Fungicide Sensitivity Update for Apple and Cherry

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

Fungicide Sensitivity Update for Apple and Cherry

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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

**STROBILURIN**

**STROBILURIN TARGET**

Cell of Apple Scab Pathogen

**STROBILURIN**

**STROBILURIN TARGET**

Cell of Apple Scab Pathogen

Mutation causes alteration of strobilurin fungicide target in cell

- Altered target site

**STROBILURIN**

**STROBILURIN TARGET**

Cell of Apple Scab Pathogen

Strobilurin fungicide can’t bind target, cells now resistant

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

**STROBILURIN**

**STROBILURIN TARGET**

Cell of Apple Scab Pathogen

G143A

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**
  - Orchard 1 -- 20 / 25 resistant
  - Orchard 2 -- 25 / 25 resistant
  - Orchard 3 -- 12 / 21 resistant
  - Orchard 4 -- 25 / 25 resistant
  - Orchard 5 -- 24 / 24 resistant
  - Orchard 6 -- 22 / 22 resistant
  - Orchard 7 -- 17 / 24 resistant
  - 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
Oceana county – 13
Fruit Ridge – 19
Eastern MI – 5
NW Michigan – 12
E. Lansing – 2
Ohio – 4
Wisconsin – 1
Ontario – 9
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

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)
- Boscalid (Pristine)
- Syllit
- 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)
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