

## High Tunnel Tomatoes

### Introduction

High tunnels, also known as hoop houses, are relatively simple polyethylene-covered greenhouses placed over irrigated ground beds. These structures are generally unheated and 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. Both determinate and indeterminate tomatoes 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 and frost protection as well. 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 is generally 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, indeterminates 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.

#### *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.

Moveable high tunnels can be relocated to a new site each season to facilitate crop rotation and to avoid nutrient depletion of the soil. Another benefit to moveable high tunnels is the ability to rotate the tunnel to different locations in the field to prevent the buildup of soil-borne diseases. Often tunnels that remain in the same location, producing the same crop for a number of years, will have high levels of soil pathogens. This can lead to progressively high disease loads and crop losses. The soil in moveable tunnels can be worked prior to erecting the structure.

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 or by tapping the crop support system (i.e. stakes or cages).

#### *Pest management*

As a result of 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, 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.

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. However, 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.

#### *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 preparing both the soil and the tunnel, 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) largely involves such labor-intensive activities as hand spraying and 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 budget information is based on production of 170 plants in a 96 foot by 20 foot high tunnel. Production costs for irrigated tomatoes are estimated at \$240. Harvest and marketing costs, including 20 hours of hired labor at \$8.50 per hour, are estimated at \$465. Total expenses, including both variable and fixed, would come to approximately \$1,075. Presuming gross returns of \$1,700, returns to owner labor, land, capital, and management would be approximately \$625. These estimates assume 40 hours of owner/operator labor, meaning the producer makes approximately \$15 per hour to contribute to their own labor, land, capital, and management.

### **Selected Resources**

- How to Build a High Tunnel (University of Kentucky)  
<http://ces.ca.uky.edu/robinsonstation/Horticulture/How%20to%20build%20a%20high%20tunnel.pdf>

- Walking to Spring: Using High Tunnels to Grow Produce 52 Weeks a Year (Au Naturel Farm, Kentucky, 2003) *Available for purchase using the order form at this site*  
<http://aunaturelfarm.homestead.com/bookorderform.html>
- Center for Plasticulture (Pennsylvania State University)  
<http://plasticulture.cas.psu.edu/>
- High Tunnel Tomato Production, M170 (University of Missouri, 2004) *The entire publication is available for purchase only; however, portions are included on the HighTunnels.org Web site (see links below)*  
<http://extension.missouri.edu/explore/manuals/m00170.htm>
- High Tunnel Trellising (University of Minnesota Extension, 2007)  
<http://www.extension.umn.edu/distribution/horticulture/components/M1218-6b.pdf>
- High Tunnel vs. Field Grown Tomato Culture (HighTunnels.org)  
<http://www.hightunnels.org/ForEducators/TomatoProduction/Versus.htm>
- High Tunnels (North Carolina State University)  
[http://www.ces.ncsu.edu/depts/hort/greenhouse\\_veg/topics/topics-pages/HighTunnels.html](http://www.ces.ncsu.edu/depts/hort/greenhouse_veg/topics/topics-pages/HighTunnels.html)
- Production of Tomatoes within a High Tunnel (HighTunnels.org)  
<http://www.hightunnels.org/ForGrowers/WarmSeasonVegetables/warmseasonvegtomprod.htm>
- Tomato Budget for 1000 Square Foot High Tunnel (HighTunnels.org)  
<http://www.hightunnels.org/ForGrowers/WarmSeasonVegetables/warmseasonvegbudget.htm>

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*Photos courtesy of Michael Bomford, Kentucky State University (plants) and Brent Rowell, University of Kentucky (fruit)*

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For additional information, contact your local [County Extension](#) agent