



# Hop Farm Management and Trellis Construction



# Green House



- ▶ Rhizomes are potted in our green house in early March
- ▶ They will remain in the green house until planting which is usually in July.
- ▶ Rhizomes are tested for disease by the nursery we purchase them from.



# Planting

- ▶ Planting is done manually
- ▶ The plants are spaced at 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 planting 10-12 acres a day.





# Crop and Plant Spacing





# Stringing

- ▶ Stringing
- ▶ String begins as soon as the ground has thawed.
- ▶ 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.



# Training

- ▶ Training begins June 1<sup>st</sup>.
- ▶ 2-4 Vines are wrapped clockwise around the string. The number depends on variety.
- ▶ The vines have a month to grow to the top of the string.
- ▶ Training is labor intensive with crews of 8-15 people.
- ▶ A crew of 10 can train about 10 acres a day.





# Fertilizer and Spray Plans

- ▶ Fertilizer is put on plants through a fertigation system as well as granular fertilizer.
- ▶ Sprays are used to control weeds and disease.



# Harvest

- ▶ Top Cutter
- ▶ Stripper
- ▶ Harvest Starts around the 20<sup>th</sup> of August.
- ▶ Top Cutter cuts top of vines which drop into a trailer.
- ▶ The vines are loaded into a stripping machine to remove cones.
- ▶ Different varieties will be ready at different times.





# Top Cutter and String Tower Specs

- ▶ Twining tower
  - ▶ -10' X 10' platform
  - ▶ -9' to platform floor
  - ▶ -Built in ladder for easy access to platform
  - ▶ -Telescopes to 15'
  - ▶ -Lower platform for string storage
  - ▶ -Two or Four wheel axles
  - ▶ -Hydraulic lift is controlled by foot from the platform
  - ▶ -Custom sizes available
- ▶ Top cutter specs
  - ▶ Drive options -Hydraulic driven from tractor PTO
  - ▶ -Self contained Honda engine powered unit
  - ▶ -Telescopes up and down 5 feet
  - ▶ -Electric over hydraulic controls
  - ▶ -Head pitches up and down
  - ▶ -Optional left and right angle
  - ▶ -Cuts both sides of a row at one time
  - ▶ -Can be mounted to most wheel loaders, telehandlers, tractors (need 10,000# 4 X 4 machine)
  - ▶ -Custom options available



# Processing

- ▶ Once the hop vines are cut they are taken to the stripping machines.
- ▶ Cones are extracted and taken to drying floors.
- ▶ Once dried the cones are compressed into bales.
- ▶ Bales go through a pellet mill to become the hop pellets most commonly used in brewing.





# 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





# Require Tools and Machinery

- ▶ Skid Steer with auger (14" and 18")
- ▶ Telehandler (forks and man basket)
- ▶ Tractor
- ▶ Shovels
- ▶ Come-alongs
- ▶ Cable pullers
- ▶ 1/2" Sockets
- ▶ Hammers
- ▶ T-post (metal fence posts)
- ▶ 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 the 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.



# Assessing the Build Site



- ▶ **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 Prep

- ▶ Clearing Land - Removal of 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. (Can be done later).





# 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 Pole Holes

- ▶ Anchor poles will be every 14' along the Bridle.
- ▶ Every 28' along the Ribbon
- ▶ Drilled to a depth of 3'



# Drilling Anchor Pin Holes

- ▶ Anchor pins will be 14' from base of anchor pole.
- ▶ Pin holes re 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.



# Back Filling and Watering in Anchor Pins

- ▶ After the concrete has set back fill the holes completely.
- ▶ Add water to the holes to force any air pockets out.
- ▶ Back fill and smooth holes over.
- ▶ Air pockets will cause the anchor pins to pull up slightly which will weaken trellis.





## 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 ¾" staples.
- ▶ The two tag ends should be equal in length and hang on the ground.



# Pitching Anchors

- ▶ 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.





## 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 and ribbon).
- ▶ The corners are pitched to split the difference between the two pulling directions.



# 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.



# Laying Out Cable

- ▶ Cable is layout 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 needs to be ran from one anchor pin to the anchor pin on the opposite end of the field.
- ▶ Bridle and ribbon will be ran 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

- ▶ Cross wires are attached to each anchor pole on one side of the trellis first.
- ▶ The cable is wrapped around the anchor pole above the anchor wraps and secured to itself using 5/16" clamps.
- ▶ The 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

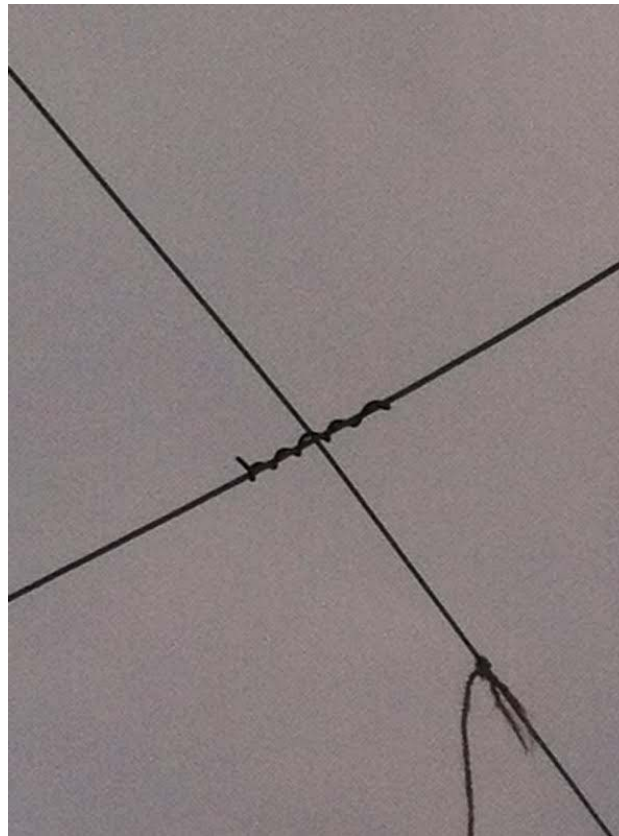


- ▶ The cross wire needs to be raised and set on top of the of the field poles.
- ▶ This can be done with a boom arm or with workers in a man basket.
- ▶ Once the tensioned cross wire is placed on top of the field poles a 3" staple is hammered in to hold the cable in place.
- ▶ Large fields may require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



# 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.



# Resources



- ▶ **Empire Hops-** Trellis Construction and Farm Management.  
Dan Wiesen (231) 645-4557
- ▶ **Empire Orchards-** Hop Plants  
Dan Wiesen (231) 645-4557
- ▶ **Herman Mobile Service-**  
Implements and Tractor Sales.  
Phone: (231) 256-0065
- ▶ **Pine River Group:** Trellis Materials  
Ron Grunwall (616) 548-1541