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

Michael Bomford, PhD
Kentucky State University
College of Agriculture, Food Science & Sustainable Systems
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>
<tbody>
<tr>
<td>1</td>
<td>Budget Plus Series</td>
<td>$3,600.00</td>
</tr>
</tbody>
</table>

|   | 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                         |
## 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></td>
<td>$100</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>Variable 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</td>
<td>$9,000</td>
<td>$1,780</td>
</tr>
<tr>
<td>(1,000 lb @ $6/lb)</td>
<td>(6,000 lb @ $1.50/lb)</td>
<td></td>
<td></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

<table>
<thead>
<tr>
<th>Product Category</th>
<th>Quality</th>
<th>Qty</th>
<th>Certified</th>
<th>Conv</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lettuce: Butterleaf</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boston, MA</td>
<td>PQ</td>
<td>24 Ct</td>
<td>$41.25</td>
<td>$18.00</td>
</tr>
<tr>
<td>Los Angeles, CA</td>
<td>PQ</td>
<td>24 Ct</td>
<td>$37.00</td>
<td>$12.00</td>
</tr>
<tr>
<td>Philadelphia, PA</td>
<td>PQ</td>
<td>24 Ct</td>
<td>$41.25</td>
<td>na</td>
</tr>
<tr>
<td>San Francisco, CA</td>
<td>PQ</td>
<td>24 Ct</td>
<td>$34.00</td>
<td>$15.00</td>
</tr>
<tr>
<td>Seattle, WA</td>
<td>PQ</td>
<td>24 Ct</td>
<td>$36.95</td>
<td>$21.00</td>
</tr>
</tbody>
</table>

http://www.rodaleinstiute.org/Organic-Price-Report
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?
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
Why use two layers?
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 170ºF for 15 days.
- Sufficient to reduce human pathogen levels below detectable limits.
Summer cover crop
Global N Cycle

Annual nitrogen flow to and from terrestrial ecosystems

Anthropogenic

Pre-industrial

Combined

Atmosphere
110

Biosphere, 10

Reactive nitrogen

Ocean, via atmosphere, 55

Rivers & lakes, 60

Ground-water, 15

Fossil fuel use, 25

Industry, 130

Bacteria & algae, 140

Lightning, 5

Fixed, 300

Recycled

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

Greenhouse
- Transplant production
- Growth
- Harvest

Field
- Transplant production
- Growth
- Harvest

Fall high tunnel
- Transplant production
- Growth
- Harvest

Spring high tunnel
- Transplant production
- Growth
- Harvest
Questions?

Michael Bomford
502-597-5752
Michael.Bomford@KYSU.edu
http://Organic.KYSU.edu