



**Natural Resources Conservation Service
CONSERVATION PRACTICE STANDARD**

HIGH TUNNEL SYSTEM

Code 325

(ft²)

DEFINITION

An enclosed polyethylene, plastic, or fabric covered structure used to protect crops from sun, wind, excessive rainfall, cold, or to extend the growing season in an environmentally safe manner.

PURPOSE

Improve plant health and vigor.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to land capable of producing crops. This practice applies where sun or wind intensity may damage crops, or where an extension of the growing season is needed due to climatic conditions.

The practice applies only where crops are grown in the natural soil profile (i.e. tables/benches, portable pots, hydroponically, etc. are not permitted).

CRITERIA

Plan supportive conservation practices to address all environmental concerns associated with the installation and use of the high tunnel systems such as erosion, and runoff.

Grow all crops in the natural soil profile. Install raised beds (with a maximum depth of 12 inches) to improve soil access, condition, and fertility.

The practice does not include greenhouses or low tunnel systems.

Using the high tunnel structure to provide shelter or housing for any livestock, or to store supplies or equipment, is not permitted.

Locate structures to avoid buried public utilities.

Locate the structure near a viable water source for irrigation.

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your Natural Resources Conservation Service [State office](#) or visit the [Field Office Technical Guide](#).

Plan, design, and construct the high tunnel structure from a manufactured kit in accordance with manufacturers' recommendations. Construct the frame using metal, wood, or durable plastic; reaching at least 6 feet in height at the peak of the structure. If available, install a supplemental manufacturer's kit to provide additional structural support. Construct end wall framing using metal, wood, or durable plastic in accordance with the manufacturers' recommendation. Cover end walls with greenhouse grade plastic, polycarbonate, wood, or other. Vary entry/exit point design and installation to facilitate movement of equipment and supplies needed for the production of planned crops.

Select the high tunnel covering material of a significant thickness to withstand the temperature change for the period required and have a 4-year-minimum lifespan. For polyethylene covers, use a minimum 6-mil greenhouse grade, UV-resistant material.

For organic producers, it will be the responsibility of the producer to make sure that all permissible activities, design, material used, and material specifications are consistent with the USDA Agricultural Marketing Service National Organic Program, National Standards on Organic Agricultural Production and Handling.

Construct high tunnel structures on level grade or the naturally occurring slope if the slope does not exceed five percent.

Remove or roll up high tunnel structure cover at the end of the growing season, if damaging snow loads occur in the region, unless the structure is designed by the manufacturer to withstand expected snow loads.

In conditions where the intensity or duration of sunlight can shorten the growing season, use the appropriate thickness of shade cloth in place of, or in addition to, impervious plastic covers. When shade cloth is used alone, end walls are not required.

High tunnels shed a large amount of water and can create drainage and ponding issues where none previously existed. Direct runoff away from the high tunnel structure to avoid ponding.

Outside the high tunnel structure, vegetate all exposed surfaces disturbed during construction in accordance with CPS Code 342, Critical Area Planting. If climatic conditions preclude the use of seed or sod, use CPS Code 484, Mulching.

Seek verification and approval from the manufacturer, prior to construction when any significant modifications to the high tunnel structure design are planned, to ensure that any warranties remain in effect.

CONSIDERATIONS

If desired, capture runoff and use it for irrigation purposes, if allowed by State law; however, do not rely on the runoff water as the only source of irrigation water. Use the criteria for NRCS Conservation Practice Standard (CPS), Roof Runoff Structure (Code

558), to design any structure needed to meet the runoff criteria above. Empty captured runoff into surface or underground outlets, or onto the properly protected ground surfaces. Size surface and underground outlets according to the criteria for CPS Underground Outlet (Code 620) to ensure adequate capacity. Provide for cleanout as appropriate. When runoff from tunnel cover empties onto the ground surface, provide a detention basin, storage reservoir, or stable outlet, if needed. Utilize surface or ground outlets such as rock pads, rock-filled trenches with subsurface drains, concrete and other erosion-resistant pads, or preformed channels to provide stable outlets.

Manage the high tunnel system to maintain or improve soil health by following a soil management system that creates a favorable habitat for soil microbes by utilizing the following considerations:

- minimize physical, chemical, and biological soil disturbance increase diversity below ground by diversifying the plant rotation
- when possible, keep a living root growing year round
- keep the soil covered with residue and growing plants year round.

Locate the high tunnel conveniently for ingress/egress of plant materials, equipment, and other operation and maintenance activities.

Remove or manipulate side covers to control internal temperatures and humidity. Follow manufacturer's design recommendations when installing vents, fans, or heaters. Consider including shade cloth in your high tunnel structure, when appropriate, to provide sun protection and extend the growing season. If available, consider installing a supplemental manufacturer's kit to provide additional structural support.

In conditions where wind loads are damaging, select the tunnel cover and structure designed by the manufacturer to withstand expected wind loads, or manage the tunnel system in a manner that limits wind damage. It is suggested to set the end posts in concrete to minimize destruction. Use thicker gauge steel 12-14 gauge to withstand the wind and consider a double layer of plastic to increase the structure's integrity.

Consider setting end posts in concrete, the use of heavier 12 to 14 gauge steel, and a double layer of plastic to increase integrity of the structure.

Consider a minimum clearance of 10 to 20 feet between side by side high tunnel installations for snow removal and cover installation.

Consider potential shading of high tunnel structures by other structures, or trees, and locate at a distance of at least two times the height of the tree or structure.

Control weeds with soil fabrics, covers, or mulches.

Consider additional conservation practices, where appropriate, including, but not limited, to the following:

- Critical Area Planting (342)
- Conservation Crop Rotation (328)
- Cover Crop (340)
- Diversion (362)
- Heavy Use Area Protection (561)
- Integrated Pest Management (595)
- Irrigation Water Management (449)
- Mulching (484)
- Nutrient Management (590)
- Roof Runoff Structure (558)
- Salinity and Sodic Soil Management (610)
- Underground Outlet (620)

PLANS AND SPECIFICATIONS

Prepare plans and specifications in accordance with the criteria of this standard.

As a minimum, the plans and specifications include the following:

- Identify purpose (resource concerns).
- Document the planned growing season.
- Layout and location of the high tunnel system.
- Plans and specifications for supporting practices meeting the requirements of the corresponding conservation practice standard.
- The planned width and length of the seasonal high tunnel.
- Statement that the seasonal high tunnel will be built per the manufacturer's directions.
- Material list and structural details, from the manufacturer; including all necessary appurtenances for the complete system.
- Manufacturer's warranty.
- Site preparation, procedure, and timing for installing the high tunnel cover (construction sequence), including supporting practices for erosion control, runoff, and vegetative establishment.
- Procedure and timing to remove or roll up the high tunnel cover prior to inclement weather conditions.
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OPERATION AND MAINTENANCE

Managing a tunnel requires intensive and vigilant attention by the producer.

Prepare and review an operation and maintenance (O&M) plan with the landowner and/or operator responsible for the practice. Provide specific instructions for proper operation and maintenance of each component of this practice, and detail the level of repairs needed to maintain the effectiveness and useful life of the practice.

Periodically inspect the high tunnel and repair, reinstall, or replace, as needed to accomplish the intended purpose.

Manage the structure in a manner that limits wind and/or snow damage. Close sides and ends before storm events. In areas that receive snow and ice, the structure should be closed prior to winter weather.

Remove snow and ice from the structure cover and sides promptly to prevent structure failure.

When the structure is at serious risk of collapse due to weather conditions, consider slashing the plastic cover to relieve pressure and save the framework.

Perform soil tests regularly to monitor nutrients and to monitor salt build-up. The soils under the immobile high tunnels may require periodic “flushing” to remove salt build-up. This is accomplished by removing the cover for a season to allow natural precipitation to infiltrate, or by artificially flooding the ground under cover.

If needed, seed all disturbed earth surfaces outside of the high tunnel and maintain the vegetation throughout the structure’s life.

Removal of cover materials shall be consistent with the intended purpose and site conditions.

Plan for proper disposal of the cover at the end of its useful life.

Do not compromise the intended purpose of the high tunnel structure, or its cover, by inappropriate equipment use on or near the site.

REFERENCES

Community Garden Guide Season Extension - High Tunnel, NRCS. Rose Lake Plant Materials Center, East Lansing, Michigan.

“High Tunnel Production Manual”. Penn State University College of Agriculture, Department of Horticulture. White, L. and Orzolek, M. 2003

"High Tunnels: Using Low-Cost Technology to Increase Yields, Improve Quality and Extend the Season". Ted Blomgren, Cornell Cooperative Extension, and Tracy Frisch, Regional Farm and Food Project. Published by the University of Vermont Center for Sustainable Agriculture. 2007.

“Minnesota high tunnel production manual for commercial growers”. Edited by: Terrance T. Nennich, Sr., University of Minnesota Extension and Suzanne Wold-Burkness, University of Minnesota. 2013.

“Growing Under Cover: A Guide to Polytunnel Options for Kansas Growers”; Kansas Rural Center; Kim Scherman, 2014.