United States Department of Agriculture

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

HIGH TUNNEL SYSTEM

Code 325

(ft^2)

DEFINITION

An enclosed polyethylene, polycarbonate, plastic, or fabric covered structure that is used to cover and protect crops from sun, wind, excessive rainfall, or cold, 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.

This practice is intended for crops grown in the natural soil or in raised beds. It is not applicable to crops grown on benches or in pots.

CRITERIA

Laws and Regulations. All Federal, state and local laws, rules, and regulations, including local inland wetland agency regulations, governing the construction and use of this practice as well as setbacks for property boundaries shall be followed. Planned work shall comply with all federal, state, and local laws and permit conditions and requirements. **The landowner shall obtain all necessary permits prior to construction or any land clearing activities.**

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

Crops must be grown in the natural soil. Raised beds may be installed to improve soil condition or access. Raised beds should be a maximum of 12” deep, unless they are accommodating a disability or remediating soil contamination. Agrability needs and soil contamination on existing urban cropland should be identified through the planning process and addressed as part of the high tunnel system.

The practice does not include greenhouses or low tunnel systems.

The practice cannot be used to provide shelter or housing for any livestock, or to store supplies or equipment.

Locate structures to avoid buried public and private utilities.

Locate the structure near a viable water source for irrigation.

The high tunnel structure must be planned, designed, and constructed from a manufactured kit in accordance with manufacturers' recommendations. The high tunnel frame must be constructed of metal, wood, or durable plastic; and be at least 6 feet in height at the peak of the structure. If required for enclosure, end wall covering may be greenhouse-grade plastic, polycarbonate, wood, or other. Use structures with the entry/exit point sized 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 shall 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 while maintaining compliance with NRCS standards.

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

Where snow loads may damage the structure, the tunnel cover shall be removed or rolled up at the end of the growing season unless the structure is designed by the manufacturer to withstand expected snow loads.

Where wind loads may damage the structure, 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.

Where the intensity or duration of sunlight can shorten the growing season, the appropriate thickness of shade cloth may be used 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. Provide a detention basin, storage reservoir, or stable outlet when runoff from tunnel covers empties onto the ground surface with potential to cause erosion.

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

Significant modifications to the high tunnel structure design must be verified and approved by the manufacturer prior to construction to ensure that any warranties remain in effect.

CONSIDERATIONS

Runoff and Ponding

Runoff may be captured and used for irrigation purposes, if allowed by State law. Runoff should not be relied on as the only source of irrigation water. Use the criteria for Connecticut CPS Code 558, Roof Runoff Structure, to design any structure needed to meet the runoff criteria above. Runoff may empty

into surface or underground outlets, or onto the ground surface when properly protected. Size surface and underground outlets according to the criteria for Connecticut CPS Code 620, Underground Outlet, to ensure adequate capacity. Provide for cleanout as appropriate. Surface or ground outlets such as rock pads, rock-filled trenches with subsurface drains, concrete and other erosion-resistant pads, or preformed channels may be used.

Soil Condition

Consider managing 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:

- minimizing soil disturbance (physical, chemical and biological)
- using plant diversity in the rotation to increase diversity below ground
- keeping a living root growing year round as much as possible
- keeping the soil covered with residue and growing plants year round

Location

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

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 two times the height of the tree or structure.

Ventilation

Remove or manipulate side covers to control internal temperatures and humidity. Installation of vents, fans, or heaters should be considered and should be included in the manufacturer's design and recommendations. If providing protection from the sun extends the growing season, consider a high tunnel structure that includes shade cloth.

Installation

If available, consider installing a supplemental manufacturer's kit to provide additional structural support.

Consider setting end posts in concrete, the use of heavier 12 to14 gauge steel, and a double layer of plastic to increase integrity of the structure.

Control weeds with soil fabrics, covers, or mulches.

Consider additional conservation practices where appropriate to include:

- CPS Code 328, Conservation Crop Rotation
- CPS Code 449, Irrigation Water Management
- CPS Code 590, Nutrient Management
- CPS Code 595, Integrated Pest Management
- CPS Code 342, Critical Area Planting
- CPS Code 484, Mulching
- CPS Code 558, Roof Runoff Structure
- CPS Code 362, Diversion
- CPS Code 620, Underground Outlet
- CPS Code 561, Heavy Use Area Protection
- CPS Code 340, Cover Crop

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.
- Document the planned growing season.
- Layout and location of the high tunnel.
- Site preparations and the required supporting practices for erosion control, runoff, and vegetative cover according to 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.
- Procedure and timing to remove or roll up the high tunnel cover prior to inclement weather conditions.
- Procedure and timing to add or replace shade cloth for protection from the sun for the high tunnel cover.

OPERATION AND MAINTENANCE

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

Prepare an operation and maintenance (O&M) plan and review with the landowner and/or operator responsible for the practice. Provide specific instruction 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 and mineral 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 using sprinkler irrigation.

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.

Operation of equipment near and on the site shall not compromise the intended purpose of the high tunnel structure or its cover.

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.