Getting Started With High Tunnels

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Research and Extension
Events and Happenings

- Tomato Nutrition in High Tunnels Webinar: 03/15/2015.
- View All Events and Happenings

Featured:

- Moving the Needle. Accomplishments of the National Strawberry Sustainability Initiative 2013-2014
- Cool Season Vegetables

Join the [hightunnels] listserv:

The [hightunnels] listserv comprises over 850 members, most of which are growers using high tunnels. The listserv is a great place to learn what growers are doing with high tunnels, what crops and
PRIMO RED

DAYS: 65
FRUIT SIZE: 8.5oz.
PLANT TYPE/HEIGHT: Compact
VIGOR: 3 out of 5

Mean Weight Per Plant
- Marketable
- Total

Average Fruit Size by Weight
- Marketable
- Total

Average Fruit Size by Weight: Harvest Date

2014 KVGA High Tunnel Tomato and Bell Pepper Variety Trials
Microclimate Modification
High Tunnels

- All shapes and sizes
  - Three or four season

- Climate Control
  - Season Extension
  - Use of low tunnels, etc.
  - Protection

- Reduced Foliar Disease

- Access to new market windows

- Production stability

Photo courtesy: S. O’Connell (NCSU)
Incredible growth of warm and cool season crops
Why High Tunnels?

Environmental Protection

- Early/late frosts
- WIND
- Thermal Stress
- Storms
- Heat ??
Frost Protection

Protecting crops from early/late frosts
Easter freeze
33 deg F – Tunnel
24 deg F – Field
Overnight Lows (°F)
Outside: 39
No Cover: 49
Cover Only: 56
Cover and hoops: 53
Wind Protection
Storm Protection

Hail damage on lettuce
Protection from Heat

High Tunnels *CAN* be cooler than the field

- Ventilation
- Plastic type
  - UV/IR blocking
- Shade cloth
  - 30% is recommended
  - Timing
  - Structural ??
Protection from Heat

High Tunnels = Early Planting Date

- Fruit set before heat
- Plant is established
  - Root system
  - Foliage – fruit shading
- Planting Preference
  - Scheduling
  - Varieties
  - Transplant quality
2014-15 AFRI Food Security Project

Heirloom
Hybrid

High tunnel
Open-field

Heirloom
Hybrid
Heirloom
Hybrid
Heirloom
Hybrid
Heirloom
Hybrid

Total Fruit Yield (lbs/plant)

High tunnel
Open-field
High Tunnel
Open-Field

2014
2015
2014-15 AFRI Food Security Project

Total Fruit Yield (lbs/plant)

Heirloom | Hybrid | Heirloom | Hybrid | Heirloom | Hybrid | Heirloom | Hybrid

High tunnel | Open-field | High Tunnel | Open-Field

2014 | 2015

High tunnel
Open-field
High Tunnel
Open-Field
Protection from Heat

Shade Cloth

- New area of research
- Few recommendations
- White vs. Black vs. Metal
  - Depends on the goal
- Disadvantages:
  - Crop growth
  - Cost
Fruit Quality

VS
Poly Covering

Plastic Types

• Clear vs. UV/IR blocking

• Single vs. double layer

• Light Diffusion
  – Luminance brand

• “Woven” plastics

• Colored plastics ??
  – No data yet
Management

Managing the High Tunnel

• Maintain good soil quality

• Irrigation
  – No rain in the tunnels
  – Overhead irrigation?
  – Fertilizer injector when possible

• Nutrient management
  – Similar to field
  – Be careful of soil salt build-up
  – Always use compost wisely
Soil Moisture - CEFS 2008

Daily average soil moisture fluctuations
• Manage/Ventilate sidewalls
  – Summer Crops – close when nights are <55°F
  – Winter Crops – Varies with crop/climate
  – Automated sidewall curtains

Note: metal brackets to hold sidewall

Hand crank for sidewalls
Ventilation

Need to Protect, but Allow Ventilation

- Sidewall height
- Obstructions (6x Rule)
- Orientation of tunnel
Management

Disease Management in High Tunnels

• Reduced foliar disease
  – Leaf wetness

• Foliar diseases in tunnels
  – Powdery mildews
  – Botrytis
  – Viruses

• Reduced crop rotation
  – Soilborne pathogens
  – Moveable tunnels

Soil almost never freezes under row cover in tunnels.

Outside  

Inside
Verticillium wilt - Tomato
Early Tomato Production
Diversifying with Rootstocks

Transplant Propagation

Rootstock Evaluation

Tomato Grafting

Rootstock-Microbe Interactions

High Tunnel Production

Big Foot RZ
61-060 RZ
King Kong RZ
Integrated Pest Management

OMRI-approved Fung. & Pest.

Biological control
Sanitation
Cultural control
Environmental control
Genetic resistance
Crop Selection
Growing system
Site Selection
Knowledge/Experience
## Crop Rotation in HTs

### The Challenge: Generating Per SqFt Revenue

<table>
<thead>
<tr>
<th>Crop Type</th>
<th>Production Window</th>
<th>Sale Price</th>
<th>Gross Revenue/ft(^2)</th>
<th>HT Crop</th>
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</thead>
<tbody>
<tr>
<td>Tomato</td>
<td>Apr – Oct</td>
<td>$2.50/lb</td>
<td>$3.66</td>
<td>1</td>
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<tr>
<td>Lettuce</td>
<td>Sept – May</td>
<td>$2.00/head</td>
<td>$1.30</td>
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<tr>
<td>Spinach</td>
<td>Sept – May</td>
<td>$45.50/lb</td>
<td>$1.09</td>
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<tr>
<td>Cucumber</td>
<td>Apr – Aug</td>
<td>$1.50/lb</td>
<td>$1.62</td>
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<tr>
<td>Bell Pepper</td>
<td>Apr – Oct</td>
<td>$1.50/lb</td>
<td>$2.30</td>
<td>5</td>
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<tr>
<td>Salad Mix</td>
<td>Sept – May</td>
<td>$8.00/lb</td>
<td>$2.40</td>
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<tr>
<td>Beets</td>
<td>Sept – May</td>
<td>$2.00/lb</td>
<td>$1.92</td>
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</tr>
</tbody>
</table>

- $0.44/ft\(^2\)/year fixed costs for structure (KRC, 2017)
- $0.49/ft\(^2\)/year fixed costs for structure (NCSU, 2013)
  - 2 years of tomato production ($2.60/lb) paid for structure (Sydorovych et al., 2013)
Crop Rotation at Peregrine Farm (Graham, NC)
Scouting For Pests

- Weekly (at least)
- Economic thresholds
  - UCD IPM Guide
- Beneficials
OMRI-Approved Pesticides

Caterpillars and Worms

- Particularly sensitive
  - Ingest and contact
- Bt toxin
  - Dipel vs. Xentari
- Spinosad (Entrust)
- Azadirachtin
- Pyrethrins (Pyganic)
Biological Control

Using Beneficial Insects

- A few companies
- Greenhouse industry
- Numerous species
  - Predators, parasites, and parasitoids
- Applying pesticides
- Handling
  - Keep cool and act fast
  - Pesticide sprays

IPM Laboratories (New York)
Management

Cover Crops

• Also known as “green manures”, cover crops are extremely important for soil health
  – Organic matter
  – Soil microbial health

• Suppress Weeds

• Add / Recover nitrogen
  – Highly-leachable $\text{NO}_3$
  – Legume cover crops fix N

• Can be used as mulch
  – No-till or strip-tillage

• Can reduce excess nutrients (P)

• Reduce soil erosion
Beneficial habitat planted around the tunnel
What About Cover Crops?

- OREI Regional Grant
  - UMN, UKY
  - Ashlee Skinner (MS)
- Comparing benefits of CC vs. spinach
  - Economic vs soil-building
- Identifying crops for HT production
  - “Short windows”
  - Summer, fall, over-winter
<table>
<thead>
<tr>
<th>Year</th>
<th>Greens</th>
<th>Grafted Tomatoes</th>
<th>Cover</th>
<th>Cover</th>
<th>Greens</th>
<th>Greens</th>
<th>Greens</th>
<th>Cover</th>
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<tbody>
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<td>Yr 1</td>
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<td></td>
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<tr>
<td>Yr 2</td>
<td>Cover</td>
<td>Cucurbits/Melons</td>
<td>Cover</td>
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<td>Greens</td>
<td></td>
<td></td>
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<tr>
<td>Yr 3</td>
<td>Greens</td>
<td>Strawberries</td>
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<td>Greens</td>
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<td>Peppers</td>
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<td>Sweetpotato Slips</td>
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January: December
### Think About Revenue in the Long Term

<table>
<thead>
<tr>
<th>Yr</th>
<th>January</th>
<th>December</th>
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<tbody>
<tr>
<td>Yr 1</td>
<td>$1.09</td>
<td>$3.66</td>
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<tr>
<td>Yr 2</td>
<td>Cover</td>
<td>$1.20</td>
</tr>
<tr>
<td>Yr 3</td>
<td>$1.09</td>
<td>$1.76+</td>
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<tr>
<td>Yr 4</td>
<td>$1.30</td>
<td>$2.17</td>
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<tr>
<td>Yr 5</td>
<td>Cover</td>
<td>$1.25</td>
</tr>
<tr>
<td>Yr 6</td>
<td>$0.55</td>
<td>$4.30</td>
</tr>
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</table>

Average Annual GROSS Rev = $4.09 per ft²  
Overhead (structure) Costs = 11%
## Putting the Pieces Together

### Think About the Timing – Pest Cycles, Labor, etc.

<table>
<thead>
<tr>
<th>Yr 1</th>
<th>Grafted Tomatoes</th>
<th>Yr 6</th>
<th>Greens</th>
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<table>
<thead>
<tr>
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<th>Cucurbits/Melons</th>
<th>Yr 5</th>
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<tr>
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<th>Strawberries</th>
<th>Yr 4</th>
<th>Cover</th>
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<tbody>
<tr>
<td>Greens</td>
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<tr>
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<th>Peppers</th>
<th>Yr 6</th>
<th>Greens</th>
</tr>
</thead>
<tbody>
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<td>Cover</td>
<td></td>
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*January to December*
Summary

Using High Tunnels for Vegetable Production

• MAXIMIZE the benefit of the tunnel
• Manage soil moisture and humidity in the tunnel
• Variety selection -> Market niche
• Be generous on fertility
  – Potassium (K) is mega-important (tomatoes)
  – Tissue analysis is worth the time
• Watch for worms and be proactive at managing pests.
• SANITATION, SANITATION, SANITATION
QUESTIONS??