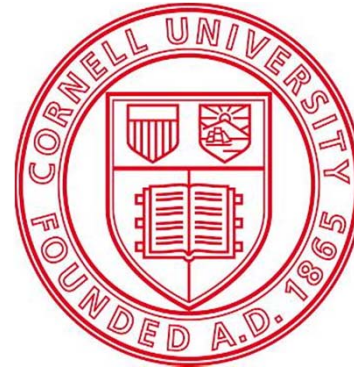


The dynamics of Qol qualitative resistance in *Venturia inaequalis* populations in the Northeast US

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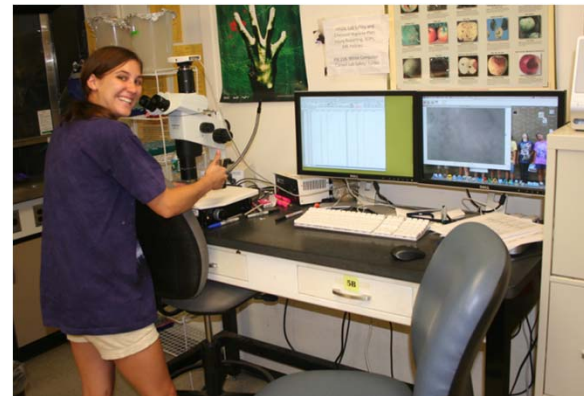
Objectives

- How is qualitative resistance to QoI fungicides determined?
- What is the prevalence of qualitative resistance to QoI fungicides in the region?
- What are the implications of QoI qualitative resistance?



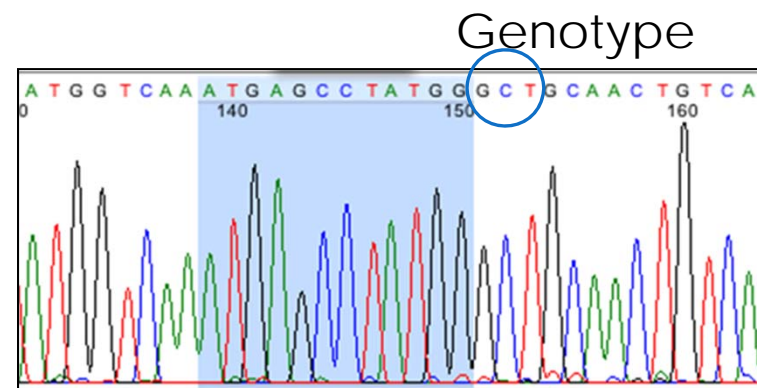
Site-specific fungicide resistance survey for apple scab

- Survey service offered at NYSAES from 2004 to present
 - Over 100 unique commercial, baseline, research orchards (NY, VT, WV, NH, MA, ME, RI, MI, OH, IN, & CT represented)
- Several orchards have practical resistance to Qols
 - > 10 Qol applications
 - Primarily quantitative resistance



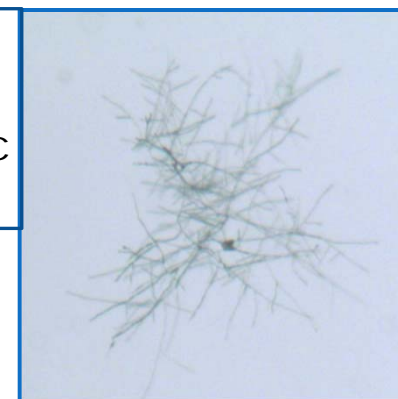
Determining qualitative resistance to Qol fungicides

- Qol resistance can be both quantitative (many genes involved) and qualitative (one gene involved)
- Qualitative resistance mechanism: G143A point mutation in the target site: mitochondrial *cytochrome b* (*cyt b*) gene
- Two methods for determining qualitative resistance to Qol fungicides



Growth on
trifloxystrobin +
salicylhydroxamic
acid (SHAM)

Phenotype



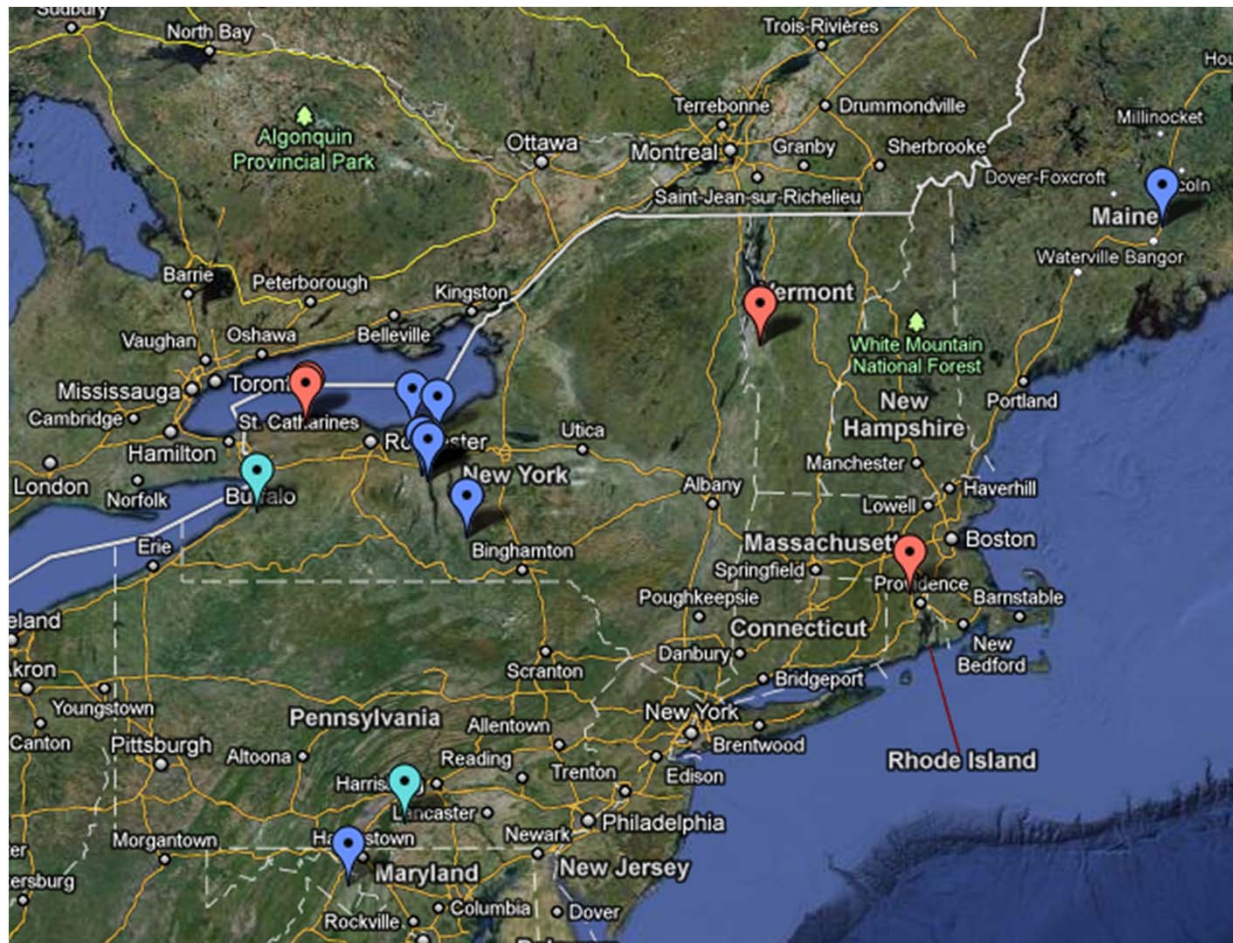
Determining qualitative resistance to Qol fungicides

- Survey uses the phenotypic method (growth assay), but spot checks suspicious isolates w/genotypic method
- Also test isolates on trifloxystrobin alone (quantitative): covers other genetic contributions
- Historically all sensitive isolates > wild type genotype
- What about isolates with high growth on trifloxystrobin alone (quantitative): could mutation be present?
 - Multiple copies of mitochondrial genes/organism

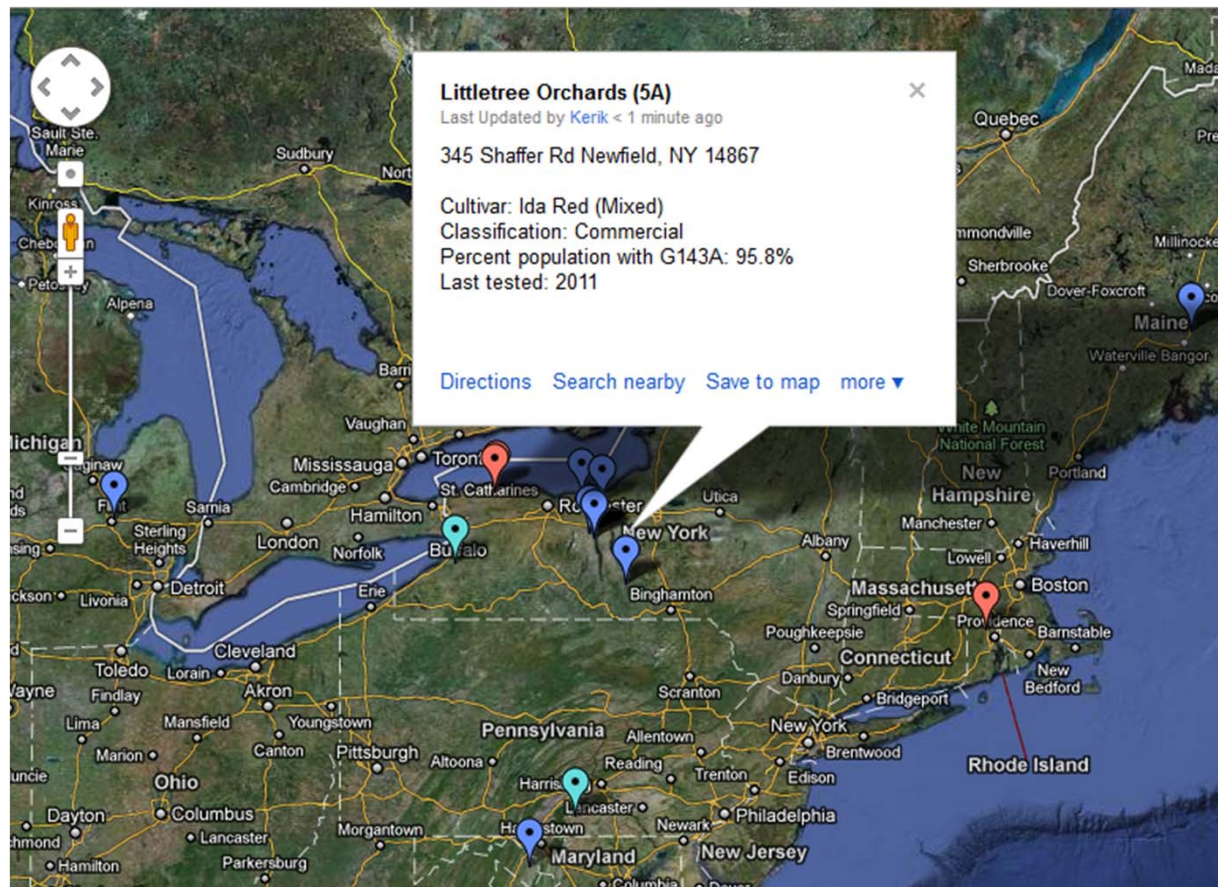
Prevalence of qualitative resistance to QoI fungicides

- Isolates from the site-specific fungicide resistance survey are tested for qualitative resistance using the phenotypic method
 - Modified FRAC method: conidia spread on medium containing trifloxystrobin + salicylhydroxamic acid (TR+S)
 - Growth and germination after 1-2 weeks

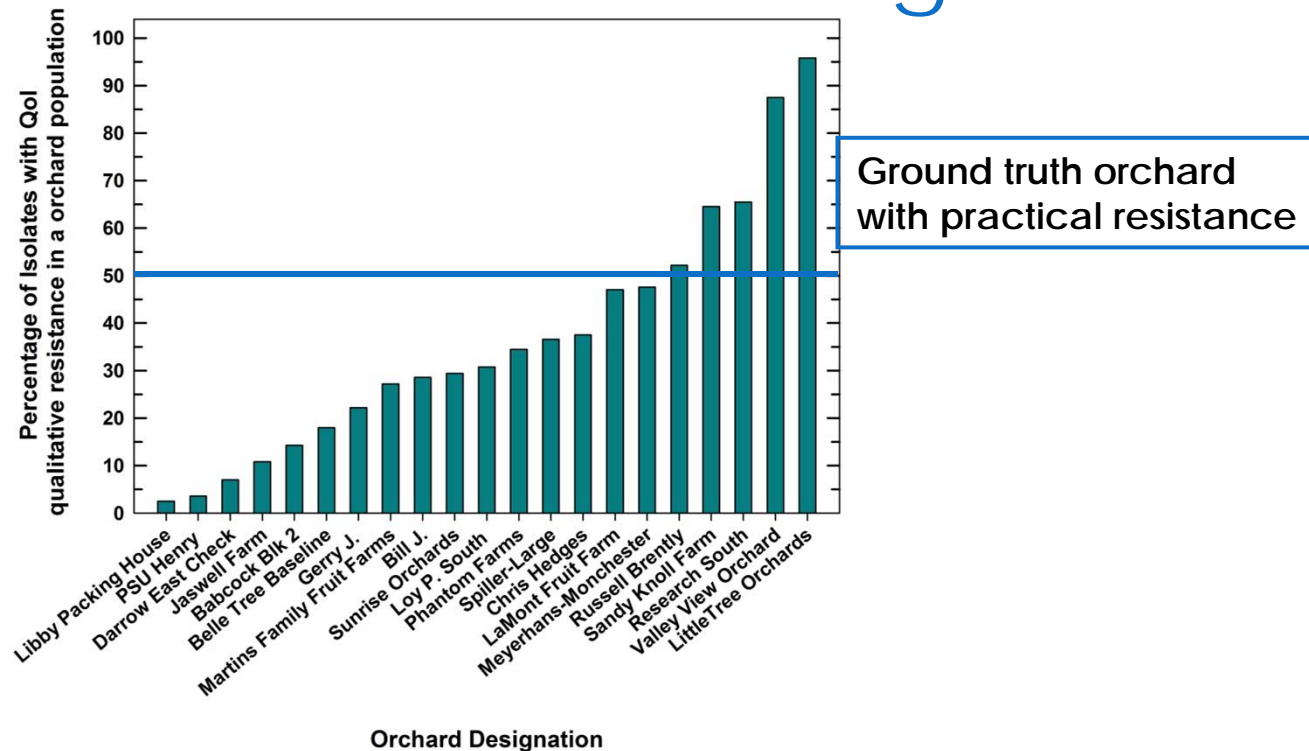
Prevalence of qualitative resistance to Qol fungicides



Prevalence of qualitative resistance to QoI fungicides



Orchards with qualitative resistance to Qol fungicides



- In many orchards, members with qualitative resistance - small percentage of population
- Few orchards have potential for practical resistance
 - Isolates could shift quickly if mutation copy number increases with Qol use

What are the implications of Qol qualitative resistance?

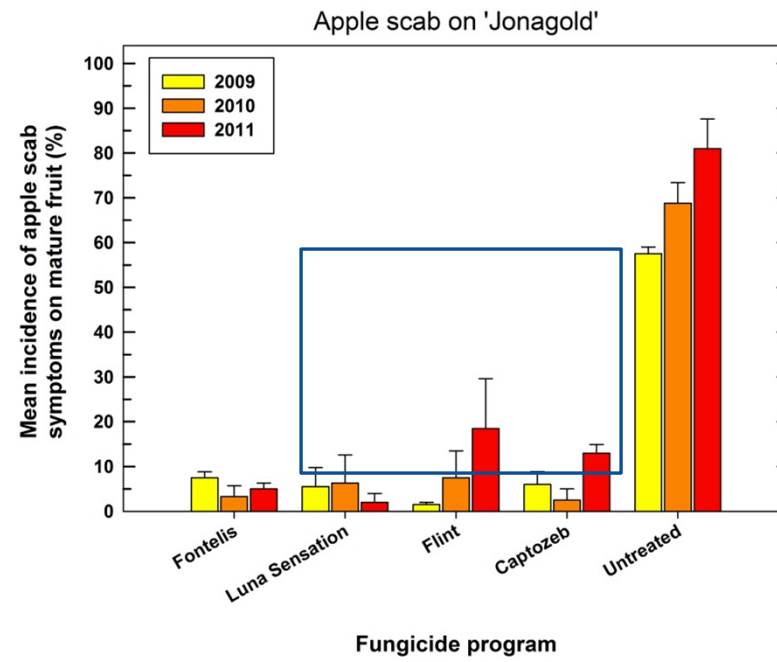
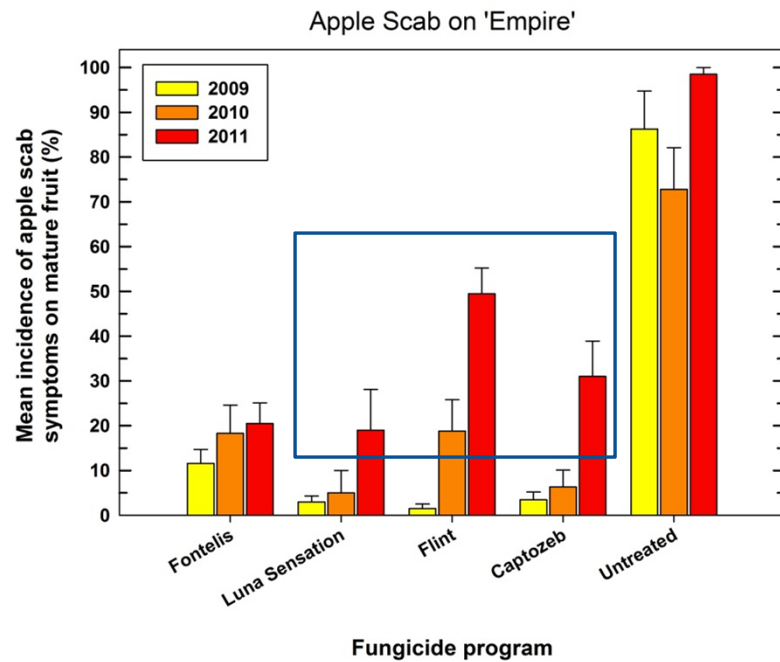
Performance of Qols in an orchard that developed Qol resistance



Implications of Qol qualitative resistance?

- Site: Mature 'Empire' and 'Jonagold' - M.9/M.111 interstem
- Population sensitivity to Qol fungicides
 - 2009: 0% of members had QR, TR mRG: 0.05%
 - 2010: 2.5% of members had QR, TR mRG: 10.3%
 - **2011: 49.5 of members had QR, TR mRG: 65.5%**
- Fungicide treatments
 - Timed at 7-10 day intervals from bloom to 2nd cover
 - Protectants (manzate/captan): green tip - tight cluster
- Disease assessment
 - Incidence of apple scab on mature fruit at harvest

Apple scab field trials



- 2009-2010: QoI treatments effective on 'Empire' when population was fairly sensitive
- 2011: QoI product failure coincident with increased qualitative resistance
- SDHI and SDHI/QoI premix products not impacted, and QoI control failure less apparent on less susceptible cultivar

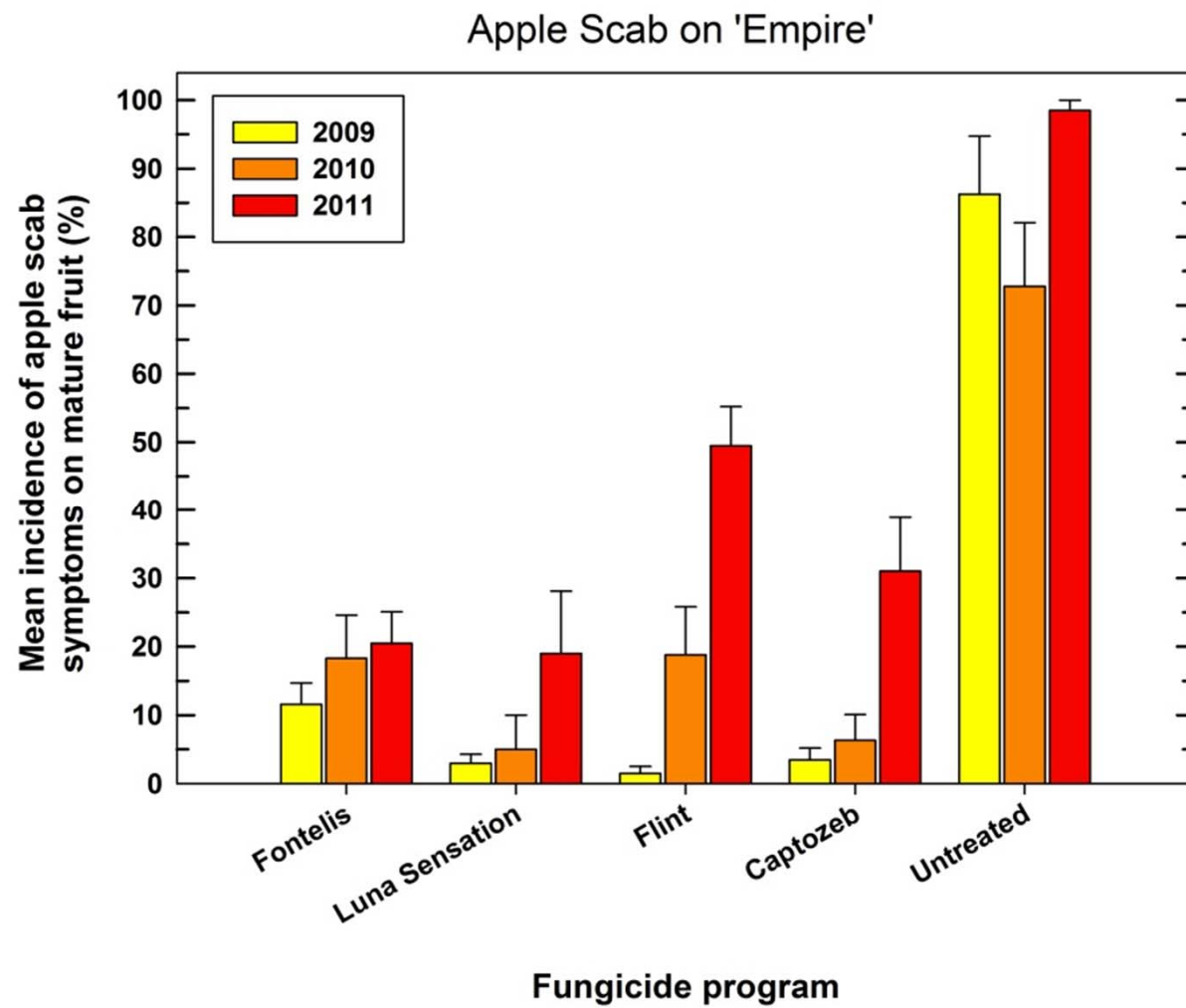
Conclusions:

- Isolates with high growth on trifloxystrobin can have mutation
 - May not notice the mutation using genotypic method alone
 - May be more qualitative Qol resistance than we initially believed
 - Isolate response on amended media > best indicator of field resistance
- There are some orchards with population members that possess the G143A mutation for qualitative resistance, but qualitative and practical resistance to Qols is not widespread in the region
- Practical resistance is possible in orchard where a high percentage of the population possesses the G143A mutation, but the SDHI/Qol premix products may prevent Qol resistance escapes.

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Apple scab on 'Jonagold'

