poles per Row</td>
<td>7</td>
<td>4</td>
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<tr>
<td>Ft Between Poles</td>
<td>28-56ft</td>
<td>90ft</td>
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<tr>
<td>Total # of Poles</td>
<td>81</td>
<td>44</td>
</tr>
<tr>
<td>Total # of Anchors</td>
<td>44</td>
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<tr>
<td>Total Footage of Cable</td>
<td>7600ft</td>
<td>6600ft</td>
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<tr>
<td># of Plants V-Bine</td>
<td>648</td>
<td>825</td>
</tr>
<tr>
<td># of Plants Single</td>
<td>144</td>
<td>0</td>
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<tr>
<td>Total # of Plants</td>
<td>792</td>
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<td>Total Area Required</td>
<td>51,000sqft</td>
<td>42,000sqft</td>
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<tr>
<td>Service Life</td>
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<td>40+ years</td>
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</table>

On the following page is a schematic incorporating the information from this page. It shows a comparison of all of the features of a wooden pole trellis system vs a steel post system- including distance between poles, number of anchors needed, cabling footage, and overall square footage of land used to install a one acre field.
Resources Used in Writing this Article

Hops Trellis Construction, Brad Bergeford 2014. The Ohio State University South Centers, Pyke ton, OH. A review of the trial field installation

Hop Production 101, Diana R. Cochran and Bryn Takle December 2016. Iowa State University Extension and Outreach.

www.schmidthops.com Stephan Schmidt, Owner of Schmidt Farm, Farmington, NY

Griffin Supply, Hammond, IN. The concept for the steel trellis system discussed in this paper was designed by Terry Frahm and his engineering team.

Photos on the following pages;
Photos 1 and 2, The Ohio State University South Centers, Piketon, OH.
Photo 3, University of Kentucky Robinson Center, Quicksand, KY.
Photos 4 - 7, Norbrook Farm Brewery, Colebrook, CT.
Photos 8 – 10, Lazy Fox Hops, Brightwood, VA.