

COMMUNITY GARDEN GUIDE SEASON EXTENSION

HIGH TUNNEL

Extending the growing season in many Great Lakes States' gardens is essential so seed can be saved and vegetables can be successfully grown. A number of season extension techniques are available to the gardener. Costs for season extension range from tens of dollars to tens of thousands of dollars, depending on the type of season extension employed.

A High Tunnel is a greenhouse-like structure which modifies the climate to create more favorable growing conditions for vegetable plants. Many commercially available High Tunnels are on the market in numerous widths and lengths. High Tunnels are Quonset hut or Gothic arch shaped and constructed of metal bow frames that are covered with a single layer of polyethylene. Ventilation is achieved by means of a combination of roll-up side vents; end vents; and, occasionally, roof vents. They are constructed of metal bows that are connected to metal posts that are driven into the ground. One layer of greenhouse grade, 6-mil polyethylene covers the structure. Generally, the end walls are framed-in to create door and ventilation areas.



High Tunnels are not heated and depend on the plastic covering to modify internal climate to the advantage of the plants growing inside.

ADVANTAGES/DISADVANTAGES

Advantages Using High Tunnels

- 1) Improved fruit/vegetable quality and size.
- 2) Increased fruit/vegetable production.
- 3) Extended growing season, 2-4 weeks.
- 4) High profile, 6+ feet allows access into the High Tunnel.
- 5) Allows management of High Tunnel crops during inclement weather.
- 6) Frost protection, 4+ F.
- 7) Wind protection for plant seedlings.
- 8) Insect protection.
- 9) Plant foliage stays drier if trickle irrigation is used; reducing some moisture-related plant diseases.
- 10) Compatible with many production aids/techniques, row cover, trickle irrigation, etc.
- 11) Gothic arch style High Tunnels shed snow fairly readily.
- 12) Irrigation needs of crops are easily managed.

Disadvantages Using High Tunnels

- 1) Requires fairly regular attention to control internal High Tunnel temperatures, especially early season.
- 2) Snow must be removed from base areas along the side of the High Tunnel to minimize accumulation that will prevent snow from sliding off the High Tunnel.
- 3) Quonset hut style High Tunnels do not readily shed snow.
- 4) Disposal cost of plastic covering after lifespan of plastic has expired.
- 5) Moderate high cost per square foot of production area.

HIGH TUNNEL SELECTION

There are dozens of High Tunnel systems on the market. Consider working with a company in the same general geographical area since they would be the most familiar with conditions that must be considered when selecting a High Tunnel. Selection of the High Tunnel type depends on local climatic conditions, crops to be grown, and budget. Areas of heavy snow need to accommodate temporary snow load accumulation on the High Tunnel. Most High Tunnels will come with six-foot bow spacing. This is adequate where little snow accumulation occurs. Heavy snow areas require a closer bow spacing of 4-5 feet. The geometry of the bow cross section can be significant in strengthening of the bow. High Tunnels with the Gothic arch configuration tend to shed snow more effectively than the Quonset hut shaped structures. Tubular steel bows come in square, round, and elliptical cross-sections. High Tunnels come in kit form from the vendor and are relatively simple to construct.

INSTALLATION AND MANAGEMENT OF HIGH TUNNELS

Using High Tunnels for vegetable production will allow growing season extension of approximately two weeks earlier in the growing season and approximately two weeks at the end of the season. High Tunnels should be placed in an area not prone to shading. If this is not possible, shading in the afternoon is preferable to morning shade, as this will tend to keep the High Tunnel cooler. The orientation of the long axis of the High Tunnel is important. High Tunnels should be, when possible, placed perpendicular to prevailing winds to ensure proper ventilation. A secondary consideration is locating the High Tunnel with the axis oriented in a north-south direction to provide more uniform sun exposure to plants and minimize plant shading. A medium texture sand with silt or clay fines (Engineering Classification: SM,SC) sand lift of at least eight inches is recommended as a building footing for the High Tunnel if the site has heavier soil types. This will ensure adequate internal drainage and provide a basis for making soil suitable for crop production. Below is a recipe for making soil for the planting beds in the High Tunnel.

SOIL RECIPE	
<i>(All quantities based on planting beds 2.5-3 feet wide)</i>	
<u>Material</u>	<u>Quantity</u>
Course Potting Soil, 25# bale	1 bale per 10 ft. running length
Organic Granular Fertilizer (5-2-4 or similar analysis Composted Chicken or Turkey Manure Fertilizer)	5# per 10 ft. running length
OR	
Compost	4 bu. per 10 ft. running length
Organic Granular Fertilizer (5-2-4 or similar analysis Composted Chicken or Turkey Manure Fertilizer)	2.5# per 10 ft. running length
Uniformly spread potting soil or compost and fertilizer on top of the sand. Mix potting soil and fertilizer thoroughly into the top 3-4 inches of sand.	
Note: It is recommended to soil test the planting beds after all components are added to determine if additional corrective amendments are needed.	

Establish planting bed rows inside the High Tunnel and add soil amendments to beds approximately 2.5-3 feet wide. Alleyways between the beds should be about 2-3 feet wide. Allow for more lush plant growth inside the High Tunnel when compared to similar plants grown outdoors. The alleyways can remain as unmodified sand. Alleyways can be mulched with straw, sawdust, bark chips, or other similar material to suppress weed growth. Plastic can be laid down in the alleyways before laying mulch. This will conserve moisture in addition to providing better weed suppression. The plastic in the alleyways can be old High Tunnel plastic that has been removed.

The planting beds are ideal for using drip irrigation; either trickle tape or emitter systems. Drip irrigation allows for plant foliage to remain dry, reducing the risk of many plant diseases that rely on moist conditions. Modern drip irrigation systems ensure even and uniform distribution of water to all plants. The use of sweat hoses is not recommended, as the delivery of water is not uniform over the length of the hose. Overhead irrigation can be used effectively, although the possibility of plant disease may increase. If several different crops are grown in a High Tunnel at one time, it is recommended that each planting bed be installed as an independent irrigation zone. This will allow each bed to be irrigated separately based on the moisture needs of that particular crop. Soil in a High Tunnel tends to dry out over time, as soil moisture is not renewed from rainfall. Before planting a crop, it is recommended that planting beds be thoroughly moistened. Soil moisture can be monitored with a tensiometer. Maintaining uniform soil moisture and available water for growing plants is crucial. Tensiometers are available from irrigation and greenhouse supply companies and come in 6-inch, 12-inch, and 18-inch lengths. The 6-inch and 12-inch versions are suitable for most crops that can be grown in a High Tunnel. Tensiometers cost about \$60 to \$65 each plus the cost of a vacuum kit (approximately \$40) which can be used to service more than one tensiometer.



Tensiometers are effective tools to monitor soil moisture levels.

To achieve the benefit of season extension, the High Tunnel must be properly managed. The most common mistake is allowing the High Tunnel to overheat, stressing the plants and reducing fruit set on some plants such as tomatoes. If internal High Tunnel temperatures cannot be satisfactorily controlled by natural ventilation, shade materials can be used to reduce internal High Tunnel temperatures. Spray-on liquids are available that are sprayed on the outside of the High Tunnel plastic to provide shade. The spray-on products last about one growing season and must be reapplied annually. Liquid shading compounds cost about \$.01/sq.ft. Shade cloth can also be used to cool High Tunnel temperatures. The shade cloth is a loosely woven polypropylene product that comes in percent shade ratings varying from 30 percent to 100 percent. Prices range from about \$.09/sq.ft. to over \$.25/sq.ft. Be certain to provide shade to a level that provides internal cooling of the High Tunnel but does not impair plant growth. Shade cloth distributors can assist in selecting the appropriate percent shade needed depending on the crop to be grown.

When the plastic covering is installed, care should be given to place it as snugly as possible. Plastic flapping in the wind will rapidly wear out or tear. The plastic will tend to tighten as the air temperatures cool in fall and winter. The tighter plastic enables any snow accumulated on the High Tunnel to slide off more readily.

RECOMMENDED GARDEN PLANTS

The following plants will perform well when using a High Tunnel for plant protection and season extension: beet, cantaloupe, carrot, cucumber, eggplant, green bean (pole and bush), herbs, lettuce, muskmelon, pepper, radish, summer squash, and tomato.

<i>HIGH TUNNEL COMPATIBILITY</i>						
<u>Field Tunnel</u>	<u>Greenhouse</u>	<u>Hoophouse</u>	<u>Plastic Mulch</u>	<u>Floating Row Cover</u>	<u>Trickle Irrigation</u>	<u>Overhead Irrigation</u>
No	No	Yes	Yes	Yes	Yes	Yes

SOURCES

High Tunnels are available from many greenhouse distributors around the world. When searching for High Tunnels, it is important to be aware that they are also referred to by several other names which all refer to the same basic type of structure. Some other names associated with High Tunnels include: Hoophouses, Cold Frames, Hothouses, and Greenhouses.

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