

Ten Years of Studies on Systems to Modify the Sweet Cherry Production Environment: Retractable Roofs, High Tunnels, and Rain-Shelters



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Two Types of Cherry Fruit Cracking



Type 1: Rain on Fruit Skin

Cracking at the tip (stylar end) or bowl (stem end) due to long fruit contact with rainwater.

Eliminated with protective covers (reduced with some water-resistant fruit coatings)

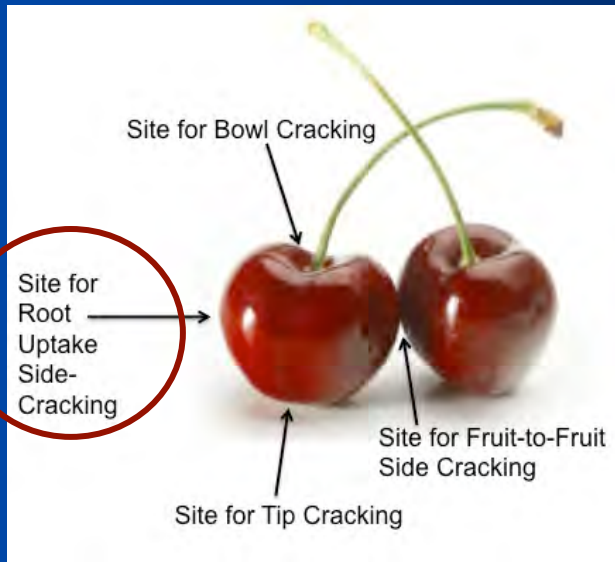
Two Types of Cherry Fruit Cracking



Type 1: Rain on Fruit Skin

Cracking at the tip (styler end) or bowl (stem end) due to long fruit contact with rainwater.

Eliminated with protective covers (reduced with some water-resistant fruit coatings)



Type 2: Excessive Water in the Soil

Fruit side cracking (due to rain or irrigation water taken up by the roots and pumped into the fruit (*especially when leaves have low evapotranspiration*)).

Can occur even with protective covers; must manage soil moisture and drainage!

Protected Tree Fruit Production = Localized Climate Change



Pole and Cable Tent Structures:

- least expensive, movable vs. fixed, venting

Three- vs. Four-Season High Tunnels:

- multi-bay, snow loads, single layer plastic, heat

Greenhouse-like, Automated Structures:

- most expensive, most manipulation options



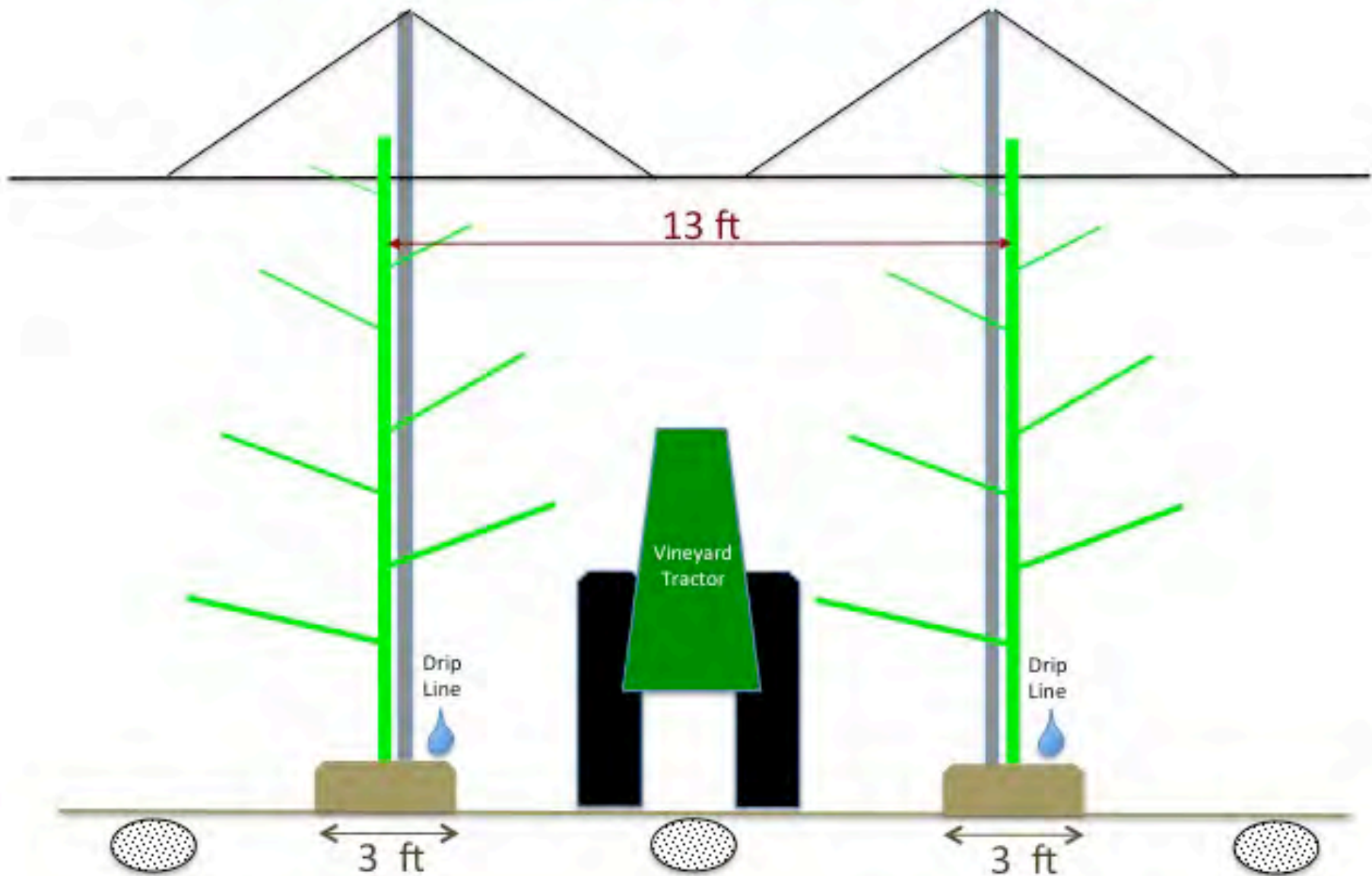


Fixed or Hand-
pulled Pole and
Cable Covers



Vented Covers (VOEN) – Fixed protection from rain and hail; passive venting of heat in summer

13 ft Pole-Cable Tent Covers: TSA (6 ft spacing, 558 trees/acre) Conical Fruiting Wall + Tractor Sprayer + Berm (3 ft x 1 ft) + Drain Tile





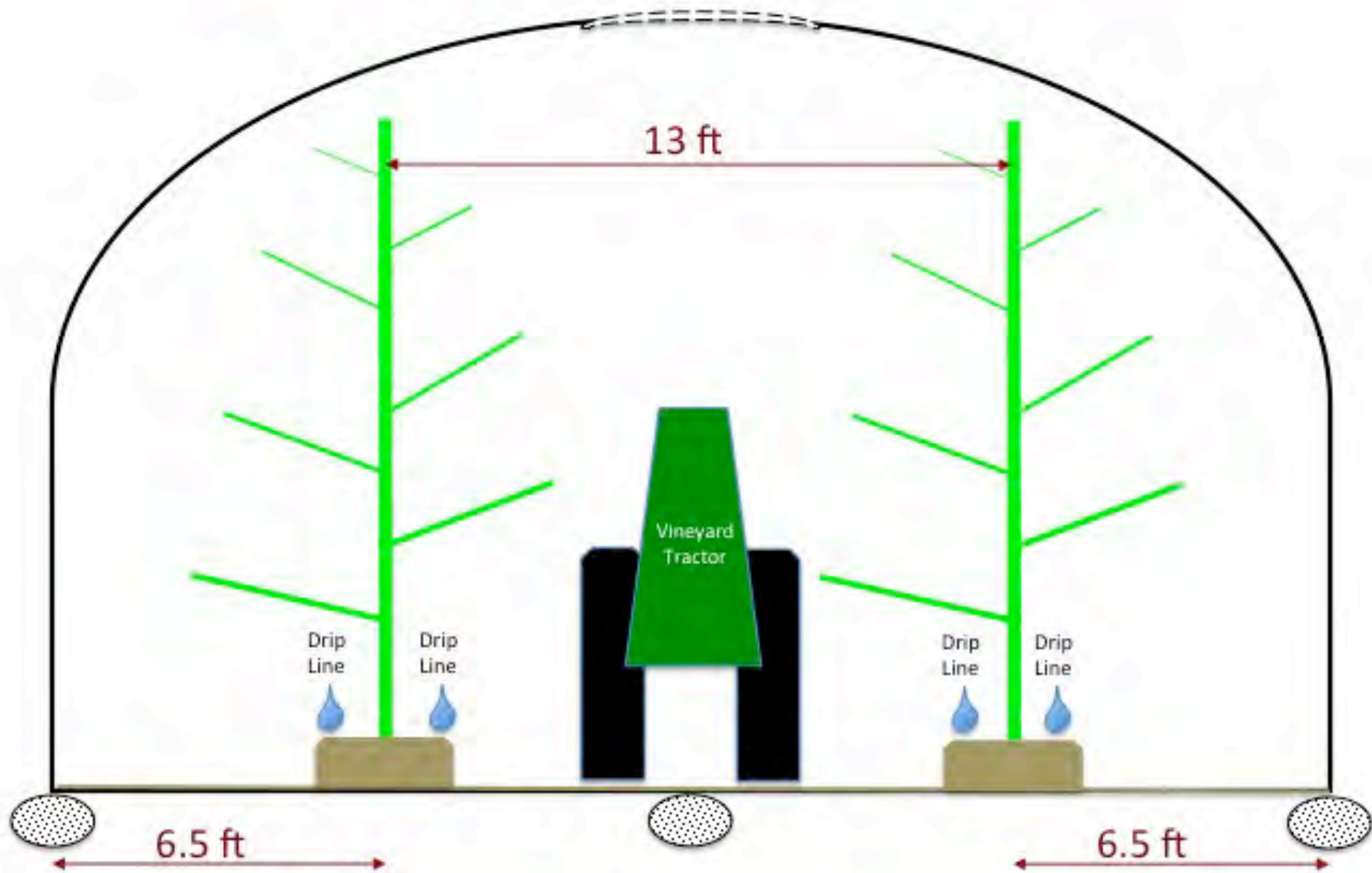
Multi-Bay High Tunnels



Multi-Bay High Tunnels with doors and bird nets

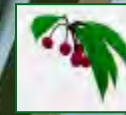


26 ft Tunnel: TSA (6 ft spacing, 558 trees/acre) Conical Fruiting Wall + Tractor Sprayer + Berm (3 ft x 1 ft) + Drain Tile + Netted Plastic



Programmable Retractable Roof Covered Sweet Cherries





Gutters to remove rainfall

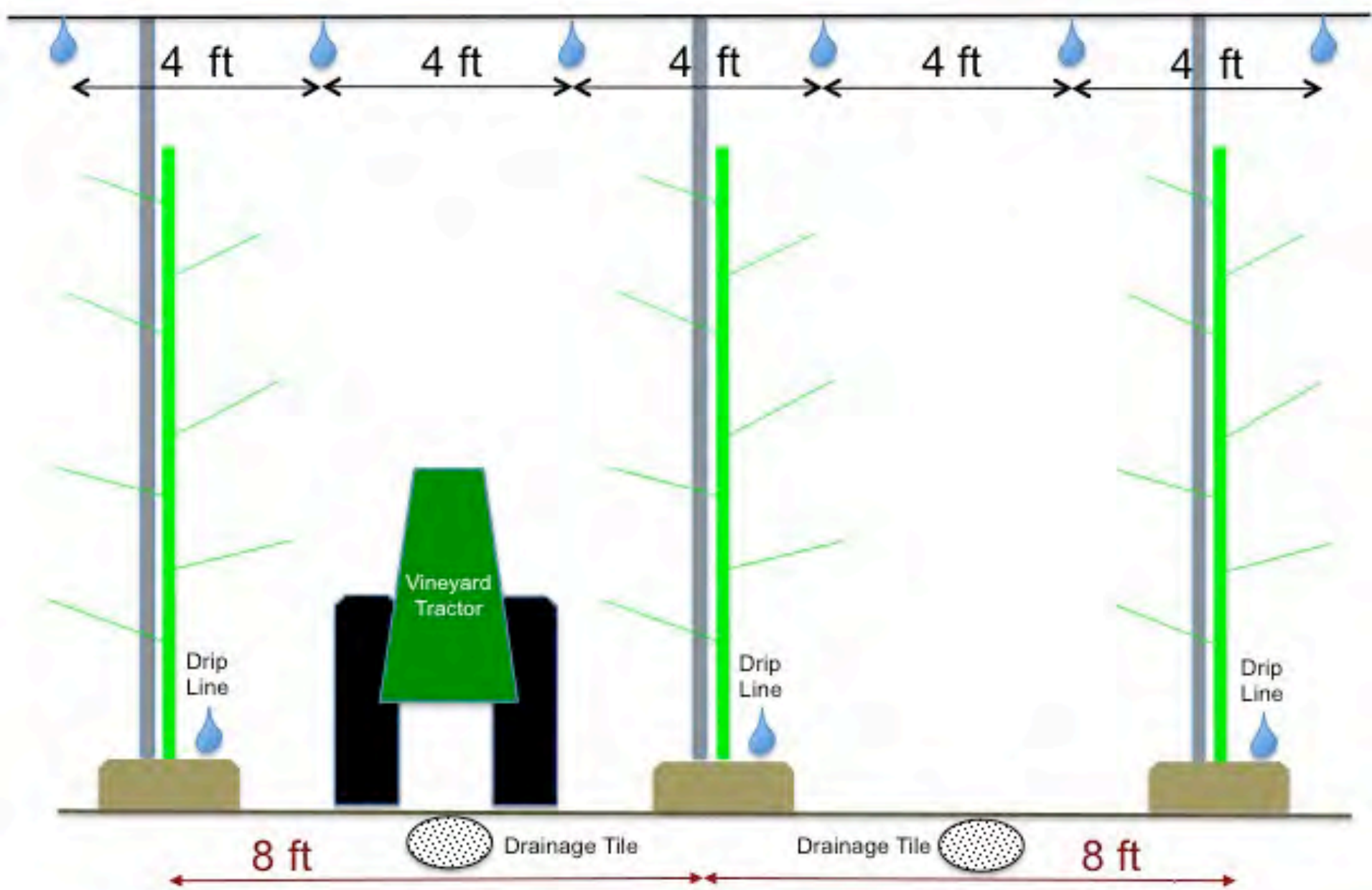


Roof Panels Open and Close in Response to Rain, Wind, and High and Low Temperature Set-Points to Optimize Growing Conditions (Cravo X-frame)



Retractable Flat-Roof with drainage slits; retractable benefits, lower cost, less control of Type 2 cracking

8 Ft Flat Roof Retractable Covers: UFO (6 ft spacing, 907 trees/acre) or SSA (3 ft spacing, 1815 trees/acre) Vertical Fruiting Walls + Tractor Sprayer





MSU Tunnel Fruit Projects



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MSU Hort Farm (HTRC, 2010)

Nine multibays 8.0 x 62 m (26 x 200 ft)

Organic cherry and raspberry production systems

Clarksville (CHES, 2005)

Three multibay 8.6 x 49 m (28 x 160 ft) tunnels

(Haygrove) initially cherries, now planted to apricots, plums, nectarines

2012 Cherries – Cravo retractable X-frame roof (7 rows), VOEN cover (5 rows)

2013 Cherries – Cravo retractable flat roof structure

Southwest (SWMREC, 2005)

Eight multibays 7.4 x 62 m (24 x 200 ft)

cherries, raspberries, strawberries, blackberries

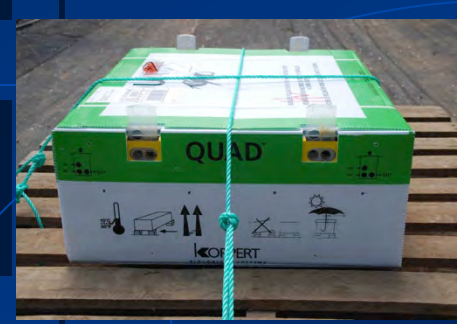


Cover First or Plant First? Impact of Covers on Growth



Earlier leaf area and fruiting structure development = higher early fruit yields

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

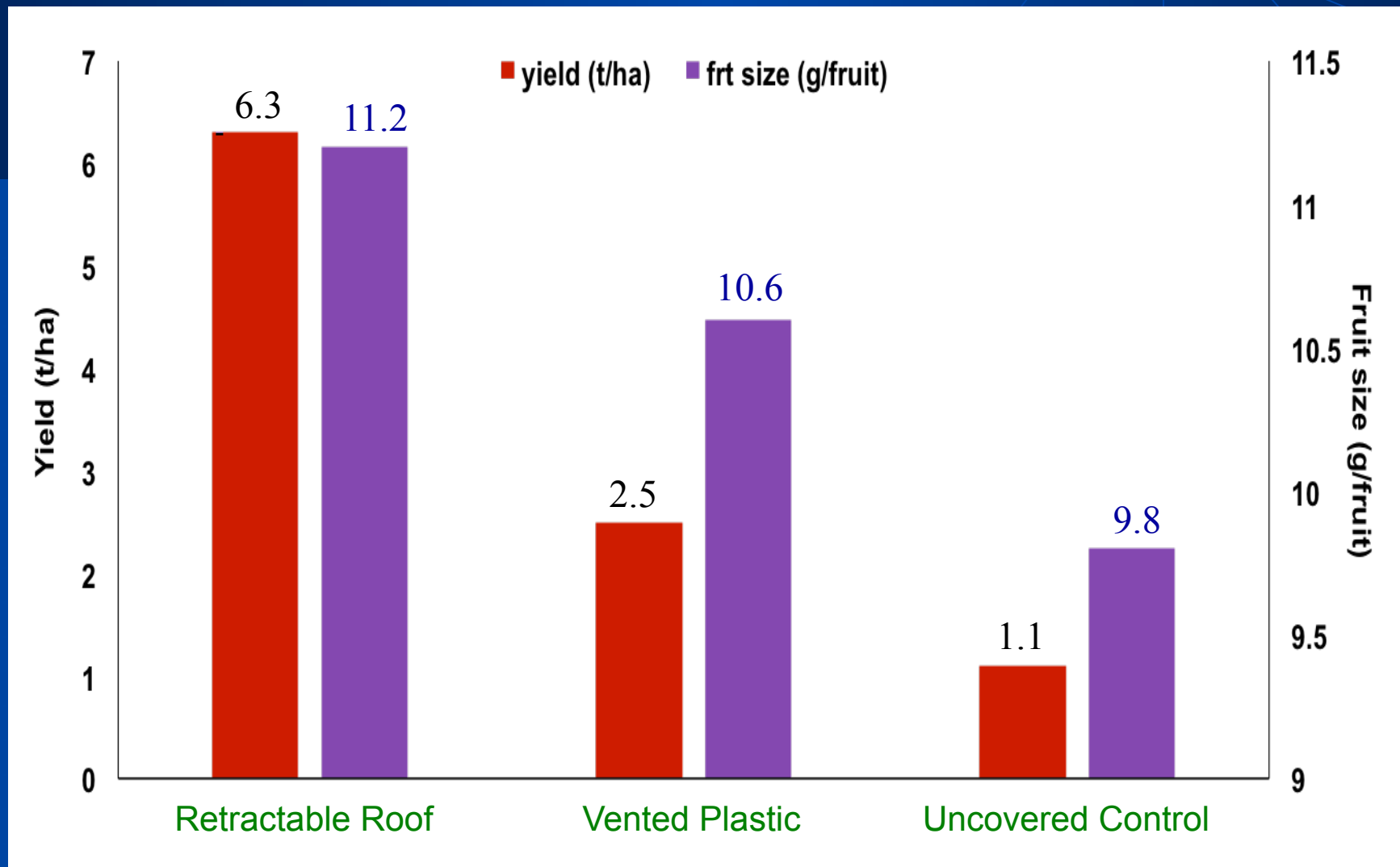


	<u>'Rainier' /Gisela 5</u>		<u>'Rainier' /Gisela 6</u>	
	<u>Covered</u> <u>(tunnel)</u>	<u>Open</u> <u>(no tunnel)</u>	<u>Covered</u> <u>(tunnel)</u>	<u>Open</u> <u>(no tunnel)</u>
<i>Tree Yield</i> (kg/tree)	21.4	20.4	22.6	22.0
¹ <i>Orchard Yield</i> (ton/ha)	22.9	21.8	24.2	23.6
<i>Fruit Weight</i> 100 fruit mean (g)	10.4	9.9	11.2	9.6

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



2014 Covering Systems: Yield and Fruit Size



MSU Tunnel Research: 80,000 BTU Propane Heaters;
for every $+1^{\circ}\text{C}$, need ~ 13 heaters/ha



Cravo Heating: for every $+1^{\circ}\text{C}$, need ~ 4.5 heaters/ha





2009 SWMREC 'Rainier' Harvest, GDH Effects

<u>Date</u>	<u>Plot (cover date)</u>	<u>Diam</u>	<u>Wt (g)</u>	<u>Brix</u>
6/22	Tunnel 4 (13 Mar)	34	15.5	18.8
	Tunnel 3 (20 Mar)	32	13.2	17.4
	Tunnel 2 (27 Mar)	31	11.8	17.7
	Tunnel 1 (8 Apr)	28	9.1	15.8
	No Tunnel	25	7.0	14.3



Solid-Set Canopy Spray Systems



On-Hoop Orientation



Over-Row Orientation

Mist Cooling to Delay Spring Budbreak (Jim Flore)

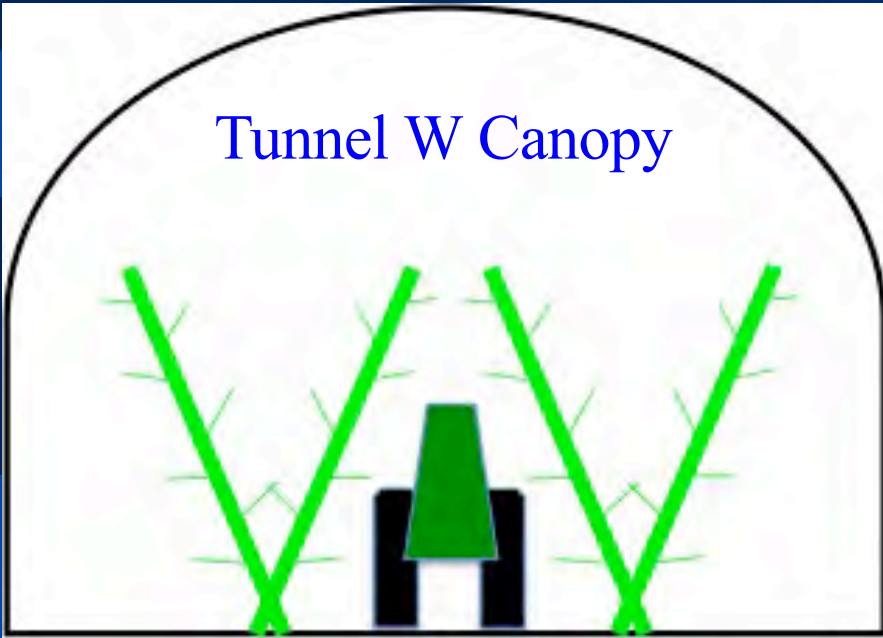


Bloom delay of 7-10 days (2013); longer is feasible

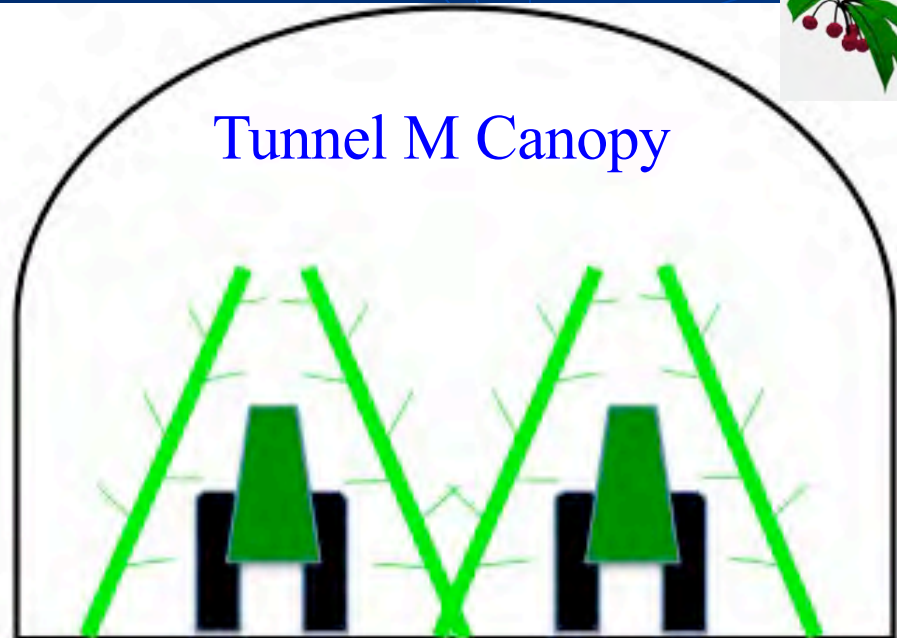




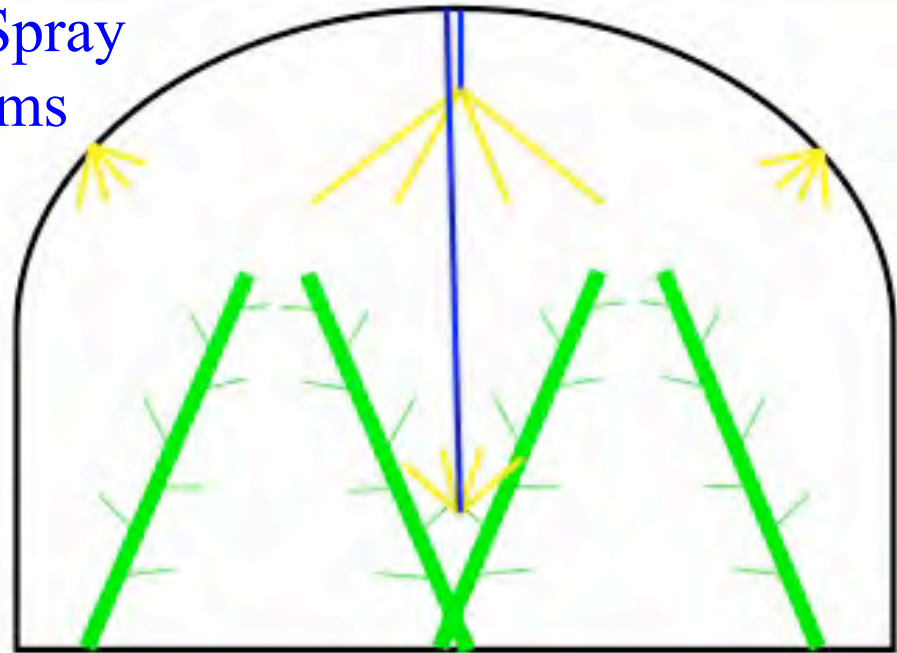
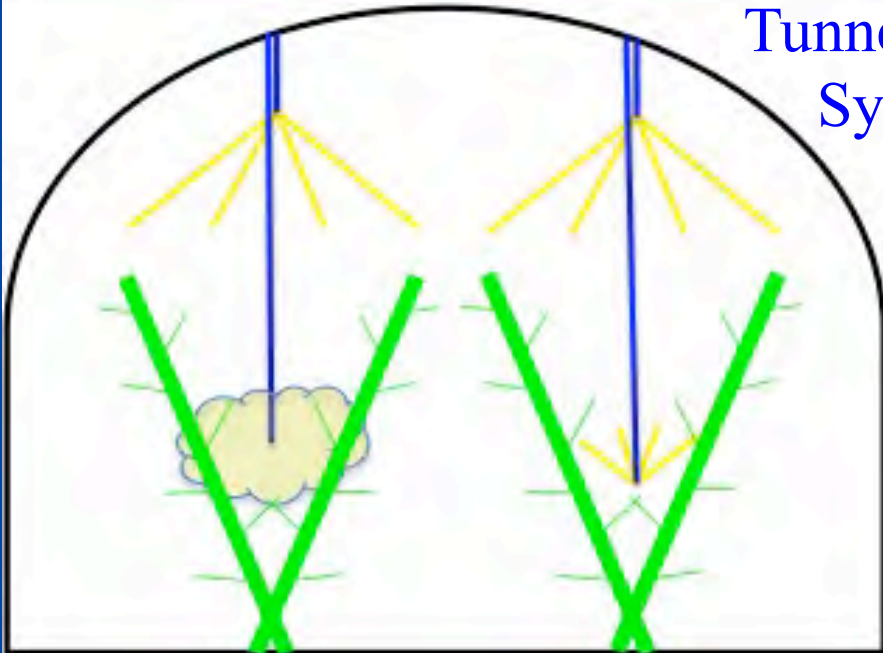
Tunnel W Canopy



Tunnel M Canopy



Tunnel Spray Systems



Covering Systems: Protective Attributes



	Pole and Cable			High Tunnel			Programmable Retraction	
	Fixed, Non-Vented	Retract-able	Fixed, Net-Vented		Roof Non-Vented	Roof Net-Vented	Flat Roof w/ Drainage Slits	Peaked Roof with Gutters
<i>Protection from:</i>								
Type 1 fruit cracking	X	X	X		X	X	X	X
Type 2 fruit cracking*	-	-	-		-	-	-	X
Spring frost	~	~	-		+	-	++	++
Hail, wind	+	-/+	+		++	++	++	++
<i>Pseudo-monas</i>	~	-	+		++	+	++	++
<i>Blumeriella</i>	+	-	+		+++	+++	+++	+++

Covering Systems: Other Attributes



	Pole and Cable			High Tunnel		Programmable Retraction	
	Fixed, Non-Vented	Retractable	Fixed, Net-Vented	Roof Non-Vented	Roof Net-Vented	Flat Roof w/ Drainage Slits	Peaked Roof with Gutters
<i>Other effects:</i>							
Early bloom & ripening	-	-	-	+	-	++	++
Sequenced ripening	-	-	-	++	-	-	-
Advanced foliation	-	-	-	++	+	++	++
Full light	-	+	-	-	-	+	+
Fruit blush formation	~	+	-	-	~	+	+
Excessive heat	~	-	-	+	-	-	-
<i>Cost</i>	\$	\$	\$\$	\$\$	\$\$+	\$\$\$+	\$\$\$\$\$+



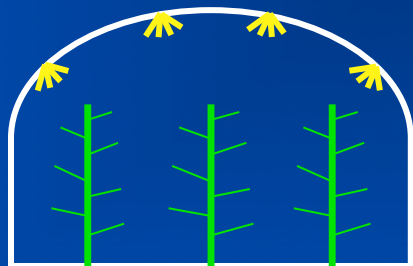
For additional information, see:

Greg Lang's MSU Website:

www.hrt.msu.edu/greg-lang

The MSU Cherry Website:

www.cherries.msu.edu



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