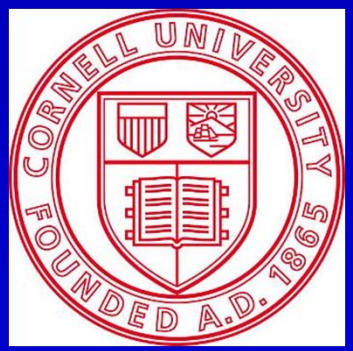
Implications of off-season scab sprays on the selection of *V. inaequalis* populations

Sara M. Villani and Kerik D. Cox

NYSAES

Department of Plant Pathology and Plant Microbe Biology - Geneva

Cornell University



Conventional Scab Management

- Silver tip
  - Urea fertilizer ground spray (inoculum reduction)
- Green tip ⟶ ½ in. green
  - Captan/EBDC
- Tight cluster ⟶ 2nd cover
  - Site-specific fungicide chemistry + protectant
- Summer maintenance program (captan)

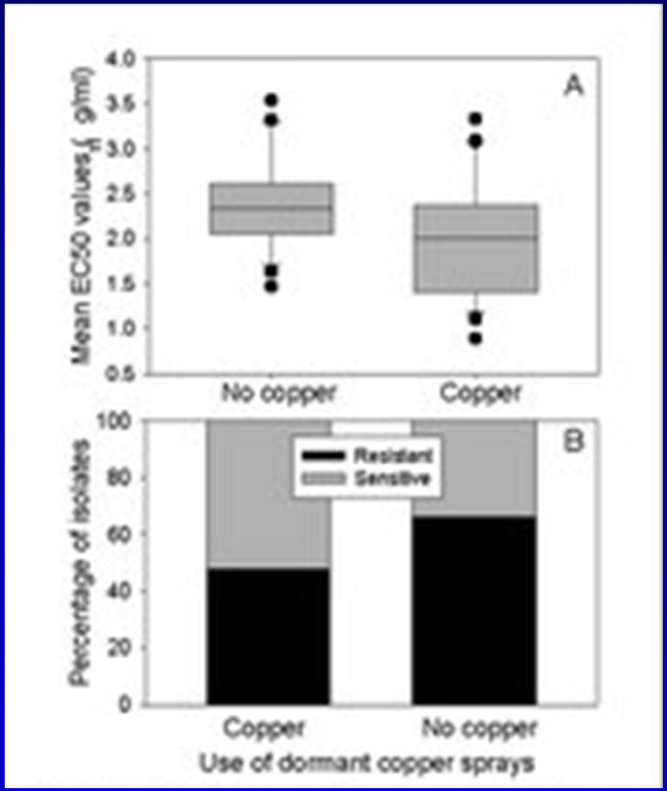
http://www.umass.edu/fruitadvisor/clements/index.html

Off-Season Scab Sprays

- Summer (3rd cover ⟶ harvest)
  - Increasingly moderate growing seasons
  - Control for flyspeck, sooty blotch, summer rots
  - Implications of late-season site specific fungicide applications?
- Dormant applications (early spring or late fall)
  - Reduce overwintering scab inoculum
  - Copper application

Off-Season Scab Sprays: Preliminary Investigations

- Ngugi *et al.* 2011: Grower survey



- Dormant copper application ⟶ increased DMI sensitivity
  - Destruction of overwintering inoculum (especially previous year's "survivors")
  - More conscientious grower?

Off-Season Scab Sprays: Preliminary Investigations

- NYSAES 'McIntosh'/'Cortland' Orchard-November 2009
  - Dormant Flint 50 WG application to DMI-resistant *V. inaequalis* population

NYSAES Research Orchard								
Sample	Row	Tree	Orchard Average % RG (% of Isolates over 90% RG)			Threshold Average % RG (% of Isolates over 90% RG)		
			Myclobutanil	Dodine	Trifloxystrobin	Myclobutanil	Dodine	Trifloxystrobin
1	2	4	72.9 ± 6.8 (28)	42.7 ± 5.3 (3)	16.1 ± 5.7 (7)	54.9 (10)	55.0 (10)	22.5 (10)
2	2	14	70.3 ± 7.2 (37)	38.8 ± 6.6 (16)	13.0 ± 5.1 (5)	54.9 (10)	55.0 (10)	22.5 (10)
3	9	8	66.3 ± 5.0 (20)	23.9 ± 3.9 (2)	8.9 ± 3.7 (2)	54.9 (10)	55.0 (10)	22.5 (10)
4	9	16	58.5 ± 4.8 (14)	23.3 ± 4.9 (7)	8.9 ± 3.4 (0)	54.9 (10)	55.0 (10)	22.5 (10)
5	14	1	88.1 ± 5.3 (51)	38.0 ± 3.9 (7)	29.5 ± 6.0 (12)	54.9 (10)	55.0 (10)	22.5 (10)
6	16	10	53.4 ± 5.3 (5)	21.8 ± 4.9 (2)	20.4 ± 5.5 (5)	54.9 (10)	55.0 (10)	22.5 (10)
Composite	-	-	73.2 ± 5.2 (33)	32.1 ± 4.5 (7)	13.5 ± 4.1 (5)	54.9 (10)	55.0 (10)	22.5 (10)

- Diminished *in vitro* TR efficacy in 2010 *V. inaequalis* populations receiving additional stroby application in the fall

2011 Research Questions

1. How do dormant (early silver) applications of copper, magnesium and myclobutanil (DMI) effect DMI fungicide sensitivity profiles of emerging *V. inaequalis* populations in an SI-resistant orchard?

2. Do “scab season” or harvest applications of Inspire or Inspire Super fungicide predispose *V. inaequalis* populations for resistance the following season?

2011 Dormant Applications

- Dormant applications in a ‘McIntosh’/‘Cortland’ orchard with a DMI-resistant *V. inaequalis* population (April 4, 2011)
  - Applications applied with handgun to drip (200 psi)

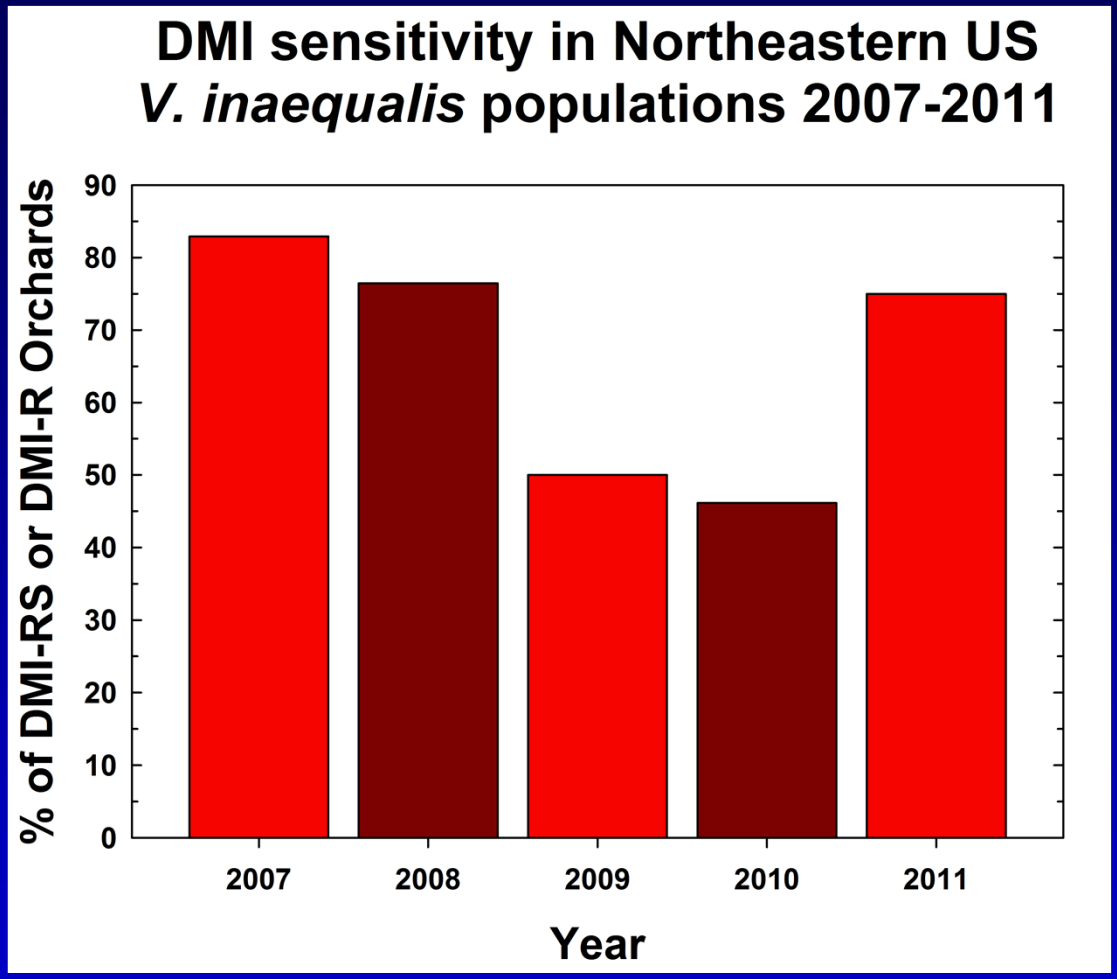
Treatment	Application Rate (amt/A)	Row
Untreated	n/a	1-4
Rally 40WSP	5 oz.	5-7
Badge X2 + Lime-Calcium	16 oz.+ 24 fl oz.	8-10
EARTHTEC	300 gal	11-13

2011 Dormant Applications

- Leaves with primary scab lesions collected from ‘McIntosh’ trees for each treatment during 2011 growing season
  - Trees were left unsprayed during conventional scab management program (GT-2nd cover)

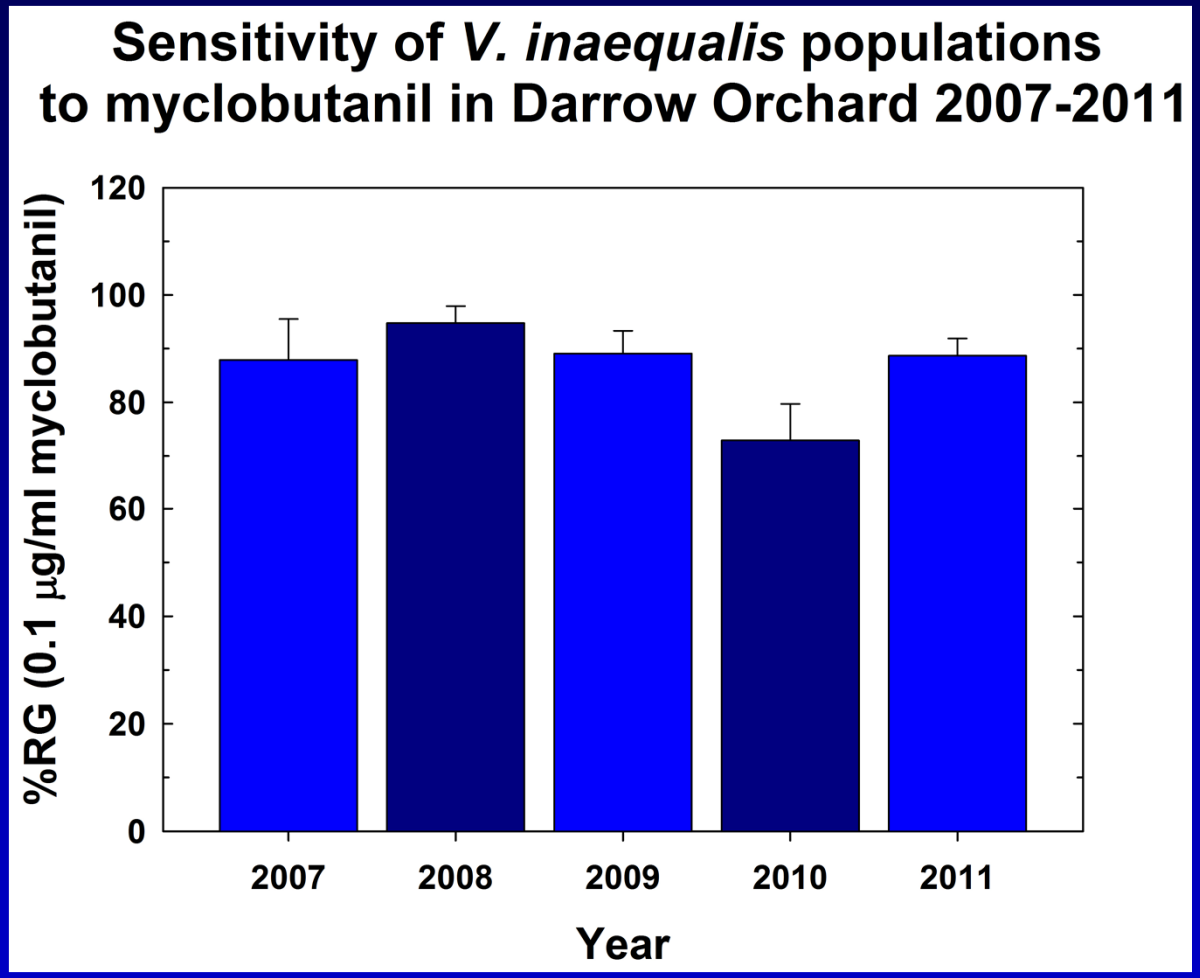
- Fungicide sensitivity to myclobutanil (0.1µg/ml)
  - Microscopy aided mycelial relative growth assays
  - Minimum of 25 individual scab lesions evaluated for each treatment; 5 microcolonies/lesion

2011 Dormant Applications



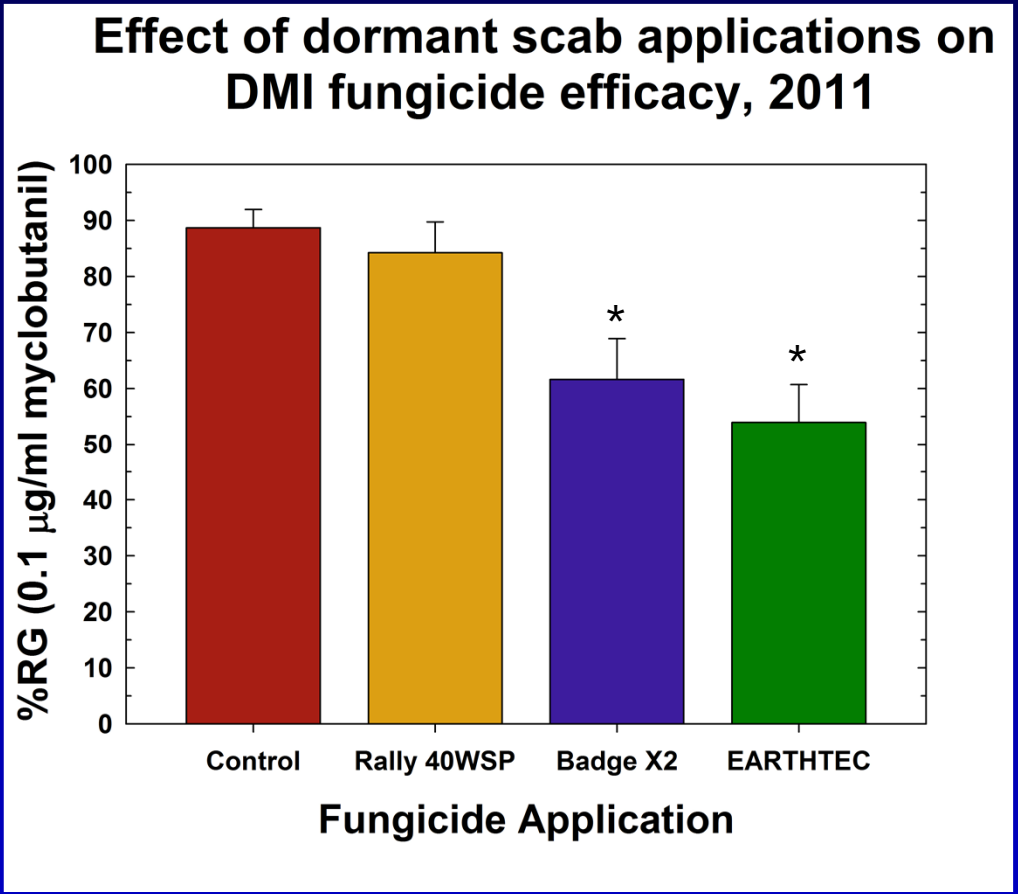
- Greater than 75% orchards surveyed in 2007, 2008, 2011 exhibited a decline in sensitivity (*in vitro)* to DMI fungicides
  - Slightly more sensitive populations in 2009 and 2010
  - Failure in the field? Depends on circumstances

2011 Dormant Applications



- *V. inaequalis* population has stable resistance *in vitro* to myclobutanil over 5 year span
  - Practical resistance to Rally 40WSP in the field

2011 Dormant Applications



- *In vitro* performance of myclobutanil greatly improved for *V. inaequalis* populations receiving dormant copper or magnesium applications
- Dormant application of Rally 40WSP no effect on DMI sensitivity

2011 Dormant Application Conclusions

- Applied in the early spring as a dormant application, Badge X2 and EARTHTEC significantly (P <0.05) increased the sensitivity of *V. inaequalis* populations to the DMI fungicide, myclobutanil.
  - Destruction of resistant overwintering *V. inaequalis* isolates? (ie-the “survivors”)
- Interestingly, dormant application of Rally 40WSP did not increase resistance to myclobuntanil
  - High frequency of resistant isolates already in the orchard ⟶ too few sensitive isolates to “kill off”
- No differences in efficacy of other site-specific fungicide chemistries (e.g. QoIs) between dormant treatments

2011 Research Questions

1. How do dormant (early silver) applications of copper, magnesium and Rally 40WSP (DMI) effect DMI fungicide sensitivity profiles of emerging *V. inaequalis* populations in an SI-resistant orchard?

2. Do “scab season” or harvest applications of Inspire or Inspire Super fungicides predispose *V. inaequalis* populations for DMI resistance the following season?
   - Increase in selection pressure on DMI resistant *V. inaequalis* populations?

Effect of 2010 Inspire Applications

- 2010 scab season applications and summer applications of Inspire or Inspire Super fungicides
  - 'Empire'/'Jonagold' orchard
  - DMI resistant *V. inaequalis* population

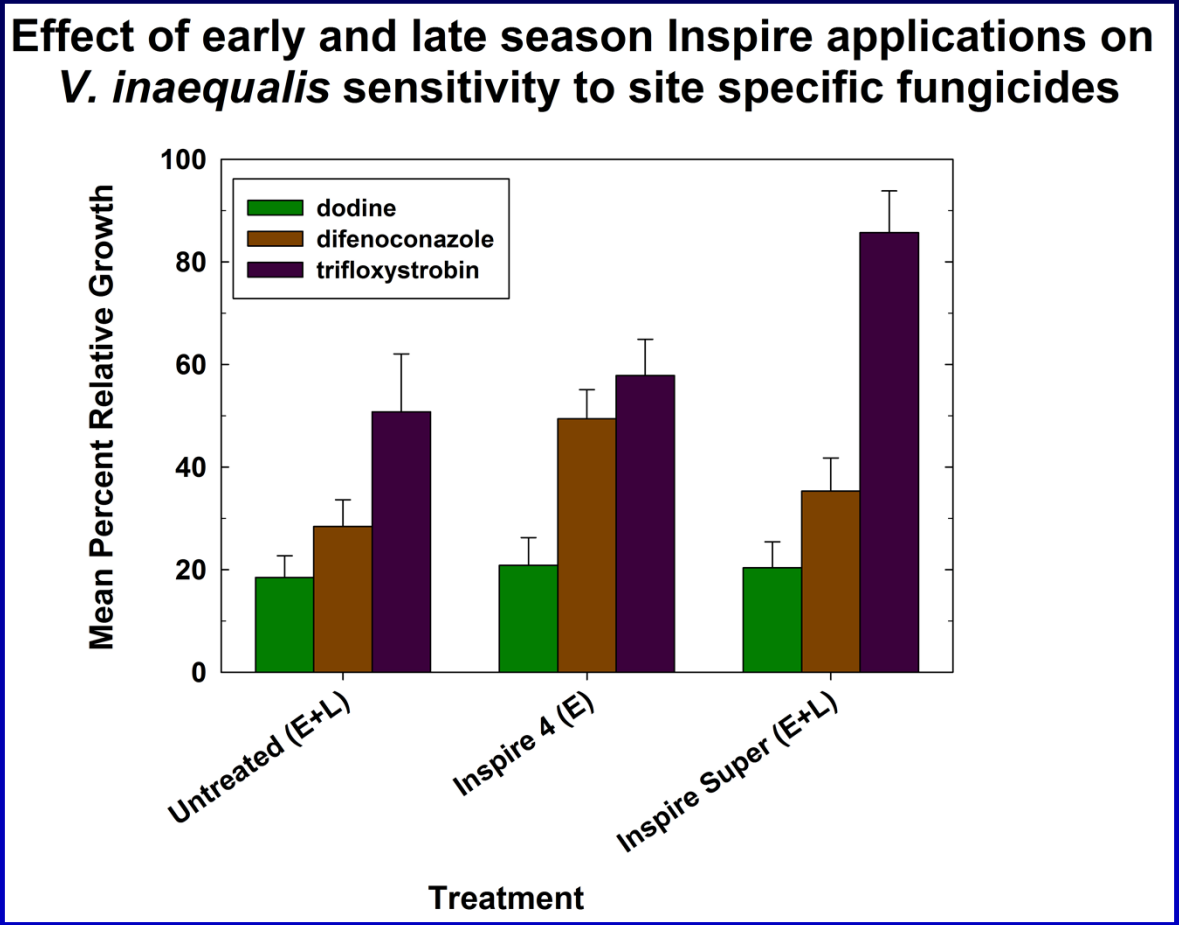
Treatment	Early Season Program (# applications)	Late Season Program (# applications)
Untreated	8	4
Inspire	4	0
Inspire Super	4	4

- 2011: trees treated only with captozeb

Effect of 2010 Inspire Applications

- Leaves with primary scab lesions collected from ‘Empire’ trees for each treatment during 2011 growing season
- Fungicide sensitivity to difenoconazole (Inspire) (0.1µg/ml), trifloxystrobin (0.02µg/ml), and dodine (0.2µg/ml)
  - –Microscopy aided mycelial relative growth assays
  - –Minimum of 25 individual scab lesions evaluated for each treatment; 5 microcolonies/lesion

Effect of 2010 Inspire Applications



- Reduced DMI sensitivity for Inspire-early treatment
- Reduced sensitivity to trifloxystrobin when Inspire applied all season long
- No change in dodine sensitivity across all treatments

Effect of 2010 Inspire Applications

- Treatment profiles not due to chance
  - Non-selective pressure check (dodine)
- Anilinopyrimidine component (Vanguard) of Inspire Super may have removed highly resistant members
  - Inspire alone for entire season or just at end of season?
- Reduce sensitivity to trifloxystrobin following full year of Inspire Super use ⟶ multi-drug mechanism?
  - Should we be worried about premix products?

Future Endeavors

- Second year data for both trials, and include “early, full, and late season only” Inspire and Inspire Super treatments

Acknowledgements

- State, federal, and institutional funds appropriated to the New York State Agricultural Experiment Station
- Agrichemical company support through product testing
  - Bayer, BASF, Syngenta, Cheminova, DuPont, & Dow Agrosciences

- Summer SMOR Crew!

Questions?