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Installing an Overhead Irrigation System in a High Tunnel

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Introduction



Information in this guide is supplied by the Vegetable Production Systems Laboratory (VPSL) at The Ohio State University with the understanding that no endorsement of named products is intended, nor is discrimination or criticism implied of products mentioned or not mentioned. To simplify technical terminology, or for the purpose of information, trade names of products and equipment occasionally will be used.

Methods described in this guide are the VPSL's, developed with material manufacturer input. The manufacturer's guidelines for overhead irrigation system design are compiled in the <u>Netafim Sprinkler Systems Design Guide</u>, which informed many of the details of the assembly depicted in this guide. Specific components and dimensions of the assembly were tailored to pre-existing infrastructure at the sites of installation and may differ from what is required in other situations. This resource will distinguish explicit manufacturer recommendations from personal experiences of VPSL staff.

Photographs in this guide were taken during separate installations of overhead irrigation systems in two 48' x 21' high tunnels (HTs) located at Horticulture Unit 1 at the Ohio Agricultural Research and Development Center (OARDC), on August 5th, 2020 and September 30th, 2020.

The systems were installed by two VPSL staff members, requiring between 3-4 hours of labor to complete and document each installation. Installation can be successfully performed in a similar timeframe by one person. A second person was included to ensure ladder safety and assist with handling tools and parts.

Various approaches to create effective overhead irrigation systems in HTs are available. Regardless of approach, all system components should be appropriate for HT conditions and uses.

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About Overhead Irrigation in High Tunnels



Overhead irrigation has value in HT production. Using an overhead system, water can be delivered without the complications of drip tape and associated systems. Similarly, overhead irrigation can provide coverage difficult to achieve with drip irrigation, which can be important when growing cash or cover crops seeded or transplanted at high densities, managing soil moisture between crops, or providing frost protection or evaporative cooling under carefully selected conditions. Overhead irrigation systems can be in place year-round or seasonally depending on production needs, and it is possible to relocate them as needed. Also, overhead irrigation systems are relatively inexpensive, customizable, and installed relatively quickly and easily. This guide contains information on what to expect when setting up one example of an overhead irrigation system and how to do it.

Tools & Parts Inventory

Tool / Part	Quantity
Field Tape Measure	1
Tape Measure	1
Sod Staples	6
Marker	1
Utility Knife	1
3 mm Hole Punch	1
Drill-Driver or Flathead Screwdriver	1
Teflon Plumber's Tape	1
Step Ladder	1
³ ⁄4" Low-density Polyethylene (PE) Tubing	70'
48" Hanging Assembly	13
SpinNet BR-BR-GR Sprinkler	13
³ ⁄ ₄ " 120 Mesh Disc Filter	1
³ ⁄4" 35 PSI Pressure Regulator	1
¾" Female Garden Hose Thread (GHT) x Female Pipe Thread (FPT) Adapter	1
³ ⁄ ₄ " Quick Disconnect Set	1
³ / ₄ " Easy Loc x Male Pipe Thread (MPT) Adapter	3
³ / ₄ " Male Pipe Thread End Cap	1
³ ⁄ ₄ " Easy Loc Elbow	2
1" (Trade No. 12) Stainless Steel Hose Clamp	3
2" (Trade No. 32) Stainless Steel Hose Clamp	15

Tools





- 1. Field Tape Measure
- 2. Tape Measure
- 3. Sod Staples

- 4. Marker
- 5. Utility Knife
- 6. 3 mm Hole Punch
- 7. Drill or Screwdriver
- 8. Teflon Plumber's Tape
- 9. Step Ladder

Parts



- 48" Hanging Assemblies 2.
- SpinNet BR-BR-GR Sprinklers 3.
- 1" Stainless Steel Hose Clamps 4.
- 5. 2" Stainless Steel Hose Clamps
- 6. 3/4" Easy Loc Elbows

- 120 Mesh Disc Filter 8.
- ³⁄₄" Quick Disconnect Set 9.
- 10. ³/₄" Female GHT x FPT Adapter
- 11. ¾" MPT End Cap
- 12. ³⁄₄" Easy Loc x MPT Adapters



The following section details the process of preparing the overhead supply line for installation. The overhead supply line is the "backbone" of the system. It is attached to the center purlin at the peak of the HT and serves as the point of attachment for all hanging sprinkler assemblies along the length of the system.

Tools & Parts Required:

- Field Tape Measure
- Sod Staples
- Utility Knife

Marker ¾" Low-density PE

Tubing

- ³⁄₄" Easy Loc Elbows

Section III of XII



Steps:

- 1. Stretch out field tape measure alongside the length of the HT.
- 2. Lay out tubing, staking down with sod staples to prevent it from coiling.
 - Note: ¾" Low-density PE Tubing was chosen for the supply line based on manufacturer recommendations for an overhead irrigation system of this size, and for its ultraviolet (UV) and acid resistant properties. (<u>Netafim, 2014</u>; <u>Netafim, 2017</u>).
- 3. Using a utility knife, carefully cut the tubing to the length of the center purlin on your HT. Make sure the cut is clean, straight, and even to prevent a leaky connection.
 - **Note:** The HT shown is 48' long, so the tubing is cut to 48', as well.



Steps (continued):

- 4. Starting 6' from either end of the tubing, make a mark every 3'. These marks will indicate where to punch holes for the hanging sprinkler assemblies. In this case, there are 13 marks from 6' and 42'.
 - Note: 3' spacing is specified by the manufacturer (Netafim, 2014).
 - **Tip:** Do <u>not</u> punch holes yet. Waiting to punch holes until the tubing is in place at the peak of the HT helps ensure that all sprinklers hang plumb from the center purlin. During a previous installation, in which holes were punched prior to hanging the supply line, the tubing had been somewhat twisted while it was laid out. The sprinklers did not hang plumb, and it was necessary to splice in a new section of tubing to correct the issue—an avoidable waste of time, effort, and material.





Steps (continued):

- 5. Install ³/₄" Easy Loc Elbows at either end of the cut tubing by loosening the threaded locking mechanisms, pushing the barbed ends into the tubing, and re-tightening the threaded locking mechanisms over the tubing.
 - Note: This type of elbow was chosen over a simple barbed elbow based on lab personnel's preference to reduce the number of potentially abrasive metal hose clamps located near the HT plastic covering.

Overhead Supply Line & Hanging Assembly Installation



The following section of the guide details the process of installing the overhead supply line on the center purlin at the peak of the HT, as well as installing the hanging sprinkler assemblies on the overhead supply line. These steps are performed concurrently to reduce the number of trips up and down the ladder.

Tools & Parts Required:

- Step Ladder
- Drill-Driver

3 mm Hole Punch

- 2" Hose Clamps
- **Overhead Supply Line**
- 48" Hanging Assemblies

Overhead Supply Line Installation



Steps:

- 1. Lay out the overhead supply line inside the HT, directly beneath the center purlin.
- 2. Beginning at the end of the HT where the water source is located, use a 2" Stainless Steel Hose Clamp to attach the tubing to the center purlin where it meets the end wall of the HT. Although the clamp does not directly contact the HT plastic covering, it should be oriented to minimize its surface area near the plastic, to reduce its abrasive risk.
- 3. Position the ladder under the first bow in from the end wall. Hold the supply line taut and use another hose clamp to attach the line to the center purlin, directly before the point where the first bow connects to the purlin.
- 4. Reposition the ladder, placing it beneath the first mark on the supply line (in this case, at the 6' mark). Holding the supply line taut, position a hose clamp next to the mark, and tighten it to attach the supply line to the purlin.

Overhead Supply Line Installation



Tip 1: Hold the supply line taut and secure it in place with hose clamps to prevent "bellies" from forming in the line between sprinklers. Bellies allow water to pool between irrigation sessions which could be problematic in the long term. This "tighten as you go" approach is different from the approach used when assembling kit furniture, tightening lug nuts on tires, and completing other operations.

Tip 2: Pre-loosen hose clamps in advance to speed-up the process and use a drill-driver (with a flat head or hex head bit) instead of a screwdriver.

Hanging Assembly Installation



Steps (continued):

- 5. After attaching the tubing to the center purlin with the hose clamp, use a 3 mm hole punch to punch a hole at the first mark on the supply line.
- 6. Push the male barbed fitting end of the hanging assembly into the hole.
 - Note: The 48" hanging assembly used in this HT was selected based on manufacturer recommendation that the sprinkler head model used in this system should hang 6-7' above the crop (<u>Netafim, 2014</u>).

Hanging Assembly Installation



Steps (continued):

- 7. Repeat Steps 4-6 at each marking along the length of the overhead supply line.
 - **Note:** In this HT, a hanging assembly is installed every 3' from the 6' mark to the 42' mark (i.e., 6' from each end wall of the HT) 13 total.
 - Tip: Make sure holes are punched in the correct location on the underside of the supply line, which will allow for the hanging assembly to hang plumb from the peak of the HT. A partner can be helpful for double checking from ground level. Previously installed hanging assemblies serve as a useful visual guide for proper alignment.
- 8. After installing the final hanging assembly, continue hanging the supply line until it reaches the end wall of the HT, mirroring Steps 2-4 at the opposite end of the HT.

Drain Out Line Installations



The following section details the process of installing drain-out lines on both ends of the system, beginning with the end of the HT opposite from the water supply. Periodically draining water from both ends of the system or as needed prevents standing water from lingering in the system for long periods, contributing to mineral and microbe build-up and the occurrence of issues resulting from the water freezing.

Tools & Parts Required:

- Tape Measure
- Utility Knife
- Teflon Plumber's Tape
- ¾" Low-density PE Tubing
- ¾" Easy Loc x MPT Adapter

- ¾" FPT End Cap
- ¾" Male Quick Disconnect Fitting
- 1" Stainless Steel Hose Clamp

Opposite End Drain Out Line Installation



Steps (photos on next page):

- 1. Upon reaching the end of the HT, measure the distance between the overhead supply line and a point that can be reached comfortably from a standing position.
- 2. Based on the measurement taken in Step 1, cut a section of Low-density PE tubing to the same length.
- 3. Apply Teflon Plumber's tape in a clockwise direction to the male pipe threads on a $\frac{3}{4}$ " Easy Loc x MPT fitting.
- 4. Thread ³/₄" FPT End Cap onto the fitting.
- 5. Install the end cap assembly on the length of tubing prepared in Step 2.
- Install the tubing and end cap assembly on the ³/₄" Easy Loc Elbow positioned at the peak of the end wall.

Opposite End Drain Out Line Installation

Near End Drain Out Line Installation

Steps (continued):

- 6. Return to the end of the high tunnel where the water source is located. Assess the path that the supply line will need to span from the water source to the overhead supply line. Consider measuring the length of that path, the fittings that will be necessary to accommodate the path of semi-rigid tubing and any hardware that may be necessary to secure the supply line so that it will not be a nuisance or hazard.
 - Note: In this HT, there is a large enough gap to feed the tubing behind the brackets that connect the square tube end wall studs to the first bow of the structure. Upcoming Steps 7-9 describe an approach specific to this HT, which may differ from other types of structures.

Near End Drain Out Line Installation

Steps (continued):

- 7. Unroll the remaining coil of Low-density PE Tubing. Feed downward from the peak of the tunnel, behind the end wall stud brackets, until it reaches a convenient and accessible drain out point between the water source and the doorway.
- 8. Using a utility knife, trim the tubing at the HT peak, so it is long enough to reach the $\frac{3}{4}$ " Easy Loc Elbow at the end of the overhead supply line.
- 9. Push the cut end of tubing onto the elbow fitting and fasten.

Tip: With both the new length of tubing and the overhead supply line secured in place, it may be difficult to connect the two sections. Consider loosening the first hose clamp on the overhead line enough to bring the two ends of tubing together at the joint. After making the connection, re-tighten the hose clamp in its original position.

Near End Drain Out Line Installation

Steps (continued):

- 10. Slip a loosened 1" (No. 12) Stainless Steel Hose Clamp over the hanging end of the drain out line.
- 11. Install the male end the ¾" Quick Disconnect set by pushing the barbed end into the tubing. Tighten the hose clamp to ensure a leak-free connection.
 - Note: The female end of the ¾" Quick Disconnect set will be installed later, after assembling the header components.

The following section details the process of installing the header assembly at the water source and connecting it to the supply line at the drain out point. This HT contains a frost-free hydrant with a ³/₄" Male GHT connection. A different type of water source will require different, compatible fittings. Depending on pre-existing infrastructure and local regulations, a backflow prevention device may be required, as well. The specific models of the essential components of this header assembly were selected based on manufacturer recommendations (<u>Netafim, 2013</u>; <u>Netafim, 2014</u>; <u>Netafim, 2018b</u>).

Tools & Parts Required:

- ¾" Female GHT x FPT Adapter
- ¾" 120 Mesh Disc Filter
- ³⁄₄" 35 PSI Pressure Regulator
- ¾" 35 PSI Pressure Regulator
- ¾" Easy Loc x MPT Adapters
- ¾" Female Quick Disconnect Fitting

Steps:

- 1. Apply Teflon Plumber's tape to male pipe threads on both ends of the ³/₄" 120 mesh disc filter. Paying attention to the arrow indicating the direction that water should flow, thread the ³/₄" FPT x Female GHT adapter onto the in-flow end of the filter.
- 2. Taking note of the arrows indicating the direction that water should flow, thread the in-flow end of the ³/₄" 35 PSI Pressure Regulator onto the out-flow end of the filter.
- Apply Teflon Plumber's tape in a clockwise direction to the male pipe threads on a ³/₄" Easy Loc x MPT adapter and thread the fitting into the out-flow end of the pressure regulator.
- 4. Install entire assembly by threading female GHT end of the ³/₄" FPT x Female GHT adapter onto the male GHT connection on the frost-free hydrant.
 - Note: A ³/₄" Female GHT x Male GHT vacuum breaker can be installed between the hydrant's male GHT connection and the female GHT connection on the inflow end of the header assembly.

Steps (See Photos on Next Page):

- 5. Push one end of the remaining coil of Low-density PE Tubing onto the barbed end of the header assembly and fasten with the threaded locking mechanism.
- 6. Uncoil the tubing towards the supply line. Use a utility knife to cut the tubing where it meets the drain out point between the doorway and the water source.
- 7. Slip a loosened 1" Stainless Steel Hose Clamp over the newly cut end of the tubing and install the female end the ³/₄" Quick Disconnect set by pushing the barbed end into the tubing. Tighten the hose clamp to ensure a leak-free connection.
- 8. Connect the ³/₄" Quick Disconnect set by pushing the fittings together and tightening down the levers on either side of the female end.

System Flushing

The following section details flushing this one-line sprinkler system. At this stage, the entire system has been assembled <u>except</u> the sprinkler heads. The manufacturer recommends flushing the line(s) before proceeding with that final step, to prevent blockages and/or sprinkler malfunctions due to the presence of debris (<u>Netafim, 2014</u>).

Tools & Parts Required:

- None

System Flushing

Steps:

- 1. Remove the end cap from the drain-out assembly at the opposite end of the HT.
- 2. Turn the water on.
- 3. Water will begin flushing through the hanging assemblies and drain-out line at the end of the HT. Wait for the water to flush through all openings in the system.
 - **Tip:** While the water flushes through the system, use the time to check for leaky connections at the header assembly and other connection points.
- 4. Turn the water off. Disconnect the drain out point at the water source end of the HT to allow for water to completely drain from the system.
- 5. Return the end cap to the drain-out assembly at the opposite end of the HT and reconnect the quick disconnect set at the water supply end of the HT.

Sprinkler Head Installation

The following section details installing sprinkler heads, the final step before the system is operational. The sprinkler head model used in this system was selected based on manufacturer recommendations, which are based on the width of the high tunnel and the height of the sprinklers above the crop (<u>Netafim, 2014</u>; <u>Netafim, 2018a</u>).

Tools & Parts Required:

- SpinNet Brown-Brown-Green Sprinklers

Sprinkler Head Installation

Steps:

- 1. Push the male compression fitting on the sprinkler assembly's check valve into the female compression fitting at the end of the hanging assembly.
 - Note: The sprinklers shown consist of (1) a check valve, (2) a mist control mechanism, (3) a body, and (4) a spinner. All parts are pre-assembled by the manufacturer. The photo above on the left shows the assembly taken apart.
- 2. Repeat Step 1 at each hanging assembly down the length of the HT.
- 3. Once all sprinkler heads have been installed on the hanging assemblies, turn the water on. Observe each sprinkler to ensure that it is functioning properly.
 - Note: Upon the completion of this step, the overhead irrigation system is fully assembled and operational.

System Operation

The following section details the operation procedure for the overhead irrigation system shown in this guide. Certain steps may differ somewhat from other examples of overhead irrigation systems, depending on specific infrastructural features (e.g., water supply hardware) and system componentry.

Tools & Parts Required:

- None

System Operation

Steps:

- 1. Lift the hydrant handle to turn on water.
 - **Note:** The hydrant in this HT functions as a manual on-off valve. Irrigation episodes may be automated via use of an electric- or battery-powered valve.
- 2. Verify all sprinkler heads are functioning properly. Allow system to run for the duration required to meet irrigation demand.
 - Note: This system uniformly delivers 0.5 inches of water per hour in a 48' x 21' HT. (<u>Sprinkler Warehouse, 2017</u>).
- 3. Depress the handle on the hydrant to turn off water. Drain water from the system periodically to minimize mineral and microbial buildup. Open both drain-out lines, uncouple the quick disconnect set near the header assembly, and remove the end cap from the drain out assembly at the end of the HT.

Maintenance & Winterization

The following section details maintaining and winterizing an overhead irrigation system such as the one shown in this guide. Proper system maintenance is critical for achieving optimal performance and maximizing the working lifespan of all system components. Performing winterization steps is important to prevent system damage possible at below-freezing temperatures. This guide describes a full winterization process, as well as a partial process for growers intending to use an overhead irrigation system throughout the winter.

Tools & Parts Required:

- Acid- or Chlorine-based Detergent
- Disinfectant
- Chemical Injector
- Air Compressor

Maintenance

Steps:

- 1. The manufacturer recommends flushing the system with appropriate cleaning chemicals prior to winterization. (<u>Netafim, n.d.a</u>; <u>Netafim, n.d.b</u>).
 - For buildup of organic compounds: Inject an acid- or chlorine-based detergent, adhering to the ratio and duration specified by the product label.
 Flush system with water, if directed by the label.
 - **For biofilm:** Inject a disinfectant, adhering to the ratio and duration specified by the product label. Flush system with water, if directed by the label.
 - **Note:** Organic growers should confirm the certifiability of any product prior to use (Organic Materials Review Institute, 2021).
 - **Warning:** Depending on the product used, these steps may not be able to be performed with a crop in place. <u>Check the product label.</u> If necessary, skip these steps, proceed with winterization, and plan to perform the maintenance at the first opportunity between crop cycles.
- In addition to regular cleaning of the disc filter with clean, medium pressure water (22 psi and upwards), it may be necessary to remove and immerse the discs in a diluted acid- or chlorine-based solution (<u>Netafim, 2003</u>).

Winterization

Full Winterization Steps:

- 1. Open drain out lines at either end of the system and remove sprinkler heads.
- Blow out the lines with an air compressor. Start at low pressure and gradually increase, paying attention not to exceed 40 psi. Water will exit the system from the hanging assemblies and the drain out assembly at the opposite end. Continue until water stops exiting the system.
- 3. Remove the header assembly from the hydrant. Along with the sprinkler heads, store away until the system is brought back into operation.

Partial Winterization Steps:

- 1. Open drain out lines at either end of the system and remove sprinkler heads between irrigation episodes.
- 2. When irrigation/frost protection is needed, reverse the actions taken in Step 1, operate the system, and then repeat Step 1 once finished.

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