

Results of the 2014 Fungicide Sensitivity Monitoring Program and Implications for Scab Management in 2015



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Management of Pecan Scab

What makes scab so difficult to control?

- weather
- susceptible cultivars
- tight orchards (restricted air movement, high RH, long periods of leaf wetness)
- poor spray coverage
- reduced sensitivity of the scab pathogen to fungicides

History of Fungicide Resistance in Pecan Scab

Fungicide resistance in the pecan scab fungus, *F. effusum* prior to 2008:

- resistance to MBC fungicide benomyl reported in mid-1970s in Georgia (same MOA as thiophanate-methyl)
- significant decrease in sensitivity to DMI fungicides 1995-2003 associated with poor scab control
- significant shifts in sensitivity to fentin hydroxide (TPTH) in 1998, but control failures not documented

Fungicide Sensitivity Monitoring

In 2008:

- A rapid fungicide sensitivity assay was developed to facilitate statewide monitoring efforts and provide growers with timely results
- Samples from a limited number of orchard locations were collected and tested using the new method

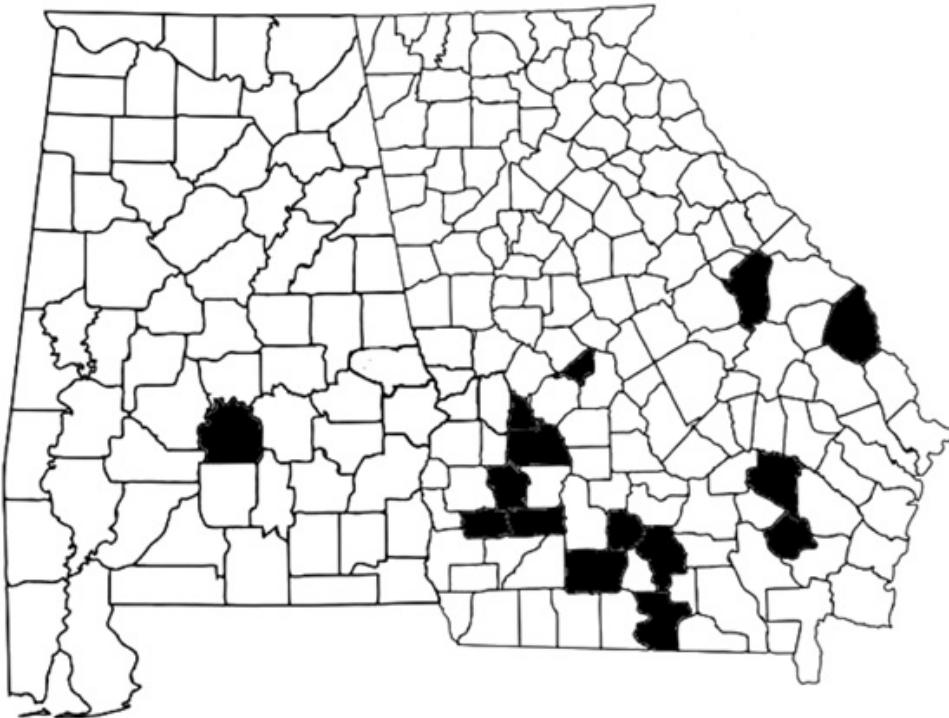
In 2014:

- Fungicide sensitivity monitoring was offered as a “free” service to growers in Georgia
- Growers submitted samples for testing and received a report of the results by email

Fungicide Sensitivity Monitoring

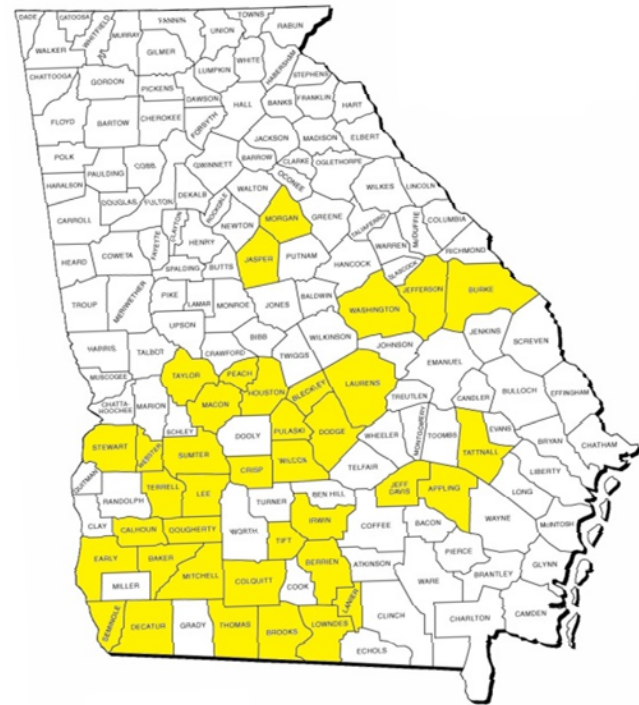
2008

33 samples collected
from orchards in GA and
AL



2014

179 samples received from
38 counties in GA

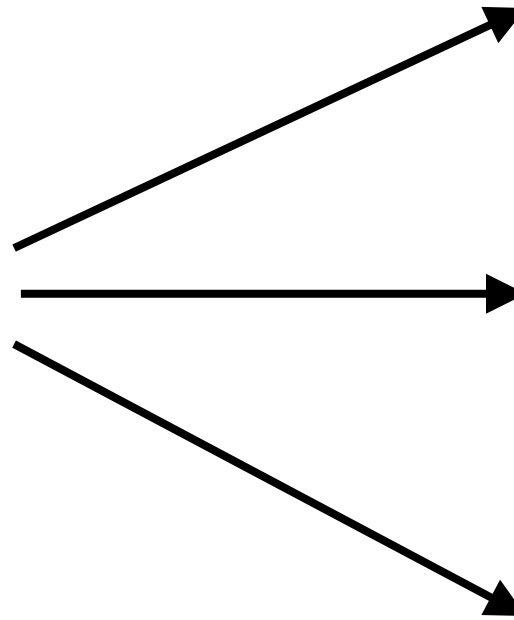


Fungicides Included in the Sensitivity Assay

FRAC code	Fungicide	Concentration (µg/ml)	
30	Fentin hydroxide (Super Tin, Agri Tin)	30	0
11	Azoxystrobin (Abound, Quadris Top*)	10	0
1	Thiophanate-methyl (Topsin-M)	1	0
U12	Dodine (Elast)	3	0
3	Propiconazole (Orbit, Propimax, etc.)	1	0
3	Tebuconazole (Folicur, Tebuzol, etc.)	1	0

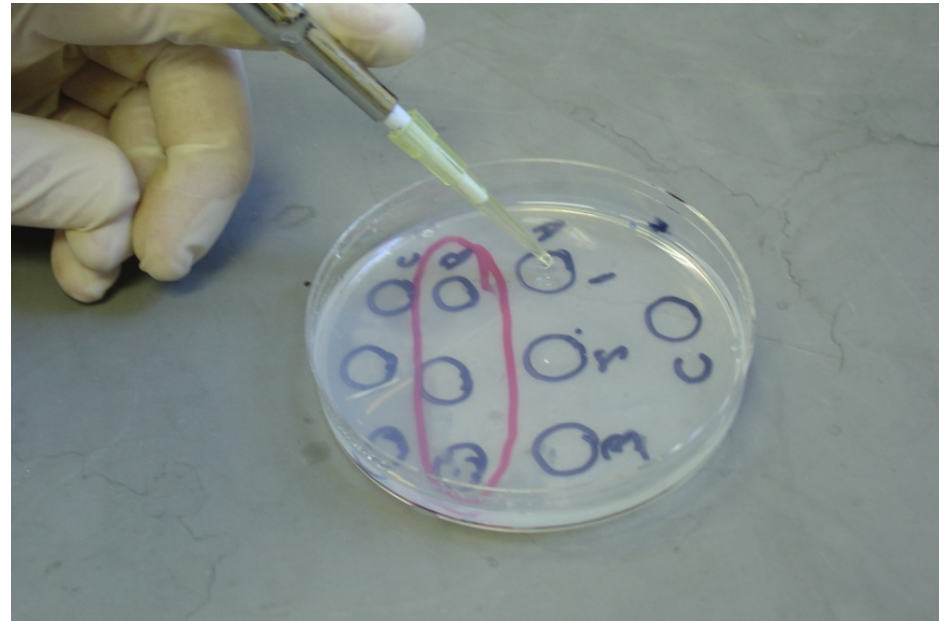
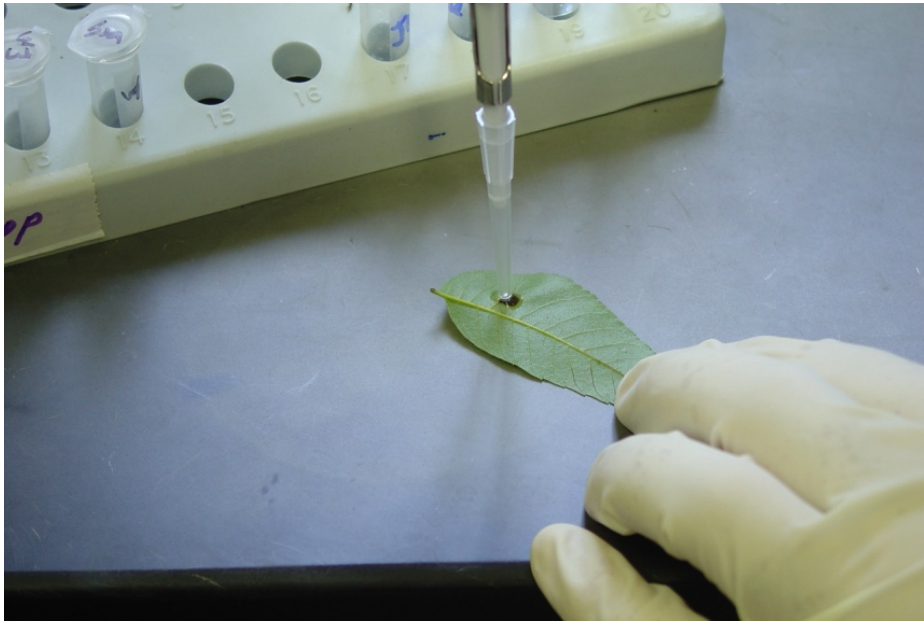
Leaf Scab Samples

50 leaflets per orchard, divided into 3 groups:



Spores collected from 15 lesions per group

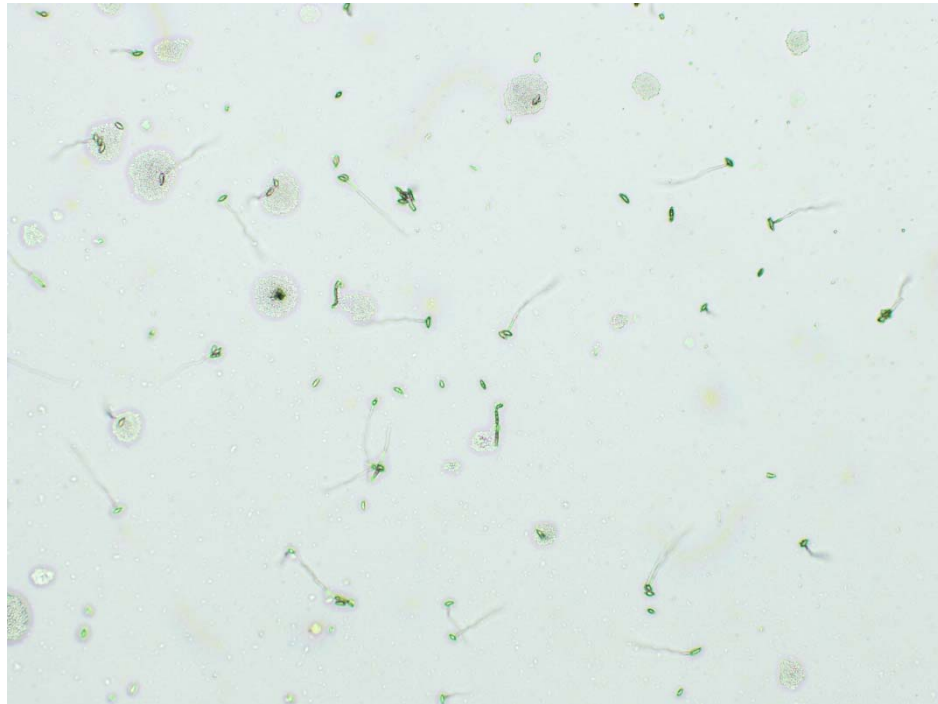
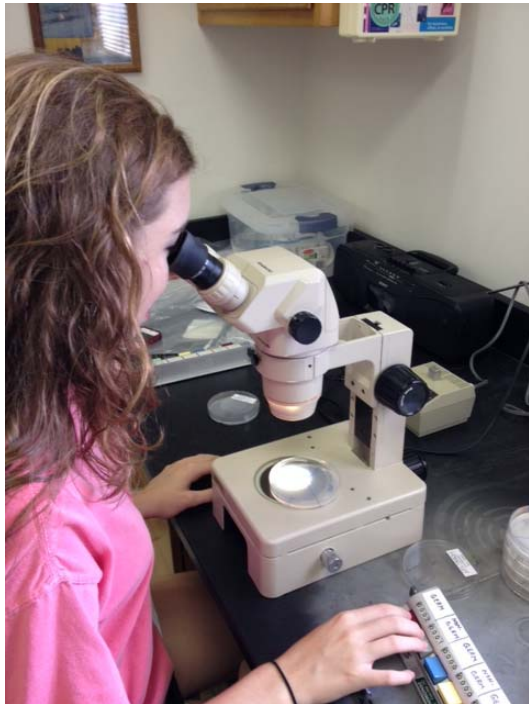
Fungicide Sensitivity Monitoring Assay



Spores washed from individual lesions and transferred to fungicide-amended and non-amended (control) medium

Spore Germination (2 days)

50 spores examined, % germination recorded

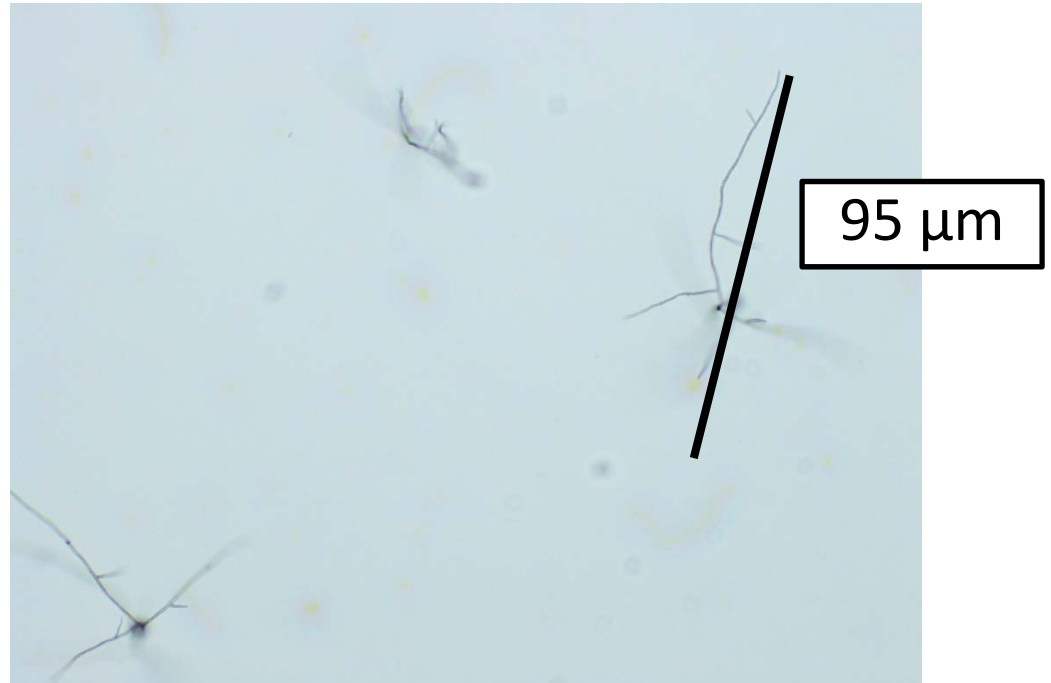


Relative germination (RGm):

$$= \frac{\% \text{ germination on fungicide medium}}{\% \text{ germination on control medium}}$$

Micro-Colony Growth (3 days)

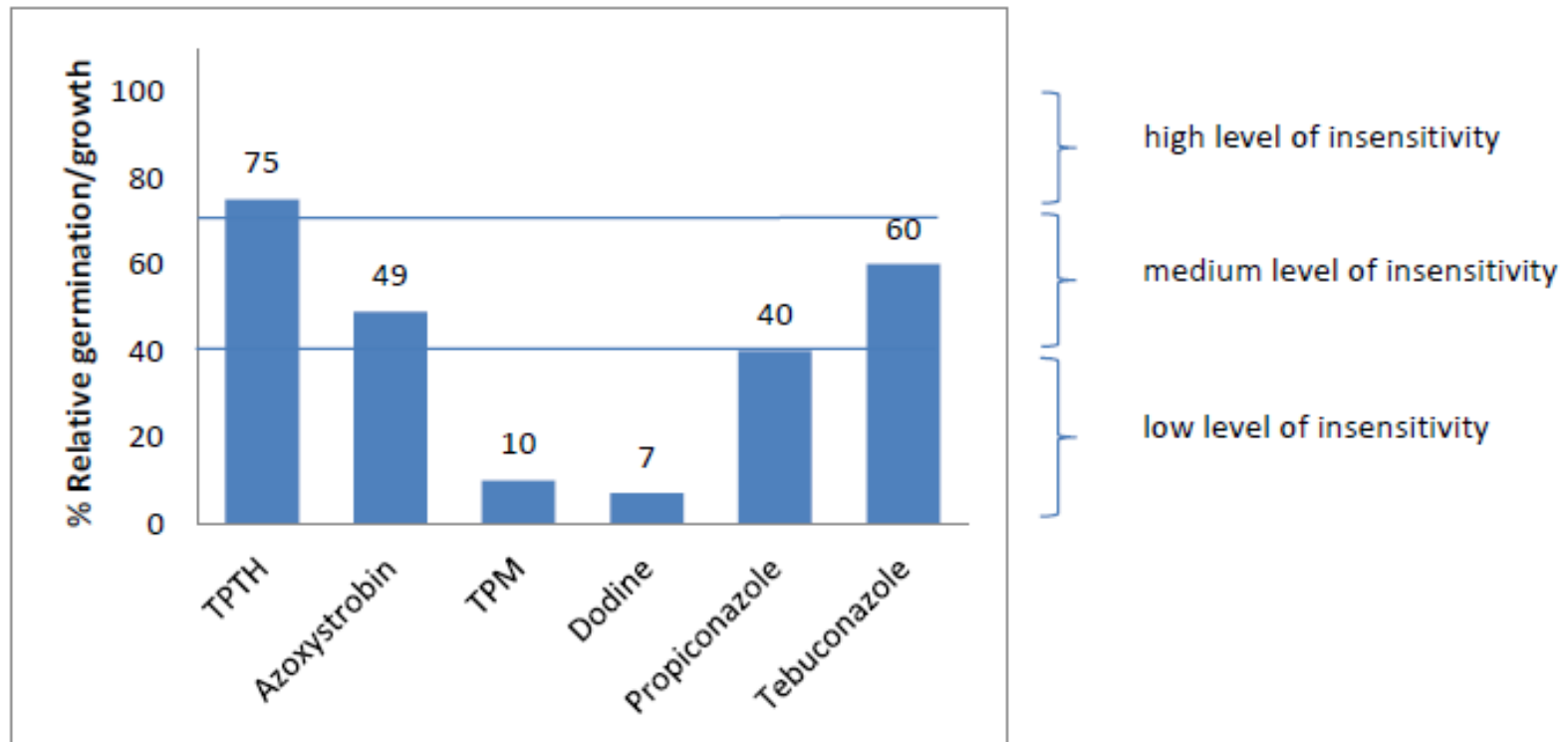
Diameters of 10 micro-colonies measured:



Relative growth (RGr):

$$= \frac{\text{mean colony diameter on fungicide medium}}{\text{mean colony diameter on control medium}}$$

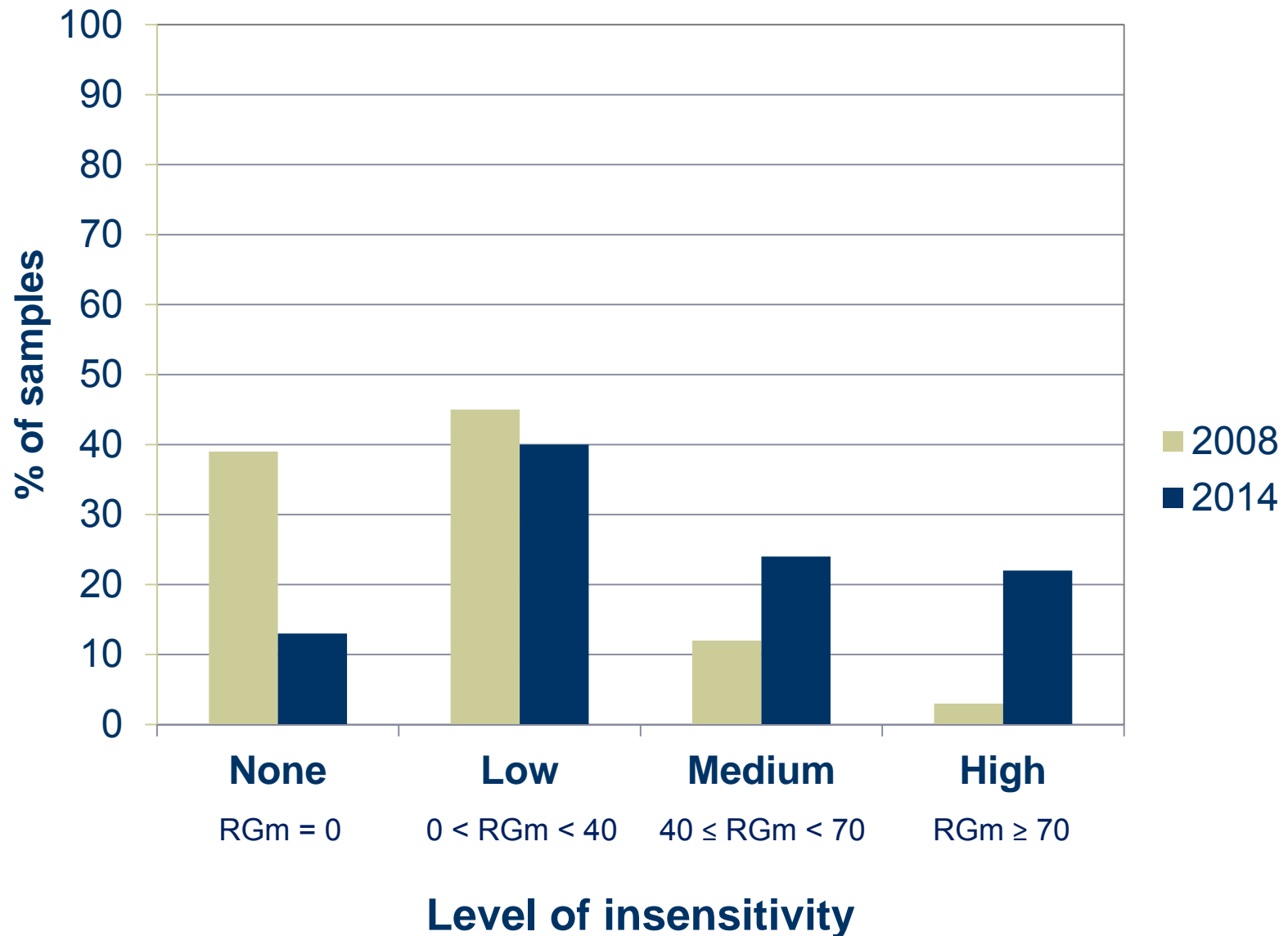
Results Reported to Grower



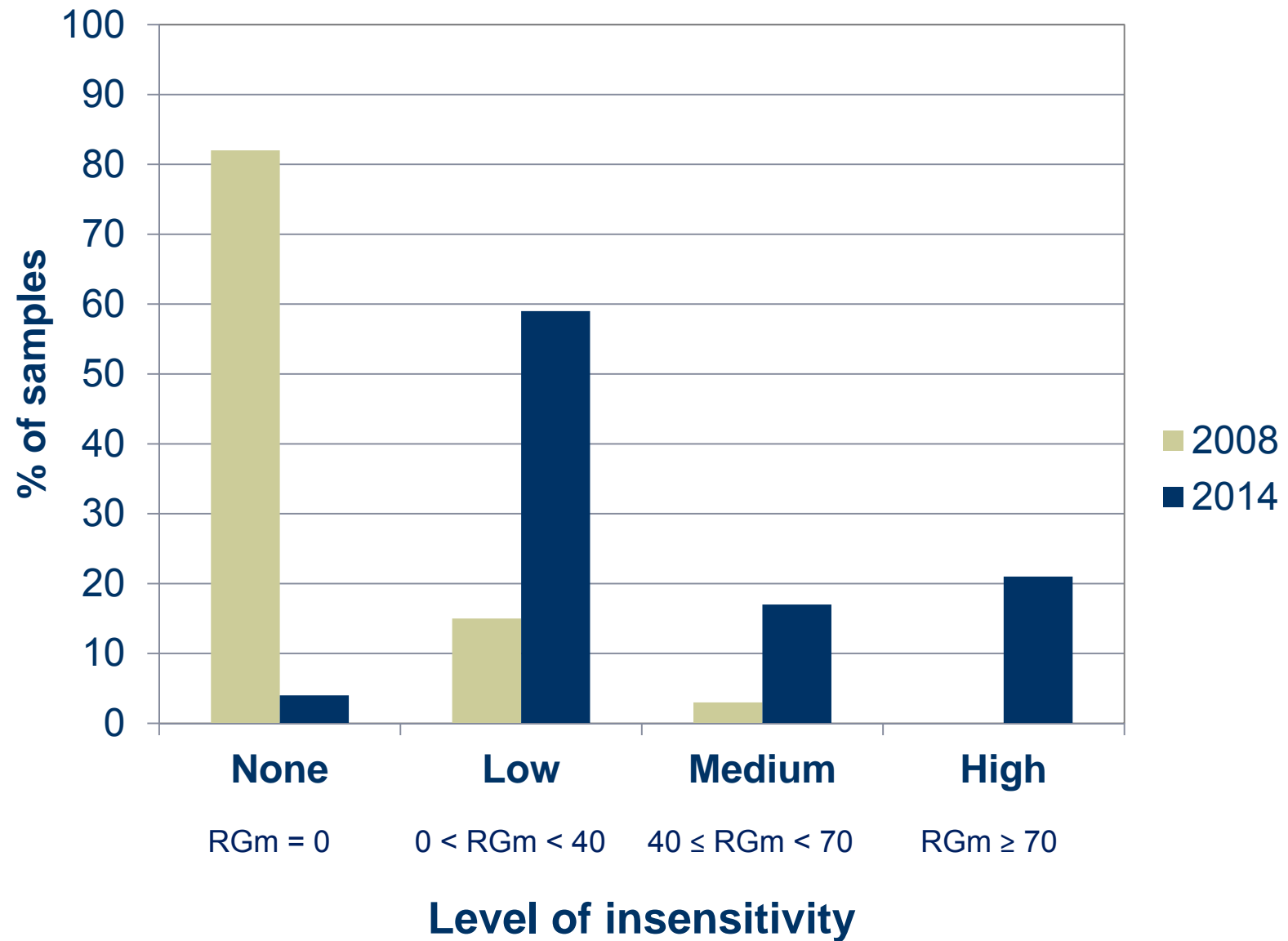
Key to interpretation of assay results:

% RG	Level of insensitivity
0	none (sensitive)
1 - 39	low
40-69	medium
70 or more	high

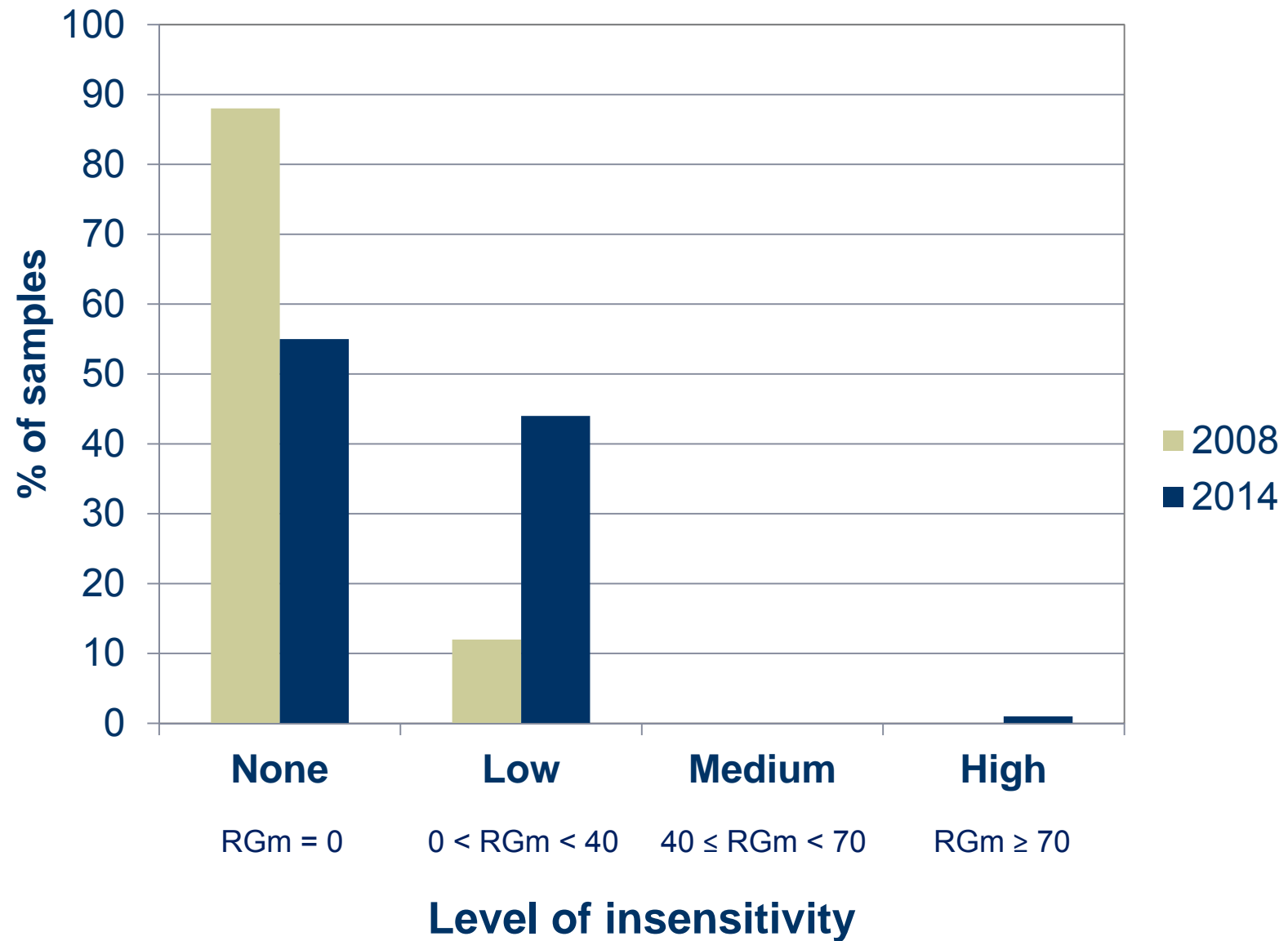
Insensitivity to Fentin Hydroxide (30 µg/ml)



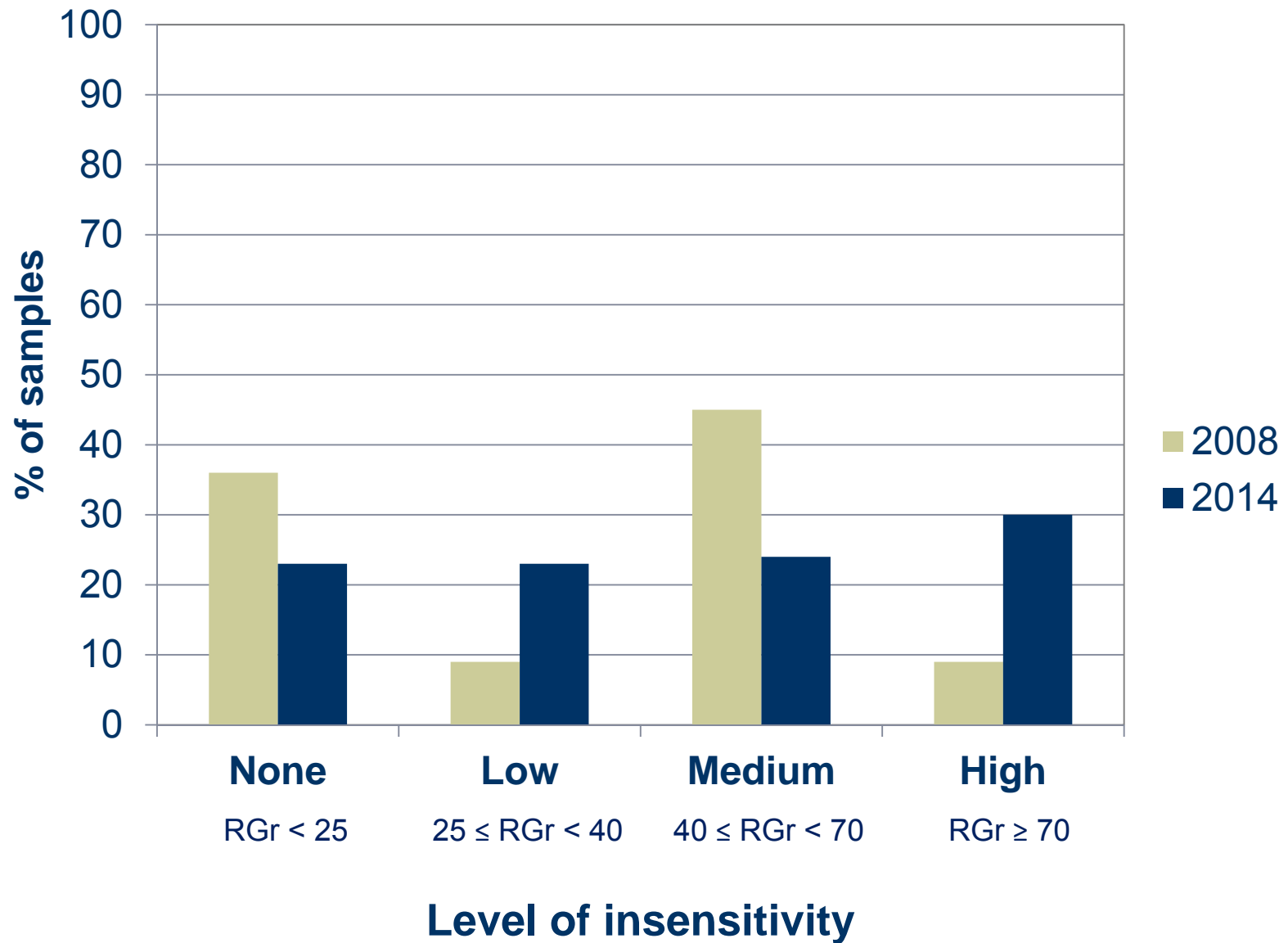
Insensitivity to Thiophanate-methyl (1.0 µg/ml)



Insensitivity to Dodine (3.0 µg/ml)



Insensitivity to Propiconazole (1.0 µg/ml)

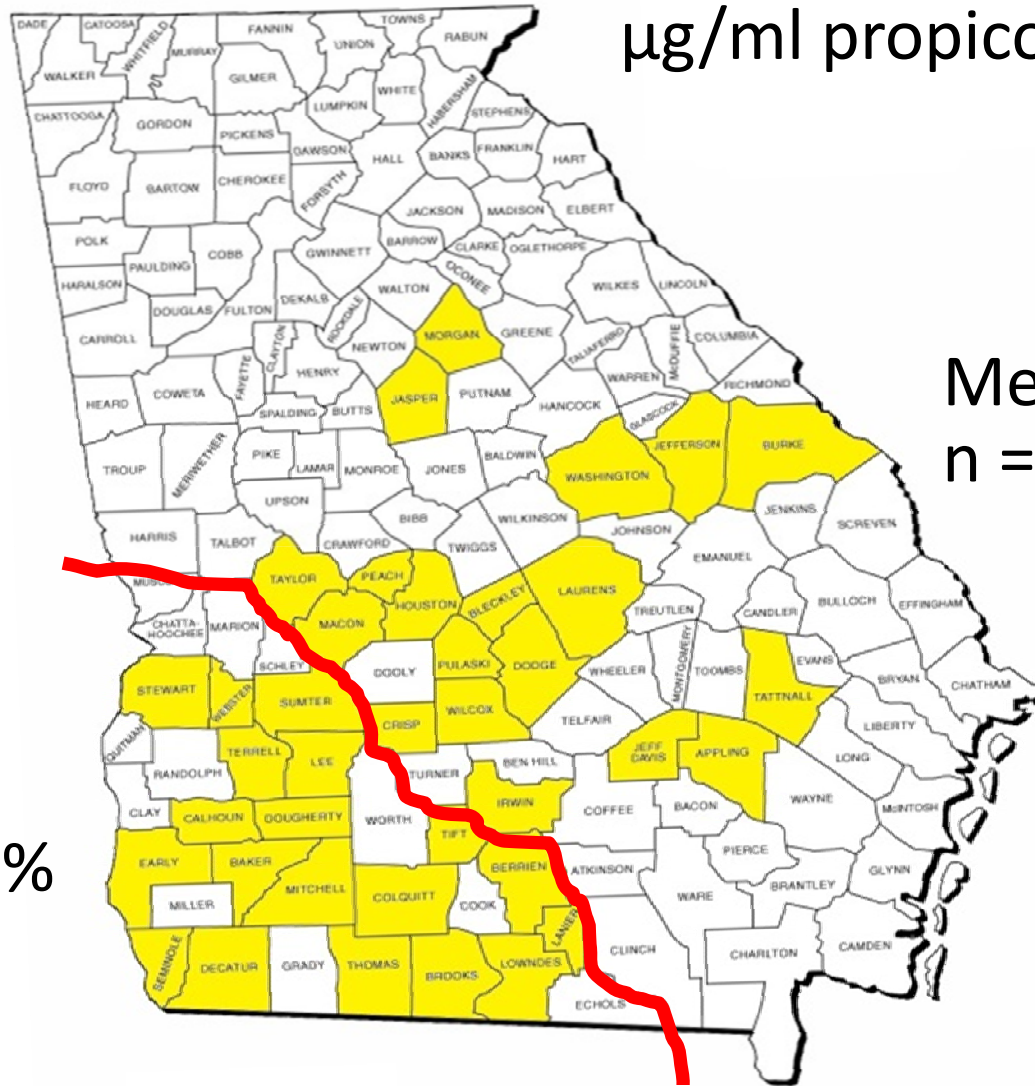


Regional Differences in Sensitivity to DMIs

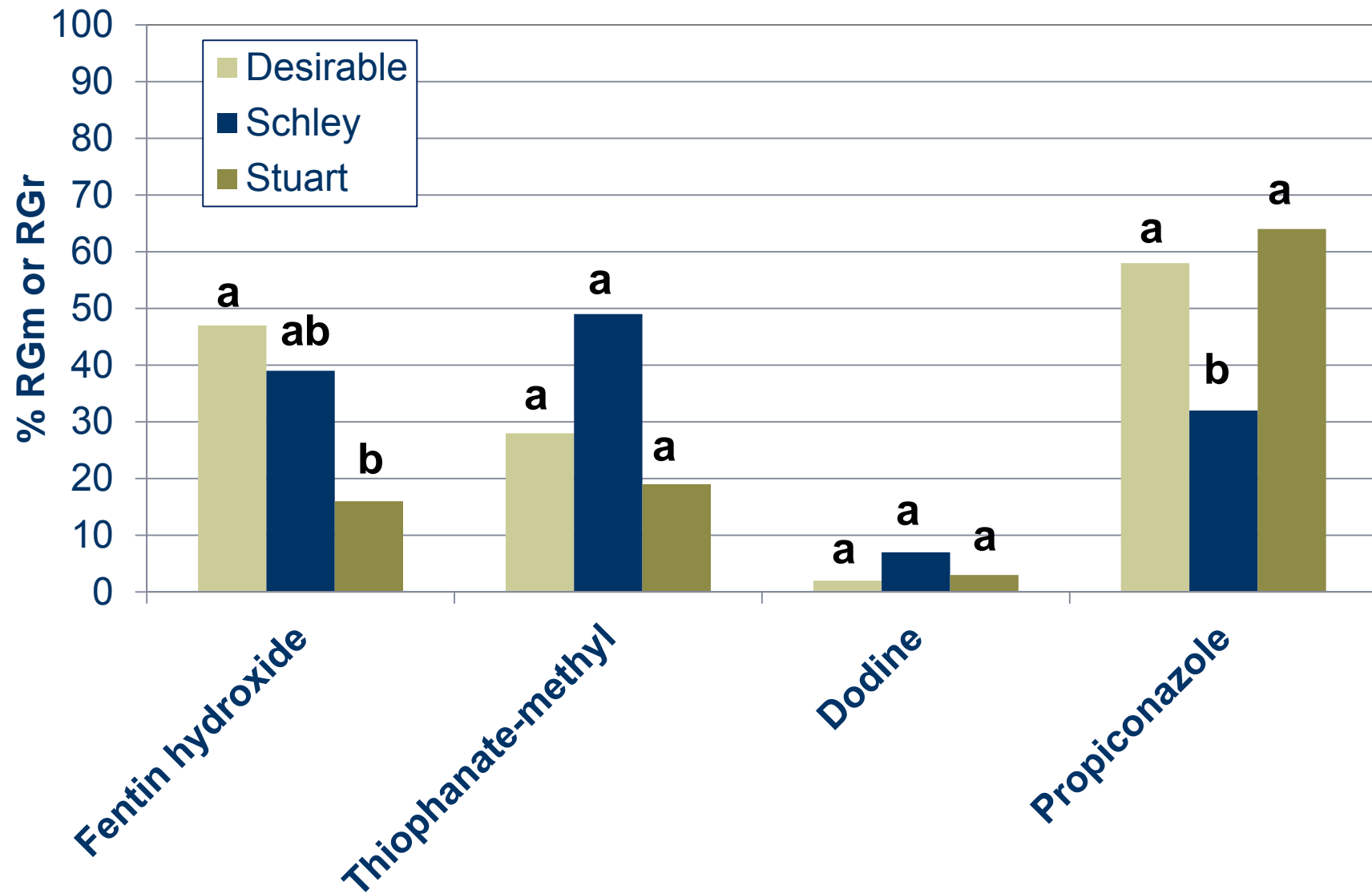
Mean RGr on 1.0
 $\mu\text{g/ml}$ propiconazole

Mean = 64%
n = 81

Mean = 34%
n = 43



Differences in Sensitivity Among Cultivars



Resistance to Multiple Fungicide Classes

# of different fungicide classes to which a sample tested highly insensitive*	2008		2014	
	# Samples	%	# Samples	%
4	0	0	1	~1
3	0	0	1	~1
2	0	0	17	11
1	4	12	67	43
0	29	88	70	45
Total	33	100	156	100

* Fungicide classes: organotin, DMIs, MBCs, and guanidines
 Highly insensitive: $R_{Gm} \geq 70\%$ or $R_{Gr} \geq 70\%$

Sensitivity to QoI Fungicides

- The rapid assay method is not accurate for azoxystrobin (QoIs)
- A PCR-based assay has been developed to detect the genetic mutations that confer resistance to QoIs
- 77 isolates tested in 2010; no mutations found
- Need to test more isolates for presence of mutations

What Have We Learned From Monitoring?

- The relative levels of insensitivity to different fungicides and changes over time are consistent with fungicide use patterns
- The greatest shifts in sensitivity have been observed for fenitrothion hydroxide and propiconazole, and to a lesser extent, thiophanate-methyl
- Little change in sensitivity to dodine over the past 6 years
- Evidence suggests existence of multiple resistance in some locations

What Does It Mean for Scab Management?

- Thresholds for “low”, “medium” and “high” insensitivity categories are arbitrary and provide an indication of “relative”, rather than “absolute” level of insensitivity.
- “High insensitivity” in an orchard does not necessarily mean complete loss of fungicide effectiveness.
- For fentin hydroxide and DMIs, the highest labelled rates may provide effective control; avoid reduced rates, including rates of individual components of mixtures.
- Resistance management is more important than ever! This includes non-chemical disease management.

Acknowledgments

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