Undercover Research: Growing Sweet Cherries Under High Tunnels in Michigan

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High Tunnel Cherries

Tunnels are expensive and alter many production factors; the economics are more favorable when tunnels improve multiple factors (i.e., more than covers for cracking!)
Multibay (3-Season) Tunnels

Probably most suitable for growers:

- with non-ideal growing conditions
- whose clientele value local/regional or organic produce (i.e., farm markets, pick-your-own operations, or premium retailers)
- who can provide intensive management
Tunnel Management Objectives for Sweet Cherry Production?

Increased protection from:
- rain-induced fruit cracking
- rain-disseminated diseases
- spring frosts?
- wind damage to fruit
- altered early/late ripening
- harvest in any weather
- reduced chemical inputs
- bird protection
MSU Tunnel Cherry Project

Clarksville (CHES)
Three connected 8.6 x 49 m (28 x 160 ft) tunnels were established in 2005 in the middle of an existing high density sweet cherry orchard (planted in 2000)

Southwest (SWMREC)
Four connected 7.4 x 62 m (24 x 200 ft) tunnels; duplicate new research plots, + / - tunnels, planted in 2005

- Luminance polyethylene: transmits 88% PAR, 43% IR, partially screens UVA and UVB light
At CHES: Tunnels Established over Rainier, Lapins, and Sweetheart on Gisela 5 and 6

16 ft
SWMREC Tunnels - Whorled Axe (548 trees/acre)

Red: Skeena/Gi5
Blush: Rainier/Gi5
+ 42 Test Varieties

“Purpose-Built Tree Canopies”
Tunnel Orchard Floor Management
Black woven polypropylene weed barrier:
- control weeds without herbicides
- reduce host plants for bacteria or insects
- conserve soil moisture
- warm soil for earlier root activity in spring
- absorb heat for re-radiation in spring
- serve as a barrier for soil-emerging insects
- 2007-08 Extenday or Sun-Up applied after fruit set

Tree row weed barrier, grass tractor alley (CHES)
SWMREC: Optimization of Tree Canopy Architectures & Growth
Increased GDD, Reduced PAR

SWMREC Growing Degree Days
Total Accumulation from Bloom until Harvest

SWMREC Daily Light Integral
Accumulation From Plastic On to Plastic Off
The tunnels generally reduced wind gusts during fruiting by 5 to 10 mph.
Spring Temperature Management

2006-07: open ends & sides, slight protection from mild frosts
2008: closed ends & sides, daily heat effects, nightly heat loss
2009: closed ends & sides, supplemental heat retention?
High Density Sweet Cherry Tree Training

Early tree establishment; balanced, more horizontal growth

April 2008

June 2008
Impact of Season-Long Covers on Growth

Trees are up to 24% taller; leaf size is about 20% larger.

Trunk girth was 18% smaller in 2006, then increased by ~35%.

Lateral shoot length was clearly greater under tunnels.

Projected Year 4 Fruiting Area
Effect of Reflective Orchard Floor Fabric (Installed in 2007) on Tree Growth

<table>
<thead>
<tr>
<th>Cultivar / Rootstock</th>
<th>Increase in TCSA (cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tunnel</td>
</tr>
<tr>
<td></td>
<td>Extenday</td>
</tr>
<tr>
<td>Early Robin / Gi12</td>
<td>33.3</td>
</tr>
<tr>
<td>NY 119 / Gi 5</td>
<td>17.2</td>
</tr>
<tr>
<td>Rainier / Gi 5</td>
<td>19.7</td>
</tr>
<tr>
<td>Skeena / Gi 5</td>
<td>25.2</td>
</tr>
<tr>
<td>Ave</td>
<td>23.9</td>
</tr>
</tbody>
</table>

+34%
High Tunnels: Effects on Cropping and Fruit Quality

MSU Tree Fruit Research
## 2006 ‘Rainier’ Sweet Cherry Yield and Fruit Size, with and without High Tunnels (MSU-CHES)

<table>
<thead>
<tr>
<th></th>
<th>‘Rainier’/Gisela 5</th>
<th></th>
<th>‘Rainier’/Gisela 6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Covered (tunnel)</td>
<td>Open (no tunnel)</td>
<td>Covered (tunnel)</td>
</tr>
<tr>
<td><strong>Yield (lb/tree)</strong></td>
<td>30.1</td>
<td>55.2</td>
<td>22.0</td>
</tr>
<tr>
<td><strong>1Orchard Yield</strong></td>
<td>6.7</td>
<td>12.3</td>
<td>4.9</td>
</tr>
<tr>
<td>(ton/acre)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fruit Weight</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 fruit mean (g)</td>
<td>12.5</td>
<td>8.3</td>
<td>12.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fruit Size Distribution (%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 mm &amp; larger</td>
<td>73</td>
<td>3</td>
<td>81</td>
</tr>
<tr>
<td>26 to 29 mm</td>
<td>24</td>
<td>39</td>
<td>17</td>
</tr>
<tr>
<td>24 to 25 mm</td>
<td>3</td>
<td>38</td>
<td>2</td>
</tr>
<tr>
<td>23 mm &amp; smaller</td>
<td>1</td>
<td>20</td>
<td>0</td>
</tr>
</tbody>
</table>

1Tree density is 1083 trees/ha (446 trees/acre)
### 2007 ‘Rainier’ Sweet Cherry Yield and Fruit Size at MSU-CHES, with Bumblebee Pollinators

<table>
<thead>
<tr>
<th></th>
<th>‘Rainier’/Gisela 5</th>
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<tbody>
<tr>
<td><strong>Tree Yield</strong> (lb/tree)</td>
<td>Covered (tunnel) 47.1</td>
<td>Open (no tunnel) 44.9</td>
</tr>
<tr>
<td><strong>Orchard Yield</strong> (ton/acre)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fruit Weight</strong> 100 fruit mean (g)</td>
<td>10.4</td>
<td>9.9</td>
</tr>
</tbody>
</table>

Significantly improved blush in tunnel

1Tree density is 1083 trees/ha (446 trees/acre)
## 2008 ‘Rainier’ Sweet Cherry Yield, Fruit Size, and ‘Rainier’ & ‘Lapins’ Fruit Cracking at MSU-CHES

<table>
<thead>
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<td></td>
<td>Covered (tunnel)</td>
<td>Open (no tunnel)</td>
<td>Covered (tunnel)</td>
</tr>
<tr>
<td><strong>Tree Yield</strong> (lb/tree)</td>
<td>42.0</td>
<td>32.6</td>
<td>71.5</td>
</tr>
<tr>
<td><strong>Orchard Yield</strong> (ton/acre)</td>
<td>9.4</td>
<td>7.3</td>
<td>15.9</td>
</tr>
<tr>
<td><strong>Fruit cracking</strong> (%)</td>
<td>60</td>
<td>89</td>
<td></td>
</tr>
<tr>
<td><strong>Lapins fruit cracking (%)</strong></td>
<td>32</td>
<td>91</td>
<td></td>
</tr>
</tbody>
</table>
Rain-induced fruit cracking can occur even when fruit are kept dry, if the rainfall, humidity, soil, and temperatures are “right”; managing excess soil water is critical!

Drainage

Ground Gutters

Tunnel Gutters
High Tunnels: Effects on Insect and Disease Pests

In 2006-07, to determine the potential impact of tunnels on pest issues, no fungicides or insecticides were used at CHES.
Excellent non-chemical control of:
- Japanese beetle
- cherry leaf spot
- less incidence of bacterial canker but copper still needed
Additional Pest Control Issues:

- cherry fruit fly (soil barrier, spinosad)
- mites and aphids (predators)
- mildew (resistant varieties) and brown rot (no organic controls yet)
Target: A narrow tree canopy to create a “fruiting wall”, composed of very uniform fruiting units to facilitate precision in 1) optimizing Leaf Area-to-Fruit Number (LA:F) ratios for target fruit quality and 2) renewal of fruiting units.
Optimizing Space:

“fruiting wall” strategies
- the “UFO” system
- Marchand oblique canopy
- super slender axe
- palmette canopy

Management Issues:

- Cropping on spurs vs. non-spur flowers
- When and how to renew fruiting units
“Scouting” for Light; Summer Pruning & Training
Super Slender Axe
- potential for 2nd year yields
Fruiting Wall + Solid Set Canopy Delivery (SSCD) Spray System: Optimized Tunnels (29 ft [9 m] wide)?

A 5 ft row spacing = 140 ft³ tree volume = 3.8 ft³/ft²
Existing tree volume at CHES = 6 x 6 x 9 ft = 3.3 ft³/ft²
Solid-Set Canopy Spray Delivery System
High Tunnel Cherries

www.hrt.msu.edu/faculty/langg.htm

ASHS Podcasts (2007)
High Tunnel Cherries, Part I
High Tunnel Cherries, Part II

Research Project Posters
High Tunnel Cherry Poster 2006
High Tunnel Cherry Poster 2007

Research Project Presentations
2007 High Tunnel Cherry Project Report

2008 Great Lakes Expo High Tunnel Workshop - Cherries
MSU Tree Fruit Research

Questions?

In-Kind support:
Haygrove Tunnels
Summit Tree Sales
Willow Drive Nursery
C&O Nursery
Int’l Plant Management
Klerks USA Plastics
Sun-Up Films

(http://www.hrt.msu.edu)