COOPERATIVE EXTENSION SERVICE
UNIVERSITY OF KENTUCKY COLLEGE OF AGRICULTURE, FOOD AND ENVIRONMENT
Center for Crop Diversification Crop Profile

High Tunnel Tomatoes

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Introduction

High tunnels, also known as hoop houses, are relatively simple polyethylene-covered unheated structures that typically do not use fans for ventilation. Tunnels can be covered with one or two sheets of plastic; those covered with two have an air layer in between, thus offering better insulation and, consequently, more cold protection.

High tunnels are used to extend the growing season earlier into spring and later into fall. Determinate and indeterminate tomatoes (*Lycopersicon esculentum*) can be successfully grown in this production system, yielding a potentially profitable "out of season" crop. Other advantages to high tunnel production include: higher yields, improved fruit quality, fewer culls, and a reduction in pesticide applications.

Marketing and Market Outlook

High tunnel tomato production can yield a crop 4 to 5 weeks ahead of field-grown tomatoes. After a winter of shipped-in produce, customers are often eager for that first truly vine-ripened tomato. As a result, growers able to provide the earliest locally grown tomatoes can often demand a premium price. Producers who capture this early market with a quality product may also gain loyal season-long customers. Similarly, the scarcity of locally grown late season tomatoes can provide a profitable market for growers able to extend production well into fall. A longer tomato production season can also place Kentucky growers in a better position to compete with producers to the south. Extending the season has the potential of spreading out cash-flow, increasing overall farm profits, and gaining new customers.

Marketing avenues include roadside stands, farmers markets, restaurants, locally owned grocers, community supported agriculture (CSA), produce auctions, and wholesale markets.

Production Considerations

Growing environment

High tunnels do not have a permanent heating system, but instead are passively solar-heated. Nighttime low temperatures within a structure covered with two layers of plastic (with an insulating layer of air in between) can average about 7° F to 8° F warmer than outside temperatures. Structures covered with just a single layer of plastic often realize only a 3° F increase in nighttime lows. Row covers used in conjunction with the high tunnel will provide further cold

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and frost protection. As an alternative, a portable heater can be used when unexpected drops in temperature occur. However, due to rising energy costs, the use of heaters should generally be limited to short durations. During sunny days temperatures in the tunnels can reach 30° F to 40° F higher than outside temperatures, necessitating that tunnels be adequately vented. Lacking the automated system of more elaborate greenhouses, high tunnels are ventilated by manually rolling up the sidewalls in the morning and closing them at night. Orienting the houses perpendicular to the prevailing wind on the farm will help facilitate air movement. Because tunnels prevent natural rainfall from reaching plants, drip irrigation is essential for providing the large volume of water this crop requires for quality fruit production. The irrigation system can also be used to provide fertilization during the season.

Plant selection

Growers interested in an early tomato crop should select a determinate cultivar. Determinates produce a heavy flush of tomatoes over a period of about 4 to 6 weeks. With proper planning, their production will end about the time field tomatoes begin to bear. On the other hand, indeterminate tomatoes produce a more sustained harvest over a longer period of time. Some producers will grow indeterminate cultivars early in the spring and keep them productive throughout the summer and into late fall when prices begin to rise again.

Heirloom tomatoes are also a good crop for this production system because they are less prone to cracking and have fewer disease problems in the tunnel than in the field.

Site selection

Select a level, well-drained, fertile location for tomato production. Site selection is more critical when the high tunnel is built to be a permanent structure. Once permanent tunnels are in place, amending the soil each year can present a challenge. A small tractor with a tiller can be driven into tunnels with hinged endwalls. However, if the endwalls are fixed, soil preparation will need to be accomplished by hand or with a small power tiller. The soil in movable tunnels can be worked prior to erecting the structure.

Movable high tunnels can be relocated to a new site each season to facilitate crop rotation and to avoid nutrient depletion of the soil. Rotating moveable high tunnels to different locations also helps to prevent the buildup of soil-borne diseases and/or fertilizer salts. Often tunnels that remain in the same location, producing the same crop for a number of years, will have high levels of soil pathogens, leading to progressively high disease loads and crop losses. Fertilizer salt build-up can also be avoided when the tunnel is moveable. If the tunnel is not moved, it is important to remove the plastic every 3rd or 4th year to allow salts to leach from the soil.

Raised beds of at least 6 inches will promote earliness by enhancing soil warming while also improving soil drainage. On the other hand, growers who produce greens in the same site during the winter months may decide to forgo raised beds; soils in raised beds do not stay as warm for winter crop production as soil-level beds. Using black plastic mulch will increase soil temperature, provide weed control, and reduce water loss. If organic mulch is preferred to plastic, applications should be made after soil has warmed since some organic mulches have a tendency to actually lower soil temperatures.

Planting and crop support

Healthy 4- to 5-week-old seedlings can be transplanted to the tunnel once the soil has warmed to 60° F at a 2-inch depth. For permanent high tunnels the soil stays relatively warm, which means that growers in zone 6 are often able to plant 4 to 5 weeks earlier than normal in the spring. Fall plantings can be made in early August for mid-November to mid-December harvests.

Many tomato cultivars, including determinates, grow considerably taller in the tunnel environment than they would in the field. Crop support is very important in a high tunnel for many of the same reasons it is used

in the field: better light penetration, improved air circulation, more plants per square foot, and fewer fruit in contact with the ground. Options include cages, staking, stake and weave, and trellising; some methods are more labor intensive and/or costly than others. Trellising to the tunnel roof is not advisable unless the frame has been built to support the heavy weight of fruit-laden plants. However, a separate support system can be constructed inside the high tunnel if trellising is preferred. A 20-foot by 96-foot tunnel can accommodate from 125 to 300 tomato plants depending on spacing, bed size, width of walkways, and height of sidewalls.

Pruning and pollinating
Suckers (axillary shoots) should be pruned to hasten earliness and improve air circulation. Prune only those below the first flower cluster that are less than 4 inches long. Pollination of tunnel-produced tomatoes is not adversely affected as long as there is good air movement through the structure. If the tunnel sidewalls need to be kept down for extended periods of time, it may be necessary to promote pollination by vibrating plants, using a leaf blower, or by tapping the crop support system (i.e. stakes or cages).

Pest management
Due to the unique environment within tunnels growers may encounter different disease problems in the tunnel than in the field. Since the tunnel excludes rainfall, the foliage tends to stay dry, resulting in fewer disease problems from pathogens that are spread by rain splash or require leaf-wetness for infection. However, due to the limited movement of air in a tunnel, those diseases favored by high humidity can increase in severity. Because of potential virus problems, bedding plants and other potted ornamentals should not be planted in the same greenhouse as tomatoes.

Due to the irrigation needs of tunnel-grown tomatoes, blossom end rot, a calcium deficiency caused by irregular watering, can be a problem for some growers.

Insect pests in tunnels differ as well. While the high tunnel presents a barrier to some insect pests (e.g. the sphinx moth), it is an ideal environment for others, particularly whiteflies and aphids. Typically, any insect pest that is a problem for greenhouses will be a problem in high tunnels.

Frequent scouting to monitor insect populations and disease incidence is essential. Due to the relatively high density of plants in tunnels pests and diseases can spread very quickly.

Harvest and storage
Tomatoes for fresh market are harvested when fully vine-ripe. Harvesting early in the morning before the tunnel heats up is best for both the picker and the tomato. To avoid crushing, fruit should not be packed more than two layers thick. Determinate plants can yield from 10 to 25 pounds of tomatoes per plant over a 4-week period. High tunnel tomatoes generally produce fewer culls than field-grown plants.

Labor requirements
Labor figures provided here are for high tunnel tomato production in a single 96-foot x 20- foot house. Site preparation, which includes soil preparation and getting the tunnel ready, is estimated at 5 to 8 hours. Approximately 3 hours will be needed for planting and 2 hours for staking. Labor during production (6 to 10 hours) mainly involves such labor-intensive activities as hand spraying or weeding. Harvesting and packing is expected to demand about 40 hours. In addition, high tunnels will require daily labor to manually raise and lower sidewalls for temperature and ventilation management (10 hours). These structures could also require monitoring during heavy storms. Additional labor may be necessary for producers marketing their own tomatoes.

Economic Considerations

Initial investments include high tunnel construction, land preparation, purchase of seed or transplants, and installation of an irrigation system. Additional start-up costs can include black plastic mulch, row covers, an inflation fan, and a crop support system.

High tunnels are a relatively inexpensive way to extend the growing season. Excluding labor, the approximate cost of a high tunnel is $1.30 to $1.50 per square foot. Because of their simple design, high tunnel structures are not difficult to construct and manage. Compared to the cost of a traditional production-ready greenhouse ($8 to $30

per square foot) the high tunnel requires little capital investment. High tunnel production does represent a much greater investment than growing produce in the field.

The following 2012 budget information is based on production of 200 plants in a 96-foot by 20- foot high tunnel. Production costs for irrigated tomatoes are estimated at $565. Harvest and marketing costs, including 20 hours of hired labor, are estimated at $600. Total expenses, including both variable and a $550 annual fixed cost, would come to approximately $1,715. Presuming tomato gross returns of $2,300, returns to owner labor, land, capital, and management would be $585. These estimates assume 40 hours of owner/operator labor. Total returns per high tunnel may potentially be maximized by either increasing tomato planting populations or utilizing unused space within the high tunnel for other crop production. Higher returns may also be obtained by marketing specialty varieties as well as selling early season tomatoes at prices higher than the $1.50 per pound assumed in these estimates.

Selected Resources

- How to Build a High Tunnel (University of Kentucky, 2005)
http://www.uky.edu/Ag/CCD/hightunnel.pdf
- Walking to Spring: Using High Tunnels to Grow Produce 52 Weeks a Year (Au Naturel Farm, 2003) *Available for purchase only; order form at this site*
http://aunaturelfarm.homestead.com/bookorderform.html
- Economics of High Tunnel Vegetable and Strawberry Production in the Central Midwest (Purdue University, 2007) *1.2 MB file*
https://ag.purdue.edu/hla/fruitveg/Presentations/econ_summer_crop6.pdf
- Plasticulture (Pennsylvania State University)
http://plasticulture.psu.edu/
- High Tunnels: Tomatoes (Cornell University)
http://www.hort.cornell.edu/hightunnel/crops/vegetables/tomatoes.htm
- High Tunnel Tomato Production, M170 (University of Missouri, 2004) *Available as a free download (PDF) or for purchase as a hardcopy*
http://extension.missouri.edu/p/M170
- High Tunnel Tomato Production (Utah State University, 2010)
http://extension.usu.edu/files/publications/publication/Horticulture_HIghTunnels_2010-03pr.pdf
- High Tunnel Trellising (University of Minnesota Extension, 2012)
http://hightunnels.cfans.umn.edu/files/2012/11/9-Trellis.pdf
- High Tunnel vs. Field Grown Tomato Culture (Kansas State Research and Extension, University of Missouri Extension, and University of Nebraska Cooperative Extension)
http://hightunnels.org/high-tunnel-vs-field-grown-tomato-culture/
- Managing Diseases of Organic Tomatoes in Greenhouses and High Tunnels (eXtension, 2011)
http://www.extension.org/pages/18337/managing-diseases-of-organic-tomatoes-in-greenhouses-and-high-tunnels
- Production of Tomatoes within a High Tunnel (Kansas State Research and Extension, University of Missouri Extension, and University of Nebraska Cooperative Extension)
http://hightunnels.org/production-of-tomatoes-within-a-high-tunnel/
- Tomato Budget for 1000 Square Foot High Tunnel (Kansas State Research and Extension, University of Missouri Extension, and University of Nebraska Cooperative Extension, 2004)
http://hightunnels.org/tomato-cost-return-projection-for-1000-square-foot-high-tunnel/

Reviewed by Shawn Wright, Extension Specialist (Revised 2012)
Photos by Tim Coolong (high tunnel & tomato fruit inset, pg. 1) and Bob Anderson (cherry tomatoes, pg 2), University of Kentucky

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