

Greenhouse and High Tunnels in Vegetable Production

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Outline

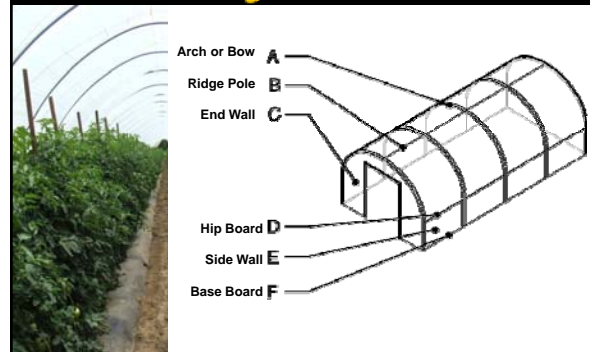
- What are high tunnels
- Type of high tunnels
- Benefit of high tunnels
- Structure of a high tunnel
- Vegetable crops in high tunnels
- Economics of high tunnels
- Resources



What Is a High Tunnel?

- A high tunnel is a plastic-covered greenhouse (structure).
 - Use solar energy
 - Often unheated but could with some supplementary heating when needed
 - Could provide an intermediate level of environmental protection and control, compared to open field conditions and heated greenhouses
 - For crop protection and season extension
- Simple structure, cheap to build

The Basic Structure of a single-bay High Tunnel



Why are High Tunnels Important?



New Hampshire University

Crop Protection



Crop Protection



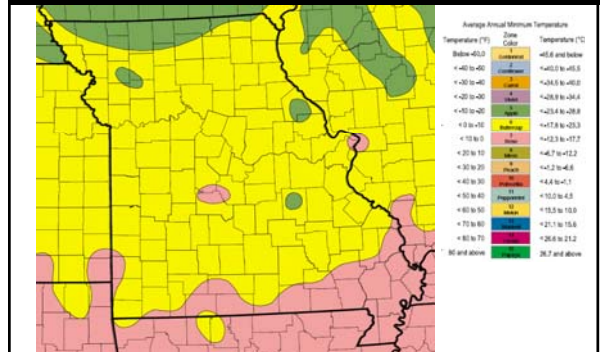
Crop Protection



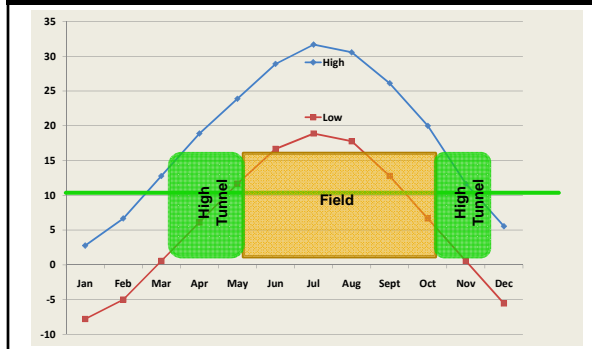
Benefits of High Tunnels

- Environmental control
 - Solar Radiation: greenhouse effects
 - Temperature: season extension
 - A single layer poly provides one hardiness zone of protection, and a second (the row cover) will provide another zone of protection (zone 5 with two layers approximately equivalent to zone 7).
 - Air temp. can be reduced by 4 degrees Fahrenheit with 30% shade.
 - Enclosed environment
 - Keep out winds, less wind erosion
 - Keep out rains, less diseases incidence.
 - Keep out of insect pests, less damage.
 - Easy to apply biological means (predators)/pollinators

Cold Hardiness Zones in Missouri



Season Extension (Warm Season Vegetables)



At the Production side

- Less stressful plants
- Earlier/Higher yield
- Less pest problems
- Better land use (trellising)
- Less soil and wind erosion
- More efficient use of water and fertilizers
- Cleaner/better quality, more marketable produce
- **Workable on rainy days**

Possible Detriments

- Initial cost is higher than that of open field production
- Higher risk: not for everybody/everywhere
 - Markets
 - Disastrous weather
- Intensive labor: mostly manual
- Enclosed Environment
 - May be also Ideal for pests
 - Pollination issues
- Hard to move!
 - Building soil salinity and soil born disease
 - Build up nematode population

Type of High Tunnels

- Single Bay
- Multiple Bay
- High Tunnels
- Low Tunnels
- FarmTek
- Zimmerman
- Hay Grove



High Tunnels



Low Tunnels



Low Tunnels in Japan with roof vents



30' x 96' Zimmerman



30' x 96' FarmTek


Hay Grove





Site Selection

- Location
 - Cold hardiness zone
 - Prevailing wind
 - Cover Crop Prior Year
 - Avoid wet or shady areas
 - Closer to the House?
- Soil
 - Good Water Holding Capacity
 - Drains Well
 - Less than 3% slope from end to end.
 - Organic Matter of 3% or higher
- Orientation
 - Light Inception
 - Prevailing Wind



Construction of a single bay high tunnel



<http://www.hightunnels.org/ForGrowers/SitePlanning&Construction/Articles/How-toBuildMetricUnits.htm>



Cost of High Tunnels

- High Tunnels (Frame ONLY)
 - \$0.75 – 1.25 per square foot
 - \$1-3 per square foot
- Greenhouses
 - 4.50- 6.50 per square foot
 - Or more

Cost of high tunnels

- Per structure or per square foot
 - $\$3500 / (30' \times 96') = \$1.22 / \text{ft}^2$
- Including extras, labor and freight
 - $\$3500 + \$1500 = \$5000 (\$1.76 / \text{ft}^2)$
- Spread out over time (10 years)
 - \$500/year
- Operating costs/management
- **Greenhouse: >\$5/ft²**

Costs of high tunnels

- FarmTek
 - $\$1200 / (18' \times 24') = \$2.77 / \text{ft}^2$
 - $\$5000 / (30 \times 96') = \$1.74 / \text{ft}^2$
- Haygrove
 - $\$22,000 / (96' \times 200') = \$1.15 / \text{ft}^2$
- Homemade
 - $\$1000 / (14' \times 100) = \$0.71 / \text{ft}^2$
 - $\$500 / (18' \times 30) = \$0.93 / \text{ft}^2$

Crops in High Tunnels

- | | |
|---------------|--------------|
| ■ Tomatoes | Strawberries |
| ■ Peppers | Brambles |
| ■ Cucumbers | Herbs |
| ■ Melons | Cut Flowers |
| ■ Cole Crops | |
| ■ Green Beans | |

High Tunnel Crops



High Tunnel Crops

Crop Value?

Markets?



High Tunnel Crops

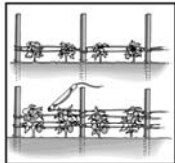




High Tunnel Tomatoes


Material Cost per 1000 ft²

Stakes and Twine	\$48.00
Labor	\$50.00



Material Cost per 1000 ft²

Cages	\$170.00 – 340.00
Labor	\$20.00



Ventilation takes labor but critical


Electric or Solar Powered may be option

Harvest and Packing

60 Hours of labor per tunnel

Total Production Cost

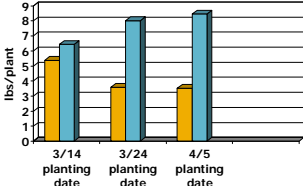
\$5.50 per plant



Tomato Yields

12-15 lbs per plant average


Some can produce as much as 30 – 35 lbs per plant



Planting Date	Yield (lbs./plant)
3/14	~5.5
3/24	~7.5
4/5	~8.5

High tunnel tomato budgets

- **Costs (fixed and variable) and prices**
 - Penn State – 17' x 96'
 - \$2,000 @ \$0.80/lb (16 lb/plant)
 - breakeven \$0.36/lb
 - University of Missouri – 20' x 96'
 - \$2,720 @ \$1.00/lb (8 lb/plant)




Economics of High Tunnel Tomatoes (1000 Ft², single layer)

6 square foot spacing of 170 Plants

Gross Income	Yield/Plant	10 lb	
	Yield/1000 Ft ²	1700 lb	
	Price	\$1.3/lb	
Total			\$2,210
Cost	Production	\$228.50	
	Labor	\$690	
	Total		\$1,073.5
Net Income			\$1,136.50

High Tunnel Resources



Welcome


High tunnels, or hoophouses, are unheated greenhouses that can help market gardeners extend their growing season so that they can improve the profitability of their farms.

This website is part of a USDA-sponsored project that is testing and promoting high tunnel systems in the Central Great Plains.

We hope to provide information developed under our project, and links to relevant sites around the world, so that growers and educators have a one-stop source where they can find information on all aspects of high tunnel construction and use.

<http://www.hightunnels.org/>

- News
- For Educators
- For Growers
- Resources
- About Us



Resources to find more information about the planning, construction, and production practices of High Tunnels.

- News
- For Educators
 - General Information
 - Disease & Insect Management
 - Structure Suppliers
- For Growers
 - General Suppliers
 - Drip Irrigation Suppliers
 - Seed Suppliers
- Resources
 - Construction How-To
 - Row Covers
 - Economics and Marketing
 - Growers using High Tunnels
 - Publications
- About Us

General Information:

American Society for Plasticulture
www.plasticulture.org

Appropriate Technology Transfer for Rural Areas
www.attra.org

Cornell University
<http://www.hort.cornell.edu/hightunnel/>

Growing Growers Training Program
www.growinggrowers.org



Questions?

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