

High Tunnel Leafy Greens and Herbs

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. They 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.

While they are often used to extend the growing season earlier into spring and later into fall, high tunnels could be used in the mid-Atlantic region for winter production of a wide variety of leafy greens and herbs. “Leafy greens” is a broad term that includes vegetables such as lettuce, spinach, and leafy plants in the Brassicaceae family. In addition to winter production, shaded and well-vented high tunnels can be used to grow some of these cool-season crops into early summer, when it would otherwise be too hot for production.

Market Outlook

High tunnels make it possible to produce herbs and leafy greens throughout the traditionally unproductive winter months. Some growers have found that winter greens are actually their most profitable use of high tunnels on the farm. Additionally, growers may benefit financially from producing cool season greens in shaded tunnels during late spring and early summer, a



time when customer demand remains high in Kentucky, but field production is winding down. Quality locally grown “out of season” produce, including greens, often commands higher prices than similar imported produce. Providing fresh off-season greens is a means of keeping a loyal customer base year round, as well as a way of gaining new customers. Extending the season also has the potential of spreading out cash-flow and increasing overall farm profits.

Marketing

Greens produced by extending the season into early summer can be sold retail via roadside stands and farmers markets. Bagged leaf lettuce mixes (sometimes called “mesclun mix”) are popular at these markets. However, those traditional marketing avenues are generally not available for winter-produced greens, so growers will need to locate alternative markets. Selling to subscription customers is a common method of marketing these winter products. Community supported agriculture (CSA) producers, who already have an established customer base, could add winter greens to their offerings. Growers who sell



primarily at farmers markets and roadside stands may be able to capitalize on their summer market contacts to build a subscription list. Delivery, whether directly to homes or to a central location, will be critical for these winter sales. An e-mail distribution list is a great way to notify customers of product availability, as well as the order deadline for the week. Orders can then be received via return e-mail or by phone.

Wholesale marketing avenues include restaurants and locally owned grocers. Other local and regional marketing opportunities may be available for bagged salad and greens mixes, especially if they are certified organically grown.

Production Considerations

Growing environment

High tunnels can provide the protective environment necessary for growing greens throughout the winter months. 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) generally 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. Because row covers also block sunlight, they should not be left on for prolonged periods during the winter. Placing the row covers over hoops will help to keep tender leaves from freezing to the fabric. 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. Often these extra precautions against cold are not necessary as many greens will recover from an overnight freeze and continue to grow with warming temperatures the following day.

Opening the sidewalls is imperative for good air circulation and temperature control, even

in winter. During sunny days, temperatures in the tunnels can be 30° F to 40° F higher than outside temperatures, necessitating that tunnels be adequately vented. Lacking the automated ventilation 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. The irrigation system can also be used to provide fertilization during the season. Watering will need to be carefully managed during the winter. Growers should closely monitor both air temperature forecasts and soil moisture. Very turgid plants may not recover as well from freezes, so it is best not to water immediately before temperatures drop below freezing. Plants should be irrigated only when tunnel temperatures are expected to remain above 32° F for a few days.

High tunnel production of leaf lettuce into early summer will require shade cloth. One experienced Kentucky grower uses 60% shade cloth while 39% shade has been used successfully in Missouri and Kansas trials growing leaf lettuce and spinach. The combination of shade and irrigation keeps soils cooler, thus improving plant establishment and reducing bolting (flowering) problems. In spite of these successes, however, summer greens production in Kentucky is quite risky. Not only is the chance of bolting especially high, but greens often develop a bitter taste in very hot weather if they are not adequately watered.

Site selection

Orienting the house in an east-west direction will maximize the amount of low winter sunlight reaching plants. Select a level, well-drained, fertile location for greens 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 could 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 tunnels is the ability to rotate the high 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 leads to progressively high disease loads and crop losses. The soil in moveable tunnels should be worked prior to erecting the structure.

Plant selection

Greens producers will need to diversify their crop offerings with an assortment of colors, textures, and leaf shapes to appeal to consumers. Select crops that are both marketable and winter hardy. Winter greens that have a history of success in Kentucky high tunnels include: arugula, Chinese cabbage, endive, Mizuna (Japanese mustard), mustard greens, Pak Choi, Russian kale, spinach, and Tat Soi (Asian mustard). Lettuces include Bibb (Boston), leaf, and romaine (cos). The following herbs could potentially be grown in high tunnels: cilantro, chives, dill, garlic chives (Chinese leeks), oregano, parsley, sweet marjoram, and thyme. For early summer production, select crops and cultivars that are bolt-resistant. Growers will need to experiment with crops and cultivars to determine what works for their production system at their particular location.

Planting

Winter greens are either direct-seeded or transplanted into ground beds. In general, plants that are harvested as heads are transplanted while those harvested as individual leaves are seeded. Transplants should be 4 to 6 weeks old, depending on the crop. Greens can be re-seeded or transplanted every 3 to 6 weeks for a continuous

harvest. Early fall plantings of spinach may require pre-germinating seed for one week in a cold room or refrigerator. Once soils cool, pre-germination is no longer necessary.

Raised beds, which enhance soil warming in the spring, may actually be a detriment to winter crop production; soils in raised beds do not stay as warm as soil-level beds.

Leaf lettuces for early summer production require extra attention. Plants will grow quickly and need to be harvested in a timely manner. Because plant regrowth usually suffers from a loss in quality, a planting may only yield a single cutting. After harvest, plants are turned under and the area seeded for the next crop.

Pest management

Due to the unique environment within tunnels, growers may encounter different insect problems within the tunnel than in the field. Because the tunnel excludes rainfall, the foliage tends to stay dry, resulting in fewer disease problems due to those 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 could increase in severity.

Insect pests in tunnels differ as well. While the high tunnel presents a barrier to some insects, it is an ideal environment for others, particularly whiteflies and aphids. Typically any insect that is a problem for greenhouses will be a problem in high tunnels. Additionally, grasshopper feeding can occur throughout the winter since the ground within the tunnel does not freeze. Without natural predators, such as birds, to help keep insects in check, serious infestations may develop very quickly.

Due to the relatively high density of plants in tunnels, pests and diseases tend to spread rapidly. Frequent scouting to monitor insect populations and disease is essential to keeping these problems manageable.

Harvest

Leafy greens are hand-harvested as whole plants (once over harvest) or as individual leaves (multiple harvests). Because the harvested products are leaves (which rapidly lose water), care must be taken to cool, pack, and sell them promptly. Some growers even use very cold water to hydro-cool their products, thus removing field heat as quickly as possible.

Romaine, Boston lettuce, Chinese cabbage, and Tat Soi are harvested as whole plants. They are cut at the base with a knife once heads have reached the desired size and density.

Crops sold in bunches include herbs, arugula, and other greens. The leaves are cut with a knife or scissors, leaving sufficient plant material for regrowth. The bottom leaves of Russian kale are harvested as the plant grows to a height of approximately 8 feet. Endive must be harvested before a strong bitter taste and toughness develops that makes them unmarketable. Leaves are bound with rubber bands or produce ties. Some plants wilt quickly and may need to be stored in water until packed or delivered.

Greens to be sold in bags as a mesclun mix or braising mix are either hand-picked or cut with scissors, and then placed in bins. After washing, greens will need the excess water removed prior to bagging. This can be accomplished by hand (using mesh bags) or with a salad spinner.

Labor requirements

High tunnel greens production for 20 weeks from a single 96-foot by 20-foot house requires labor for site preparation (10 to 15 hours), planting (3 to 6 hours), production (10 hours), and harvest/packing (40 to 100 hours). Harvest times are highly variable depending on crop mix and selection. Crops which include greens, Bibb (Boston), and romaine lettuce can be harvested and packed in considerably less time (40 to 60 hours) for the season than herbs and leaf lettuces (50 to 100 hours). In addition, high tunnels will require daily labor to manually raise and lower

sidewalls (15 to 20 hours). These structures could also require monitoring during heavy storms. Additional labor may be required for producers marketing their own greens.

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 could include black plastic mulch, row covers, and an inflation fan.

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, however, does represent a much greater investment than growing produce in the field.

The following 2008 budget information is based on romaine lettuce production in a 96-foot by 20-foot high tunnel. Costs will be similar for other crops; higher value greens and herbs could result in potentially greater returns. Production costs for irrigated romaine lettuce are estimated at \$200, with harvest and marketing costs at \$410. Total expenses per tunnel, including both variable and fixed, would come to approximately \$980. Presuming gross returns of \$1,700, returns to owner labor, land, capital, and management would be approximately \$720. This estimate assumes that the operator contributes 20 hours of labor to the operation, harvest, and marketing of the greens; all other labor is assumed to be hired at a wage rate of \$8.50 per hour.

A variety of greens and herbs can be grown in high tunnels in the winter months. Producers should formulate their own budget estimates based on what they know their potential markets are demanding. For example, members of a CSA

might be surveyed as to whether they would prefer to receive early or late-season romaine lettuce, mesclun salad mix, herbs, or a combination of all three. While production costs for different varieties may be similar, good estimates before planting will allow the producer to accurately price their crop.

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>

- Plastic Tunnels Provide Expanded Production Opportunities (University of Kentucky, 2004)
<http://www.ca.uky.edu/AGC/NEWS/2004/Jan/tunnel.htm>
- Walking to Spring: Using High Tunnels to Grow Produce 52 Weeks a Year (Au Naturel Farm, Kentucky, 2003) *Available for purchase*
<http://aunaturelfarm.homestead.com/bookorderform.html>
- Center for Plasticulture (Pennsylvania State University)
<http://plasticulture.cas.psu.edu/>
- Specialty Lettuce and Greens: Organic Production (ATTRA, 2002)
<http://attra.ncat.org/attra-pub/lettuce.html>