

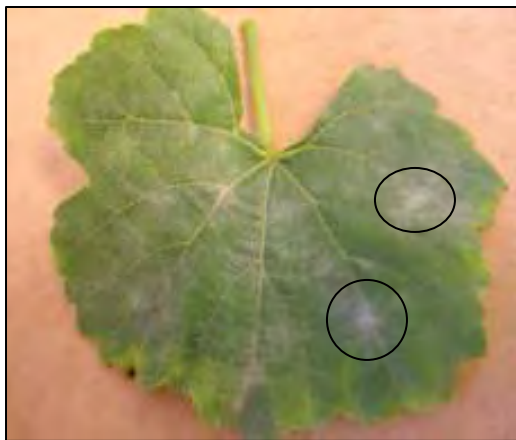
Control of Powdery Mildew in Wine Grape



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Powdery mildew

- *Uncinula necator*
- Infection appears as a white or gray powdery coating on leaves or fruit
 - Consists of fungal thread (mycelium) and spores

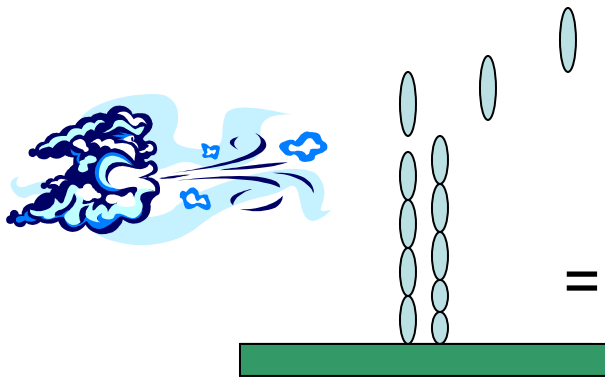


Life Cycle...



Cleistothecia are small, brown to black fruiting bodies produced by the fungus in late summer. These remain in crevices on the bark over winter and release spores during spring rains

Ascospores are discharged from cleistothecia and cause the primary infection. One ascospore infection can lead to production of thousands of conidia



Conidia are the asexual spores that cause secondary infections throughout the season. They are spread by wind



Conidia on grape leaf

Notice! The chains of spores that can be moved by wind.

Photo courtesy P. Sholberg, Agriculture & AgriFood Canada.

Weather and Powdery Mildew

- Primary infection requires a rainfall event for cleistothecia to release spores
- Secondary infection/conidia germinate under high humidity and warm temperatures
- Thrives in hot/dry
 - Unusual for fungi



Fruit Infections

- Wine grape
 - Severely infected fruit unusable
 - Imparts off-flavors and color
 - Wine made from PM-infected grapes is poor quality
 - Predisposes fruit to Botrytis bunch rot and sour rot



The recent problem...

- Increased disease pressure in hot/dry years
- In 2006, large proportion of winegrape acreage lost to PM
 - One grower estimated losses over \$49,000
 - Currently rely on strobilurins, SI's, and sulfur

The problem, cont.

- Dependence on strobilurins and SI's
 - Growers have observed reduced efficacy in field
- PM are obligate parasites (cannot live independently from host)
 - Resistance can develop more quickly
 - Documented resistance in New York and Ontario
 - Is there resistance in Michigan?

Research Goals

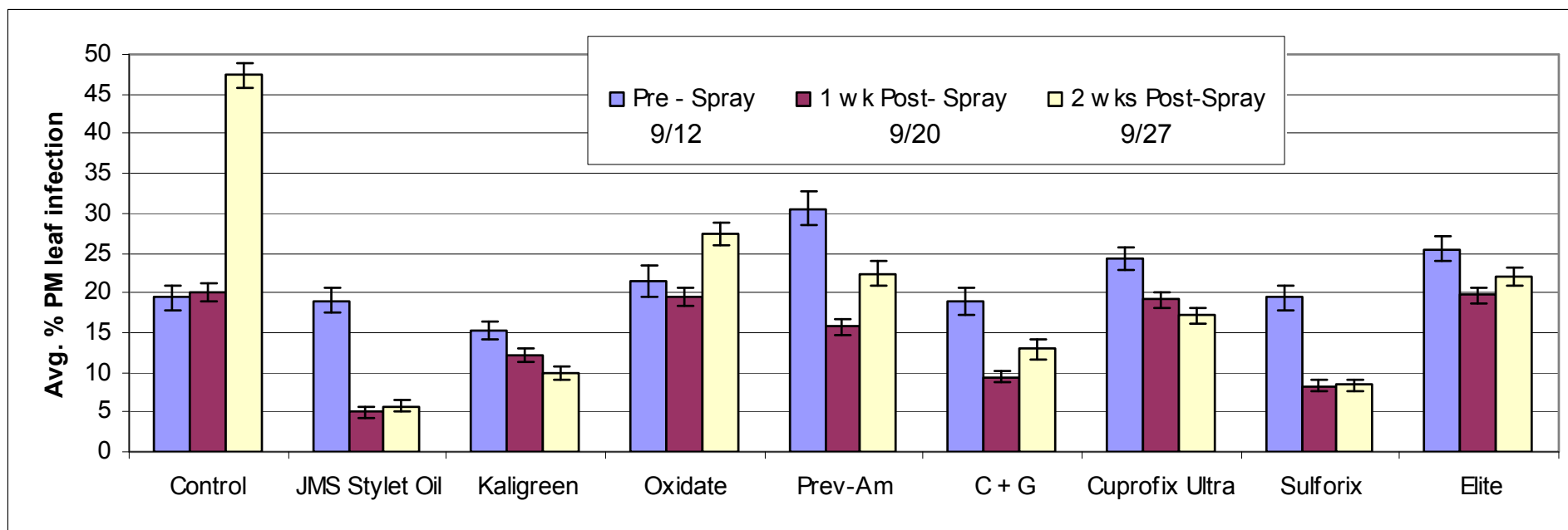
- Determine if PM in tart cherries and wine grapes is resistant to SI's and strobilurins
- Design sustainable, effective fungicide programs to minimize resistance
- Evaluate products for their potential to **eradicate** the fungus after infection
 - Grower observe PM after infection is well-established
 - Once established, PM is difficult to eradicate

Fungicide Eradication Trial, NWMHRS

- Variety: Pinot Noir
- 8 products tested in 2007 and 2008:
 - JMS Stylet Oil, Kaligreen, Sulfur, PrevAm, C + G, Cuprofix Ultra, Sulforix, Elite
- Rated percent leaf infection
- Counted cliestothecia



Fungicide Eradication Results, NWMHRS 2007



Promising Eradicants:

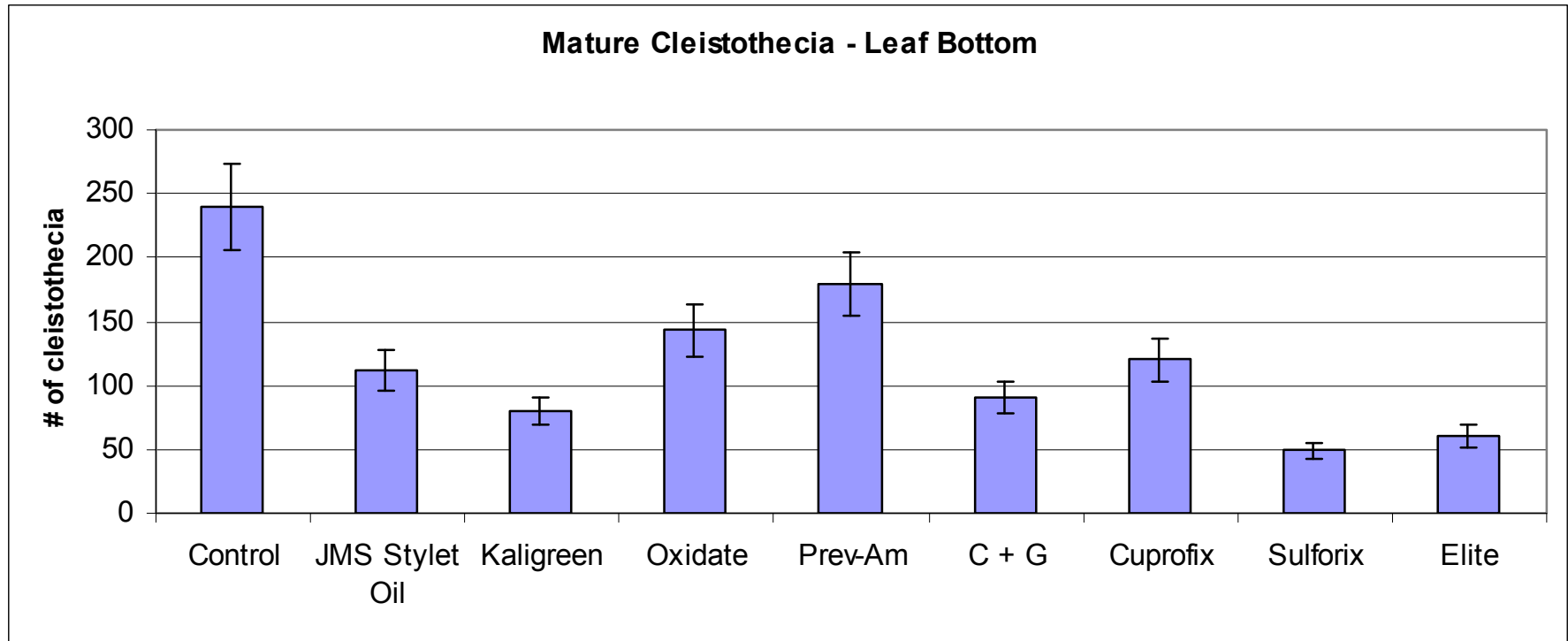
JMS Stylet oil

Prev-Am: sodium tetraborohydrate decahydrate (1%)/99% other (citrus)

C+G: food grade chemicals (organic acids)

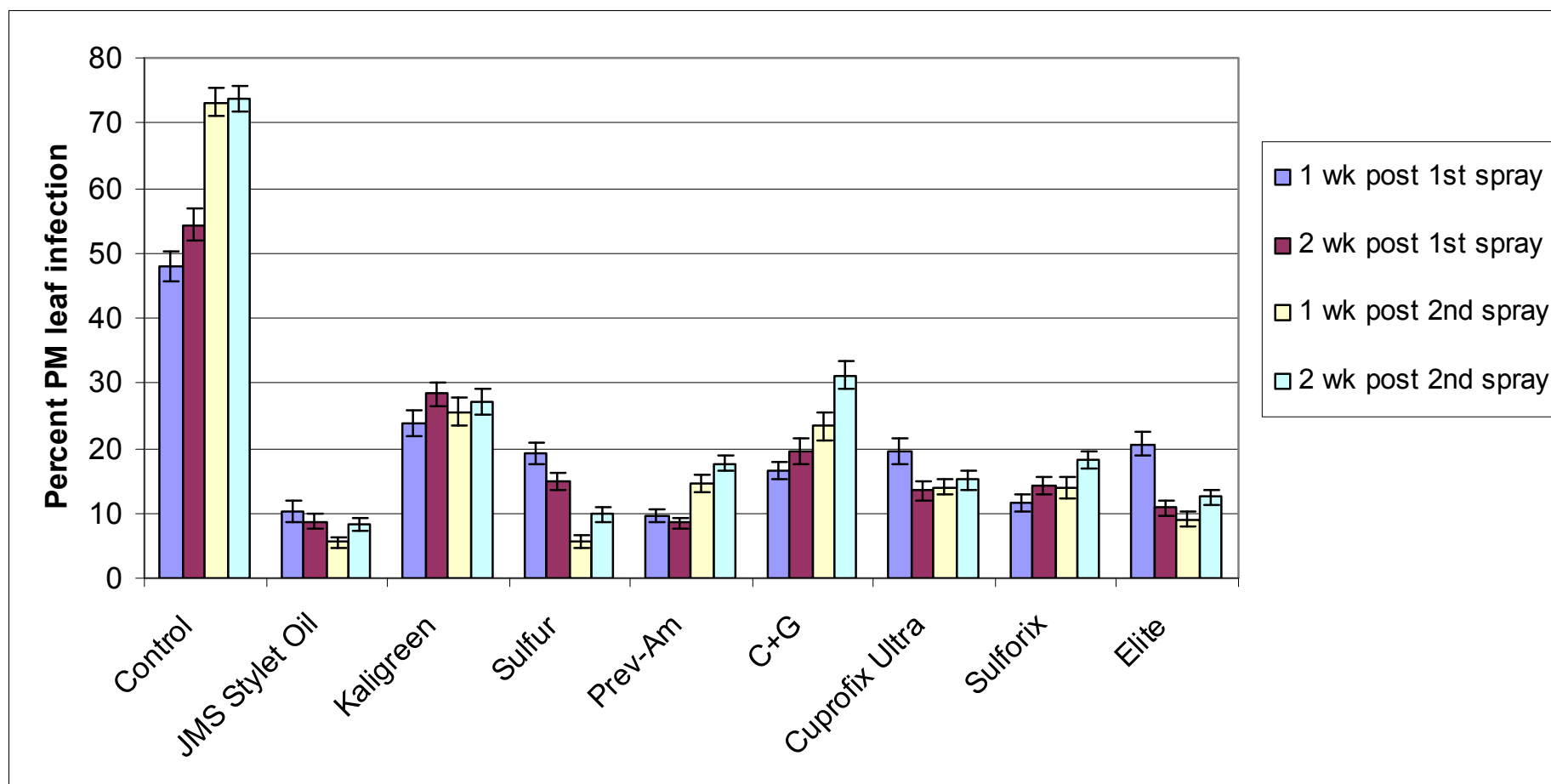
Sulfurix: Calcium polysulfides

Fungicide Eradication Trial - Cleistothecia 2007



Cleistothecia counted on October 17

Fungicide Eradication Results, NWMHRS 2008



First application on August 5

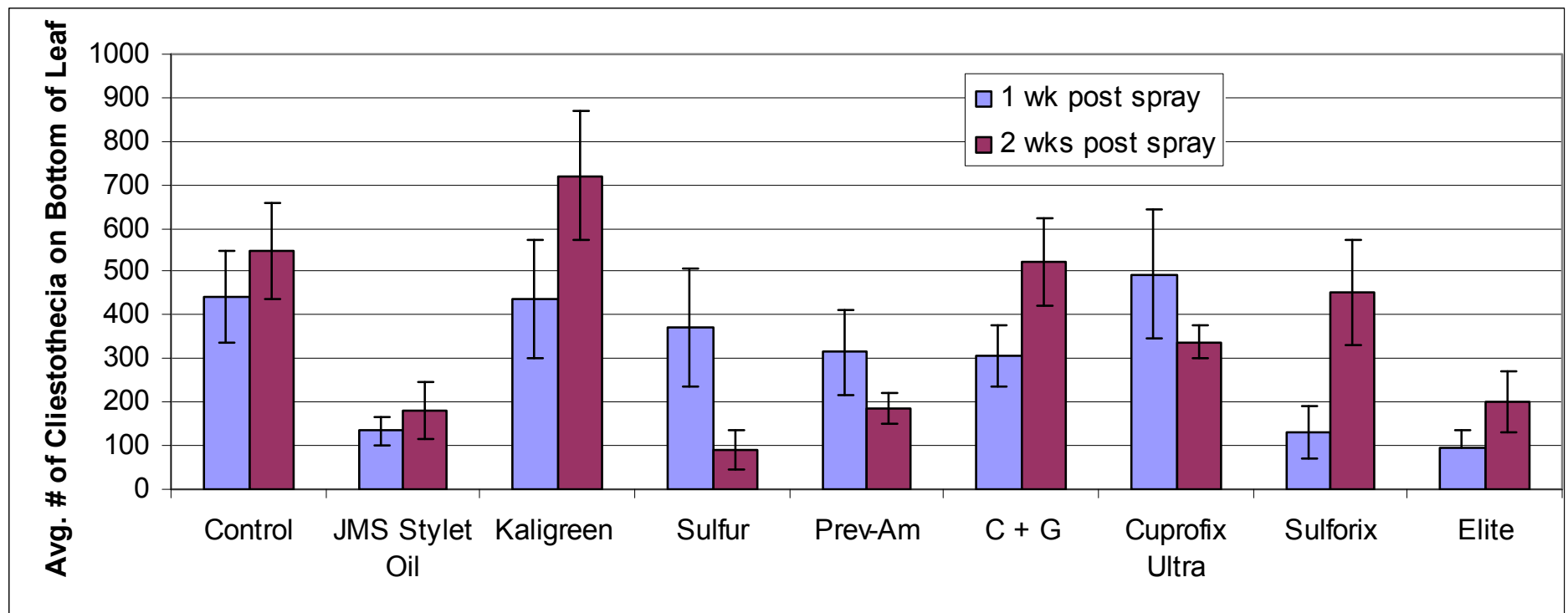
-rated for infection on 8/11 and 8/20

Second application on August 26

-rated for infection on 9/8 and 9/18

Fungicide Eradication Trial, *Cliestothechia* 2008

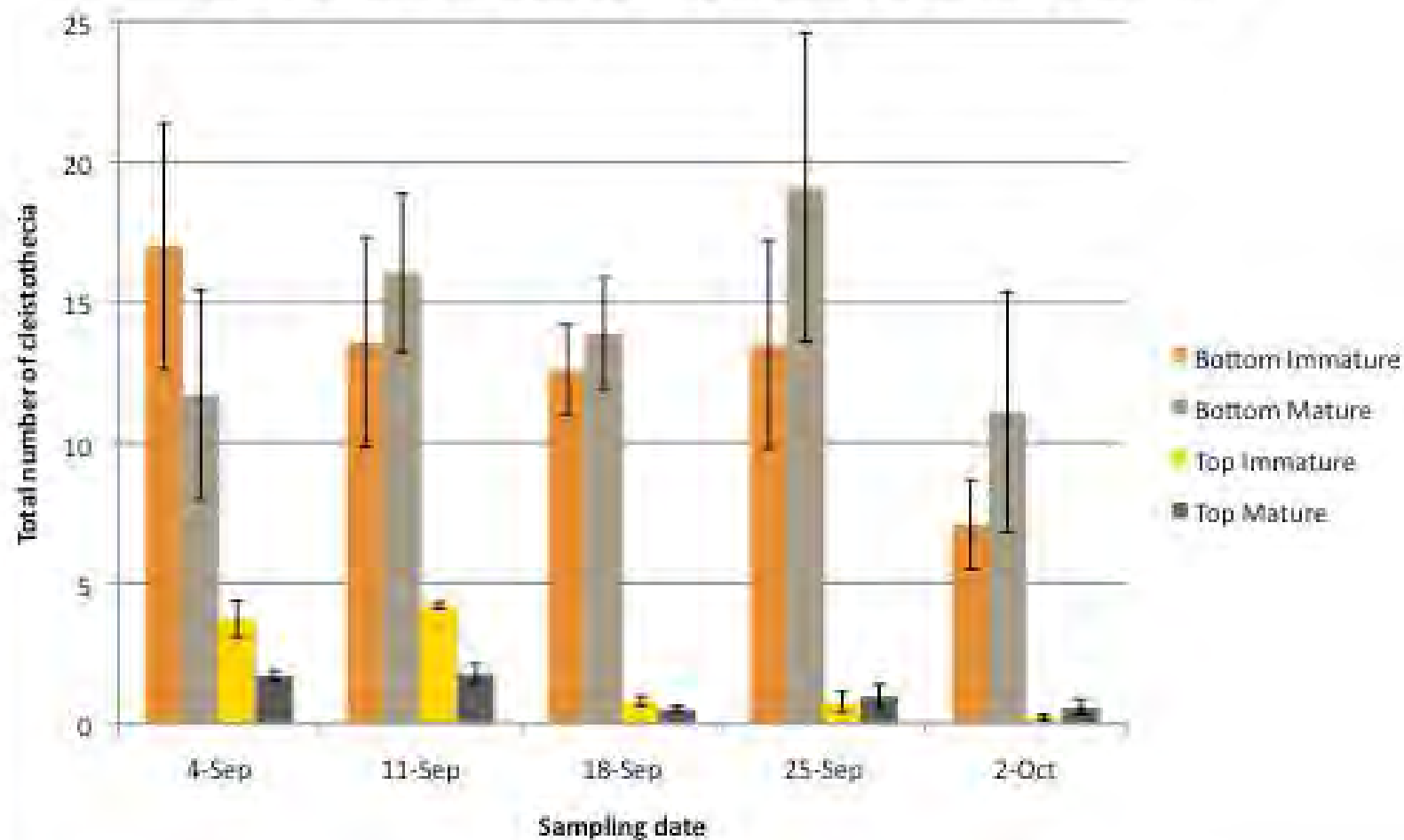
- Counted *cliestothechia* on leaves, 9/9 and 9/17



Powdery Mildew Cleistothecia Trial, 2008

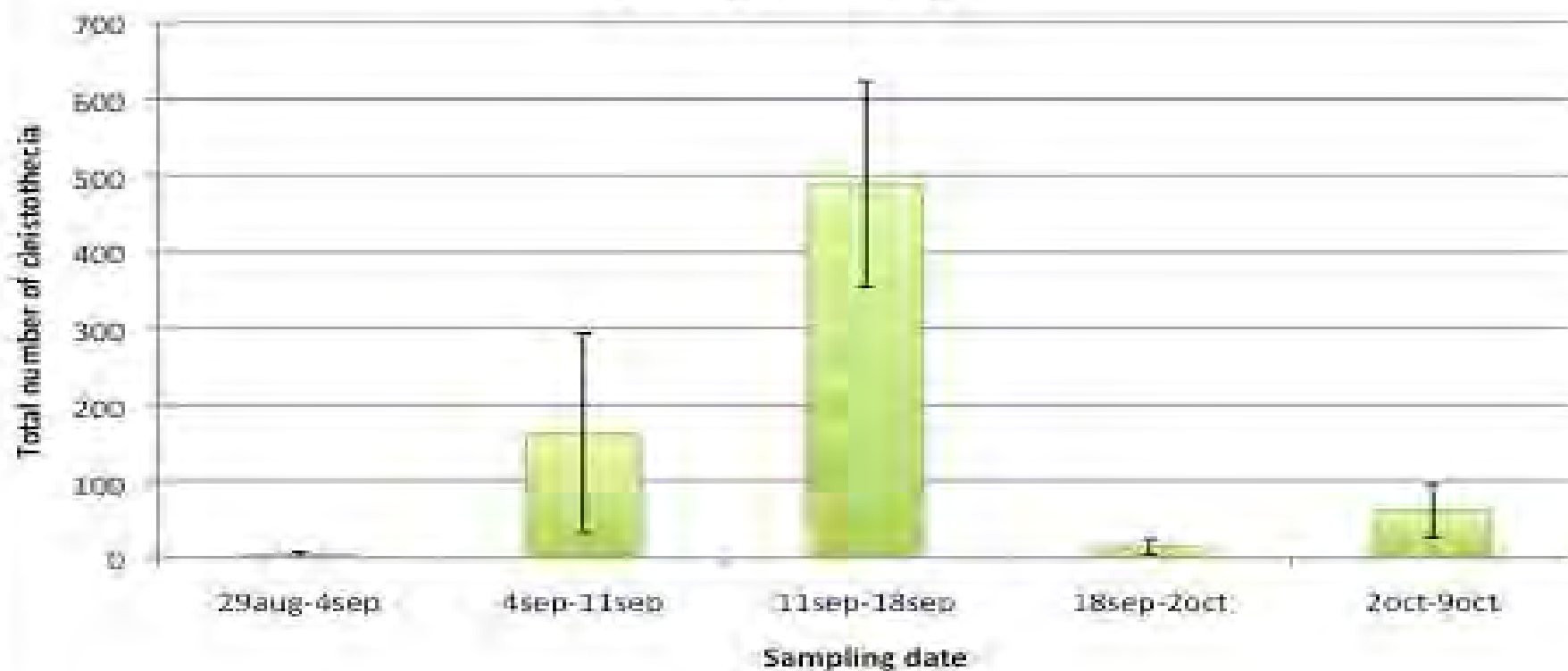
- To assess the timing and amount of cleistothecia produced by *Uncinula necator* on grape leaves under MI conditions
- Leaf samples collected from unsprayed Chardonnay vines at CHES
 - 4 samples collected weekly (Sept. 4 - Oct. 2)
 - Cleistothecium counted on top and bottom surfaces of leaves
- Funnel traps: funnels attached to soda bottles to trap cleistothecia washed from vines during rain events
 - Two sites: CHES and NWMHRS
 - Bottles collected weekly unless no precipitation and cleistothecia were counted

Cleistothecia counts for Chardoneel grapevines MSU Clarksville Horticulture Experiment Station



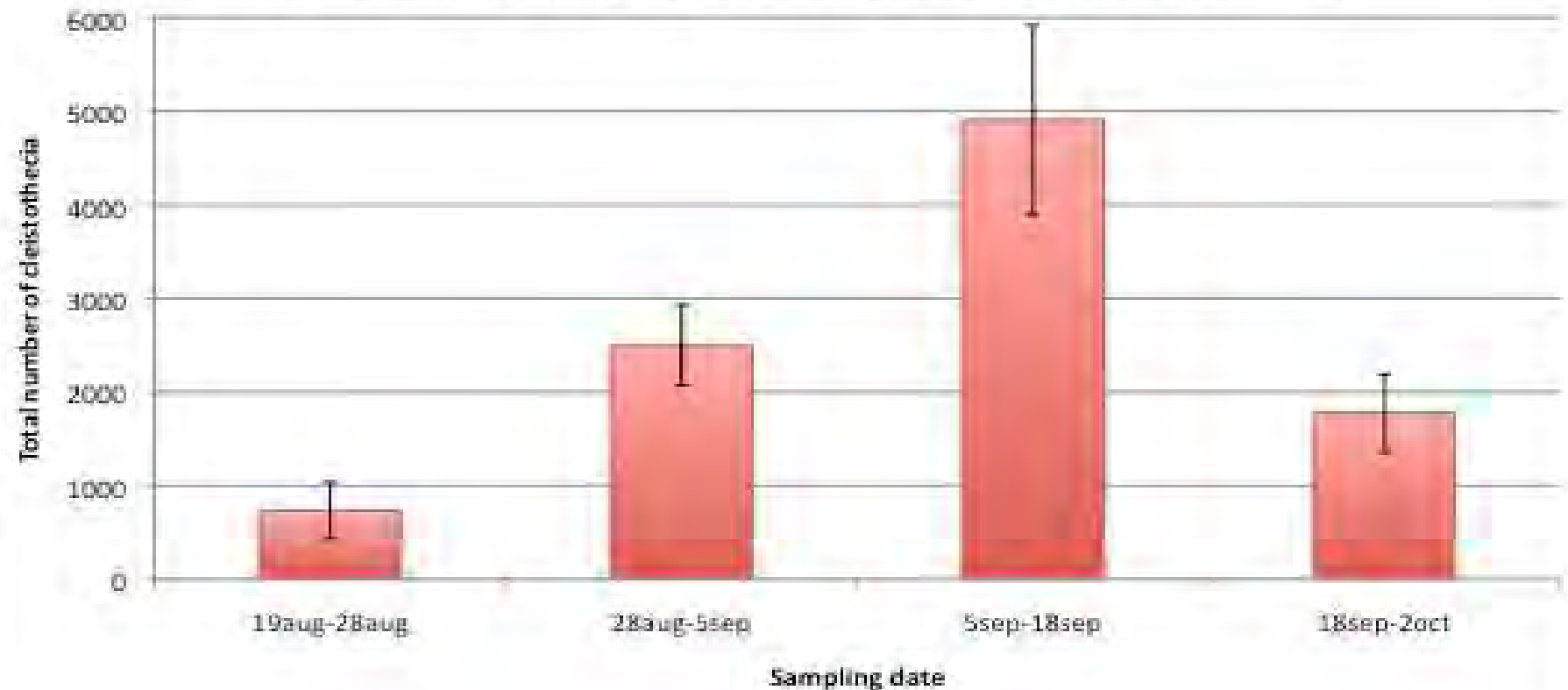
Total number of *Uncinula necator* mature and immature cleistothecia on both bottom and top surfaces of Chardoneel leaves in Clarksville, MI, in 2008.

**Average cleistothecia counts for *Uncinula necator*
MSU Clarksville Horticulture Experiment Station
(3 replicates)**



Total number of *Uncinula necator* cleistothecia collected in rain water traps placed under Chardonel grapevines in Clarksville, MI, in 2008.

Average cleistothecia counts for *Uncinula necator* Northwest Michigan Horticulture Research Station



Total number of *Uncinula necator* cleistothecia counted in rain water traps placed under Pinot Noir grapevines in Traverse City, Michigan, in 2008.

Cleistothecia Trial Results

- More cleistothecia on bottom surface of leaves
- Maximum cleistothecia dispersal in mid-September at both sites
 - Possibility to control prior to peak production and dispersal?

Fungicide Trials, 2008

- NWMRHS - dormant sprays vs. one experimental product vs. two season-long programs
- CHES - comparing six season-long programs
- TNRC - comparing three organic programs to two-season long programs



Season Long Spray Trial Results, NWMHRS 2008

Powdery Mildew Leaf Infection - 'Chardonnay'

Treatment, rate/A	Application Timing*	Overall Severity (%)
Untreated		68.3 a
Sulfur 6L 7 pt	1	70.8 a
JMS Sytlet Oil 1 gal	1	59.8 ab
Sulforix 1 gal	1	45.4 b
BASF 56000F 15.4 fl oz + Kenetic 1 pt/100 gal	2, 3, 4, 5, 6, 7, 8	0.9 c
Sulfur 6L 7 pt Elite 4 oz Pristine 10 oz	2, 3, 4, 7, 8 5, 6,	0.2 c
Sulfur 6L 7 pt Elite 4 oz Quintec 4 fl oz	2, 3, 4, 7, 8 5, 6,	0.2 c

Spray dates: 1 = Dormant, 2 = 3-5" shoot, 3 = 8-10" shoot, 4 = immediate pre-bloom, 5 = 1st post-bloom, 6 = 2nd post-bloom, 7 = 3rd post-bloom, 8 = 4th post-bloom

Season Long Spray Trial, Clarksville 2008

Powdery Mildew Leaf Infection - 'Chardonnay'

Treatment, rate/A	Application Timing*	Overall Severity (%)
Untreated		76.5 a
Dithane Rainshield 3 lb Pristine 12 oz Sulforix 1 gal	1, 2, 5, 4, 6	11.9 b
Flint 2 oz Elite 45 WP 4 oz	1, 2, 6 4, 5,	7.9 c
Adament 3 oz	1, 2, 4, 5, 6	5.3 cd
Adament 4 oz	1, 3, 5, 7	6.6 c
Dithane Rainshield 3 lb Quintec 4 oz Vintage 4 oz + Ziram 3lb	1, 2, 5, 4, 6	5.2 cd
Dithane Rainshield 3 lb Pristine 12 oz Elite 45 WP 4 oz + Ziram 3 lb	1, 2, 5, 4, 6	2.2 d

Spray dates: 1 = immediate pre-bloom, 2 = 14 day 1st post-bloom, 3 = 21 day 1st post-bloom, pea sized fruit, 4 = 14 day 2nd post bloom, start of bunch closure, 5 = 14 day 3rd post-bloom; 21 day 2nd post-bloom, 6 = 14 day 4th post-bloom, 7 = 21 day 3rd post-bloom

Season Long Spray Trial, Fennville 2008

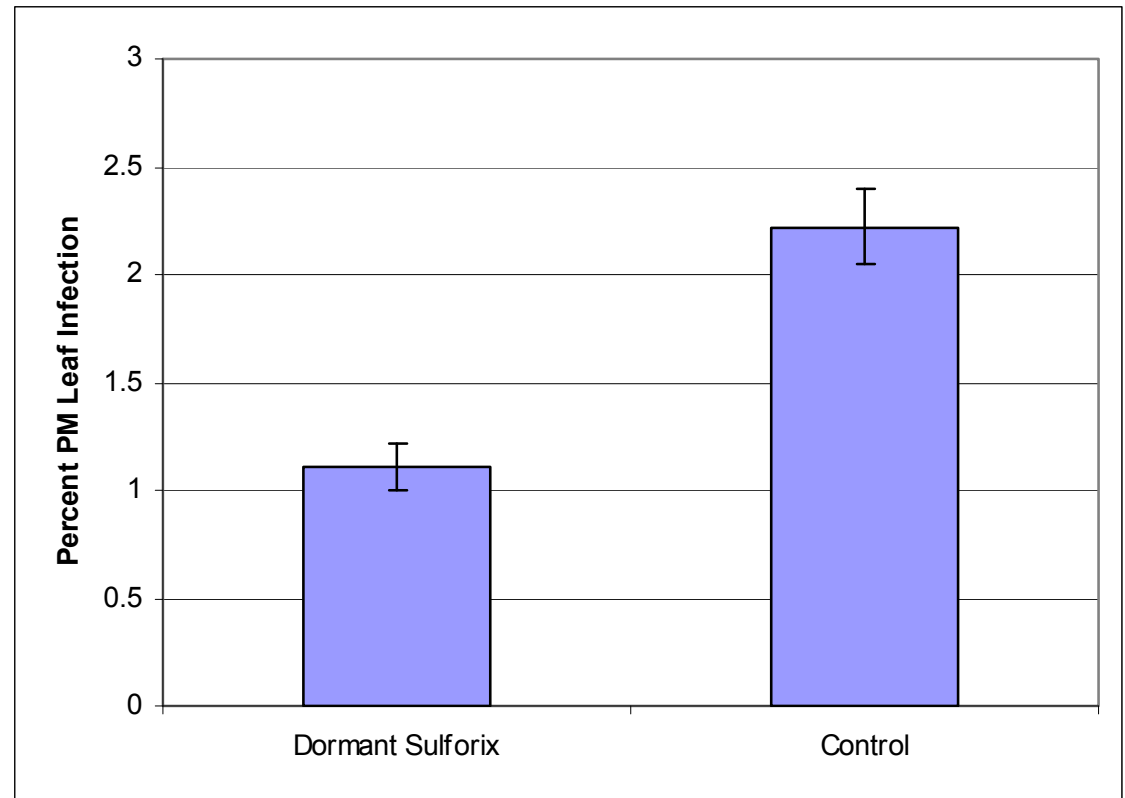
Powdery Mildew Leaf Infection - 'Chancellor'

Treatment, rate/A	Application Timing*	Overall Severity (%)
Untreated		82.8 a
Sonata + NuFilm 17 0.5 pt Kaligreen 3 lb	1, 3, 5 2, 4,	41.8 b
Sonata + NuFilm 17 0.5 pt JMS Sytlet Oil 2% (v/v)	1, 3, 5 2, 4,	29.9 b
Serenade Max 1.5 lb + NuFilm 17 0.5 pt JMS Sytlet Oil 2% (v/v)	1, 3, 5 2, 4,	14.7 c
Dithane Rainshield 3 lb Pristine 12 oz Elite 4 oz	1, 2, 4, 3, 5	8.0 cd
Dithane Rainshield 3 lb Pristine 12 oz Elite 4 oz + Ziram 3 lb	1, 2, 4, 3, 5	3.4 d

Spray dates: 1 = bloom, 2 = 1st post-bloom, 3 = 2nd post-bloom, 4 = 3rd post-bloom, 5 = 4th post-bloom

Dormant Spray Trial, 2008

- Grower-cooperator site in NW
- 3 blocks:
 - 1 Pinot gris,
 - 2 Pinot noir
- Half sprayed w/ sulfurix before bud break, other half untreated
- Rated for PM leaf infection on 9/3



THANKS!

- Project GREEN
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- Dr. Duke Elsner, NW Wine Agent
- Laura Avila, Plant Pathology, MSU
- NWMHRS Summer Crew

