



Seasonal High Tunnel System for Crops (798)

Conservation Practice Fact Sheet



Photo Source: www.hightunnels.org

Definition

A seasonal high tunnel is a polyethylene covered structure with no electrical, heating, and/or mechanical ventilation systems that is used to cover crops to extend the growing season in an environmentally safe manner.

High tunnels are often called hoop houses and are often confused with greenhouses.

High tunnels are lower-cost versions of regular greenhouses. High tunnels are usually free-standing or gutter-connected plastic-covered structures without electrical, heating, or mechanical ventilation systems.

The sides covers of high tunnels may be rolled up or down as need to regulate the temperature or other climatic conditions inside. The entire cover or structure may be removed or dismantled if needed to protect it from heavy snowfall or impending storm or hurricane. High tunnels may also be moved from location to location.

Greenhouses are usually more expensive, glass-covered, permanent structures, often with electricity and heating.

High tunnels are also not low hoop houses that are used to cover single crop rows.

Benefits

Seasonal high tunnel structures extend the growing season by modifying the climate to create more favorable growing conditions for vegetable and other specialty crops.

By extending the growing season, high tunnels provide farmers the opportunity to successfully

grow crops, and to increase production, quality, and yields.

Potential natural resource benefits of high tunnels include: improving plant quality; improving soil quality; reducing nutrient and pesticide transport; improving air quality through reduced transportation inputs; and reducing energy use through local consumption.

NRCS has developed an interim conservation practice standard to support the use and funding of high tunnels to extend the growing season and to test the validity of potential natural resource benefits via a 3-year pilot program.

Conditions Where Practice Applies

This practice applies to cropland where the growing season extension is needed due to climate conditions and crops can be grown in the natural soil profile.

Permanently raised beds may be installed to improve soil condition, fertility, and agri-ability access, but does not apply to crops not grown in the natural soil profile (i.e. tables/benches, portable pots, etc.).

Application in the PIA

In temperate regions of the U.S. mainland, high tunnels usually extend the growing season by increasing temperature. In the Pacific Islands Area (PIA), high tunnels may be used to extend the growing season in other ways, such as by acting as 'rain-shelters' to allow for the production of high-value horticultural crops during the winter/rainy months (when crop prices are normally higher). Runoff captured from the tunnel covers may also extend the growing season by

providing a supply of irrigation water during the summer/drier months.

There is potential that high tunnels may provide benefits associated with to situations unique to the State of Hawaii: volcanic vog and Nene, *Branta sandvicensis*, or Hawaiian Goose.

Farmers on the island of Hawaii have reported significant production losses caused by vog and acid rain during periods of intense volcanic activity. Most seriously affected are flower and vegetable crops. Certain orchard crops, range grasses, and native plants are also known to be affected by vog.

Noxious sulfur dioxide gas (SO₂) and other volcanic gases emitted from the Kilauea Volcano react with atmospheric moisture, oxygen, dust, and sunlight to produce volcanic smog (vog) and acid rain.

Plant damage from vog and acid rain include yellowing, or chlorosis, of foliage, slowed growth and productivity; increased susceptibility to diseases, and even plant death.

University of Hawaii scientists have identified steps which may be taken to lessen crop damage caused by vog and acid rain, including growing plants under cover provided by structures such as high tunnels.

Vog, may cause some maintenance issues for high tunnel structures because it may corrode the hoop structures and more rapidly degrade polyethylene covers.

Recently, in certain areas of the Hawaiian Islands, Nene have been eating and damaging crops. On the Island of Hawaii, some think that Nene are seeking out crops because vog has damaged their preferred habitat and food resources. There is evidence that Nene will not enter covered structures such as high tunnels.

Requirements for High Tunnels

High tunnels must be obtained as a pre-fabricated kit. Kits normally include the frame, assembly hardware, cover, and ground posts. Farmers are not allowed to build tunnels on their own from scratch.

The frame must be constructed of metal, wood, or durable plastic; and be at least 6 feet in height at their highest point.

The cover must be, at a minimum, a 6-mil greenhouse-grade, UV resistant polyethylene.

Farmers are responsible for obtaining their own high tunnel kits from a supplier or manufacturer. There are numerous types, shapes, and sizes available. .

The high tunnel kit must be planned, designed, and constructed in accordance with manufacturer's recommendations.

Some high tunnels require components such as end panels or doors as well as baseboards. These components may either be purchased from the kit manufacturer or constructed by farmers from locally purchased materials per the manufacturer's recommendations.

Financial Assistance for High Tunnels

The PIA NRCS is offering financial assistance payments to farmers to install high tunnels through Farm Bill conservation programs including the Environmental Quality Incentives Program (EQIP), the EQIP Organic Initiative program, and the Agricultural Management Assistance (AMA) program.

NRCS will make payments on a maximum of 2,178 square feet per agricultural operation. This may be installed as one or more free standing or gutter-connected tunnels. A farmer may plan and install more than 2,178 square feet, however the program payment will be limited to this amount. .

Farmers who receive financial assistance are required to install supporting practices to address all environmental concerns associated with the use of high tunnels. These "required" practices must be planned and installed along with the high tunnels as part of a complete "system."

Farmers are required to complete a first, second and a third year annual report to document their growing season, crop yields and quality, use of nutrients and pesticides. This info will be used by NRCS to evaluate the natural resource benefits of high tunnel systems and decide whether to continue the use of the practice after the end of the 3-year pilot.

Farmers are responsible for maintaining the high tunnels and components for a minimum of four years.



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Supporting Practices Fact Sheet

Required Supporting Practices

Farmers who receive financial assistance are required to install supporting practices to address all environmental concerns associated with the use of high tunnels. These “required supporting practices” must be planned and installed along with the high tunnels as part of a complete “system.”

Runoff into and from the high tunnel covers must be controlled so that it does not cause ponding, erosion, sedimentation, and/or water quality problems.

Runoff may be controlled via the installation of various structural practices or it may be captured and used for irrigation. The minimum design capacity for runoff control structures shall be a 10-year storm frequency, 5-minute rainfall precipitation event.

Seeding and vegetation shall be established on all disturbed earth surfaces.

A separate Jobsheet or construction plan must be prepared for each required supporting practice.

Most of these supporting practices may be eligible for Farm Bill program financial assistance to assist farmers with installation.

Following is a brief description of some of the supporting practices which may be installed.

- Diversion (Code 362) – A channel may be installed via this practice to prevent runoff from entering or reaching a tunnel structure and causing ponding, erosion, and other problems.
- Grassed Waterway (Code 412) – A grassed channel may be installed to carry runoff from a diversion or concentrated flows to a stable outlet and to stabilize gully erosion.
- Surface Drainage, Field Ditch (Code 607) – A graded ditch may be installed to collect excess water around a tunnel to a suitable outlet.
- Subsurface Drain (Code 606) – Tubing, tile, or pipe, may be installed beneath the ground to collect and/or convey drainage water.
- Underground Outlet (Code 620) – Conduits may be installed beneath the ground to convey surface water to a suitable outlet.
- Roof Runoff Structure, Code 558) – A manufactured gutter system may be installed to collect, control, and transport rainfall from a tunnel structure cover. Only gutter systems manufactured to fit the tunnel structure may be installed.
- Critical Area Planting (Code 342) – Establishing permanent vegetation to stabilize areas with existing or expected high rate of soil erosion rates by water.
- Conservation Cover (Code 327) – Establishing permanent vegetative cover to reduce soil erosion and sedimentation.

Other Supporting Practices

“Other supporting practices” are not required, but may be needed for the high tunnels to achieve its intended purpose and potential natural resource benefits.

These “other” practices may be installed along with or after the high tunnels.

These “other” practices also require the preparation of a separate Jobsheet or construction plan and may also be eligible for Farm Bill program assistance.

Following is a brief description of some of the other supporting practices which may be installed.

- Irrigation Storage Reservoir (Code 436) – A reservoir made by constructing a dam, embankment, or pit may be installed to conserve water by holding it in storage until it is used to meet crop irrigation requirements.
- Pond Sealing or Lining, Flexible Membrane (Code 521A) – A manufactured hydraulic barrier to restrict, impede, and control seepage from water storage structures.
- Water Harvesting Catchment practice, Code 636) – A storage tank or excavated pond may be installed to store collected runoff from precipitation for crop irrigation.
- Irrigation System, Microirrigation (Code 441) – An irrigation system for frequent application of small quantities of water as drops, tiny streams or miniature spray through emitters to improve efficiency and control application, and to avoid runoff and leaching below the root zone.
- Irrigation Water Management (Code 449) – Implementing a plan to control the volume, frequency, and application rate of irrigation water to improve efficiency and to avoid runoff and leaching below the root zone.
- Conservation Crop Rotation (Code 328) – Revising the crops and/or sequence of crops grown to address soil erosion, pest and nutrient management, and other resource concerns. A conservation crop rotation may include the planting of a cover crop. Rotating the location of the tunnel will allow this and also allow rain, wind, sun, and cold temperatures to cleanse the soil from disease build up.
- Cover Crop (Code 340) – A grass, legume or forb may be planted on a site during the uncovered period to reduce erosion, increase soil organic matter, promote nitrogen fixation, and for other conservation purposes.
- Contour Farming (Code 330) - Using ridges and furrows by farming operation to change the direction of runoff from downslope to around the hillslope to reduce soil erosion.
- Row Arrangement (Code 557) – Establishing crop rows in a direction, grad and length reduce provide drainage and erosion control.
- Nutrient Management (Code 590) – Implementing a plan to manage the amount, source, timing, and method of application of nutrients to reduce environmental risks such as those associated with nutrient runoff and/or leaching.
- Pest Management (Code 595) – Implementing a plan to manage the amount, source, timing, and method of pesticide application to reduce environmental risks such as pesticide runoff and/or leaching.
- Access Road (Code 560) – Installing a travel-way for equipment and vehicles which allows access for enterprise activities while protecting natural resources.
- Windbreak/Shelterbelt Establishment (Code 380) – Rows of trees or shrubs which may be planted to shelter the high tunnels and protect the plants inside from wind related damage.

Please refer to Section IV the PIA NRCS [electronic Field Office Technical Guide](#) for additional practices which may be considered for installation.

Seasonal High Tunnel System for Crops – Jobsheet

Jobsheet Prepared for			
Client Name:	Tom Farmer	Business Name:	Mahalo Farm
Plan Name:	EQIP 2010 Plan	Contract #:	123456
Tract#	640	Land Unit #:	1
Jobsheet Prepared by			
Name:	Joe Planner	Title:	Soil Conservationist
Date Prepared:	2/1/2010		

Climate Condition to be Modified (“X” which climate conditions need to be modified by the high tunnel(s) to extend the growing season.)	
	Temperature (too cold or too hot)
X	Rainfall (too little, too much, and/or uneven distribution during the year)
	Wind (too little or too much)
	Other, name: _____
Description of why the climate condition is a problem and how it affects the growing season and crop growth:	
<i>Natural rainfall is too high at times and too low at times preventing farmer from growing certain types of crops and lowering crop quality and yields.</i>	

Potential Natural Resource Benefits (“X” all that may occur)	
X	Improve plant quality (increase crop production, quality and/or yields by modifying climate condition)
X	Improve soil quality (increase soil organic matter content, reduce fertilizer and pesticide application)
X	Improve water quality from reduced nutrient and pesticide transport
X	Improve plant quality (increase crop production, quality and/or yields by protecting crops from vog)
X	Improve plant quality (increase crop production, quality and/or yields by protecting crops from Nene)
	Other, name: _____

Current Site Conditions	
Description of the current site conditions which may affect the installation of the high tunnel(s) and supporting practices including:	
Current crops grown on the site to be covered by high tunnel(s):	<i>Head lettuce, romaine, and daikon.</i>
How crops grown (open field, on ground, raised earthen bed, etc.):	<i>Open field, on raised earthen beds.</i>
Are crops irrigated or non-irrigated?	<i>Irrigated</i>
If irrigated, irrigation system type (sprinkler, drip, furrow, etc.):	<i>Sprinkler</i>
Source of irrigation water (county, farmer’s reservoir, etc.):	<i>Farmer has own reservoir on farm</i>
Rainfall inches / year and other indicators:	<i>100 inches per year</i>
Slope and other topographic conditions on site:	<i>Very flat < 2% slope</i>
Sheet and rill erosion rate on site:	<i>6 tons/acre/year measured via RUSLE2</i>

Other pertinent soil erosion indicator(s):	<i>Wind erosion rate: 6 tons/acre/year</i>
Soil Loss Tolerance "T" value for site:	<i>5 tons/acre/year</i>
Soil Conditioning Index value:	<i>+1</i>
Other pertinent soil condition indicator(s):	
Water runoff problems onto site from surrounding area:	<i>None. Existing grassed diversion channel above site prevents runoff from slopes above from entering site.</i>
Location of nearby streams or other water bodies:	<i>Stream located about 500 feet from site</i>
Previously implemented or existing conservation practices on site:	<i>Irrigation Storage Reservoir, Diversion, Conservation Crop Rotation, Sprinkler Irrigation System</i>
Other site conditions of consideration:	<i>None</i>

High Tunnel(s) to be Installed			
Item	Structure 1	Structure 2	Structure 3
Width:	<i>30 ft</i>		
Length:	<i>72 ft</i>		
Total Square Feet:	<i>2,160</i>		
Height (in center):	<i>10 ft</i>		
Polyethylene Cover Type:	<i>6 mil, greenhouse, UV resistant polyethylene film</i>		
Frame Material:	<i>14 gauge structural steel tubing</i>		
Manufacturer:	<i>ClearSpan</i>		
Other components: (end panels, doors, baseboards)	<i>Pre-fab end panels and baseboards</i>		

Required Supporting Practices ("X" all require practices) (Farmers who receive financial assistance are required to install supporting practices to address all environmental concerns associated with the use of high tunnels. These "required supporting practices" must be planned and installed along with the high tunnels as part of a complete "system." A separate Jobsheet or construction plan must be prepared for each required supporting practice.)			
"X"	Practice	Description	Purpose
	Diversion (Code 362)		
	Grassed Waterway (Code 412)		
	Surface Drainage, Field Ditch (Code 607)		
	Subsurface Drain (Code 606)		
	Underground Outlet (Code 620)		
X	Roof Runoff Structure (Code 558) (manufactured gutter system)	<i>Manufactured gutter system</i>	<i>Collect and transport rain from tunnel cover to irrigation storage reservoir</i>
	Critical Area Planting (Code 342)		
	Conservation Cover (Code 327)		
	Other, name:		
	Other, name:		

Other Supporting Practices			
("Other supporting practices" are not required, but may be needed for the high tunnels to achieve its intended purpose and potential natural resource benefits. These "other" practices may be installed along with or after the high tunnels.)			
"X"	Practice	Description	Purpose
	Irrigation Storage Reservoir (Code 436)		
X	Pond Sealing or Lining, Flexible Membrane (Code 521A)		
X	Irrigation System, Microirrigation (Code 441)	<i>Drip irrigation system</i>	<i>Efficiently apply irrigation water</i>
X	Irrigation Water Management (Code 449)	<i>Irrigation mgt plan</i>	<i>Efficiently apply irrigation water</i>
	Water Harvesting Catchment (Code 636) (storage tank or pond)		
X	Conservation Crop Rotation (Code 328)	<i>Revise crop rotation and rotate location of tunnel</i>	<i>Grow other crops with higher returns and rest land</i>
X	Cover Crop (Code 340)	<i>Plant legume</i>	<i>Protect land, increase soil organic matter, and nitrogen fixation</i>
	Contour Farming (Code 330)		
	Row Arrangement (Code 557)		
X	Nutrient Management (Code 590)	<i>Nutrient mgt plan</i>	<i>Manage fertilizer application</i>
X	Pest Management (Code 595)	<i>Pest mgt plan</i>	<i>Manage pesticide application</i>
	Access Road (Code 560)		
	Windbreak/Shelterbelt Est. (Code 380)		
	Other, name:		
	Other, name:		

High Tunnel System Installation
<ul style="list-style-type: none"> • Prepare site according to manufacturer's instructions. • Lay out building location according to site plan. • Assemble high tunnel structure according to manufacturer's instructions. • Install supporting practices as scheduled, according to Jobsheets or construction plans provided.
<i>Install pre-fab end panel and baseboard components according to manufacturer's instructions.</i>

Operation and Maintenance Plan / Requirements
<ul style="list-style-type: none"> • Covered area will be periodically inspected, and shall be reinstalled or repaired as needed to accomplish the intended purpose. • Removal of cover materials shall be consistent with the intended purpose and site conditions. • Operation of equipment near and on the site shall not compromise the intended purpose of the cover. • High tunnel structures and components must be maintained for a minimum of four years.
Site-specific or additional operation and maintenance requirements, if any:
<i>Roll up side covers to control internal temperatures, if needed. Remove plastic cover or dismantle entire structure, if storm or hurricane is impending.</i>

Practice Location	
The practice location is shown on the following document: ("X" below)	
X	On the conservation plan map located in conservation plan file folder.
	On another job sketch, drawing, map, photo. Name: _____

Job Sketch
The following job sketches, drawings, maps, and/or photographs have been prepared to assist with practice implementation, operation and maintenance. Type of information which may be shown includes: location, orientation, and size of the high tunnel(s) and supporting practice to be installed. (The empty box below may be used to create a job sketch or to insert a job sketch file. Separate job sketch documents should be stapled to this Jobsheet.)

Example job sketch not available for this example jobsheet.

Practice Approvals

This section documents the practice approvals and the client's acknowledgement of his/her responsibilities.

Design Approval (To be completed by a NRCS certified conservation planner.)		
By signing below, I am certifying that the plans and specifications for the high tunnel(s) and required supporting practices as documented in this Jobsheet meet the criteria in the Pacific Islands Area Conservation Practice Standard.		
Print Name	Signature	Date
<i>Joe Planner</i>	<i>Joe Planner</i>	3/1/2010

Client's Acknowledgement (To be completed by the client after design approval.)		
By signing below, I acknowledge that I:		
<ul style="list-style-type: none"> • have reviewed this Jobsheet and have an understanding of its contents and requirements; • will make no changes to this Jobsheet, without prior concurrence of NRCS; • will install, operate, and maintain this practice in accordance with this Jobsheet; • will obtain all necessary permits and/or rights, comply with all ordinances and laws, and notify all utilities pertaining to the installation, operation, and maintenance of the practice; and • complete and submit a first, second, and third year annual report to NRCS. 		
Print Name	Signature	Date
<i>Tom Farmer</i>	<i>Tom Farmer</i>	3/2/2010

High Tunnel Layout Notes (Description of pre-installation layout assistance (staking and layout, conference, design modifications, etc.) provided to the client, if any.)			
Description of Assistance Provided:			
Assistance Provided by:	Print Name	Signature	Date
	<i>Mike Engineer</i>	<i>Mike Engineer</i>	3/4/2010

Checkout Notes (Documentation of field check done to determine the amount installed and actual materials and methods used.)			
Amount installed:	<i>2,160 sq. ft.</i>		
Were the high tunnel(s) installed in accordance with this Jobsheet? If no, explain.	Yes.		
Were all required supporting practices installed in accordance with this Jobsheet? * If no, explain.	Yes, see separate check out notes for supporting practices.		
Checkout Completed by:	Print Name	Signature	Date
	<i>Bob Technician</i>	<i>Bob Technician</i>	3/15/2010

* Checkout notes for supporting practices are documented on separate Jobsheets or construction check out notes for each practice.

Installation Approval (To be completed by a NRCS certified conservation planner after practice checkout.)		
By signing below, I am certifying that the high tunnel(s) and required supporting practices have been installed in accordance with this Jobsheet, as verified by the practice checkout notes.		
Print Name	Signature	Date
<i>Joe Planner</i>	<i>Joe Planner</i>	3/16/2010