

# Undercover Research: Growing Sweet Cherries Under High Tunnels in Michigan

Gregory Lang  
Michigan State University



## 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



*Photo courtesy of Phil Schwallier*

# SWMREC Tunnels - Whorled Axe (548 trees/acre)

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



“Purpose-Built Tree Canopies”

MSU Tree Fruit  
Research 

## 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

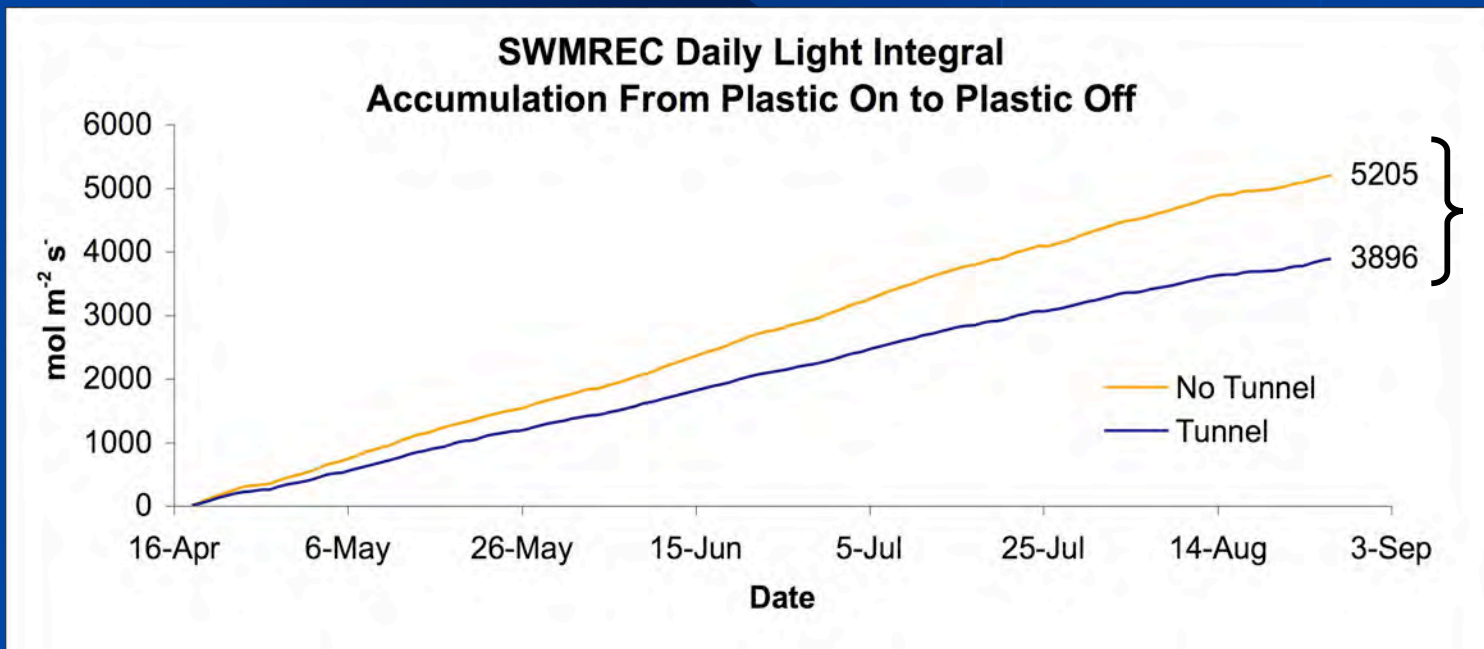
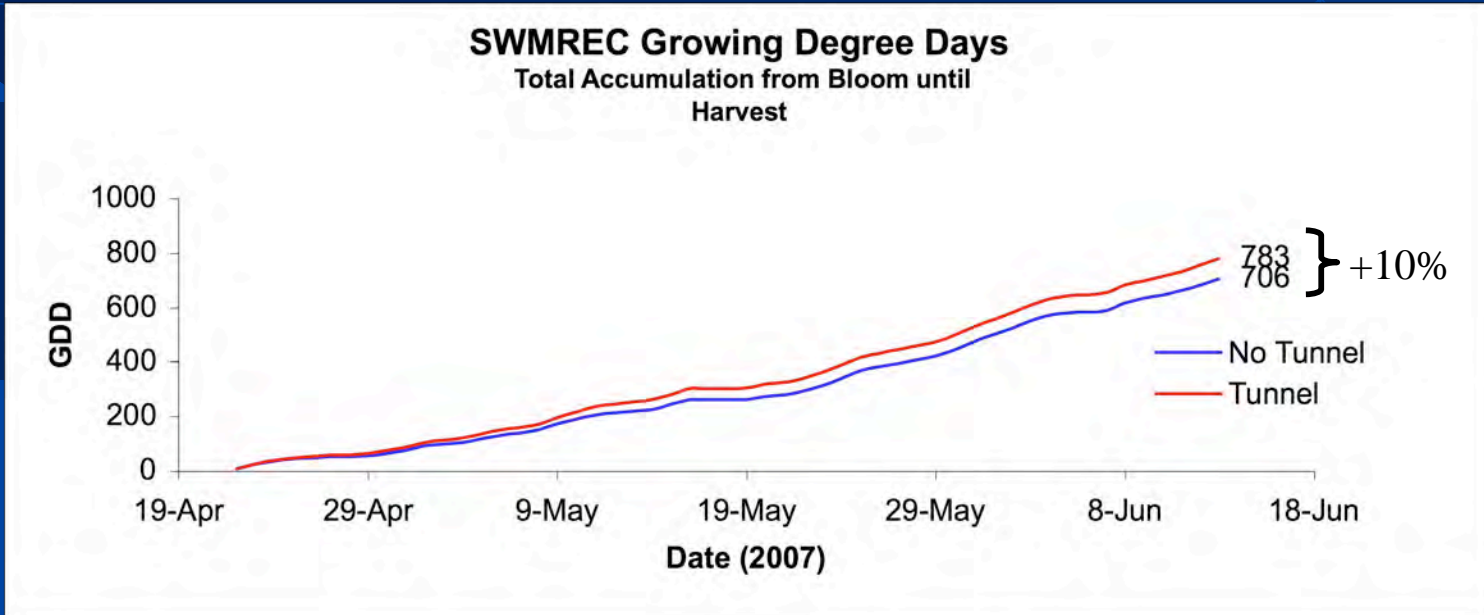
← Tree row weed barrier,  
grass tractor alley (CHES)



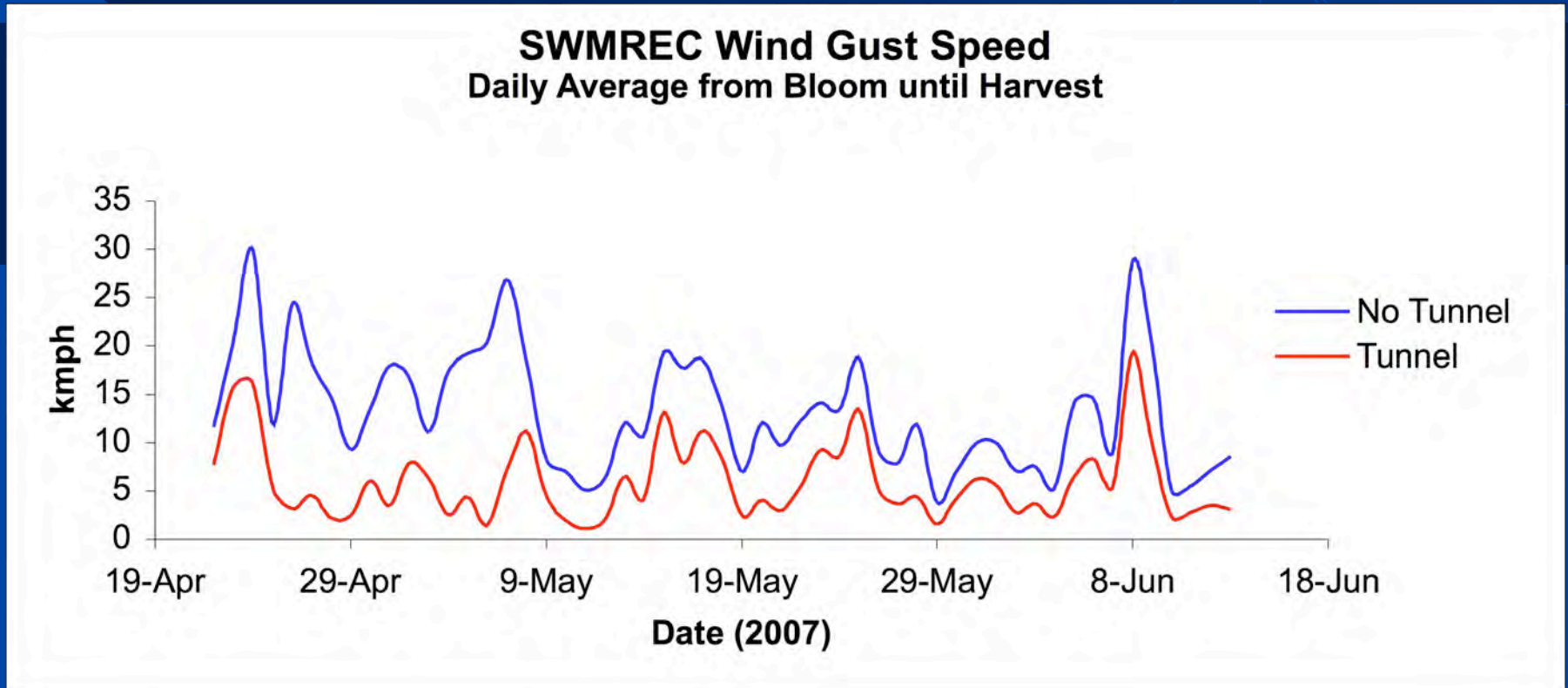
# **SWMREC: Optimization of Tree Canopy Architectures & Growth**



# Increased GDD, Reduced PAR



# Tunnels Reduce Wind Through the Orchard



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?**

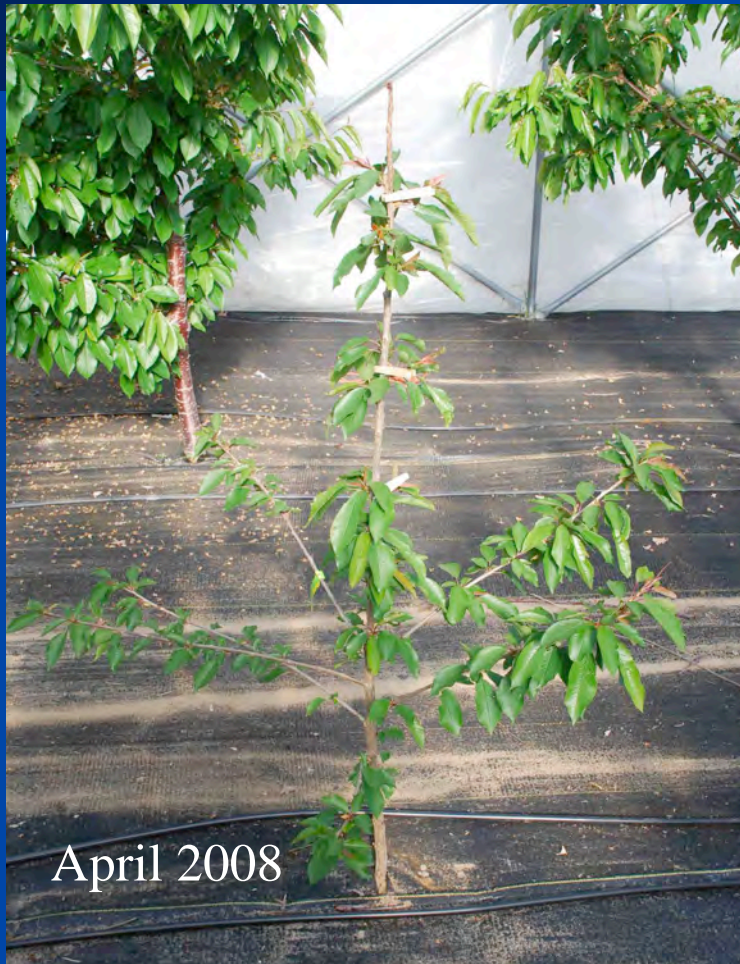


**MSU Tree Fruit  
Research**



# High Density Sweet Cherry Tree Training

Early tree establishment;  
balanced, more horizontal growth



# Impact of Season-Long Covers on Growth

Trees are up to 24% taller; leaf s

Trunk girth was 18% sm  
then increased by ~35%

Lateral shoot lengt  
greater under tunne



Projected Year 4  
Fruiting Area

# Effect of Reflective Orchard Floor Fabric (Installed in 2007) on Tree Growth



Cultivar / Rootstock	Increase in TCSA (cm <sup>2</sup> )			
	Tunnel		No Tunnel	
	Extenday	No Extenday	Extenday	No Extenday
Early Robin / Gi12	33.3	20.0	16.8	11.5
NY 119 / Gi 5	17.2	13.4	18.4	13.4
Rainier / Gi 5	19.7	19.7	15.0	12.2
Skeena / Gi 5	25.2	18.2	18.0	18.1
Ave	23.9	17.8	17.1	13.8

+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)



	<u>'Rainier'/Gisela 5</u>		<u>'Rainier'/Gisela 6</u>	
	<u>Covered</u> <u>(tunnel)</u>	<u>Open</u> <u>(no tunnel)</u>	<u>Covered</u> <u>(tunnel)</u>	<u>Open</u> <u>(no tunnel)</u>
<i>Yield</i> (lb/tree)	30.1	55.2	22.0	50.0
<sup>1</sup> <i>Orchard Yield</i> (ton/acre)	6.7	12.3	4.9	11.2
<i>Fruit Weight</i> 100 fruit mean (g)	12.5	8.3	12.5	9.3
	<i>Fruit Size Distribution (%)</i>			
30 mm & larger	73	3	81	9
26 to 29 mm	24	39	17	62
24 to 25 mm	3	38	2	25
23 mm & smaller	1	20	0	4

<sup>1</sup>Tree density is 1083 trees/ha (446 trees/acre)

# 2007 'Rainier' Sweet Cherry Yield and Fruit Size at MSU-CHES, with Bumblebee Pollinators



	<u>'Rainier'/Gisela 5</u>		<u>'Rainier'/Gisela 6</u>	
	<u>Covered (tunnel)</u>	<u>Open (no tunnel)</u>	<u>Covered (tunnel)</u>	<u>Open (no tunnel)</u>
<i>Tree Yield</i> (lb/tree)	47.1	44.9	49.7	48.4
<i><sup>1</sup>Orchard Yield</i> (ton/acre)				
<i>Fruit Weight</i> 100 fruit mean (g)	10.4	9.9	11.2	9.6



Significantly improved blush in tunnel

<sup>1</sup>Tree density is 1083 trees/ha (446 trees/acre)

## 2008 'Rainier' Sweet Cherry Yield, Fruit Size, and 'Rainier' & 'Lapins' Fruit Cracking at MSU-CHES

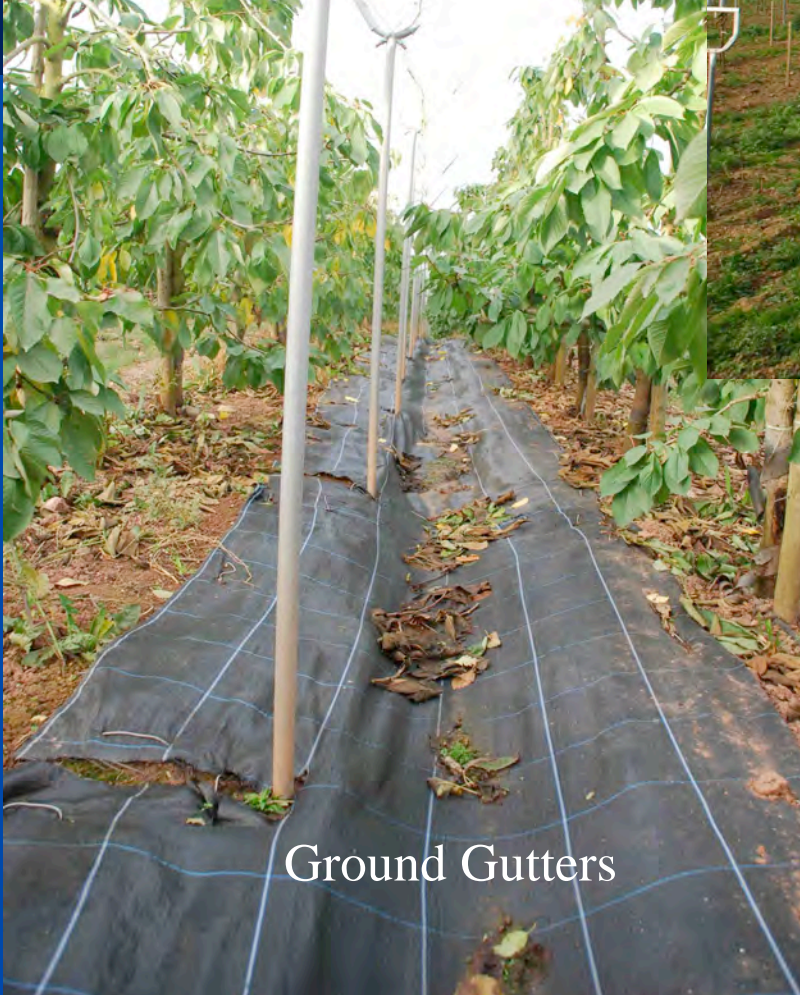


	<u>'Rainier'/Gisela 5</u>		<u>'Rainier'/Gisela 6</u>	
	<u>Covered</u> <u>(tunnel)</u>	<u>Open</u> <u>(no tunnel)</u>	<u>Covered</u> <u>(tunnel)</u>	<u>Open</u> <u>(no tunnel)</u>
<i>Tree Yield</i> (lb/tree)	42.0	32.6	71.5	28.8
<i>Orchard Yield</i> (ton/acre)	9.4	7.3	15.9	6.4
<i>Fruit cracking</i> (%)	60	89		
<i>Lapins fruit</i> <i>cracking (%)</i>	32	91		





Tunnel Gutters



Ground Gutters

## Drainage

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!

# 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

MSU Tree Fruit  
Research





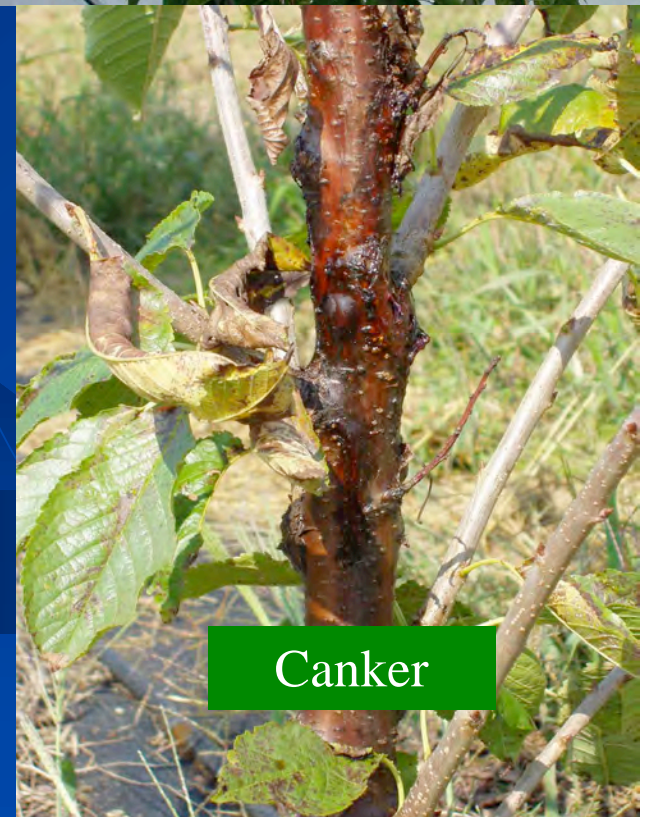
Japanese Beetle



Leaf Spot

Excellent non-chemical control of:

- Japanese beetle
- cherry leaf spot
- less incidence of bacterial canker but copper still needed



Canker

## Additional Pest Control Issues:

- cherry fruit fly (soil barrier, spinosad)
- mites and aphids (predators)
- mildew (resistant varieties) and brown rot (no organic controls yet)



Aphids



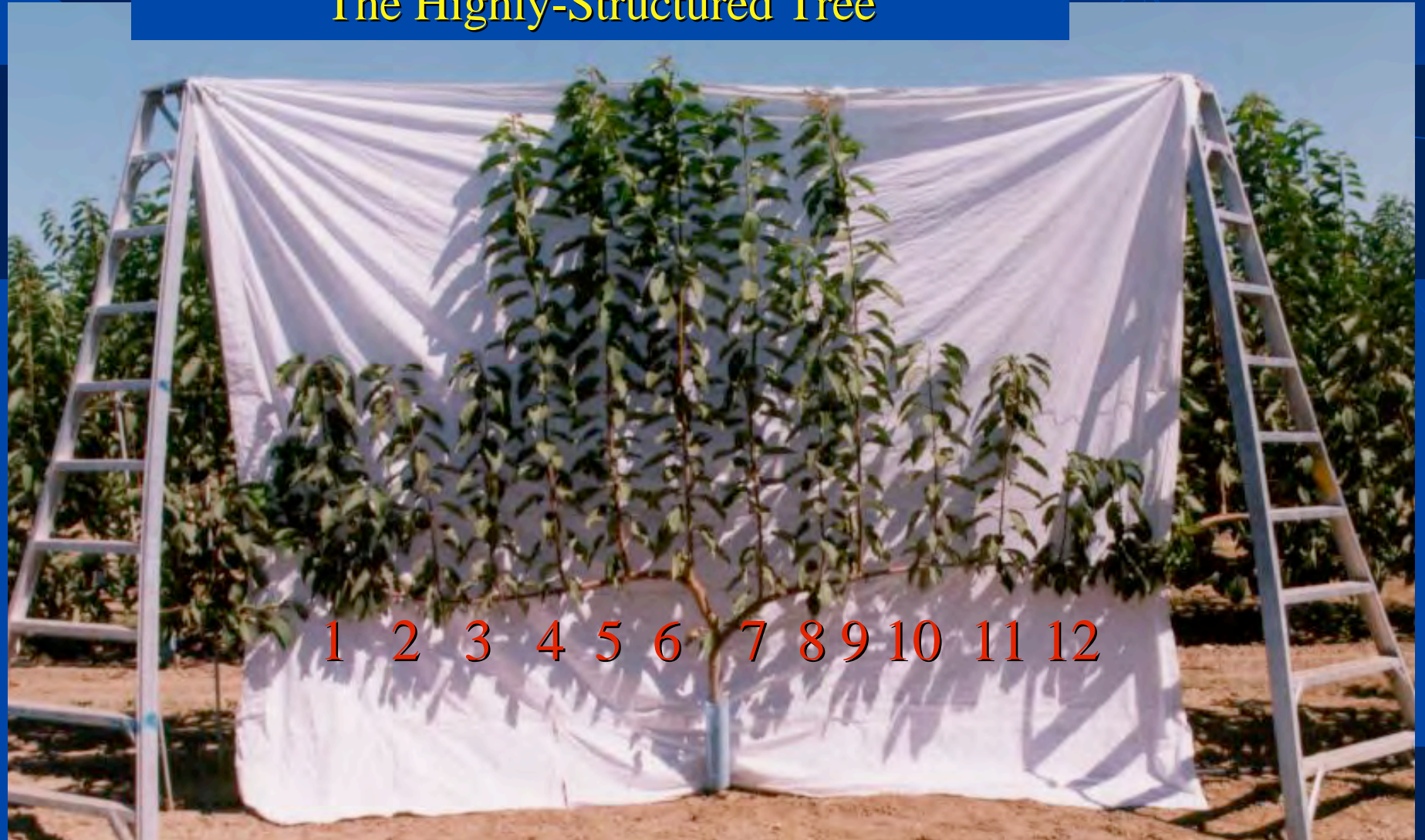
Powdery Mildew



Brown Rot

## Strategies to Optimize Precision Cropping: The Highly-Structured Tree

*MSU/Tree Fruits*



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

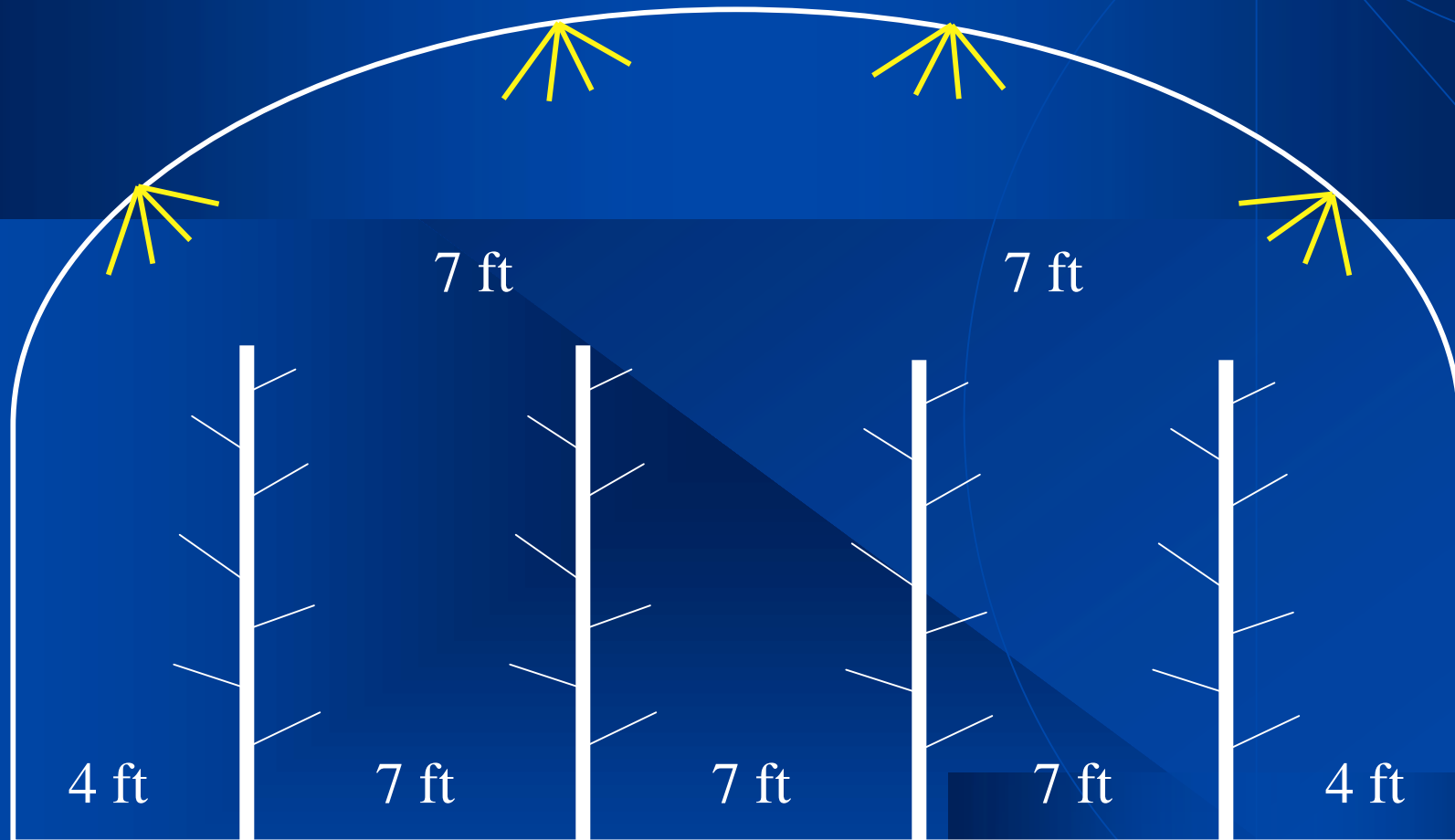
**“Scouting” for Light;  
Summer Pruning & Training**



**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 =  $140 \text{ ft}^3$  tree volume =  $3.8 \text{ ft}^3/\text{ft}^2$

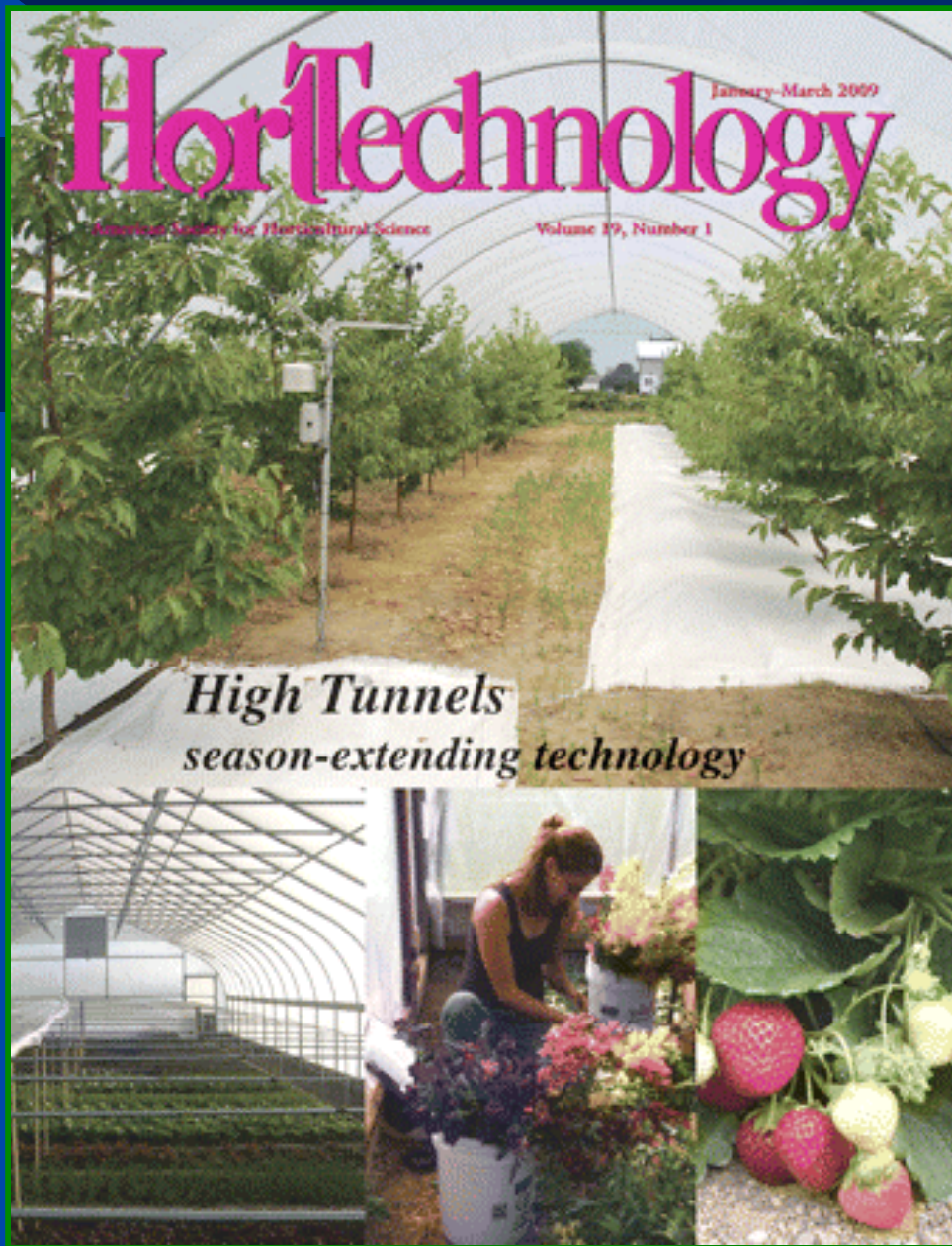
Existing tree volume at CHES =  $6 \times 6 \times 9 \text{ ft} = 3.3 \text{ ft}^3/\text{ft}^2$



Solid-Set Canopy  
Spray Delivery System



Solid-Set Canopy  
Spray Delivery System



## High Tunnel Cherries

[www.hrt.msu.edu/faculty/langg.htm](http://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](#)

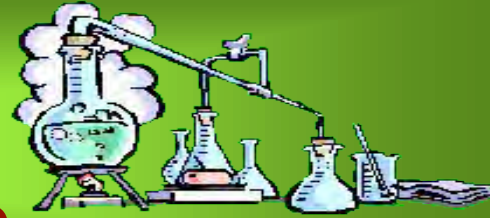
### Research Project Presentations

[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 Managemt  
Klerks USA Plastics  
Sun-Up Films



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