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Organic/Sustainable Vegetable Production in High Tunnels (including economics)
High Tunnels

- Unheated greenhouses
- Frame of metal struts
- Plastic cover
- Passive ventilation
- Soil-based production
- Simple
- Cheap
Frame, hardware: $3,500
Plastic: $800
End walls, doors: $700
Cost: $5,000+/-
<table>
<thead>
<tr>
<th>Qty.</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
</table>
| 1 30 x 96 | **Budget Plus Series**  
| | Posts: 2.197 12 Gauge Column Post  
| | Bows: 1.900 14 Gauge  
| | Purlins: 3 Runs 1.315 x 17 Gauge  
| | Trusses: 1.315 Top Brace every other Bow  
| | Side Wall Height: 4 Feet  
| | Bow Spacing: 4 Feet  
| | Hardware: Complete Hardware Package for Frame Assembly  
| | Gutter: N/A |

Atlas Greenhouse quote, 8/25/11
**Fixed Costs**
(30’ x 96’ tunnel = 2,880 sq. ft.)

<table>
<thead>
<tr>
<th>Construction</th>
<th>Materials</th>
<th>Labor</th>
<th>Life (years)</th>
<th>Cost/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frame</td>
<td>$3,000</td>
<td></td>
<td>10</td>
<td>$300</td>
</tr>
<tr>
<td>Hardware</td>
<td>$600</td>
<td></td>
<td>10</td>
<td>$60</td>
</tr>
<tr>
<td>Plastic</td>
<td>$800</td>
<td></td>
<td>4</td>
<td>$200</td>
</tr>
<tr>
<td>Construction</td>
<td>$800</td>
<td>$800</td>
<td>10</td>
<td>$80</td>
</tr>
<tr>
<td>Plastic application</td>
<td>$100</td>
<td></td>
<td>4</td>
<td>$25</td>
</tr>
<tr>
<td>Total</td>
<td>$4,300</td>
<td>$900</td>
<td></td>
<td>$665</td>
</tr>
</tbody>
</table>

$665 / 2,880 sq. ft = 21¢ per sq. ft. per year

Adapted from [Cornell High Tunnel Sample Budgets](#)
## Variable Cost & Return

<table>
<thead>
<tr>
<th></th>
<th>Mixed Winter Greens</th>
<th>Tomatoes</th>
<th>Colored Peppers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Seed/plants</strong></td>
<td>$127</td>
<td>$240</td>
<td>$200</td>
</tr>
<tr>
<td><strong>Supplies</strong></td>
<td>$285</td>
<td>$484</td>
<td>$150</td>
</tr>
<tr>
<td><strong>Production</strong></td>
<td>$180</td>
<td>$672</td>
<td>$360</td>
</tr>
<tr>
<td><strong>Harvest</strong></td>
<td>$360</td>
<td>$288</td>
<td>$108</td>
</tr>
<tr>
<td><strong>Marketing</strong></td>
<td>$240</td>
<td>$48</td>
<td>$120</td>
</tr>
<tr>
<td><strong>Fixed Cost</strong></td>
<td>$665</td>
<td>$665</td>
<td>$665</td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td>$1,857</td>
<td>$2,397</td>
<td>$1,603</td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td>$6,000 (1,000 lb @ $6/lb)</td>
<td>$9,000 (6,000 lb @ $1.50/lb)</td>
<td>$1,780 (1,000 fruit @ $1.78)</td>
</tr>
<tr>
<td><strong>Return</strong></td>
<td>$4,143</td>
<td>$6,603</td>
<td>$177</td>
</tr>
</tbody>
</table>

Adapted from [Cornell High Tunnel Sample Budgets](#)
Budgeting

• Use sample budgets as a guide to build your own. Don’t assume that others’ experience will match yours.
• Keep track of your costs and returns. Use them to build your own budget.
• High tunnels can make money or lose money. Keeping track of costs and returns helps inform management decisions.
Organic Price Premiums

- Premiums range from 50-150% at large wholesale markets
  - Rodale Organic Price report updated weekly
- Farmers market premiums closer to 50% in urban markets
- Little or no premium in rural markets.

Compare prices for Lettuce: Butterleaf across all markets

Choose a product...

Week of November 14, 2012

<table>
<thead>
<tr>
<th>Lettuce: Butterleaf</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Product Category: Vegetables)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quality</th>
<th>Qty</th>
<th>Certified</th>
<th>Conv</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boston, MA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PQ</td>
<td>24 Ct</td>
<td>$36.25</td>
<td>na</td>
</tr>
<tr>
<td>Los Angeles, CA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PQ</td>
<td>24 Ct</td>
<td>$27.75</td>
<td>$12.00</td>
</tr>
<tr>
<td>Philadelphia, PA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PQ</td>
<td>24 Ct</td>
<td>$36.25</td>
<td>na</td>
</tr>
<tr>
<td>San Francisco, CA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PQ</td>
<td>24 Ct</td>
<td>$27.50</td>
<td>$14.75</td>
</tr>
<tr>
<td>Seattle, WA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PQ</td>
<td>24 Ct</td>
<td>$29.95</td>
<td>$18.00</td>
</tr>
</tbody>
</table>

NRCS EQIP: Seasonal High Tunnel Initiative

- $2.57 per sq. ft. up to 2,178 sq. ft = $5,597
- High tunnel must be steel framed, from recognized vendor
- High tunnels may be fixed or portable
- Crops must be grown in soil
- 4 year contract
- Separate pool for organic growers
- Program ranking dates:
  - February 3rd
  - March 30
  - June 12
Where should I put my high tunnel?

- Close to house
- Good, well-drained soil
- Full sun
- Relatively level
- Wind for ventilation
- Long side facing south
- Water for irrigation
- Electricity?
- Total enclosed area: 0.75 acres
- Each tunnel: 30’ x 96’
- 10’ between tunnels
- 15’ between north tunnel and fence
- 10’ between south tunnel and fence
- 40’ garden beds
- 10’ between gardens and tunnels

Diagram:
- Young Hall
- Basketball Court
- Tunnel #1
- Tunnel #2
- Tunnel #3
- Tunnel #4
The Site with Greenhouses
Attaching plastic
Woven Poly

- Developed in Israel to diffuse light
- Much stronger than conventional poly
- More expensive (15-22¢ / sq. ft.)
- Hail and tear resistant
- 6 year warranty

Images from American horticultural Supply
Why use two layers?

-20 -10 0 10 20 30 40 50

F M A M J J A S O N D J F M A M J

Inside temp. (ºC)

-20 -10 0 10 20 30 40 50

F M A M J J A S O N D J F M A M J

Outside temp. (ºC)

Last freeze
First freeze
Last freeze

KENTUCKY STATE UNIVERSITY
Mean:
\[ y = 0.69x + 6.3, \quad R^2 = 0.95 \]

Minimum:
\[ y = 0.78x + 3.4, \quad R^2 = 0.98 \]
What about frost?
Management
(8-10 hours per week)

- **Daily**
  - Opening and closing tunnel… especially on sunny days
  - Scouting

- **Weekly**
  - Weeding
  - Watering (Drip system)
  - Seeding and Transplanting
  - Harvesting
Irrigation

- Space T-tape 12” apart
- Use nozzles to space transplants (12” for lettuce; 24” for tomato)
- Don’t irrigate before cold snaps (water stress enhances frost tolerance)
Soil Amendment

• “The producer must manage plant and animal materials to maintain or improve soil organic matter content in a manner that does not contribute to contamination of crops, soil, or water by plant nutrients, pathogenic organisms, heavy metals, or residues of prohibited substances.”

  -- NOP standards

• Not all ‘organic’ fertilizer can be used for certified organic production. Look for OMRI seal or check with your certifier.
Compost

• NOP requires C:N between 25:1 and 40:1 and temperature between 131 and 170°F for 15 days.
• Sufficient to reduce human pathogen levels below detectable limits
Summer cover crop
Global N Cycle

Flows measured in millions of metric tons (Tg) of nitrogen.

Bomford, 2011. Agriculture and Natural Gas.
Ventilation
**Sclerotinia sclerotiorum**

- Thrives in cool, moist conditions
- Persists in soil as sclerotia
- White mold of lettuce
- Broad host range
- Problem in high tunnels
Solarization

- White mold (*Sclerotinia sclerotiorum*) thrives in cool, moist conditions
- Attacks leaves, roots, stems
- Survives summer as heat-resistant sclerotia
- 4 weeks under clear plastic in August kills sclerotia
Sliding tunnels
Mixtures
Beneficial habitat
### Sample Cool Season Transplants

<table>
<thead>
<tr>
<th></th>
<th>Kale</th>
<th>Head lettuce</th>
<th>Cole crops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed transplants</td>
<td>Aug. 15</td>
<td>Monthly, Aug.-Apr.</td>
<td>Sep. 1</td>
</tr>
<tr>
<td>Transplant into tunnel</td>
<td>Oct. 1</td>
<td>3-5 weeks after seed</td>
<td>Oct. 15</td>
</tr>
<tr>
<td>First Harvest</td>
<td>Nov. 1</td>
<td>4-6 weeks after trans.</td>
<td>Dec. 15</td>
</tr>
<tr>
<td>Remove</td>
<td>May 15</td>
<td>Jul. 1</td>
<td>Feb. 15</td>
</tr>
</tbody>
</table>
Direct-seeded cool season crops

- Arugula: every 3-4 weeks
- Mesclun:
  - Oct. – Nov. and mid Feb. – Apr:
    3 weeks to harvest, re-cut weekly
  - Dec. – Feb.:
    6 weeks to harvest, 3 weeks between cuttings
- Spinach:
  - Pre-germinate in Sept.
  - 5 weeks to harvest.
  - Cut and come again until Feb.
  - Seed in Dec., lasts to Apr.
# Sample Warm Season Crops

<table>
<thead>
<tr>
<th></th>
<th>Tomatoes</th>
<th>Bell peppers</th>
<th>Cucumbers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Spring</td>
<td>Fall</td>
<td></td>
</tr>
<tr>
<td>Seed</td>
<td>Jan. 15</td>
<td>Jun. 1</td>
<td>Jan. 15</td>
</tr>
<tr>
<td>Transplant</td>
<td>Mar. 15</td>
<td>Aug. 1</td>
<td>Apr. 1</td>
</tr>
<tr>
<td>First Harvest</td>
<td>May 15</td>
<td>Nov. 1</td>
<td>Jun. 1</td>
</tr>
<tr>
<td>Remove</td>
<td>Jul. 15</td>
<td>Dec. 15</td>
<td>Aug. 1</td>
</tr>
</tbody>
</table>
Tomato season

- **Greenhouse**
- **Field**
- **Fall high tunnel**
- **Spring high tunnel**

- **Transplant production**
- **Growth**
- **Harvest**