MICHIGAN STATE UNIVERSITY | Extension

Hopyard Construction

Rob Sirrine, Michigan State University
sirrine@msu.edu
www.hops.msu.edu

Dan Wiesen, Empire Hops

Site Assessment

- **Well-** Is there a well on site? If not where is a logical site?
- **Overhead Power-** For both well hook up and interference with trellis
- **Terrain Changes-** The flatter the better
- **Determine Drive Rows-** Ideally drive rows run North-South

Field Preparation

- Clearing Land – Remove any unwanted trees and under brush
- Disc Field- Field must be leveled and soil softened to allow for marking with GPS tractor
- Fumigation- Easiest if done at this point but can be done later

Climbing Bines

- Bine climbs clockwise with the aid of trichomes
  - Phototropism
  - Thigmotropism
- In the wild, hops climb up a companion species or support
- Commercial production requires a trellis

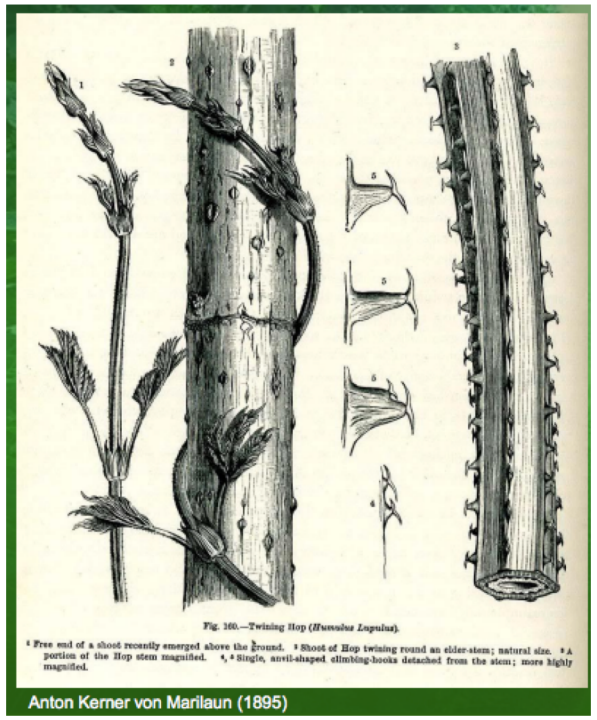


Table 1. Typical row and plant spacing in various hop-producing regions of the world (Oldham 2016; Kořen 2007; Rybáček 1991).

Country	Region	Dominant growing system*	Typical spacing between rows (m)	Typical plant spacing along the row (m)
Germany	Hallertau	V-trellis	3.2	1.3–1.7
USA	Washington State	V-trellis	4.0	0.9
Czech Republic	Saaz, Trschitz and Auscha	V-trellis	3.0	1.0
United Kingdom	West Midlands and south-east	Low 2D trellis	2.5	0.6–0.9
New Zealand	Nelson	V-trellis	2.5	1.2

Note: The openness of the V-trellis systems varies considerably from country to country with differences in row spacing. V-trellis canopies in Washington State, USA are much wider than those in Germany or New Zealand.

Trellis Construction: Required Materials

- Southern Yellow Pine (Anchor Poles)
- Red Pine (Interior Poles)
- 5/16” Cable (Bridle, Crosswire, Ribbon, and Anchor Cable)
- 1/4” Cable (Vine Line)
- 5’ Anchor Pins (5’ Steel rod with an eye hole at the top and a shepherds hook on the bottom)
- 5/16” Clamps
- 1/4” Clamps
- 3” Staples (Attaching Cross wires to Interior Poles)
- 1 3/4” Staples (wrapping cables to Anchor Poles)
- 6” Nails (Establishing wrap on Anchor Poles)
- Wiggle Wire


56’
28’
14’
5/16” Cable (Bridle, Crosswire, Ribbon, Anchor Cable)
1/4” Cable (Vine Line)

Trellis Construction: Required Tools & Machinery

- Skid Steer with auger (14” and 18”)
- Telehandler (forks and man basket)
- Tractor
- Shovels
- Come-alongs
- Cable pullers
- ½” Sockets
- Hammers
- Field Marker
- Cable Spooler
- Water Wagon
- Tampers
- 90 Degree Level
- Large Flat Bed Trailer
- Disc

Terminology

- **Anchor Poles-**Poles at the exterior or trellis and attached to anchor pins.
- **Field Poles-**Interior poles that he cross wire sits on
- **Anchor Pin-** Steel rods that are concreted into the ground that anchor cable is secured to
- **Cross Wire-** Steel cable that runs from anchor poles over field poles to support vine line
- **Vine Line-** Steel cable that runs over cross wire and attaches to bridle on each side of trellis. This is the cable that strings are attached to
- **Bridle-** Doubled up steel cable that runs on the exterior of trellis along two opposite sides (ideally North and South) that vine lines attach to
- **Ribbon-** Steel cable that runs on exterior of trellis opposite of bridle
- **Wiggle Wire-** 18” long 9 gauge wire to hold vine line in place

14’ x 3.5’ (2 strings/hill)
889 hills
55 poles
1778 strings/acre

Or

14’ x 7’ (4 strings/hill)
445 hills
55 poles
1778 strings/acre

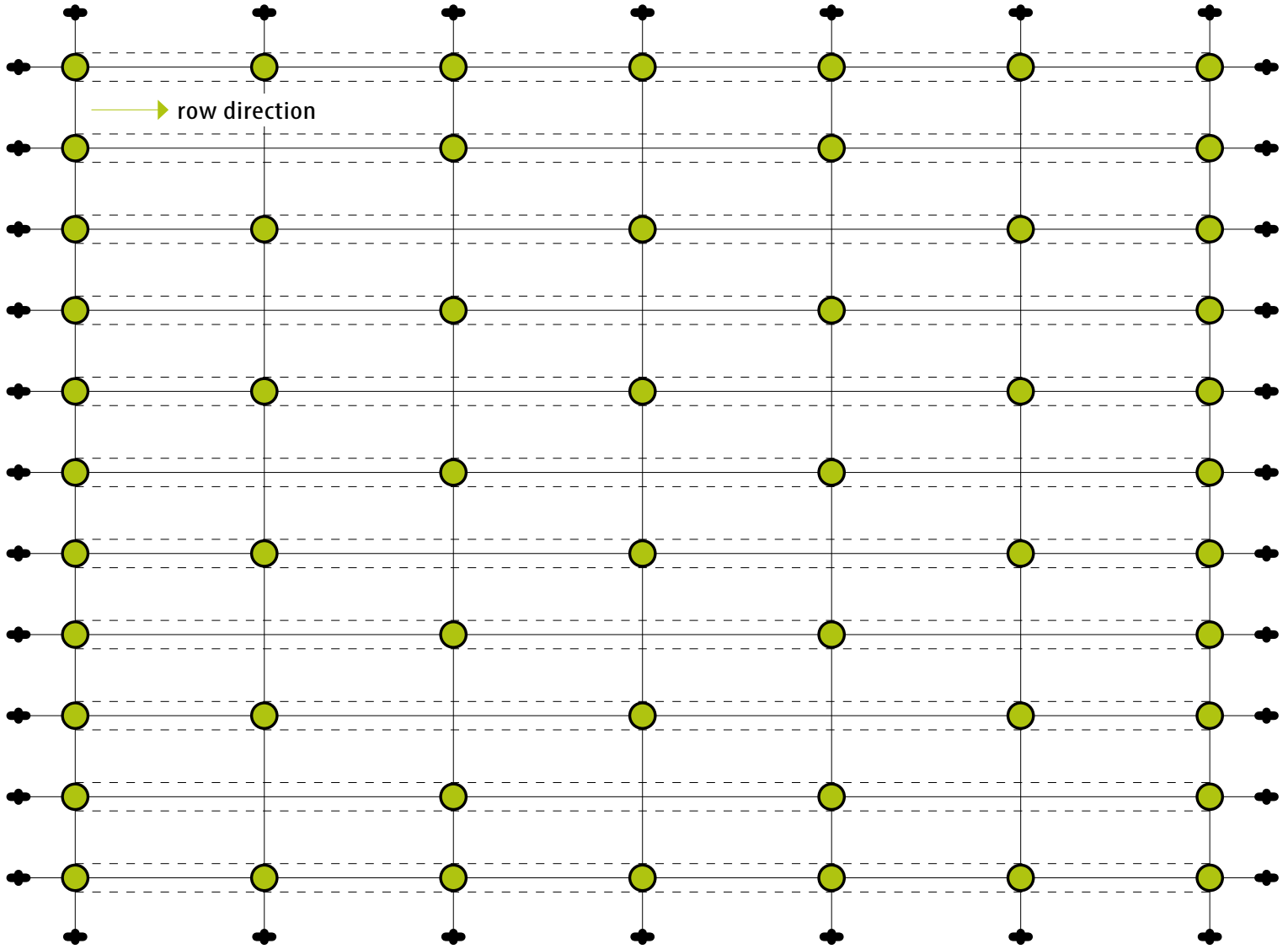


Figure 4. A possible hop yard design plan showing distribution of posts, cables, wires, stays and anchors.

posts ground anchors --- wire — cable


LOADALL
C689309

GPS Marking

- Measure 30’ off of property line to mark anchor pin line on all sides of trellis site
- The marker is pulled by a GPS driven tractor to create a grid of intersecting lines in the dirt
- Drive Rows are 14’ apart
- Cross rows are 28’ apart

Drilling Field Pole Holes

- Drill opposite of drive rows
- Drill on every other drag line
- When starting a new row drill on the drag line skipped in the previous row. This will produce a diamond pattern in the field poles
- The spacing of the field poles is 56’following the direction of the drive row but only 28’ feet following the cross wire row
- Hole Depth 4’

Laying out and Standing Field Poles

- Bunks of poles are loaded on trailers and rolled off next to drilled field pole holes
- Telehandlers are then used to stand the poles using a lifting strap
- Poles will have some play in the holes until tamped in

Tamping Field Poles

- Field poles will be tamped in by one or multiple crews of 2 to 3 people
- One person holds the pole straight in the hole and makes adjustments called out by the other worker who is standing back to sight the pole in
- Poles have to be sighted in both North-South and East-West
- Once the poles are in line and straight dirt is added and tamped solid

Drilling Anchor Poles

- Anchor poles will be every 14’ along the Bridle
- Every 28’ along the Ribbon
- Drilled to a depth of 3-4’

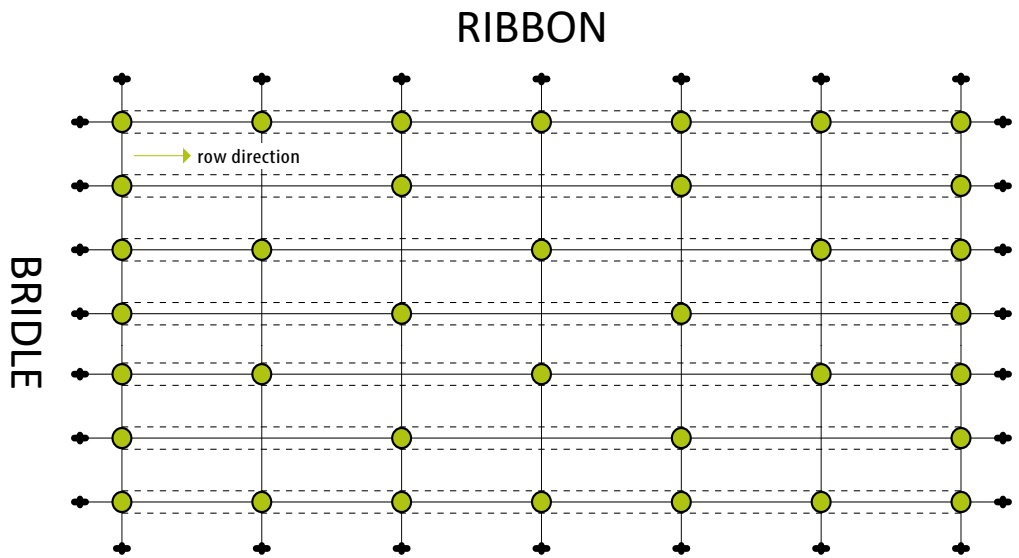


Figure 4. A possible hop yard design plan showing distribution of posts, cables, wires, stays and anchors.

posts ground anchors --- wire — cable

Wrapping Anchor Poles

- Precut sections of 5/16 cable at 45’ lengths will be attached to each anchor pole.
- A 6” Nail is pounded 3” into the anchor pole at 18’ above the ground.
- The anchor cable is center on the nail, wrapped around the pole, and secured with 1 3/4” staples.
- The two tag ends should be equal in length and hang on the ground.

Pitching Anchor Poles

- Once the anchor cables are attached to the anchor poles, the poles will be pitched.
- A hole is dug about 2’ deep in front of the anchor pole facing the anchor pin.
- A crew of 3-4 will then pitch the pole.
- One person will pull on the tag ends of the anchor cable in the direction of the pin.
- Using a level attached to a 90 degree square a worker levels the pole to a 45 degree angle.
- When the pole is level another worker inserts a metal fence post to hold the pole in place while the others back fill and tamp the pole in place.

Locking Anchors

- With the anchor poles pitched, a crew will then pull tag ends of anchor cable to the pins and make a crimp on the cable where it meets the pin
- Two 5/16” cable clamps are attached to both tag ends after then are ran through the eye of pin

Corner Poles

- Corner poles receive two anchor cables cut to 50’
- Each corner also receives two anchor pins to hold tension in each direction (bridle & ribbon)
- The corners are pitched to split the difference between the two pulling directions

Drilling Anchor Pin Holes

- Anchor pins will be 14’ from base of anchor pole
- Pin holes drilled to a depth of about 5’
- Use the anchor pin to mark depth- only the eye hole should be above the surface of the ground
- After anchor pin holes are drilled the bottom will be tamped flat and solid

Concrete

- Have anchor rods placed loosely in anchor pin holes with the shepherds hook in the bottom
- Enough concrete is added to the hole to cover the top of the shepherds hook
- Make sure the eye hole is perpendicular to the anchor pole and centered in the hole
- As the concrete is added the anchor pin should be lifted slightly to make sure the shepherds hook is suspended in the concrete
- 1 yard of concrete = 20 holes


C668366

Laying Out Cable

- Cable is laid out on the ground using a cable spooler
- The cross wire (5/16”) is ran first followed by the vine line (1/4”)
- VINE LINE MUST BE ON TOP OF CROSS WIRE
- The cable is run from one anchor pin to the anchor pin on the opposite end of the field
- Bridle and ribbon will be run on the exterior of trellis

Attaching Bridle

- Bridle Cable (two 5/16” cables) are attached at the corner anchor pole at one end of the trellis
- The bridle is wrapped, stapled, and clamped
- The bridle is loosely stapled above the anchor wraps on each post going to the opposite corner anchor pole
- The bridle is then stretched to desired tension
- After stretching the staples along each anchor pole are driven in completely.
- The same is repeated on opposite side of trellis

Attaching Vine Line

- Each vine line is attached on one side of the field to the bridle cable
- The 1/4” vine line attached to the bridle using a “crows foot” knot and clamped to itself with 1/4” clamps
- The spacing for the vine line is 3.5’ from the anchor pole leaving a space of 7’ between the two vine lines

Stretching Vine Line

- Once all vine lines attached to one side of the trellis they will be stretched from the opposite side
- The vine line is stretched using come-alongs and cable pullers
- The come-along is attached to the bridle and pulls the vine line tight
- At the desired tension the vine line is attached to the bridle using a “crows foot” knot and clamps
- The trellis must be stretched evenly. Start in the middle and move out. Stretch 3 rows and then skip 6. Repeat in each direction to corners and then come back and attach skipped rows.

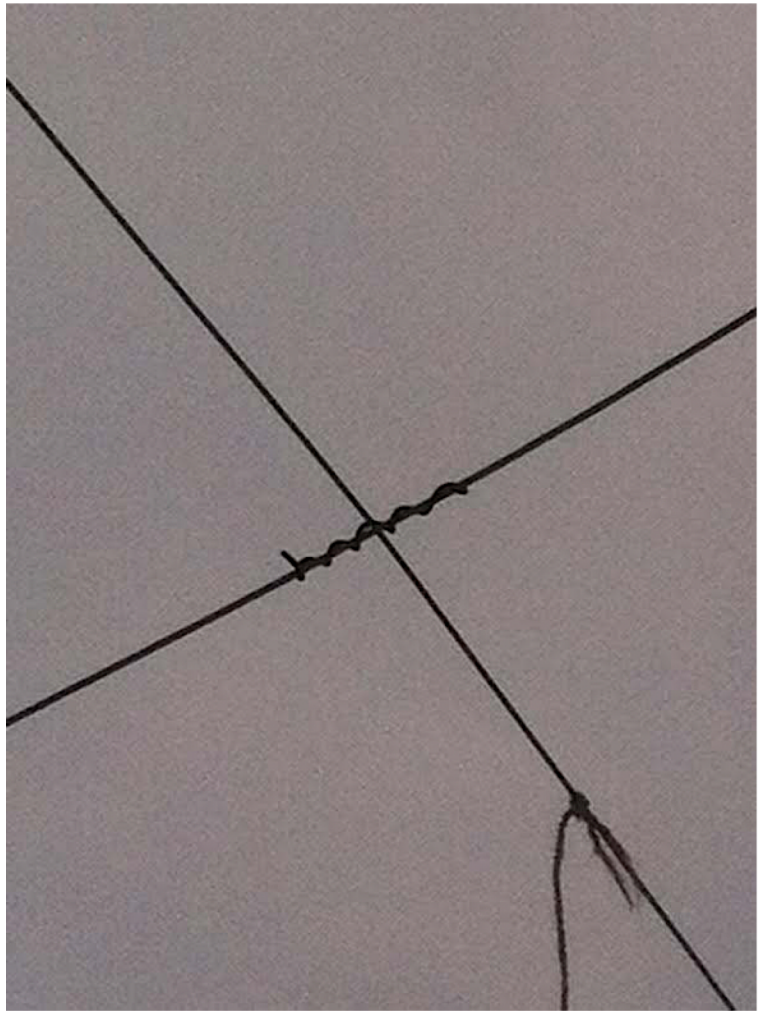
Attaching and Stretching Cross Wire

- Once all vine lines are attached to one side of the trellis, the cross wires are attached to each anchor pole on one side of the trellis first
- Cable is wrapped around the anchor pole above the anchor wraps and secured to itself using 5/16” clamps
- Cross wire is stretched from the opposite side of the field, starting from the middle and working out
- The cross wire will be stretched twice

Lifting and Stapling Cross Wire

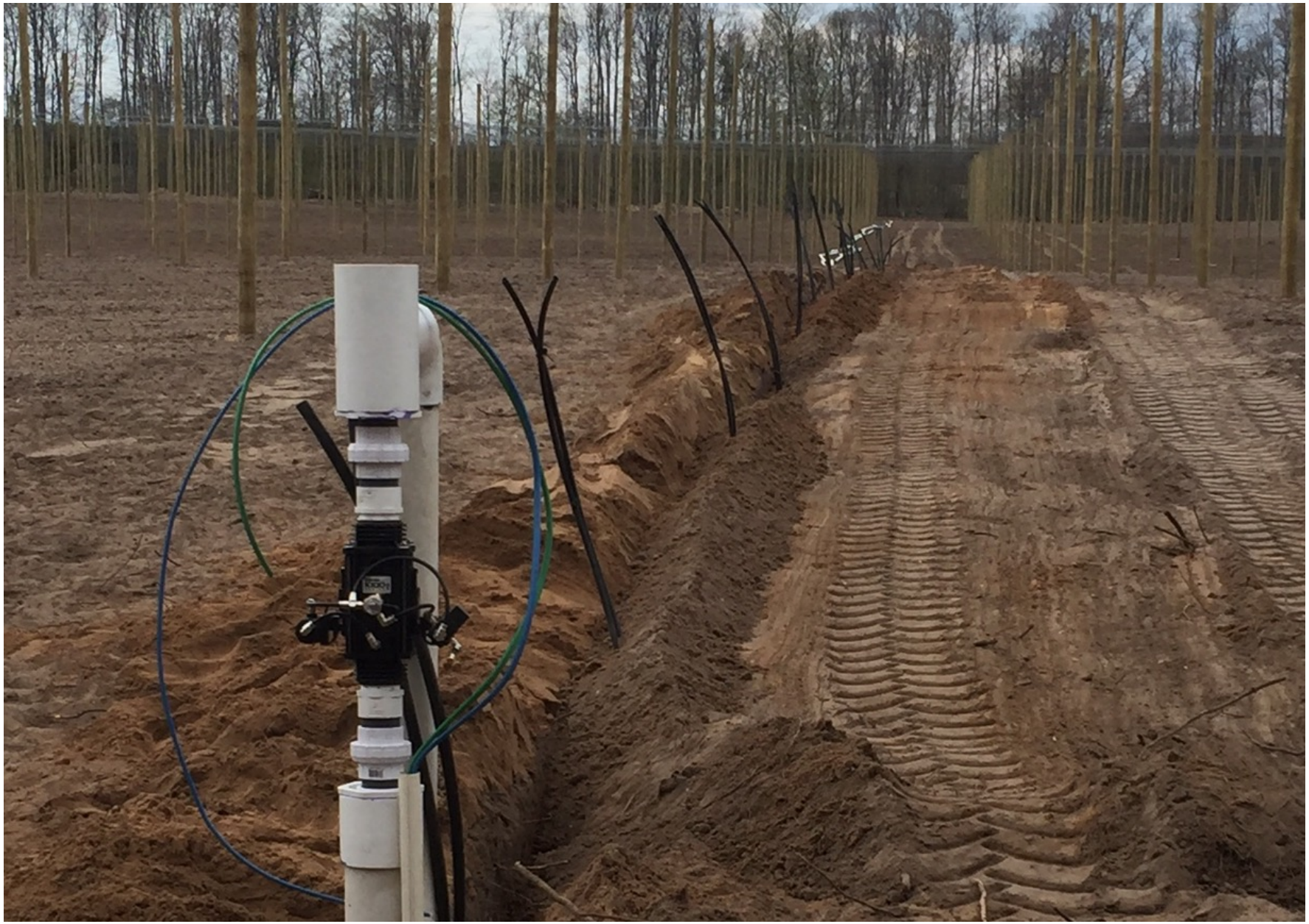
- The cross wire needs to be raised and set on top of the of the field poles
- This can be done with a boom arm or with workers in a man basket
- Once the tensioned cross wire is placed on top of the field poles a 3” staple is hammered in to hold the cable in place
- Large fields may require two stretches on both cross wire and vine line

Wiggle Wire



- Wiggle wire are 18” long, 9 gauge wire that is used to hold vine line in place
- The vine line can blow off of its spacing in high winds
- The wiggle wire is wrapped around the vine line to the cross wire to hold it in place
- Wiggle wire is attached on each vine line on every third cross wire


MI LOCAL
HOPS
Photo by Mike Moran



Irrigation

- Drip line irrigation is rolled out and placed along the planted hops
- The drip connects to the main irrigation line
- We use .26 emitters spaced 12” apart
- The drip is clamped at the end of the trellis to hold pressure

Stringing

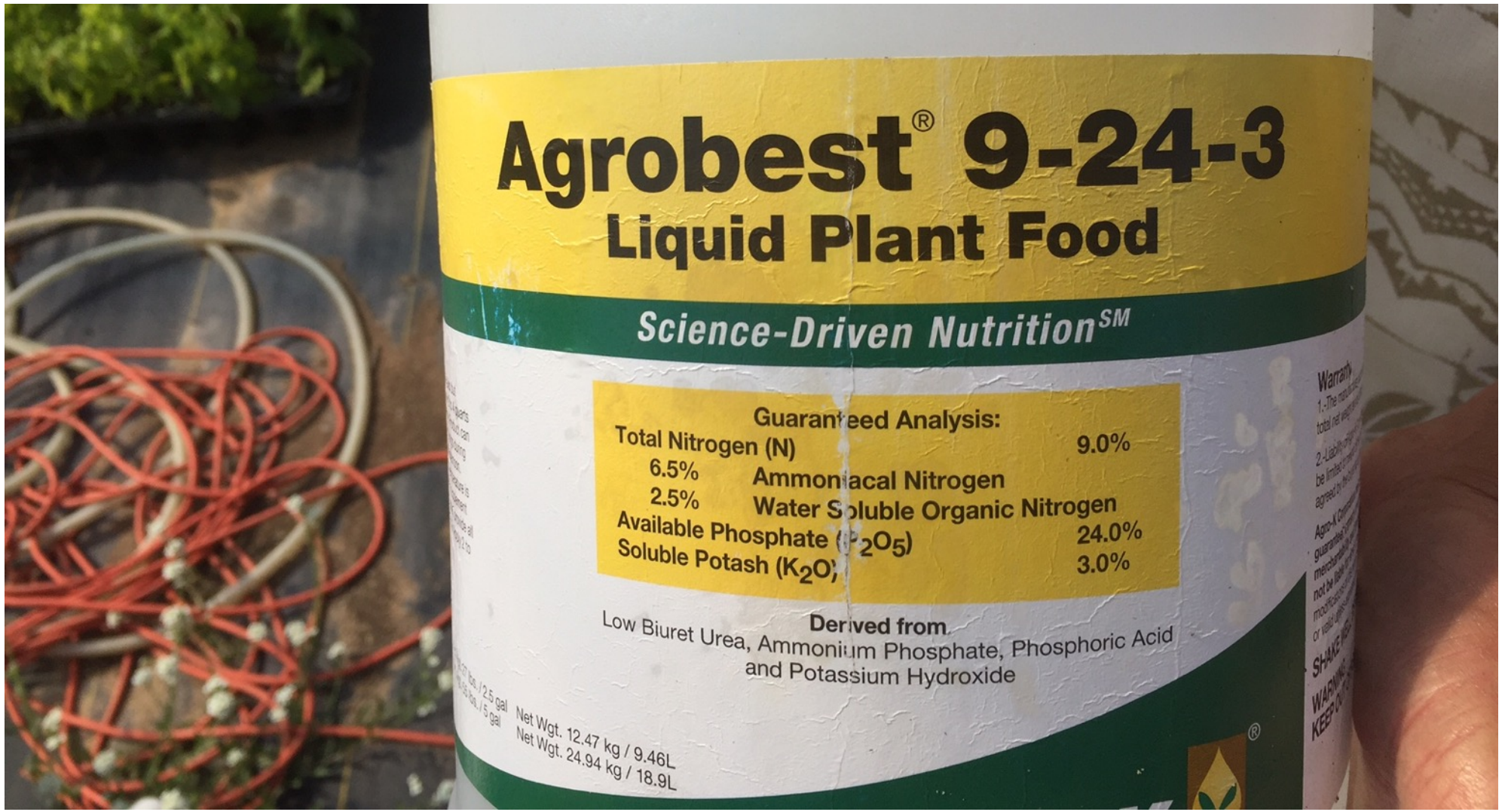
- Stringing begins as soon as the ground has thawed (April)
- Two people in the tower tie two strings each moving across the drive rows
- A team on the ground pushes the strings through the hop plant and into the ground
- The string is held in the ground with “W” clips
- The spacing of the plants matches the spacing of the strings

Twining Tower

- 10’ x 10’ platform
- 9’ to platform floor
- Hydraulic lift controlled by foot from platform
- Telescopes to 15’
- Lower platform for storing strings
- 2 or 4 wheel axles
- Custom sizes available
- Built in ladder

Planting

- Planting is done manually
- Plant spacing: 3.5’ from the post and then 7’ after that
- This comes into play when stringing in the spring
- Planting is labor intensive but moves quickly with a crew of 10 (10-12 acres/day)


Agrobest® 9-24-3
Liquid Plant Food
Science-Driven Nutrition℠
Guaranteed Analysis:
Total Nitrogen (N) 9.0%
6.5% Ammoniacal Nitrogen
2.5% Water Soluble Organic Nitrogen
Available Phosphate (P_2O_5) 24.0%
Soluble Potash (K_2O) 3.0%
Derived from
Low Biuret Urea, Ammonium Phosphate, Phosphoric Acid
and Potassium Hydroxide
Net Wgt. 12.47 kg / 9.46L
Net Wgt. 24.94 kg / 18.9L


That's all Folks!