

SMALL FARM SUCCESS

HIGH TUNNELS IN THE MID-ATLANTIC REGION

BASICS AND FARMER EXPERIENCES



A high tunnel is a simple, inexpensive, and highly versatile structure similar to a greenhouse. High tunnels provide a tremendous number of season extension production opportunities. A high tunnel will offer the opportunity for the grower to get a crop in early in the season, to stay in production later in the season and possibly to produce a crop such as greens through the winter. High tunnels also provide protection from rain and hail and can reduce disease and pest pressure. In Maryland, the seasonal weather patterns vary greatly from one year to the next, and even with these unheated tunnels it is difficult to confirm exactly the best timing and choice of crops. However, with good planning, variety selection, knowledge of market demand and close management, this low cost system can add another dimension to a vegetable or small fruit operation.

THE BASIC HIGH TUNNEL

In a high tunnel system, the tunnel is large enough for the grower to plant, monitor and harvest the crop from inside the structure. Tunnels are usually between 14 and 28 feet wide, 7 to 12 feet tall at the center depending on width, and 96 feet long. (Figure 1). However, the tunnel can be built in any four-foot interval length. Tunnels should be no wider than 30 feet, for good cross ventilation and reduction of snow accumulation on the roof in the winter. The gable-shaped frame consists of metal bows made by bending steel pipe or tubing, and potential stresses caused by the weight of snow or heavy wind must be considered.

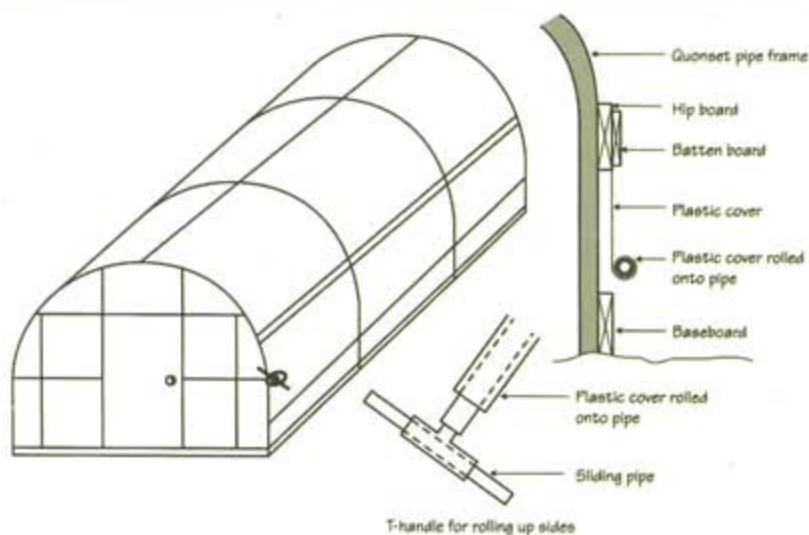
Correct construction is the first step to the successful use of the high tunnel. Investing the time laying out the corners properly and preparing the site for construction will pay off in the long term. The better the tunnel is constructed, the easier the roll-up sides will work and the easier it will be to ventilate. Orientation of the high tunnel will depend on the availability of land. An East-West orientation will maximize solar gain, but orienting the long sides to the prevailing wind will improve passive ventilation provided by the roll up sides.

Metal pipes are driven into the ground approximately 2 feet deep and set every 4 feet of the high tunnel length, providing support for the gable frame. The bows fit into the ground pipes and are attached by bolts. The ends of the structure can be plastic or wood on a wood stud frame, but

should be removable to allow access for tillage equipment and to increase ventilation in the summer. The structure is typically covered with a single layer of 6-mil polyethylene with provisions for rolling up the sidewalls. The poly is secured onto a hip board on each side of the high tunnel, about 3.5 - 5 feet above the soil line, depending on tunnel width. A vertical sidewall helps to keep rain out of the tunnel and when rolled up, provides passive ventilation. A pipe is then attached to the loose bottom end of the plastic along the length of the structure. A "T" handle on the end of the pipe is used to roll the plastic onto the pipe to open the sides. Cross-ventilation is assisted by wind and has proven to be very efficient.

Crops are usually grown directly in the soil inside the high tunnel and productivity can be maintained into or beyond the conventional growing season as long as the side vents are carefully managed. The crops that can be grown in the tunnels are limited only by the producer's imagination and market potential. Tomatoes, peppers, eggplant, greens, radishes, potatoes, raspberries, strawberries, herbs, cut flowers, tomatillos, and broccoli are some of the crops that have been successfully grown in tunnels.

During periods of cold weather the sides are lowered in the afternoon to hold heat and then raised in the morning to vent before temperatures inside get too high. The floor of the structure is covered with a



layer of 6 mil black plastic or permeable woven landscape fabric. This helps to raise the temperature inside the house, control weeds, and reduce evaporation of soil moisture. Excess moisture will raise humidity in the tunnel and may lead to disease problems. Respiration of the plants will increase humidity at night as the air cools down. Venting in the morning for 10 - 20 minutes will allow drying of any condensed water.

High tunnels can reduce the incidence of some diseases, particularly if trickle-irrigation tubing is used underneath the black plastic mulch. No water (rain or irrigation) gets onto the foliage to transport fungal spores or otherwise encourage disease development.

BENEFITS FOR PRODUCTION

The use of high tunnels for crop production creates a microclimate that provides the opportunity to increase quality. Since the plants are grown in a structure covered with one layer of plastic, the foliage, flowers and fruit do not get wet. This can reduce the incidence of many diseases. The soil does not become excessively wet because the only water supply to the plants in the tunnel is trickle irrigation. Since the floor receives no rainfall, if irrigation is done carefully, the area between the beds becomes too dry for weeds to germinate. This allows work to be done with soil amendment incorporation or the growing of a cover crop during the coldest part of the winter. Proper water management will also help to reduce the incidence of certain root rotting diseases. The single layer of plastic only reduces light levels about 10% as compared to growing outside. Therefore photosynthesis is not reduced, except in shaded parts of the plant canopy. Temperatures inside the tunnel are usually warmer than outside temperatures, providing the environment for season extension. The floor in the house will not freeze during most winters.

Passive ventilation is provided by the roll-up sides that truly make the structure a high tunnel. This ventilation cools the structure's interior and dries the foliage, again helping to reduce disease incidence. These sides can be lowered in the evening to hold in heat and can protect tender plants from blustery conditions. The structure also will provide a foundation for the use of plastic netting for crop support, shade cloth, and row covers for increased plant protection on cold nights.

PRODUCTION CHALLENGES

The use of high tunnels requires an increase in both the level and the amount of management required to grow the crop. The sides must be raised and lowered to regulate temperature and humidity. Plants must be irrigated regularly and fertigated as needed. Plants can be grown on raised beds covered with plastic or landscape fabric with the rows in between bare soil, or the entire floor can be covered with landscape fabric. Unless supplemental heat is provided, the tunnel may not be able to provide adequate protection to the plants after November or December, depending on the year.

Disease problems may occur in the protected environment; therefore, management of the environment is critical. Ventilation to avoid high temperatures or high humidity is very important. The mid-Atlantic's unpredictable weather in spring and fall requires intensive management. Powdery mildew is one disease that may be favored by the high tunnel climate and should be monitored closely.

Insects may also thrive in the microclimate created for the plants. Without a doubt, integrated pest management (IPM) scouting must begin when the plants are set out. The use of beneficial insects may be the most practical way to deal with some insect and mite problems. However, season extenders can actually be used as physical barriers to keep insects off the plants. For example, screening the sides to exclude insects and the use of floating row covers that have the edges secured will prevent many insects from reaching the crop.

Pollination for many crops such as raspberries, strawberries and tomatoes is provided to a large extent by the large amount of air movement from side to side. However, bumble bees or honey bees may be required to maximize production in the early and late part of the season when the sides are rolled up less often. Maryland researchers are currently examining the use of a honeybee hive placed at the end of a tunnel with the opposite end open during the day. The bees flying in and out will stop off on the various flowers on their way in and out each day, which should provide adequate pollination. Further research regarding the use of bees is planned.

The following farmer profiles demonstrate the versatility and value of high tunnels in their overall production and marketing plans.

CALVERT'S GIFT FARM

JACK AND BECKIE GURLEY



"Salad mix greens grew very well, with higher quality, as they were cleaner due to no splash-up problems."

Farming operations

5 acres organic vegetables, high tunnel, cut flowers and transplants with 2 farmers' markets, a 40-person Community Supported Agriculture (CSA) operation, membership in a CSA cooperative and restaurant sales. Our season is Mid-February to late December.

Marketing

The high tunnel is useful for early sales of heirloom tomato transplants. It brings in income in March and April, which are historically our slow months. The high tunnel is an excellent staging area for our transplants, primarily tomatoes, eggplants and peppers. We have an interest in developing an effective rotation for our high tunnels.

Successes with high tunnels

It works well for finishing off transplants. After the tomatoes transplants are out, we are able to transplant peppers and eggplants as the next crop in the tunnel, these are both difficult vegetables for us to grow organically outdoors. In the high tunnel we have less pest pressure especially from flea beetles. Greens were another success with the high tunnel. Salad mix greens grew very well, with higher quality, as they were cleaner due to no splash-up problems. There were no freeze issues in the spring, also.

Challenges with high tunnels

To achieve weed control with greens, we had to hand weed. But this was good exercise in March that got us in shape for the rest of the season. Leeks planted in the high tunnel didn't work.

Words of advice, do's and don'ts

Figure out how the high tunnel fits into your own operation—it must fit into the overall scheme. Timing of plantings—lettuce grows slower than the salad greens mix. The challenge is to have the lettuce and salad mix ready together. Another challenge is to know when to quit a crop and move onto the next crop. Water management is critical and so is maximizing space.

Contact information

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Sparks, MD 21152
410-472-6764

KNILL'S FARM MARKET

JIM KNILL



"We really sell our early tomatoes, and they command a better price than the tomatoes later in the season."

Farming operations

Hay, small grain, beef cattle, vegetables including sweet corn, pumpkins, cantaloupes, cucumbers, raspberries and two high tunnels. We sell through our farm market.

Marketing

The high tunnel extends the season on both ends for our farm market. Tomatoes have been our best crop with the high tunnel. We really sell our early tomatoes, and they command a better price than the tomatoes later in the season. And tomatoes bring in customers to the farm market. With our limited time we've found it is better to concentrate on the early market.

Successes with high tunnels

It's successful because of its simplicity in design, roll-up sides and low cost. By adding supplemental heat, we increase the time we can have tomatoes in the high tunnel by three weeks both spring and fall. We have stayed with tomatoes for 6 years in the same high tunnel. Using improved hybrids that are resistant to diseases, balanced fertility, and moisture control make this possible. The plastic cover for dew control really helps. Our high tunnel is dormant from the end of October to mid-March. Never thought we could (or wanted) to grow tomatoes all year round.

Challenges with high tunnels

We must be very attentive to rolling up the sides, even in May.

Words of advice, do's and don'ts

It's better to have higher hip sides than the one we have. We put ours on an incline ideally it would be better on level ground.

Contact information

Knill's Farm Market
Jim Knill
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TETER FARMS

KIM AND MICHAEL TETER



"We have been able to grow tomatoes spring, summer and fall in the high tunnel."

Farming operations

5 acres sweet corn, 1.5 acres blueberries, two high tunnels for tomatoes, early snap beans, early potatoes and early peppers. We sell to two farmers markets in Cumberland on Tuesday and Thursday, and at the local grocery store on Monday and Friday. We're building our own farm market stand and hope to increase our direct market sales.

Marketing

Tomatoes, snap beans and potatoes for the early market. Disease pressure is much lower inside the high tunnel. We have been able to grow tomatoes spring, summer and fall in the high tunnel.

Successes with high tunnels

Having early tomatoes was the initial reason for purchasing and building the high tunnels. But we are experimenting with other crops for the early market also. Our farm was hit with a hail storm last year and the only tomatoes we had came from our high tunnel. The high tunnel keeps out unwanted animals also.

Challenges with high tunnels

Having good air movement during certain weather patterns in the spring and fall. When it is cloudy and cool weather, we couldn't roll up the sides and achieve good air movement.

Words of advice, do's and don'ts

If you don't have the right soil, the high tunnel won't work. Start building the high tunnel one year in advance, then prepare the soil. This entire process takes much longer than you think. Plan to be able to roll the sides up high for adequate air movement.

Contact information

Teter Farms
Kim and Michael Teter
1900 Icy Lane
Oldtown, MD 21555
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SUMMER CREEK FARM

RICK HOOD



"The fruit from the high tunnel was very pretty."

Farming operations

27 acre organic farm, with 2 acres hay, 15 acres of barley, wheat and soybeans, 6 acres of potatoes, tomatoes, broccoli and asparagus, one high tunnel and plans for second high tunnel for 2003 season. I sell at a local farmers market and a CSA cooperative.

Marketing

The high tunnel gets me to market early, especially tomatoes and peppers. I was two weeks late planting my transplants and I still had tomatoes and peppers for the market by July 3rd.

Successes with high tunnels

Tomatoes work very well, peppers worked well also for the entire season. We were able to wholesale cherry tomatoes. The fruit from the high tunnel was very pretty.

Challenges with high tunnels

Construction was a challenge, it was a terrible fight to get plastic on in the spring because of the constant wind on our farm. Irrigation and weed control management is a learning process. I crammed 5 rows of vegetables in last season, but will cut back to 4 rows this season, it was just too crowded. The construction process requires constant traveling inside the tunnel, and soil compaction is a problem inside the tunnel if construction occurs during wet periods. Being organic, I had to use rough-cut lumber instead of pressure treated lumber. The rough-cut lumber was cheaper but won't last as long as pressure treated lumber.

Words of advice, do's and don'ts

Construction of a high tunnel takes longer than you think, so start early. It would be nice to use a laser level to shoot the lines with. Have the ends ready before you pull the plastic over, it really helps to keep the wind out of the inside. I will build my next high tunnel in August to reduce compaction problems and have much less wind to contend with.

Contact information

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HIGH TUNNEL SOURCES

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FOR MORE INFORMATION VISIT OUR WEBSITE:

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