Fungicide Sensitivity and the Management of Tart Cherry Pathogens

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Fungal Pathogens of Concern

Cherry Leaf Spot
American Brown Rot
European Brown Rot
Powdery Mildew

We are very reliant on fungicides

Cherry leaf spot
- Resistant to sterol-inhibitor (SI) fungicides
- Few alternatives, all at risk

American brown rot
- SI fungicides are susceptible to resistance development

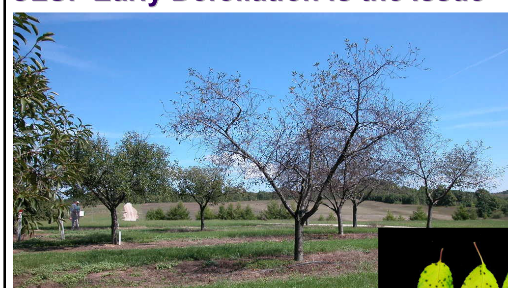
Objectives

- Evaluate available chemistries for possible use on CLS (SI resistance)
- Evaluate the sensitivity of ABR to Indar

Methods

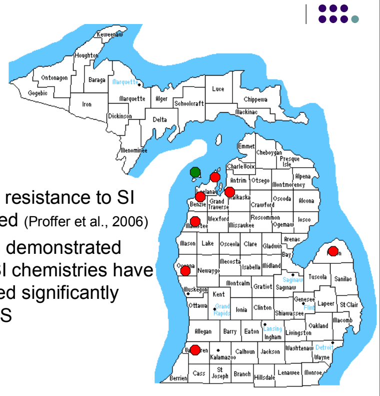
- Establish baseline, or current *in vitro* sensitivity levels to relevant chemistries
  - Track changes over time
  - Evaluate fungicide resistance management techniques
- Determine field efficacy to give perspective to sensitivities measured in the lab

CLS: Early Defoliation is the Issue



Reduced carbohydrate storage in roots
Decreased fruit set in subsequent years
Increased susceptibility to winter injury

Control of Cherry Leaf Spot



- As of 2004, statewide resistance to SI fungicides was reported (Proffer et al., 2006)
- Recent NWHRS trials demonstrated that cover sprays of SI chemistries have either failed or provided significantly reduced control of CLS

2005 Spray Trial Results

Fungicide and rate per acre	Timing	CLS Infected leaves (%)
Bravo Ultrex 82.5WDG 3 lb	bloom; shuck split	
Flint 50WG 2.5 oz	first cover	
Dodine (Syllit 65W) 2 lb	second; third cover	55.1 a
Elite 45WG 6 oz	fourth cover	
Bravo Ultrex 82.5WDG 3 lb	bloom; shuck split	
Flint 50WG 2.5 oz	first cover	
Copper Sulfate (Cuprofix Disperss 40DF) 3.5 lb	second; third cover	33.5 b
Elite 45WG 6 oz	fourth cover	
Bravo Ultrex 82.5WDG 3 lb	bloom; shuck split	
Flint 50WG 2.5 oz	first cover	
Copper Hydroxide (Kocide 2000 35DF) 4 lb	second; third cover	53.6 a
Elite 45WG 6 oz	fourth cover	
Untreated control		64.5 a

* Means followed by the same letter are not significantly different according to Fisher's Protected LSD ($\alpha = 0.05$).

CLS Spray Trial, 2006

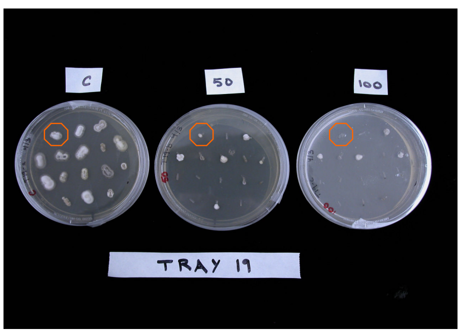
Treatment		Cherry Leaf Spot (%)		Defoliation (%)
		28-Jul	18-Sep	18-Sep
Control		61.5 a	95.1 a	90.0 a
Elite 45WG 6oz+Captan 50W 3lb	SI/Broad	5.1 b	93.3 a	36.9 b
Gem 500SC 3 fl oz	Strobilurin	2.9 b	97.7 a	49.1 c
Syllit 27 fl oz	Dodine	0.7 c	75.9 b	32.6 b

Based on the results, assessing dodine sensitivity in Michigan orchards became a relevant project

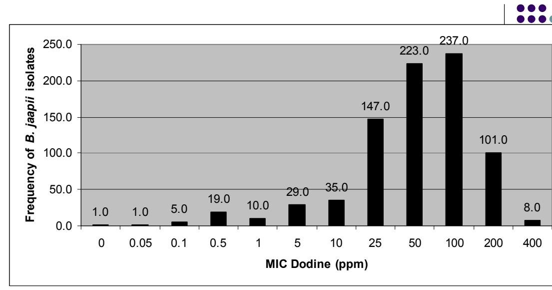
In vitro Dodine Assay Methods

•860 CLS isolates
•Isolates collected from managed and unmanaged sources

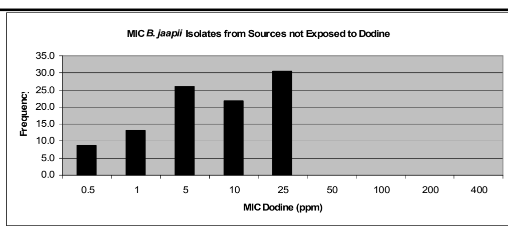
•Screened for minimum inhibitory concentration (MIC)

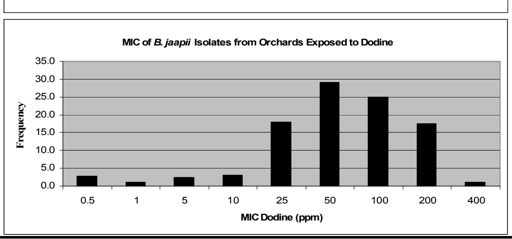


•**MIC:** the dodine level at which no colony growth occurs



- 78.5% isolates MIC was 100 ppm or less
- 21.2% had an MIC of 200-400 ppm
- 0.2% MIC was greater than 400 ppm





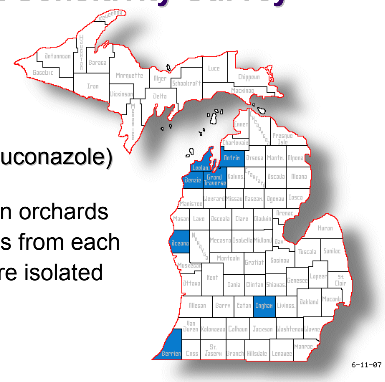
Conclusions

- The vast majority of CLS isolates are highly sensitive to dodine in lab testing
- Practical field resistance hasn't occurred but we are seeing a precursor for reduced sensitivity
- Dodine is still useful but needs to be managed for resistance and tank mixed with a broad-spectrum fungicide (captan)

American Brown Rot

- Infects cherries, mostly sweets
- Infects mainly mature fruit
- Reduces quality

ABR Sensitivity Survey

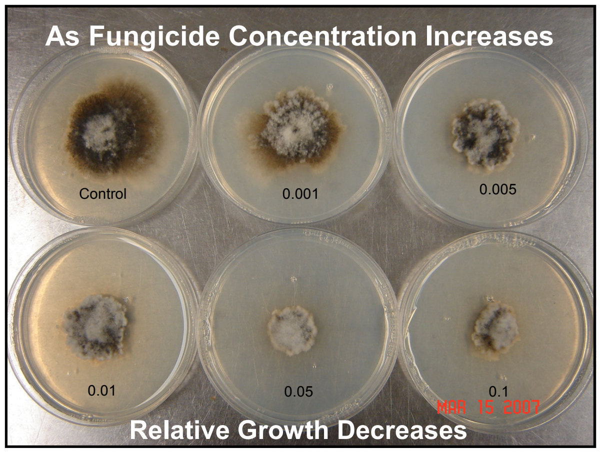


- Indar (fenbuconazole) Assay
- 23 Michigan orchards
- 10+ isolates from each
- Single-spore isolated

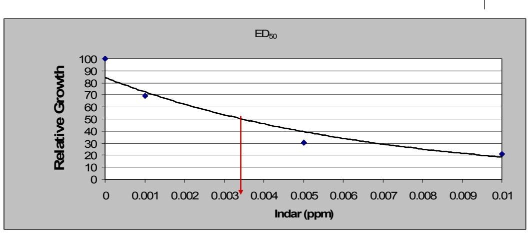
Establishing an Effective Dose

Effective dose (ED_{50}) values are the concentration of fungicide at which relative growth is reduced by 50%

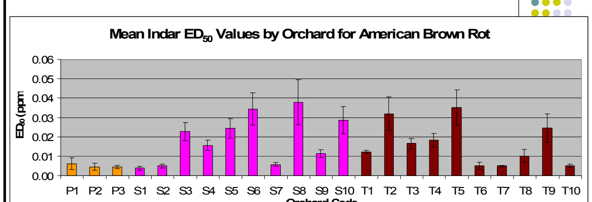
- Colony size is measured at increasing fungicide concentrations and a regression analysis is performed



Regression Analysis



Indar Assay Results



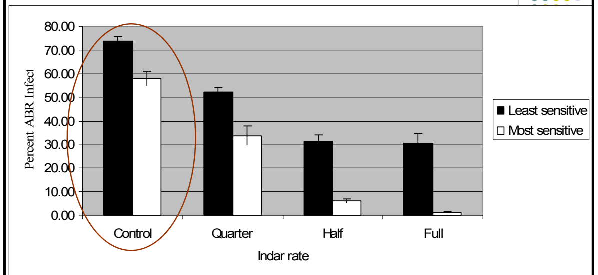
- There is significant variability
- Up to a 10-fold difference
- Variability may be a precursor of reduced sensitivity

Is the Variability of ABR Indar-Sensitivity Significant?

Fruit Assay

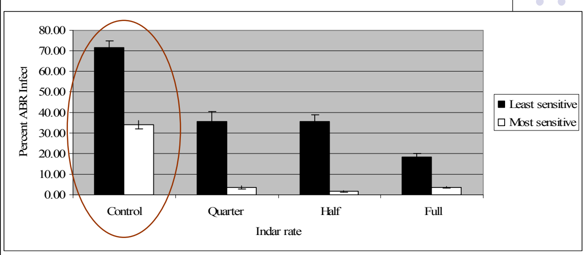
- The most and least Indar-sensitive isolates were selected
- Cherries were briefly dipped in 3 concentrations of Indar (1/4, 1/2, and full rates)
- One 20µl droplet of fungal propagules, was placed on each sweet cherry
- In the case of tart cherries, inoculum was sprayed on using an atomizer
- Cherries were incubated for 2 weeks
- The number of cherries with ABR infections was then recorded

Tart Cherry Assay



Significant differences in infection rate based on isolate sensitivity

Sweet Cherry Assay



Significant differences in infection rate based on isolate sensitivity

Indar Fruit Assay Conclusions

- Uninoculated cherries did not develop ABR infection (no latent infections)
- The less Indar-sensitive isolates appear to be more virulent
- Based on ED_{50} values, there are significant differences between the infection ability of ABR isolates in the presence of Indar

Sequencing the *CYP51* gene

- **Michigan isolates are still sensitive to Indar in the field**
- A significant mutation of the *CYP51* gene is unlikely
- Characterizing the *CYP51* genes of these sensitive isolates will be useful in future endeavors

Base pair differences between Michigan ABR isolates did not differentiate isolates based on sensitivity levels or confer changes to the amino acids

ABR Conclusions

•There is variability in the sensitivity of ABR to Indar

•This variability significantly affected the ability of the isolates to infect fruit in the presence of Indar

•Establishing the current sequence of the *CYP51* gene in sensitive populations will aid in locating possible future mutations

Amended Cherry Fungicide Spray Calendar

- **Bloom: EBR**
  - Sterol inhibitor (captan)
- **Petal Fall: CLS**
  - Chlorothalonil
- **1st–4th Cover: CLS and PM**
  - Gem (Strobi) & boscalid
  - Pristine (Boscalid & strobi)
  - Copper (weather permitting)
  - Dodine & captan
- **+ 4th Cover ABR**
  - Sterol inhibitors (captan)
- **Post Harvest: CLS**
  - Chlorothalonil

Tank-mix & new options

Thank You!

Dr. George Sundin
Dr. Tyre Proffer
Dr. Nikki Rothwell
Dr. William Kirk
The entire NWHRS staff and Sundin lab

Michigan Cherry Committee