

## Fungicide Sensitivity Update for Apple and Cherry



Northwest MI  
Orchard and  
Vineyard Show  
January 20, 2010

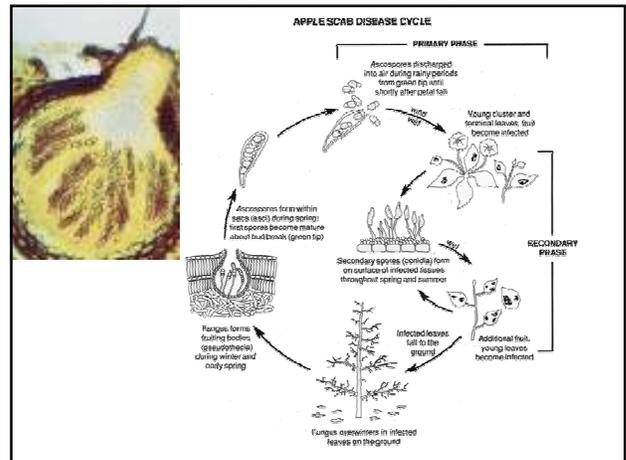
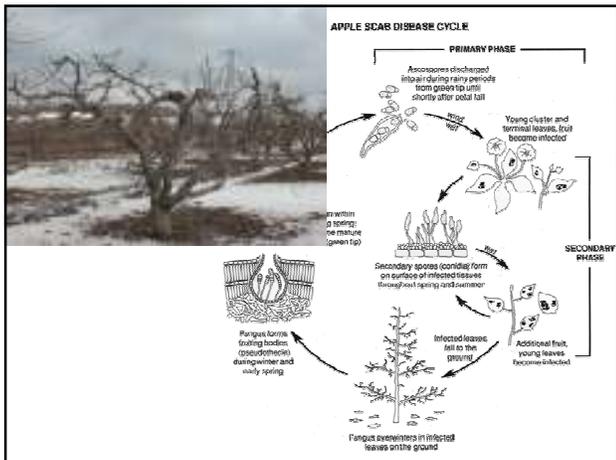
Kimberley E. Lesniak  
MICHIGAN STATE UNIVERSITY

## Fungicide Sensitivity Update for Apple and Cherry



Kim Lesniak; doctoral graduate student, MSU  
Amy Irish-Brown; Extension Educator and doctoral graduate student, MSU  
Tyre Proffer; Visiting Professor, MSU  
Gail Ehret; Field Research Technician, MSU  
Gayle McGhee; Research Associate, MSU  
George W. Sundin; Professor, MSU

MICHIGAN STATE UNIVERSITY



## Apple Scab, Strobilurin (QoI) Resistance

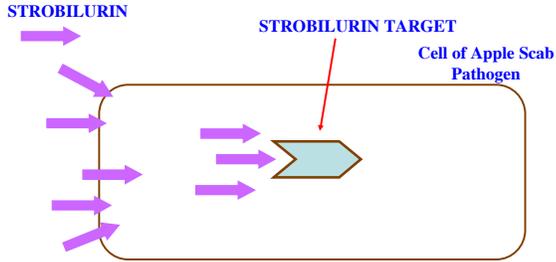
- Strobilurins (Flint and Sovran)
  - Registered in Europe, 1998
  - Registered in Michigan, 1999
- QoI-resistant apple scab isolates recovered in commercial orchards:
  - France 2004-2007
  - Chile in 2003

## *Venturia inaequalis*, Mechanisms of QoI Resistance

- Fungicide target is mitochondrial cytochrome b (*Cyt b*) gene
- G143A mutation in *Cyt b* gene
  - Change of glycine to alanine at amino acid position 143 in protein
  - Also observed in many other fungi
- Unknown mechanism(s) – few isolates, not studied further

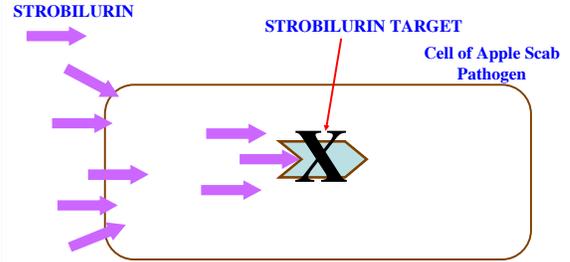
## Altered Target Site (G143A) Mediated QoI Resistance

- Altered target site



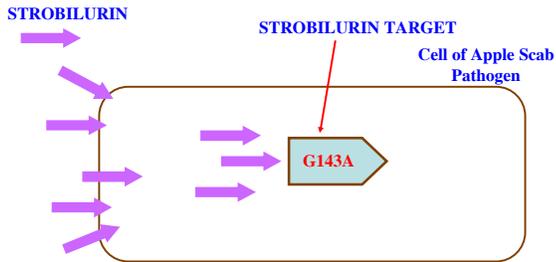
## Mutation causes alteration of strobilurin fungicide target in cell

- Altered target site



## Strobilurin fungicide can't bind target, cells now resistant

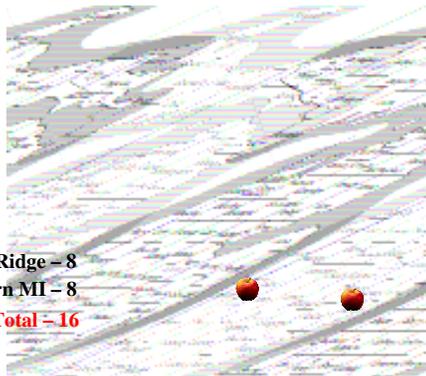
- Altered target site -- lock and key (fungus changes lock)



## Situation on the Ridge, 2008

- Loss of scab control on McIntosh
- Associated with applications of:
  - Sovran
  - Sovran + EBDC
- Eight orchards sampled
- Isolates recovered for resistance testing
  - Genetic testing for G143A mutation
  - Spore germination assays on strobilurin amended media

## Apple scab – Orchard Sampling, 2008



Fruit Ridge – 8  
Eastern MI – 8  
**Total – 16**

## Spore Germination Tests Confirms G143A Mutation in Resistant Isolates



Sensitive apple scab isolates  
on strobilurin amended media  
- spores cannot germinate



Resistant apple scab isolates  
on strobilurin amended media  
- spores CAN germinate  
- G143A mutation

## QoI Resistance Test Results (G143A), 2008

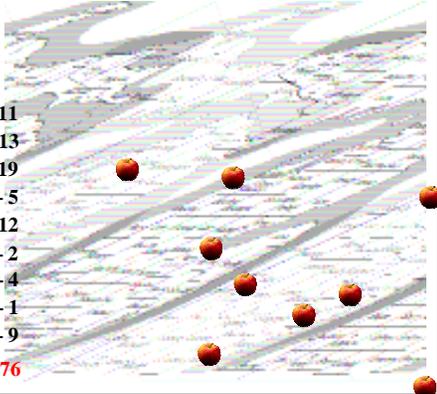
- Fruit Ridge
  - Orchard 1 -- 20 / 25 resistant
  - Orchard 2 -- 25 / 25 resistant
  - Orchard 3 -- 16 / 21 resistant
  - Orchard 4 -- 25 / 25 resistant
  - Orchard 5 -- 24 / 24 resistant
  - Orchard 6 -- 22 / 22 resistant
  - Orchard 7 -- 15 / 22 resistant
  - Orchard 8 -- 20 / 20 resistant

## QoI Resistance Test Results (G143A), 2008

- Eastern Michigan
  - Orchard 1 -- 5 / 11 resistant
  - Orchard 2 -- 3 / 10 resistant
  - Orchard 3 -- 9 / 10 resistant
  - Orchard 4 -- 6 / 10 resistant
  - Orchard 5 -- 0 / 10 ALL SENSITIVE
  - Orchard 6 -- 0 / 13 ALL SENSITIVE
  - Orchard 7 -- 0 / 11 ALL SENSITIVE
  - Orchard 8 -- 0 / 7 ALL SENSITIVE

## Apple scab – Orchard Sampling, 2009

Southwest MI – 11  
 Oceana county – 13  
 Fruit Ridge – 19  
 Eastern MI – 5  
 NW Michigan – 12  
 E. Lansing – 2  
 Ohio – 4  
 Wisconsin – 1  
 Ontario – 9  
**Total – 76**



## QoI Resistance Test Results (G143A), 2008 and 2009

- | • Fruit Ridge | <u>2008</u>          | <u>2009</u>  |
|---------------|----------------------|--------------|
| – Orchard 1   | -- 20 / 25 resistant | 15 / 15 res. |
| – Orchard 2   | -- 25 / 25 resistant | 15 / 25 res. |
| – Orchard 3   | -- 12 / 21 resistant | 17 / 22 res. |
| – Orchard 4   | -- 25 / 25 resistant | 15 / 20 res. |
| – Orchard 5   | -- 24 / 24 resistant | 12 / 12 res. |
| – Orchard 6   | -- 22 / 22 resistant |              |
| – Orchard 7   | -- 17 / 24 resistant | 21 / 25 res. |
| – Orchard 8   | -- 20 / 20 resistant |              |

## QoI Resistance Test Results (G143A), 2009

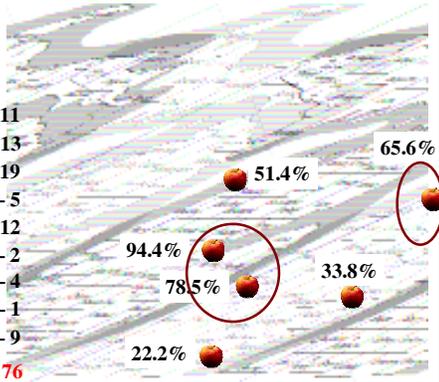
- Oceana county
  - Orchard 1 -- 19 / 25 resistant
  - Orchard 2 -- 24 / 24 resistant
  - Orchard 3 -- 25 / 25 resistant
  - Orchard 4 -- 12 / 19 resistant
  - Orchard 5 -- 21 / 25 resistant
  - Orchard 6 -- 23 / 23 resistant
  - Orchard 7 -- 25 / 25 resistant
  - Orchard 8 -- 25 / 25 resistant
  - Orchard 9 -- 25 / 25 resistant
  - Orchard 10 -- 25 / 25 resistant
  - Orchard 11 -- 25 / 25 resistant
  - Orchard 12 -- 15 / 15 resistant
  - Orchard 13 -- 24 / 24 resistant

## QoI Resistance Test Results (G143A), 2009

- Northwest MI
  - Orchard 1 -- 9 / 9 resistant
  - Orchard 2 -- 1 / 8 resistant
    - (abandoned block)
  - Orchard 3 -- 2 / 8 resistant
  - Orchard 4 -- 6 / 10 resistant
  - Orchard 5 -- 0 / 4 resistant (ALL SENS.)
    - (abandoned block)

## Apple scab – Orchard Sampling, 2009

Southwest MI – 11  
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**Total – 76**



## What About Sterol Inhibitors?

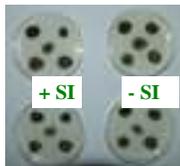
- All fungal isolates tested for QoI resistance are also being tested for SI resistance
- Relative growth assay

[if RG > 80%;  
fungus is resistant]

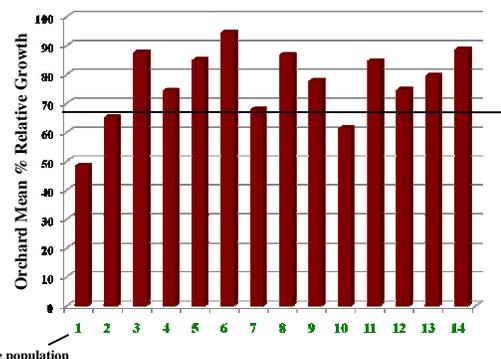


## What About Sterol Inhibitors?

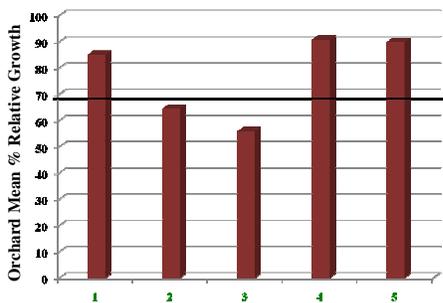
- Wolfram Koller's work:
  - Baseline orchards contain ~ 2% resistant scab isolates and have orchard mean RG of 35-45%
  - Orchards with > 40% resistant scab isolates and a total orchard mean RG > ~ 67% were identified as Resistant orchards
  - Reduced control with SI's



## SI Resistance Phenotype, Ridge 2009



## SI Resistance Phenotype, Northwest MI 2009



## Fungicide Resistance Summary for Apple

- Strobilurin (QoI) resistance is widespread, and at a high level in most areas of Michigan
  - Also in Ontario
  - Few orchards remain with QoI sensitivity
- Strobilurin fungicides should not be used for apple scab control
- SI resistance is also prevalent, and at higher levels than those observed 10-15 yrs ago

## Fungicide Resistance Summary for Cherry

- **Cherry leaf spot**
  - SI resistance an existing problem
  - Concerns with strobilurins and boscalid based on apple scab experience
- **Brown rot**
  - Developing situation with SI's

## Cherry Leaf Spot Control Chemistries, 2010

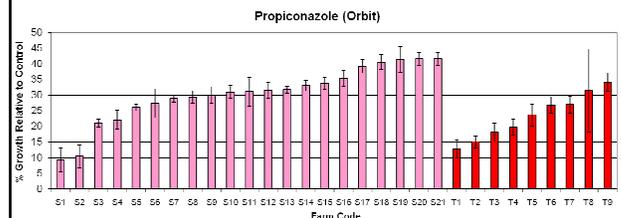
- Chlorothalonil
- Strobilurins (Gem)
- Boscalid (Pristine)
- Syllit
- Copper
- Captan
- Sterol-inhibitors

## Cherry Leaf Spot Control Chemistries, 2010

- Chlorothalonil
- Strobilurins (Gem) + Captan
- Boscalid (Pristine) + Captan
- Syllit + Captan
- Copper
- Captan
- Sterol-inhibitors

## Brown Rot – SI Resistance Update

Propiconazole (>50% RG=Resistance)



## Brown Rot SI Resistance Update, 2009

- **Resistance found in 2009 in Southwest Michigan**
  - 5 orchards; 10 infected peaches each
  - Propiconazole means; 32%, 10%, 28%, 34%, and 24% RG
  - We also found a DNA sequence known for resistance in SC, NY, and OH isolates in 54% of the MI isolates

## Brown Rot Control Chemistries, 2010

- **Sterol Inhibitors**
  - Indar – Special 24(c) label enabling up to 12 fl oz per acre
  - 8-10 fl oz per acre is a good rate for NW Michigan
- Strobilurins (Gem)
- Boscalid (Pristine)
- Rovral (use at bloom for blossom blight phase)

