



## High Tunnel System for Crops

### **Specification Guide & Product Requirements**

**MA-325**

See Massachusetts's High Tunnel System 325 conservation practice standard for more information.

This Specification Guide serves as a guide for the selection of and planning for the installation of a high tunnel. This document contains a list of considerations for the applicant, and includes a *Producer Certification* form on the last page to document that they have received, and understand, the NRCS requirements and constraints of this practice. This document will be given to all producers who apply for NRCS financial assistance to install a high tunnel.

### High Tunnel Location

- The site location must have access to a water source that can supply enough clean irrigation water to meet crop needs. Estimate roughly 125 gallons per day per 1,000 square feet of high tunnel.
- High tunnels should be located on suitable soils and sites where drainage and runoff are manageable.
- If a double-layered plastic option is chosen, electricity must be on site to run the blower fan between the layers.
- Construct high tunnel structures on level grade or the naturally occurring slope if the slope does not exceed five percent, or manufacturer guidelines, whichever is less.
- Spacing:
  - **The location shall allow a minimum of 15 feet around the structure for snow removal via plowing or snow blowing.**
  - Provide enough space around the structure to allow for maintenance and farming operations without damage to the structure or covering.
  - Avoid shade from other structures by locating the tunnel a minimum of 15 feet away from other tunnels (on any side) or structures on the north side. The distance from the tunnel to another tunnel or other structure on the south, east, or west side should generally be at least twice the height of the shading structure (e.g. locate the tunnel approximately 40 ft. away from a 20 ft. high barn on the south side).
- Other Orientation Considerations:
  - If late and early season production is a primary goal, orient the long axis of the tunnel East-West.
  - Increased width or length will impede ventilation. Natural ventilation is improved when the long axis of the tunnel is oriented perpendicular to the direction of the prevailing winds. However, note that more damage may occur to tunnels that are oriented this way.
  - In unprotected windy areas, consider orienting the structure such that an endwall will take the brunt of prevailing winds. Consider adding more purlins, cross-ties, and/or wind bracing kits.
    - Movable tunnels may have fewer ground posts, and therefore may be more susceptible to wind.

- Consider orientation of the structure and its interaction with the shading effect of endwall construction and materials.

## **Design Approval Procedure**

### **Prior to purchase:**

- The producer (program participant) is required to supply NRCS with the manufacturer's design and installation instructions for the specific model and size for review and approval. The *Required High Tunnel Materials and Design Criteria* listed below provide a checklist of required elements. The chosen high tunnel kit must meet each of these elements. Some kits may need additional elements in order to meet the minimum criteria.
- High tunnel models that are not on the *Potential Product List for Massachusetts* must be reviewed and approved by the MA NRCS State Office in Amherst, MA.

### **Required High Tunnel Materials and Design Criteria:**



**Anatomy of a High Tunnel**

- Frame is gothic style (peaked, not rounded). Minimum height is 6 feet.
- Maximum tunnel width is 30 ft. There is no maximum length restriction, however, the manufacturer specifications must support the chosen length of the tunnel.
- Bows and ground posts are at least:
  - (i) 1.90" round 14 gauge galvanized steel or stronger for tunnels  $\geq$  26 ft. wide or
  - (ii) 1.66" round 14 gauge galvanized steel or stronger for tunnels < 26 ft. wide or
  - (iii) 2.00" square 16 gauge galvanized for all tunnel widths or
  - (iv) 1.625" x 2.750" oval 16 gauge for all tunnel widths
- Bows/posts shall consist of no more than 5 individual segments, including ground posts. Typically this includes 2 ground posts, 2 half bows, and a bow connector. (Splices/sleeves

that are used to join posts/bows and are not considered segments.)

- Bow spacing shall not exceed 4 ft. apart.
- Tunnels less than 26 ft. wide must have 3 purlins; tunnels greater than 26 ft. wide must have 5 purlins. The central “ridgepole” is always required regardless of width and counts as a purlin.
- For tunnels greater than 26 ft. wide, cross-ties with trusses/braces at least every other bow are required and are recommended for all tunnels less than 26 ft wide.
- Frame is covered with at least 6-mil, 4-year UV resistant polyethylene film, or polycarbonate.
- Roll-up or drop-down sides are installed on both sides.
- End walls are framed with wood or metal and covered with UV resistant polyethylene film (at least 6-mil, 4-year), polycarbonate, or wood.
- Baseboards are installed as instructed.
- At least one end wall contains a door for access. (At least one 6' x 6' door is recommended. End wall vents are also recommended.)
- All segments of the bow must be through-bolted (carriage bolt and nut) at the connection point.

### **Suggestions—Items are not required**

- Rope (or equivalent material) is attached from hip-board to baseboard the entire length to protect sides from billowing.
- Wind bracing diagonals on each end, placed in accordance with manufacturer’s directions.

### **High Tunnel Kits**

**High Tunnel Kits must meet the minimum design criteria listed above to be eligible for program payments.**

**The Program Participant is responsible for ensuring that the high tunnel is constructed with all required components to meet the minimum criteria. For example, if wind braces or cross-ties are not included in an approved model’s “kit”, these items must be ordered separately and at additional cost.**

**Potential Vendors are listed on the next page; this is not a complete list. Vendors who would like to have their products added to the “Potential Vendor List” must send a complete set of product engineering designs showing all component dimensions, steel specifications, and pertinent connector specifications to the MA NRCS State Office in Amherst, MA for a technical review.**

**Potential Vendors (Not a complete list)**

| Vendor                                                                                                                             | Model                                                                     |
|------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|
| Four Season Tools<br>Kansas City, MO (816) 444-7330;<br><a href="http://www.smallfarmtools.com">www.smallfarmtools.com</a>         | Four Season Gothic Fixed and Moveable models                              |
| Gro Well Inc. Cheshire, CT 06410<br>(203) 272-8147                                                                                 | 30' Wide Arch                                                             |
| Harnois Industries St. Thomas, Quebec<br>(888-427-6647) <a href="http://www.harnois.com">www.harnois.com</a>                       | Ovaltech I<br>Ovaltech III                                                |
| Ledgewood Farms, Moultonborough, NH<br>(603-476-8829) <a href="http://www.ledgewoodfarm.com">www.ledgewoodfarm.com</a>             | Ledgewood Farm Gothic                                                     |
| Nolt's Produce Supplies (717) 656-9764;<br><a href="http://www.noltsproducesupplies.net/">http://www.noltsproducesupplies.net/</a> | Gothic Arch Model                                                         |
| Rimol Greenhouse Systems, Inc.<br>Hooksett, NH (603) 494-9426 <a href="http://www.rimol.com">www.rimol.com</a>                     | Nor'Easter, Eastpoint, Rolling Thunder<br>Northpoint (except 26 ft model) |

The following models are approved only if bow segment joints are drilled and through-bolted with carriage bolts and nuts by the client (not attached by self-tapping tech-screws that come with the kit.)

|                                                                                                                                 |                                                                                                                                                                                             |
|---------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Griffin Greenhouse & Nursery Supplies<br>Tewksbury, MA (978) 657-5442<br><a href="http://www.griffins.com">www.griffins.com</a> | New England, Windjammer Series 5000<br><br>Northern Star <i>High Tunnel</i> ( <b>Caution:</b> must be a High Tunnel. The Northern Star <i>Standard (cold frame)</i> model is NOT approved). |
|---------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**This information is provided only as a public service and constitutes no endorsement by the United States Department of Agriculture or the Natural Resources Conservation Service of any service, supply, or equipment listed. While every effort has been made to provide a complete and accurate listing of services, supplies, and equipment, omissions or other errors may occur, and therefore, other available sources of information should be consulted. If you have any questions, please consult your conservation planner and ask them to contact the MA NRCS State Office in Amherst, MA.**

## **Operation and Maintenance**

- Follow manufacturer's instructions for operation and maintenance of the high tunnel structure.
- Close high tunnel completely during high wind events.
- Inspect structure, cover, and surrounding area for damage periodically and after weather events. Repair and/or replace damaged components promptly. Small injuries to plastic may be repaired with greenhouse tape.
- Inspect runoff control measures frequently. Repair promptly.
- **WINTER:**
  - Close side curtains prior to seasonal freezing to prevent them from freezing open.
  - **Remove plastic for winter OR be diligent to remove ice/snow on and around the structure during and after storms as needed. Ensure that snow sheds off roof and does not pile up against sides.**
  - **Note:** If structure is in danger of collapse from wind, snow, or ice, cutting the plastic (from outside the structure) may save the metal framework.
- **Crops and Soil:**
  - Monitor and operate the high tunnel ventilation to manage temperature and moisture according to the tolerances of crops grown. Excess heat can kill the crop, and excess humidity can promote disease.
  - Monitor soil moisture and irrigate as needed. Use of drip irrigation for most crops will reduce the incidence of disease, limit weeds, and conserve water.
  - Test soils at least every other year for nutrient content, organic matter, and salt concentration. Plastic may be removed for a season to allow flushing of soil sodium as needed, or tunnel may be flooded to provide flushing effect.
- **Prohibited Uses:**
  - Storage of equipment or materials.
  - Livestock housing.
  - Growing on benches or in pots. (Plant in the soil or on raised beds.)
  - Excluding paths, no more than 10% of the square footage of the high tunnel may be used for non-crop growing space (washing and crop prep area, storage, pumps, heaters, etc).

## Before You Sign a Contract:

### Considerations for Producers Interested in Purchasing a High Tunnel with NRCS Program Assistance

#### Additional Labor:

Do you have extra labor help to manage a high tunnel?

- Pruning, trellising, weeding
- Rolling sides up and down (often daily: for weather events, *humidity and temperature control*), etc. Adds significant hours of labor during the regular growing season.
- An extended growing season means a longer labor season (less time off).

#### Location

- Should be convenient for daily management - opening and closing daily as needed for humidity and temperature and for gusty storms, harvesting, and ice and snow management and monitoring.
- **Water source** - Do you have a pressurized, viable water source within reach? Irrigation is required.
  - During the summer months, expect to use an average of 125 gallons per day per 1,000 square feet (a 30 x 70 structure is 2,100 square feet).
  - Drip irrigation is best for most crops (reduces fungal diseases by keeping leaves dry), but overhead sprinklers may be appropriate for small crops such as greens.
- Electricity (if needed). Do you need electricity to run inflation fan (if 2 layers of plastic), ventilation fans, or other desired utilities?

Winter management to prevent collapse. Ice and snow can bring a structure down quickly.

- Owner is responsible to maintain the structure regardless of weather. Terms of the contract are that, in the event of a collapse, owner must replace structure (without NRCS funding) during the 4-year lifespan.
- Snow slides off structure and piles up. Do you have adequate room to plow snow away from sides and an adequate space to pile it or push it off site? A minimum of 15 feet is needed around and between high tunnels.
- Sometimes snow may NOT slide off structure, and will need to be carefully removed during certain storms.
- Ice storms can add significant weight. Ice removal will be needed, and may involve the use of a heat source inside the structure during the storm to prevent ice buildup on the roof.

#### Soil/nutrient management:

- What method will you use to supply nutrients to your crop(s)?
  - Crops under black plastic with drip irrigation may require a fertigation system.
- Soils will need organic matter additions periodically, usually in the form of compost.
- Due to the “desert” nature of the high tunnel, salt will build up in the soil and will need periodic flushing via flooding OR removal of the plastic to allow precipitation to flush salts. Plastic removal for a significant period of time may entail sacrifice of a crop or an extended season. The University of Massachusetts soils lab provides testing for high tunnel nutrients and salt.

Will you be growing summer or winter crops?

- Heat-loving plants are not compatible in the same tunnel as those that need cooler temps or less direct sun.
- Winter crops (greens) are planted in early September when tomatoes are still producing. This may present a space conflict.
- Growing the same crops (i.e., tomatoes) in the high tunnel year after year may lead to disease issues. What will be your strategy to avoid this?

Mulching:

- Will prevent weeds, warm the soil (black plastic), and prevent evaporation of irrigation water.
- Weeds can quickly take over the high tunnel. Start with a weed-free area and apply mulching and weed control right from the beginning. Control weeds around the exterior walls as well to prevent spread into the structure.

Irrigation management – how will you monitor soil moisture to prevent damage to crops (either under- or over-watering)?

Design and Kit: Critical!

- You are responsible for purchasing and constructing a high tunnel structure with all of the components as listed in Massachusetts NRCS Selection Criteria.
  - Before accepting a manufacturer's claim that a product meets NRCS criteria, verify with NRCS prior to purchase.
  - \*\*\*\*You may need to purchase additional components even for “approved” models in order to meet criteria.\*\*\*\*
  - If you purchase a structure that does not meet NRCS Massachusetts Criteria and/or is not built to manufacturer recommendations, you will not receive payment.

Installation:

- High Tunnels are challenging to construct. Who will you hire to install your structure? Or, if you plan to install it yourself, who will assist you?
- After site prep is done, *construction of the structure may take an average of two weeks or longer.*
- Posts must be pounded into the ground at perfect 4-foot intervals, to the correct depth, AND be vertically plumb. Rocky soil will complicate this.
- You may need a lift to work on the roof components.
- Plastic must be applied on a wind-free day, with at least several laborers and a means to bring the plastic to the peak.
- End walls must have a solid frame, door(s), and optional vents and be covered with 6 mil plastic, polycarbonate, or lumber materials in accordance with specifications.
- Plastic life expectancy is 4 years. You will need to budget for new plastic every four years, and will need sufficient labor assistance to apply the new cover (on a windless day).

Consider costs in addition to your high tunnel “kit” and any extra needed components:

- delivery fees
- site preparation
- material costs for end walls, baseboards, doors and ventilation
- installation labor costs
- 100 feet of plastic is needed to cover a 96 foot long structure (plastic comes in a maximum of 100 feet)

## Producer/Participant Certification:

- I have received a copy of the attached *Massachusetts NRCS High Tunnel 325 Specification Guide*.
- I understand that I must meet the listed criteria and install the structure to NRCS and manufacturer specifications in order to receive program payments related to this High Tunnel System practice.
- I understand that I am responsible for ensuring that the chosen and approved model is ordered with all required components, as listed in this document. This may require me to order extra components, such as corner wind bracing or cross-ties, with the kit, which will increase the cost.
- I am aware that I must ensure that my chosen high tunnel kit meets Massachusetts NRCS Criteria.
- I will be responsible to maintain this structure for the 4 year lifespan.
- I will be responsible to perform Operation and Maintenance items as listed in this document. This includes timely ice and snow removal to prevent damage or destruction.
- I will be responsible to repair or replace all materials of the high tunnel *at my own expense* if any damage is sustained by ice/snow loads, wind, or other events. I may choose to obtain an insurance rider to cover structural failure.
- I certify that I understand these statements, and that I am aware of my obligation to meet the requirements of this document if I choose to sign a contract with NRCS for a program payment for a High Tunnel System. Furthermore, I understand that if I purchase and erect a structure that does not meet the minimum design criteria, I will forfeit funding and may be responsible for payment for *liquidated damages* associated with the planning and design associated with the contract.**
- I self-certify that I have an adequate water source within a reasonable distance of the planned/approved site with which to provide the necessary irrigation for the crops I intend to grow inside the structure.**

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Print Name: \_\_\_\_\_