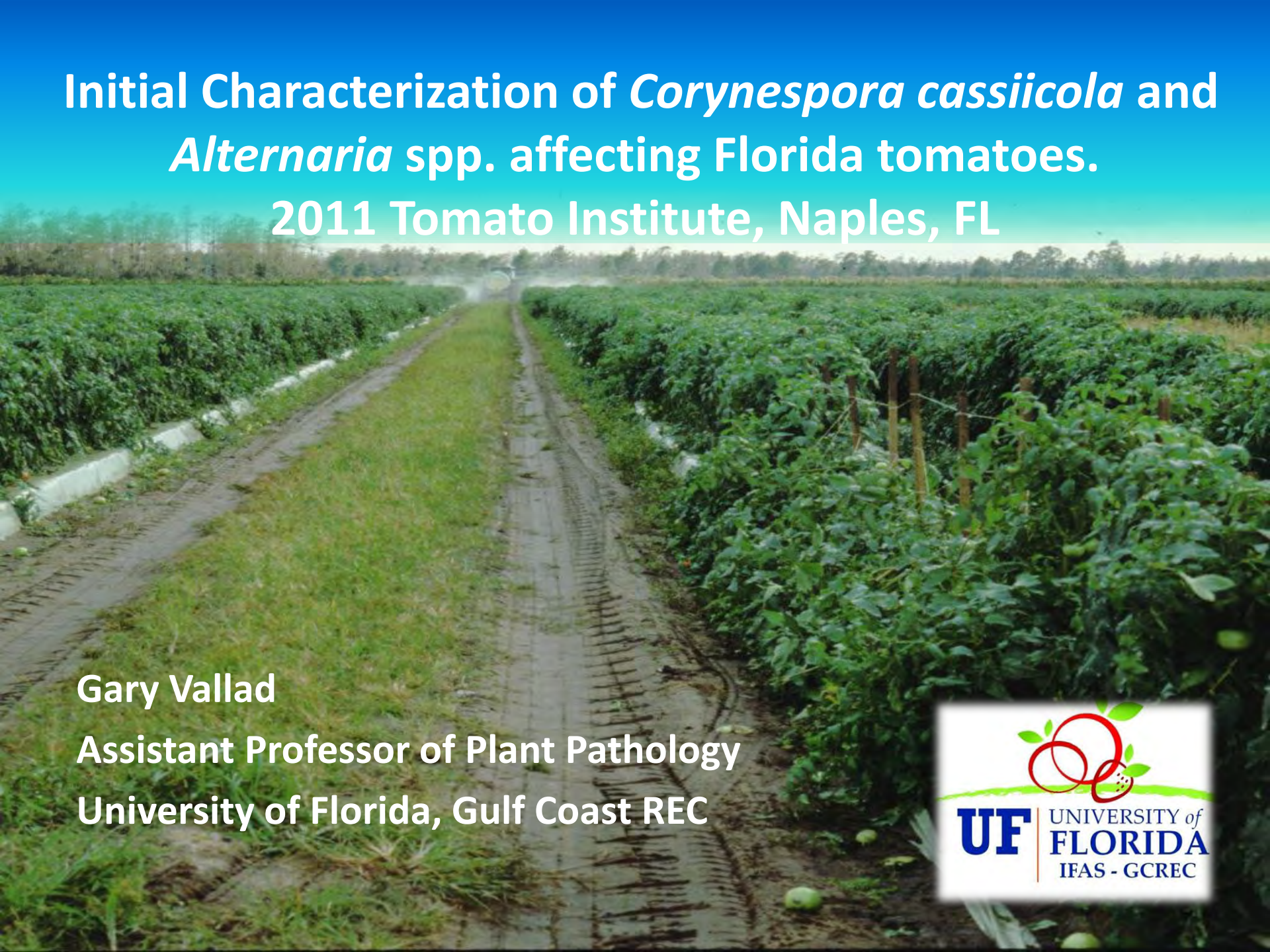
Initial Characterization of *Corynespora cassiicola* and *Alternaria* spp. affecting Florida tomatoes.

2011 Tomato Institute, Naples, FL



Gary Vallad

Assistant Professor of Plant Pathology

University of Florida, Gulf Coast REC

UF UNIVERSITY of FLORIDA IFAS - GCREC

Foliar Diseases - Fungal

1. Target Spot
    - *Corynespora cassiicola*
2. Early Blight
    - *Alternaria solani*
3. Black Mold
    - *Alternaria alternata*
4. Powdery Mildew
    - *Oidium neolycopersici*
5. Leaf Mold
    - *Fulvia fulva*
6. Gray mold
    - *Botrytis cinerea*
7. Gray Leaf Spot
    - *Stemphylium* spp.
8. Anthracnose
    - *Colletotrichum* spp.
9. Septoria leaf spot
    - *Septoria lycopersici*

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Target spot affects tomato (*Corynespora cassiicola*)

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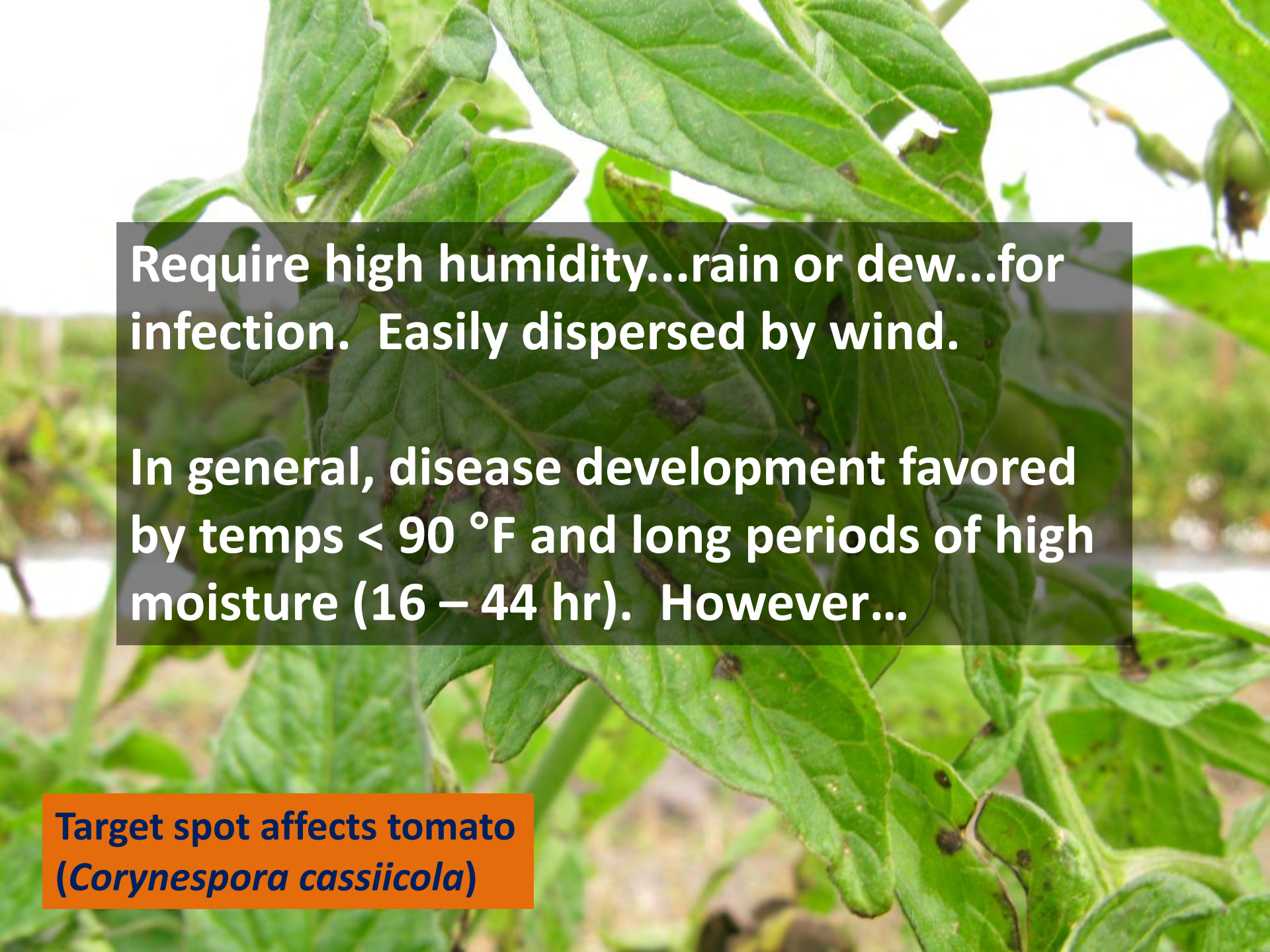
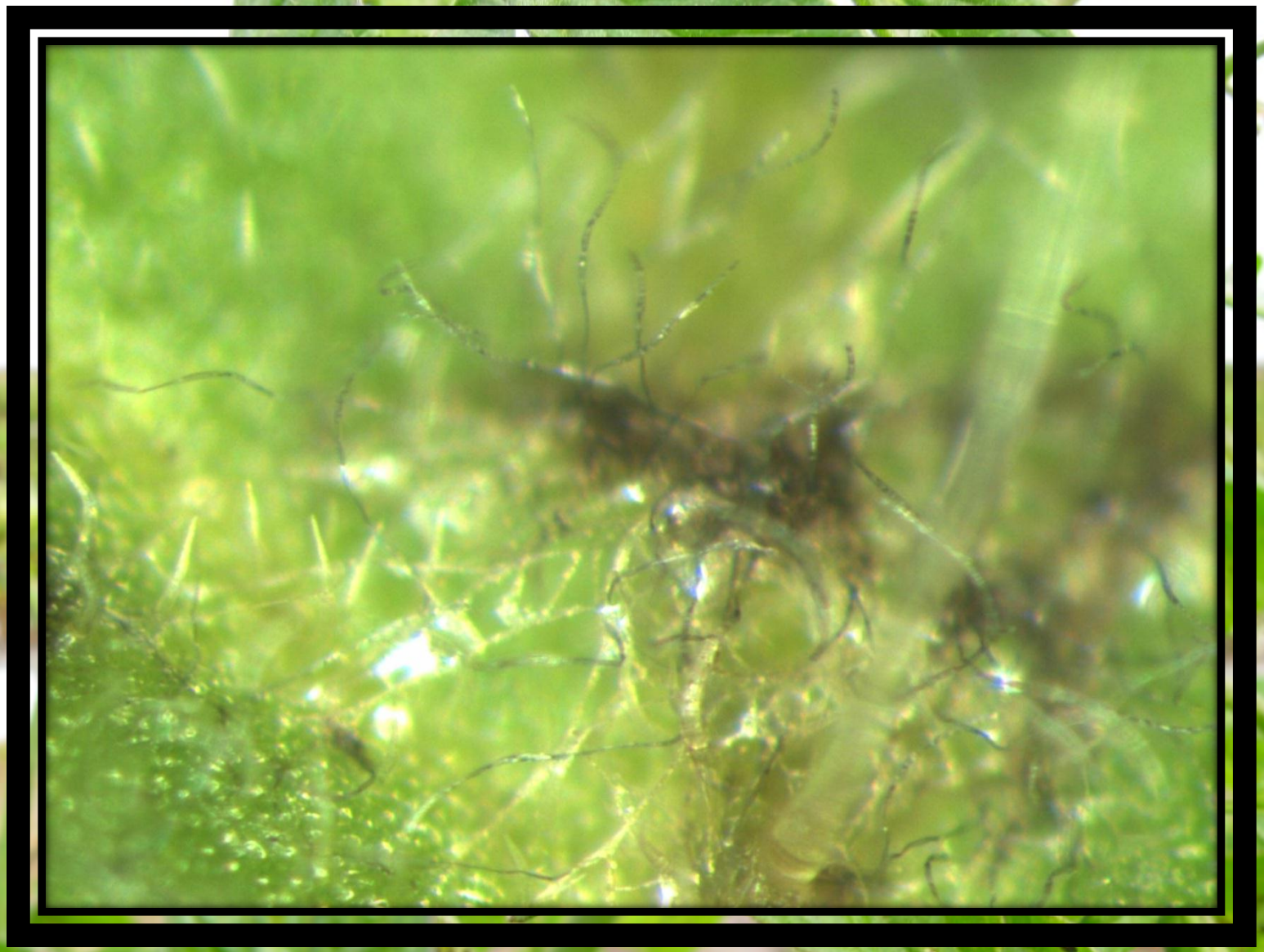


Require high humidity...rain or dew...for infection. Easily dispersed by wind.

In general, disease development favored by temps < 90 °F and long periods of high moisture (16 – 44 hr). However…

Target spot affects tomato (*Corynespora cassiicola*)



Target spot affects tomato
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Conidia are long, hyline with 4 – 20 pseudosepta.
Form singly or in chains of two to six.
Pronounced hilum at the base.

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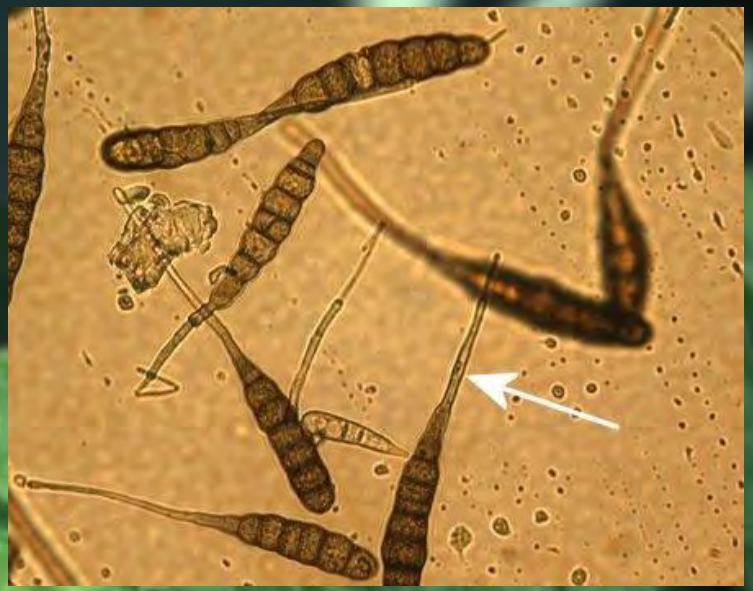
Early Blight affects tomato and eggplant (*Alternaria solani / A. tomatophila*)



Early Blight affects tomato and eggplant (*Alternaria solani / A. tomatophila*)

Rodrigues et al. 2010. First report of Alternaria tomatophila and A. grandis causing early blight on tomato and potato in BrazilNew Dis. Rep. 22:28

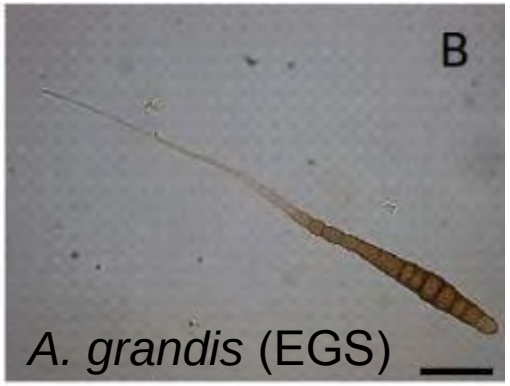
Table 1. Morphological characteristics of the *Alternaria* spp. isolates collected from infected potato and tomato plants compared with the representative isolate of *Alternaria solani*.

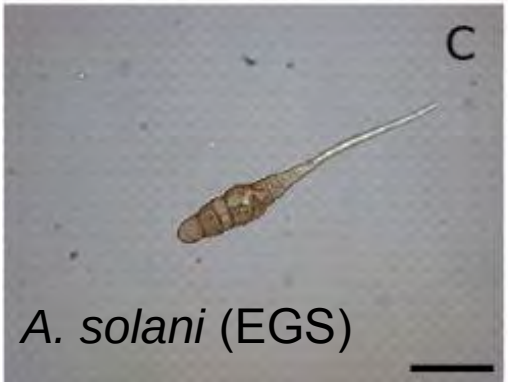
Morphological characteristic[1]	Species *A. solani*[2]	*A. tomatophila*[3]	*A. grandis*[3]
Conidium body length	85 - 100	70 - 99	102 - 184
Conidium body width	18 -22	12 - 20	14 - 17
Beak length[4]	83 - 110	99 - 197	135 - 206
Number of transversal septa	8 - 12	7 - 12	9 - 14
Number of longitudinal septa	1 - 3	1 - 4	0 - 3
Number of beaks[5]	1	1 and 2	1

[1] Range of minimum and maximum values observed in the isolates analyzed.
[2] Measurements from the representative isolate EGS 44-098.
[3] Measurements from the isolates used in this study.
[4] Measurements were made of conidia with one beak.
[5] Number of beaks predominant in conidia population (Simmons, 2007).

Can separate *Alternaria* species based on morphological characters…not trivial.

A. tomatophila (FL)





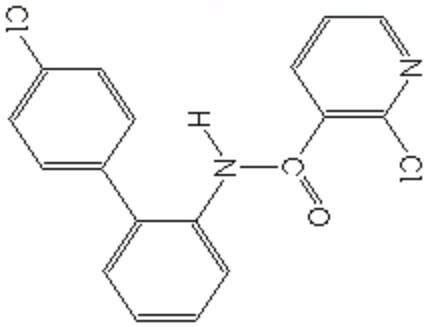
Management:

- Crop rotation – avoid rotations among Solanaceae
- Sanitation – destroy plant debris and volunteers
- Solanaceous weeds – serve as reservoir
  - *C. cassiicola* has a broad host range!
- Maintain proper fertility
- Healthy, disease-free transplants
- Chemical control

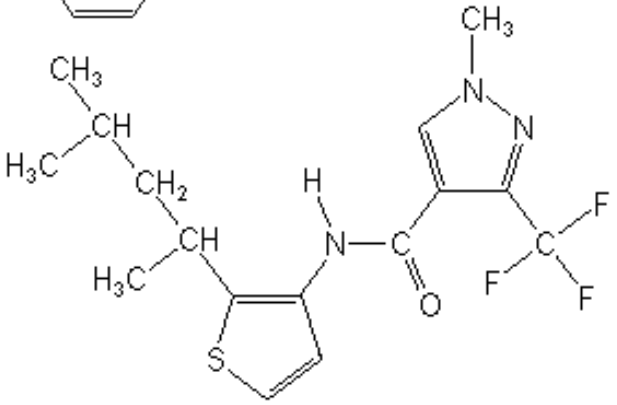
MOA (FRAC)	Fungicide	Commercial name
Multi-site, contact fungicide (M3)	Mancozeb	Dithane/Penncozeb
Multi-site, contact fungicide (M5)	Chlorothalonil	Bravo
QoI; strobilurins (11)	Azoxystrobin Fluoxastrobin Pyraclostrobin Trifloxystrobin	Quadris Evito Cabrio Flint
QoI; non-strobilurins (11)	Fenamidone Famoxidone	Reason Tanos (mix w/ cymoxanil)
SDHI; Succinate Dehydrogenase Inhibitors (7)	Boscalid Penthiopyrad* Fluopyram* Fluxapyroxad*	Endura Fontelis* (LEM-17) Luna* Xemium*
DMI; Demethylase Inhibitors (3)	Difenoconazole	RevusTop (mix w/ mandipropamid) Inspire Super (mix w/ cyprodinil)
Methionine biosynthesis inhibitors (9)	Pyrimethanil Cyprodinil	Scala Switch (mix w/ fludioxonil) Inspire Super (mix w/difenoconazole)

New SDHIs

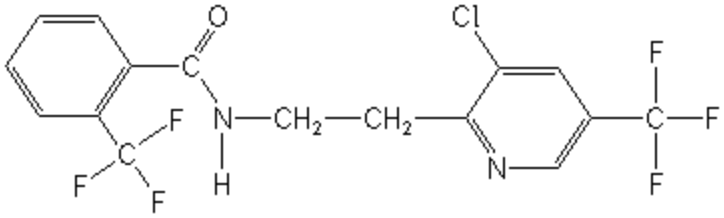
- **Boscalid**



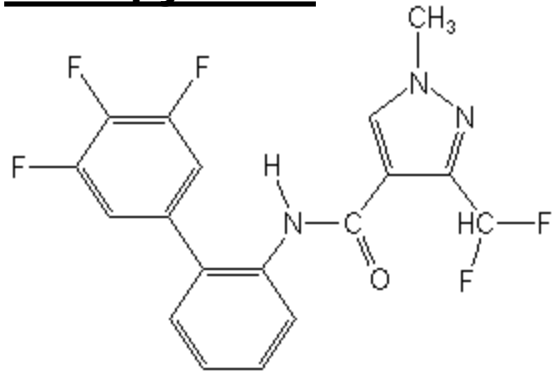
- **Penthiopyrad**



- **Fluopyram**



- **Fluxapyroxad**



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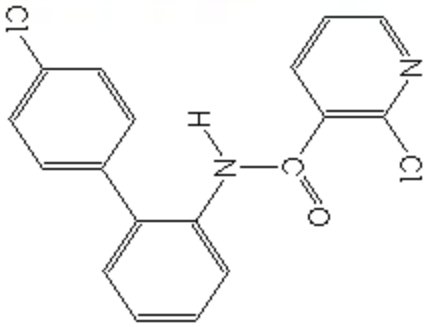

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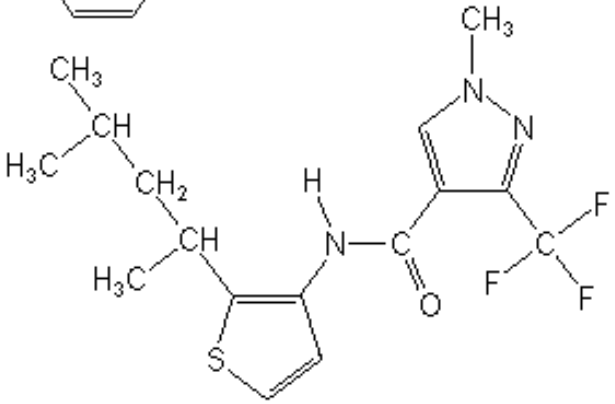
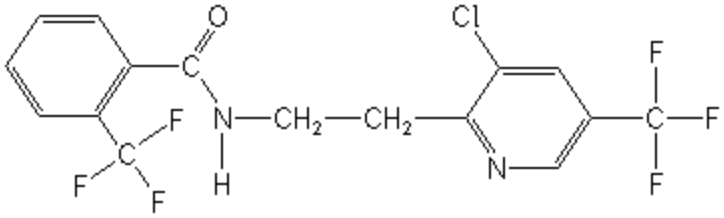
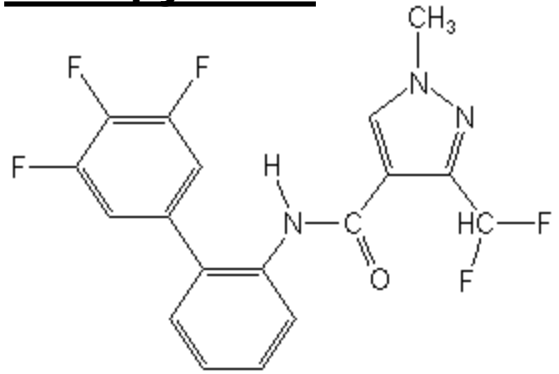


- **Fluopyram**



- **Fluxapyroxad**



Structural similarities does raise a concern of….

cross-resistance?

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TRIALS:

Tractor Sprayer:
- 210 PSI
- 60/90/120 Gal/Acre
- Weekly Apps.
- 90 ft three bed plots
- RCBD; 4 reps

Backpack Sprayer:
- 40 PSI
- 60/90/120 Gal/Acre
- Weekly Apps.
- 30 ft single bed plots
- RCBD; 4 reps

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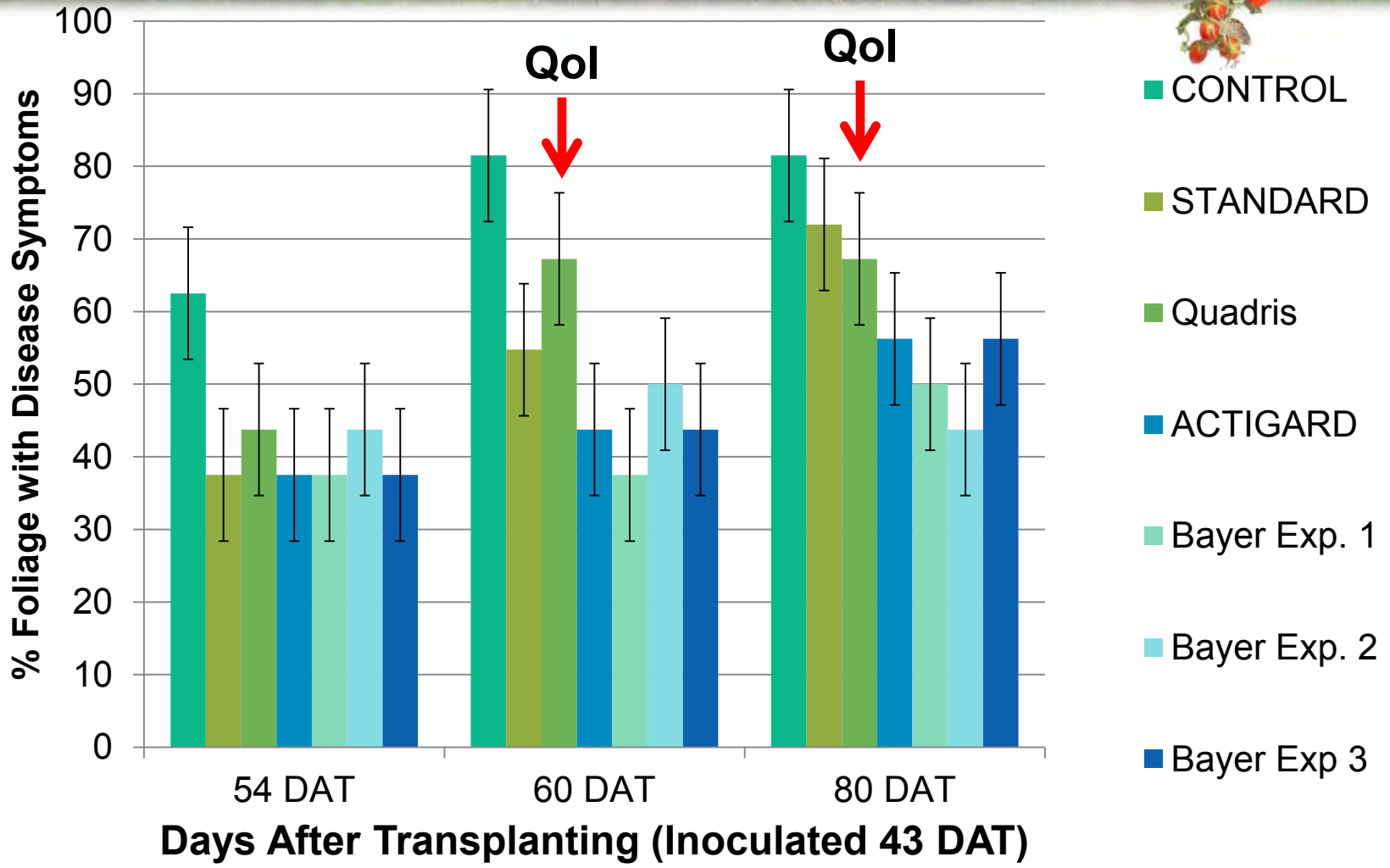
Spring 2008: Early Blight & Target Spot



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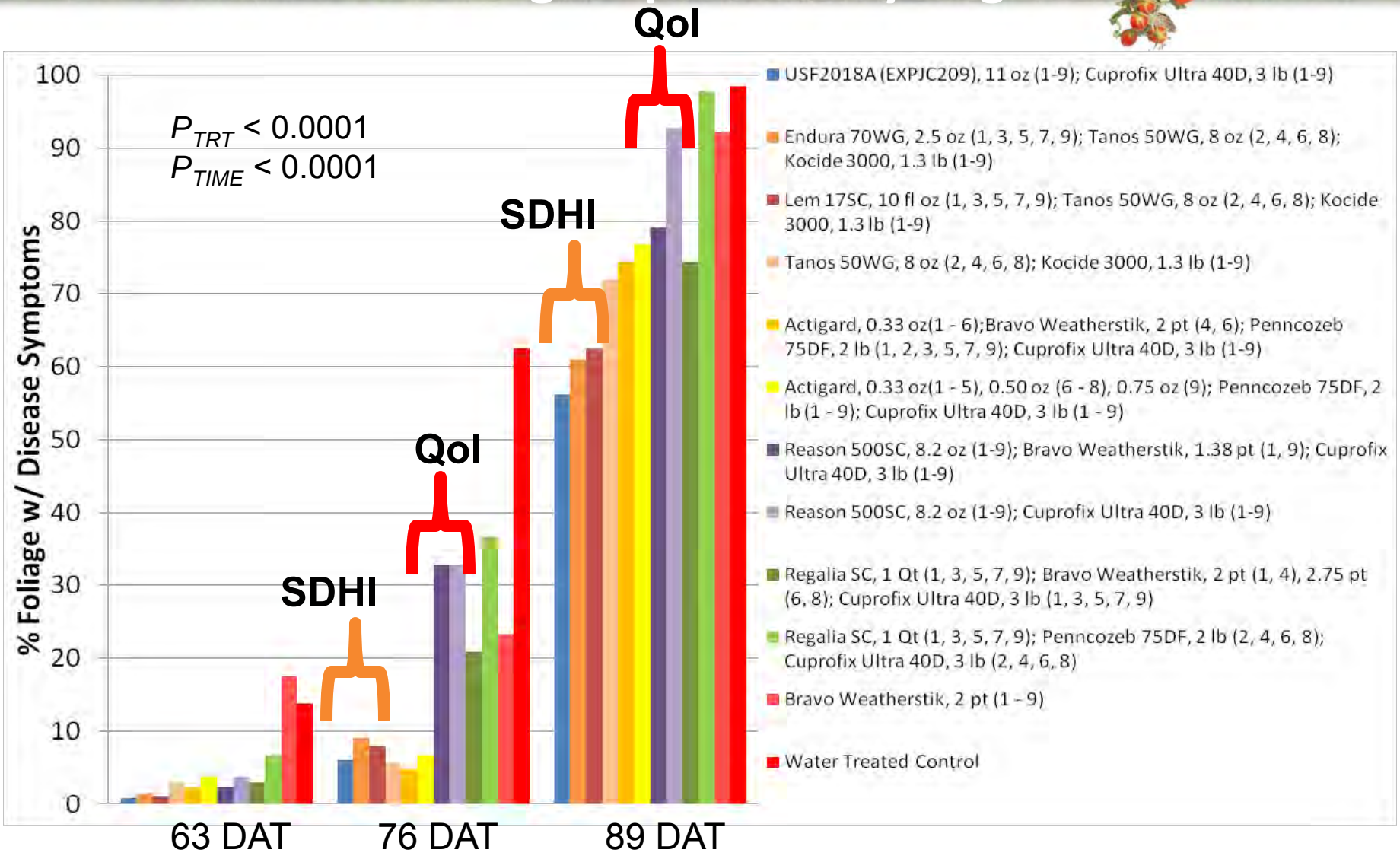
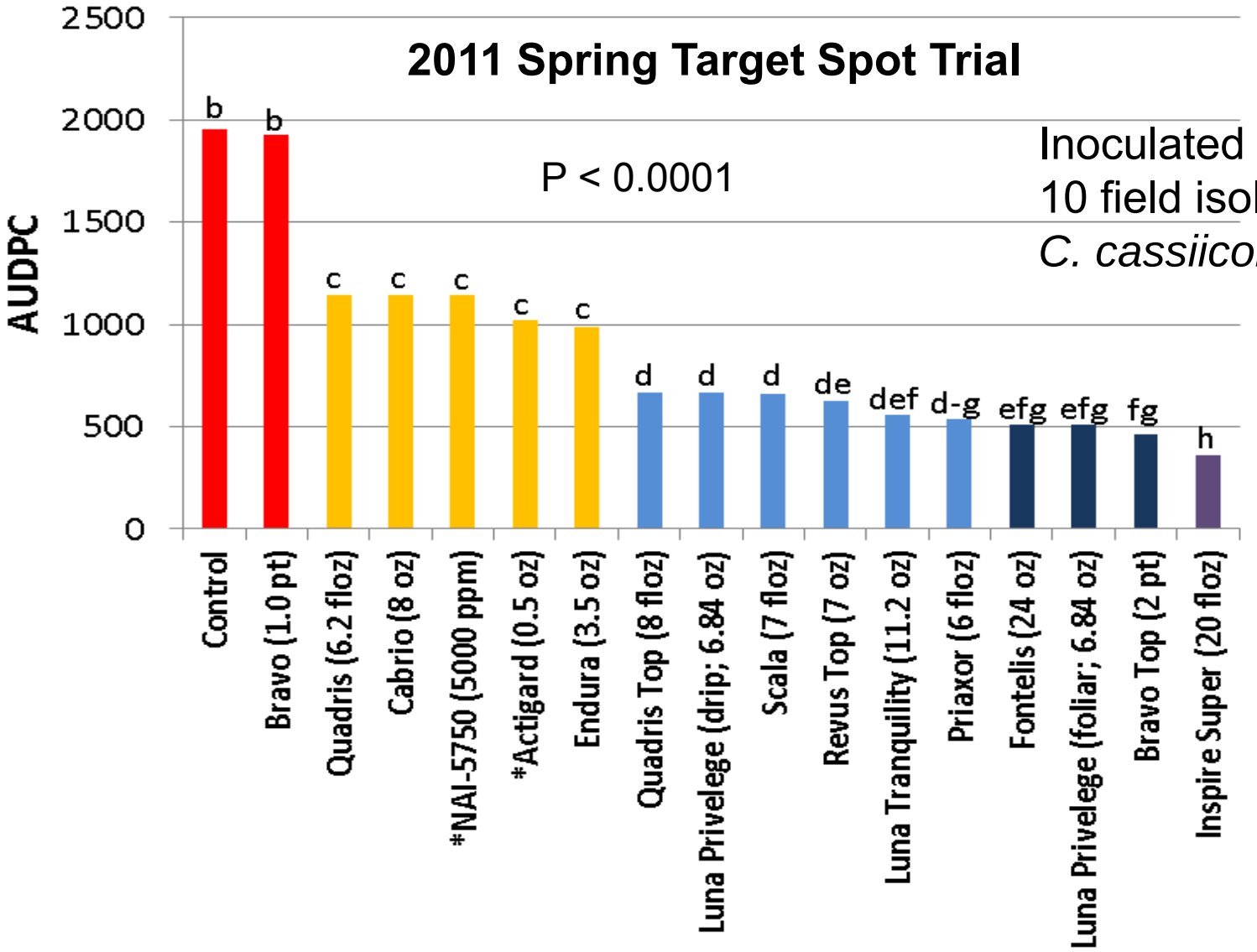
Fall 2009 - Target Spot & Early Blight





Inoculated trial with 10 field isolates of *C. cassiicola*

New SDHIs

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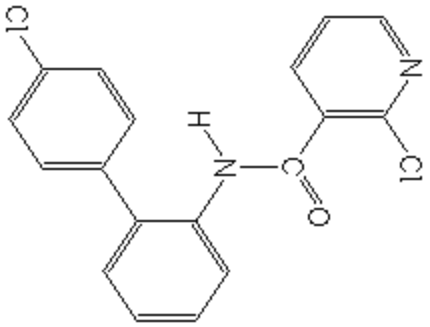
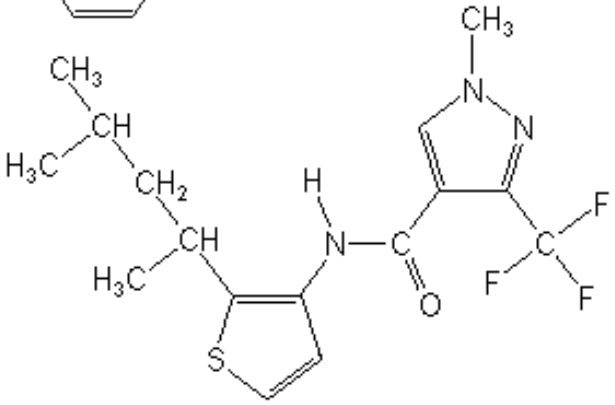
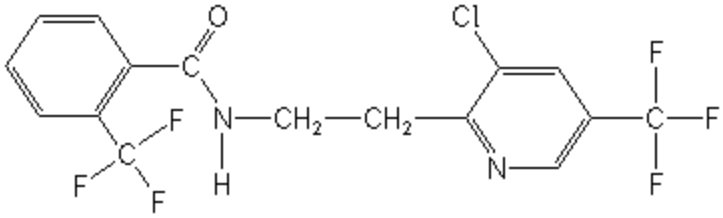


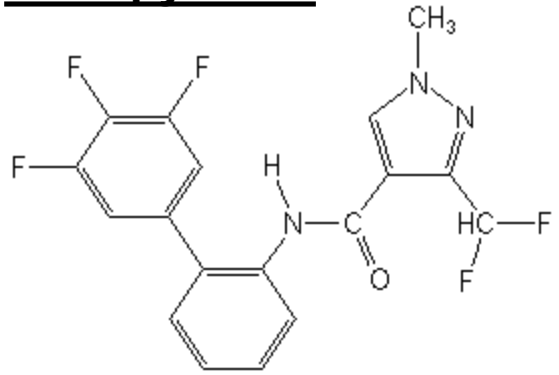
- **Penthiopyrad**



- **Fluopyram**



- **Fluxapyroxad**



Structural similarities does raise a concern of….
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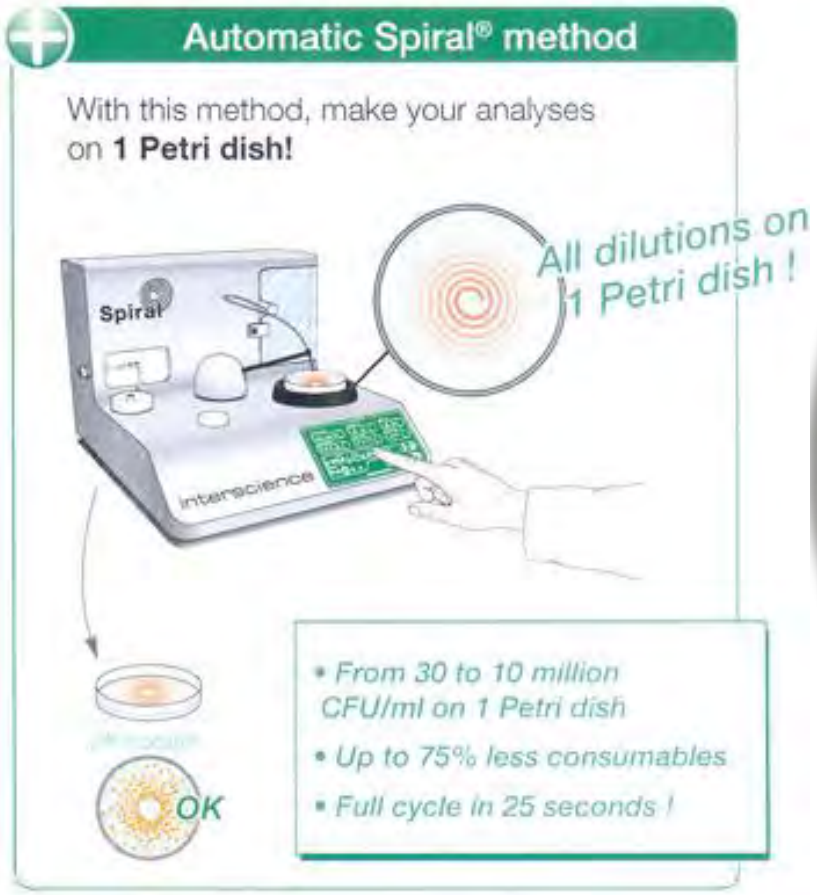
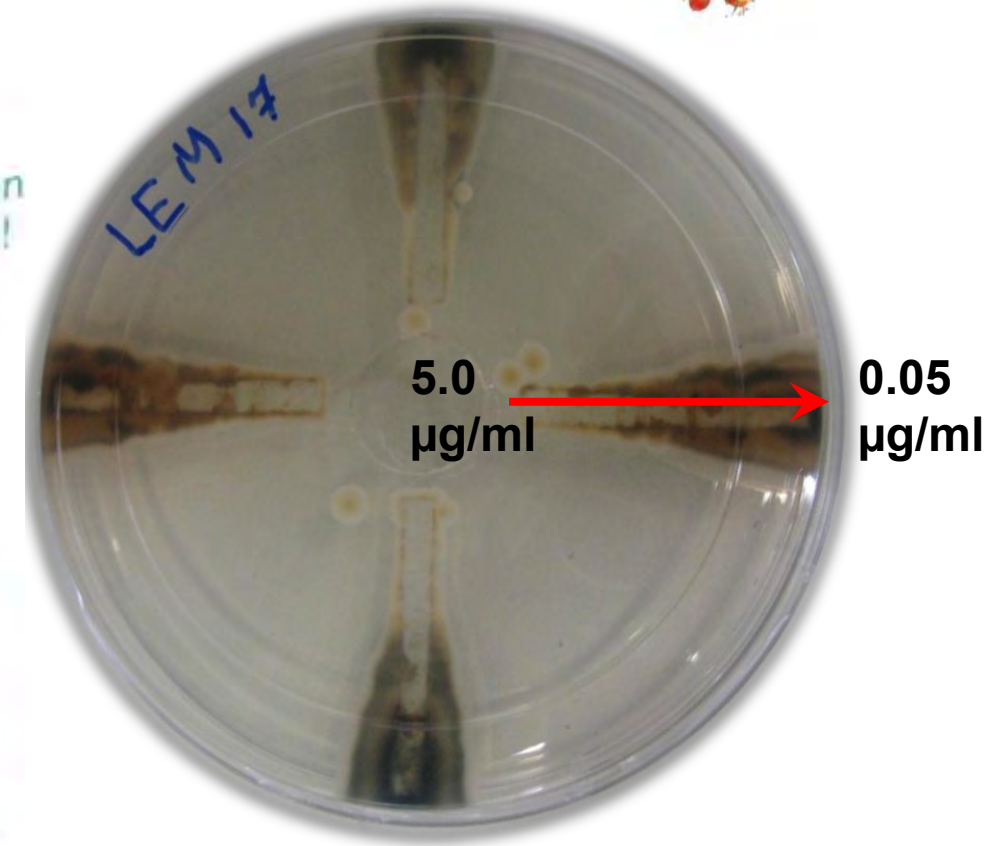
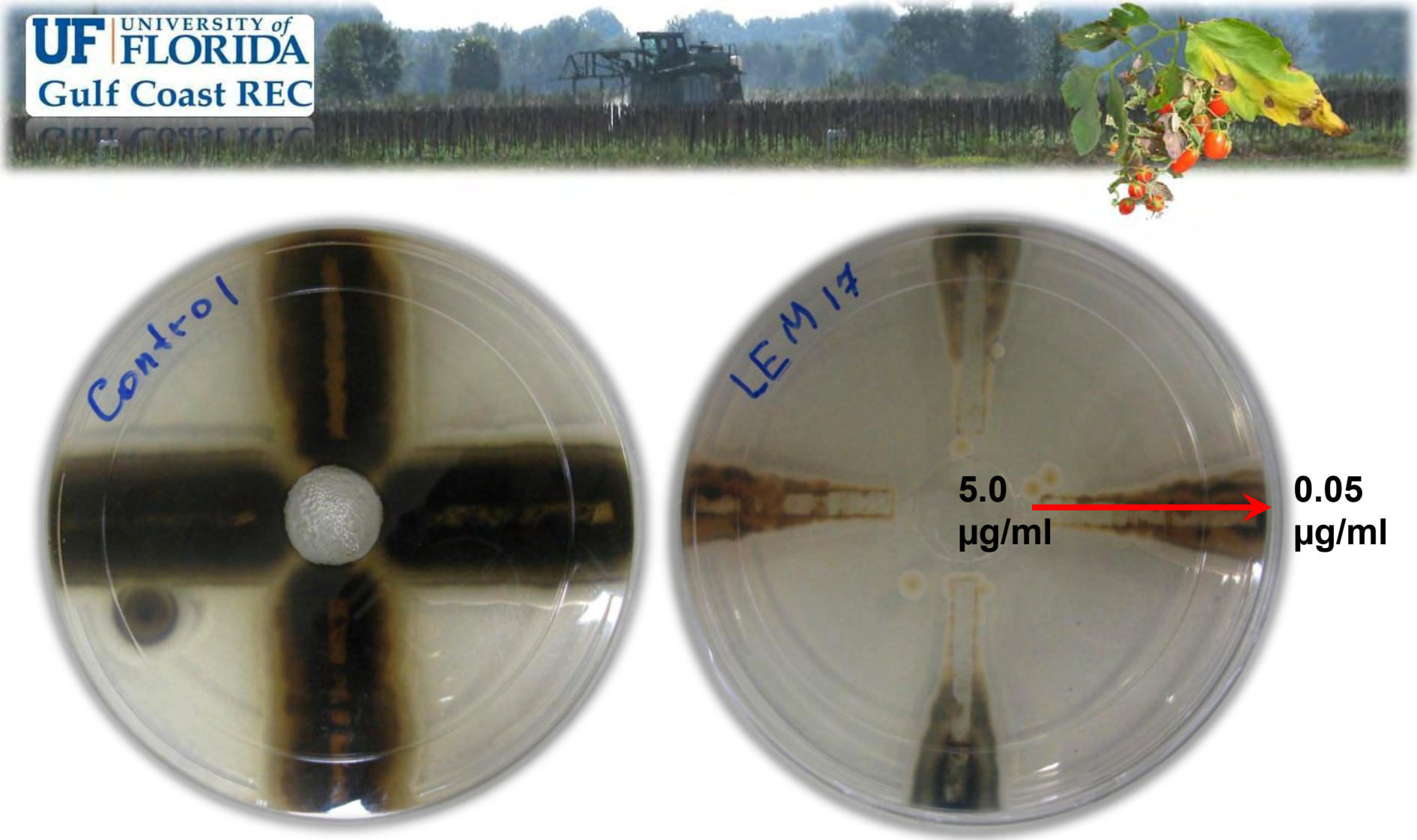
No information on fungicide resistance in *Alternaria* spp. or *Corynespora* spp. in SE





Förster, H., Kanetis, L., and Adaskaveg, J. E. 2004. Spiral gradient dilution, a rapid method for determining growth responses and 50% effective concentration values in fungus–fungicide interactions. Phytopathology 94:163-170.



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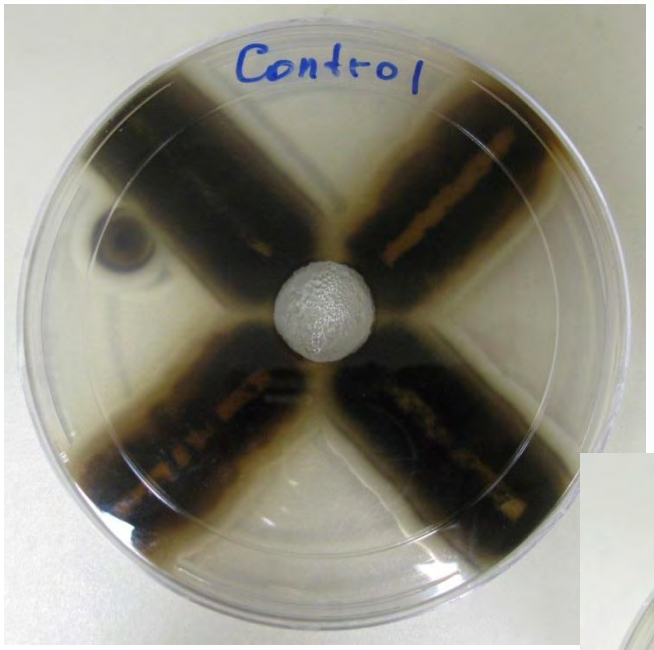
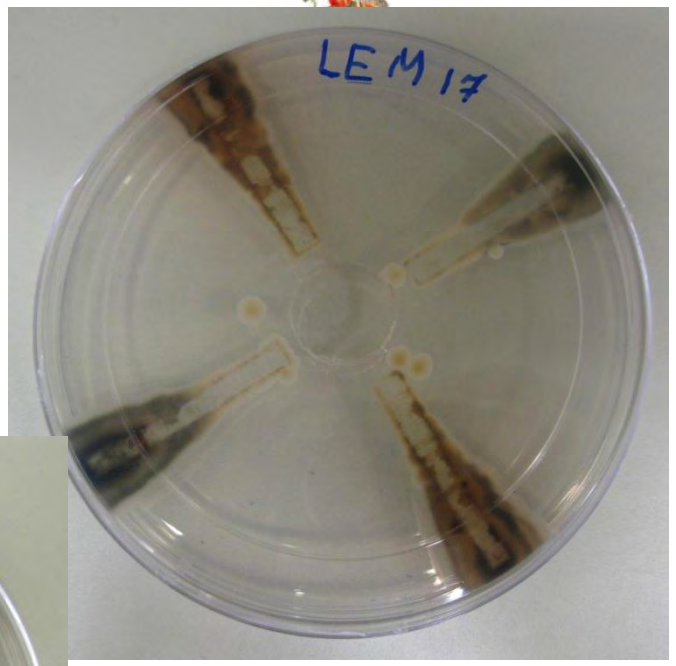
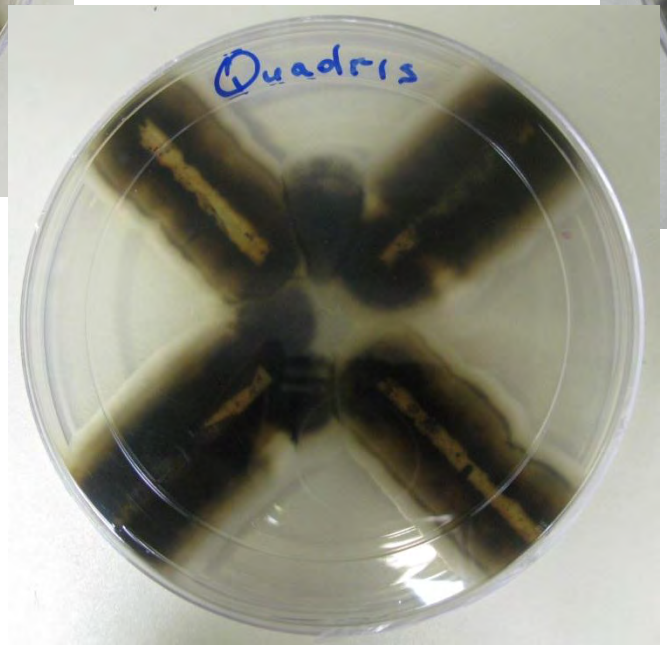




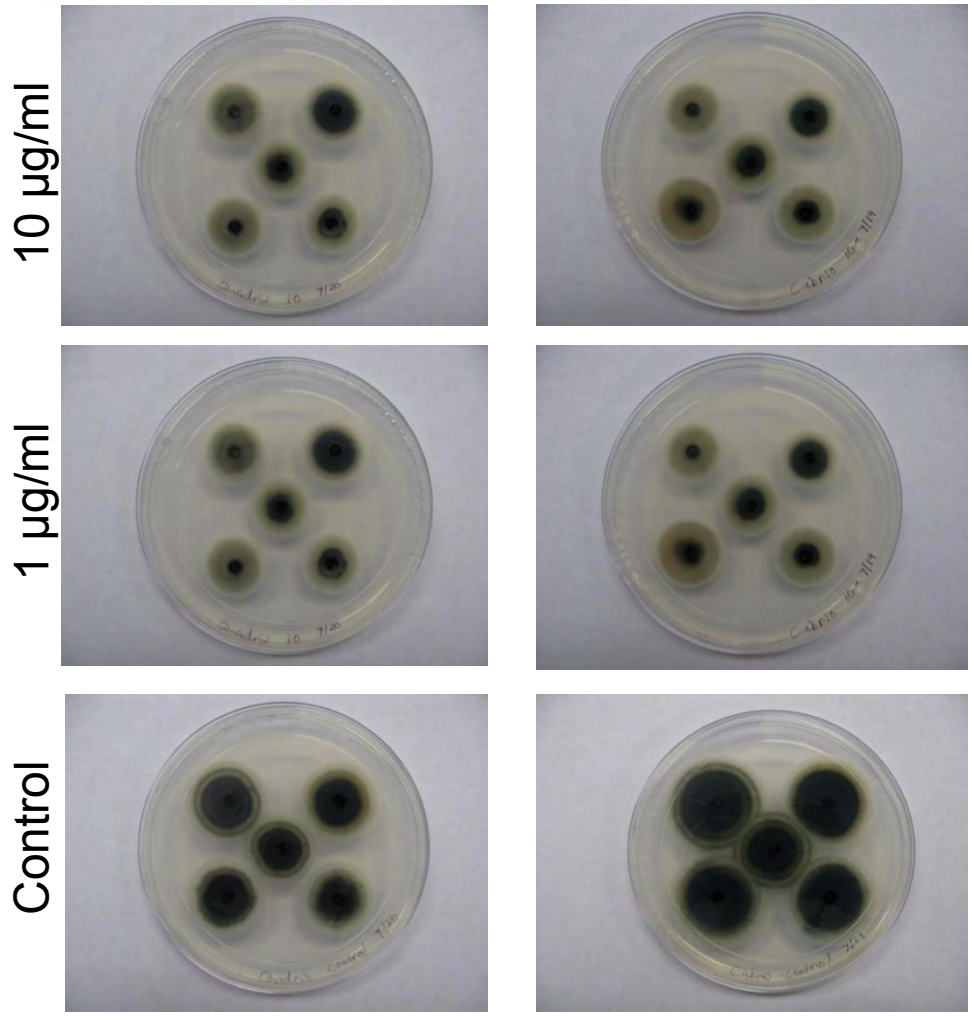



Endura
Endura
Control

Table 1. Sensitivity of *Corynespora cassiicola* isolates collected from Florida tomato production fields to a QoI and several SDHI fungicides.

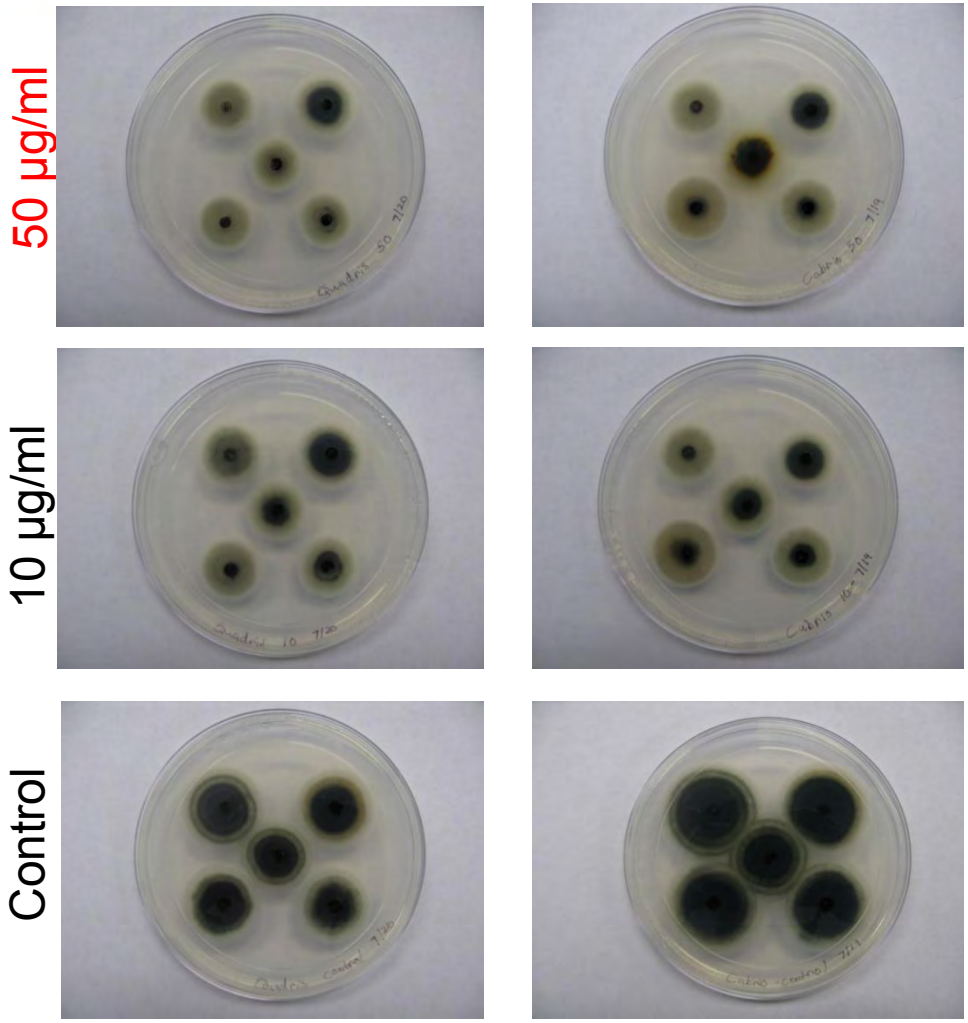
Isolate	Fungicide: estimated EC_{50} (µg/ml)			
	azoxystrobin	**boscalid**	**fluopyram**	**penthiopyrad**
GEV-1P	> 1.0	0.73	0.93	0.13
GEV-2P	> 1.0	0.76	1.21	0.21
GEV-7P	> 1.0	> 5.0	0.35	0.50
GEV-081208	> 1.0	0.30	0.45	0.11
GEV-111408	> 1.0	0.61	0.41	0.09

EC_{50} values represent fungicide concentrations that inhibited isolate growth by 50% compared to a non-fungicide amended medium (half-strength potato dextrose agar). Fungicide concentrations ranged from 0.05 to 5 µg/ml for boscalid, and 0.01 to 1 µg/ml for azoxystrobin, fluopyram and penthiopyrad.



Plug method:

- Media is prepared with fungicide mixed in.
- Then an actively growing plug of the fungus is transferred to the media.
- EC_{50} values will be higher than spiral plate method.



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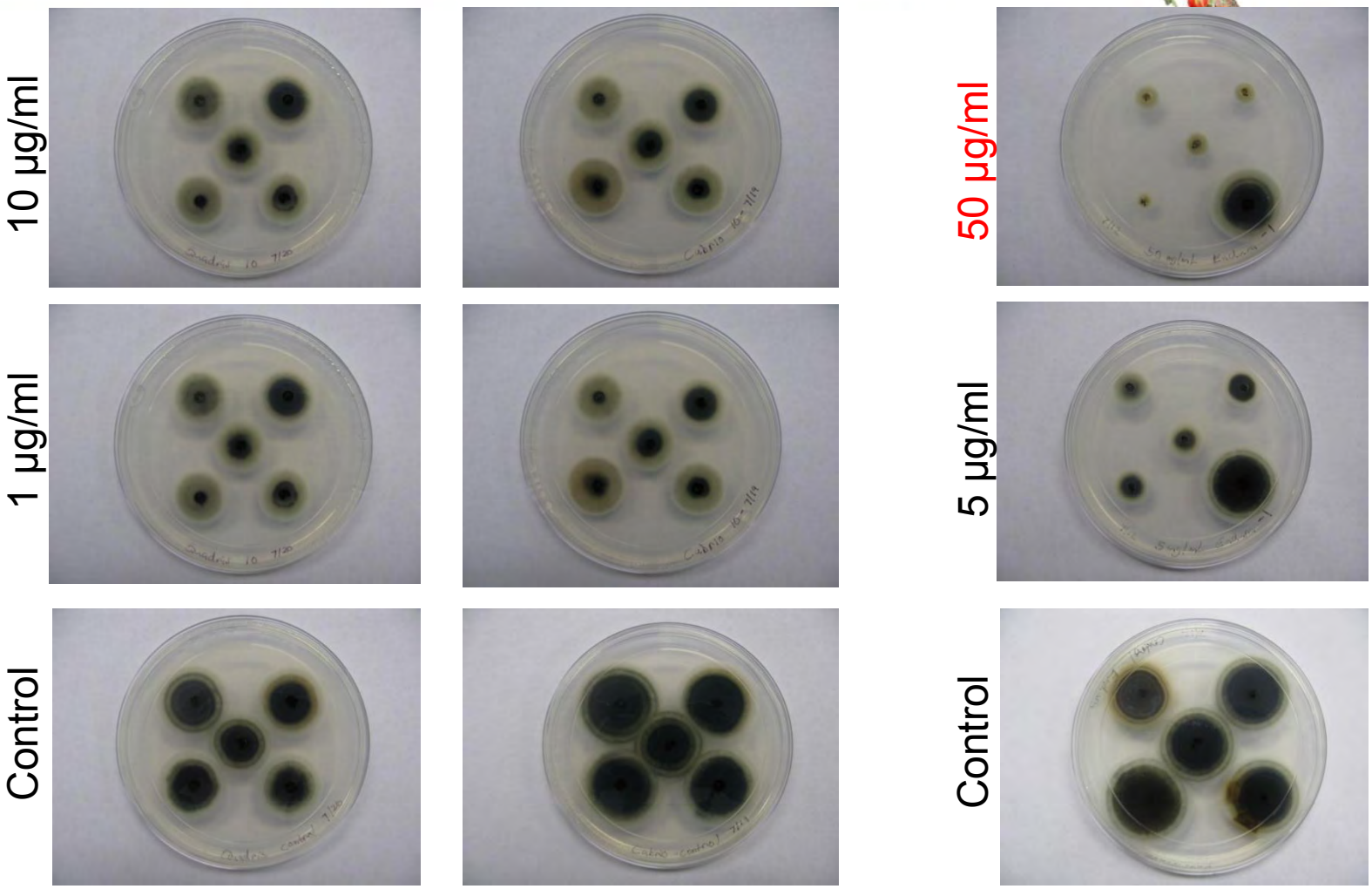

Sensitivity of Corynespora cassiicola isolates to fungicides based on plug-method

		Estimated EC_{50}:		
Isolate	**Boscalid**	**Penthiopyrad**	**Azoxystrobin**	**Pyraclostrobin**
GEV-2P	1.62	1.03	> 50	> 50
GEV-3G	1.78	1.21	> 50	14.8
GEV-4P	1.06	1.47	> 50	> 50
GEV-5G	1.51	1.03	> 50	7.9
GEV-6P	1.51	1.16	> 50	> 50
GEV-7P	> 50	5.23	> 50	> 50
GEV-8G	> 50	> 50	> 50	> 50
GEV-102008	1.01	0.59	> 50	13.3
GEV-1P	4.43*	1.00	> 50	> 50
GEV-081208	3.53*	1.01	> 50	> 50
GEV-111408	3.46*	1.00	> 50	> 50

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GEV-8G	**> 50**	**> 50**	**> 50**	**> 50**
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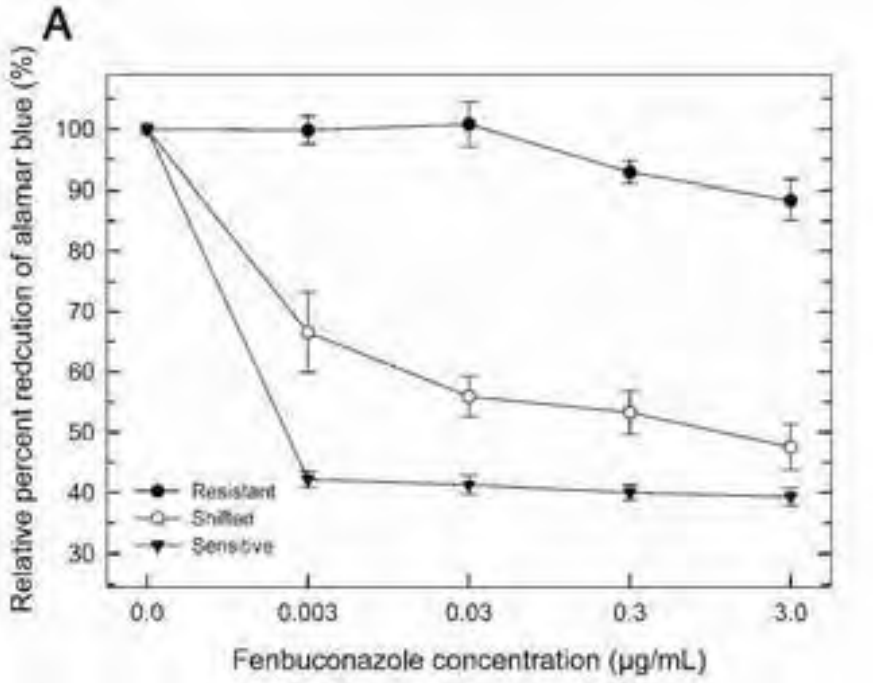
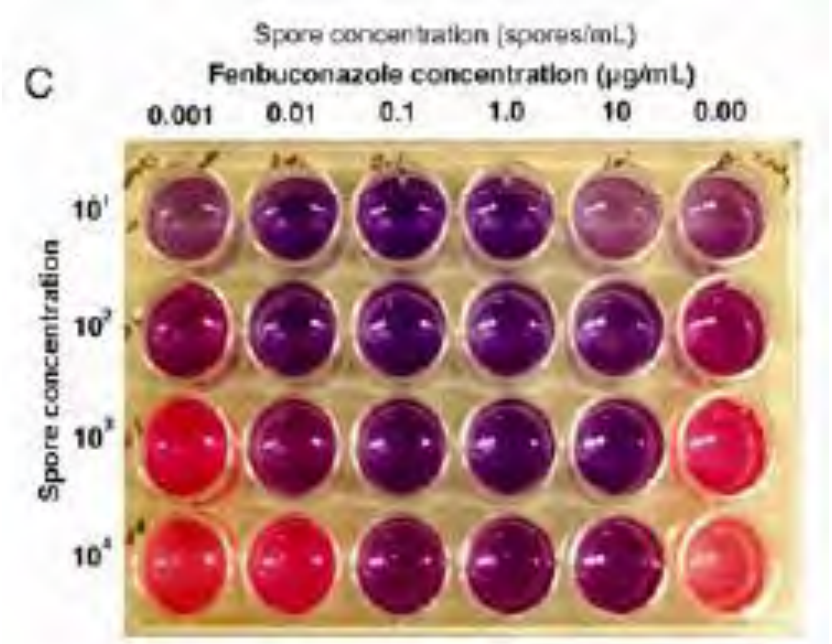
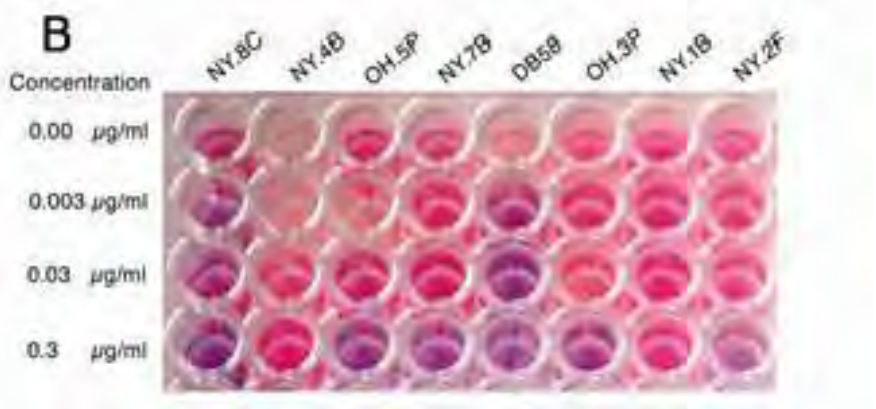
GEV-111408	3.46*	1.00	> 50	> 50

Cox, K. D., Quello, K., Deford, R. J., and Beckerman, J. L. 2009. A rapid method to quantify fungicide sensitivity in the brown rot pathogen Monilinia fructicola. Plant Dis. 93:328-331.





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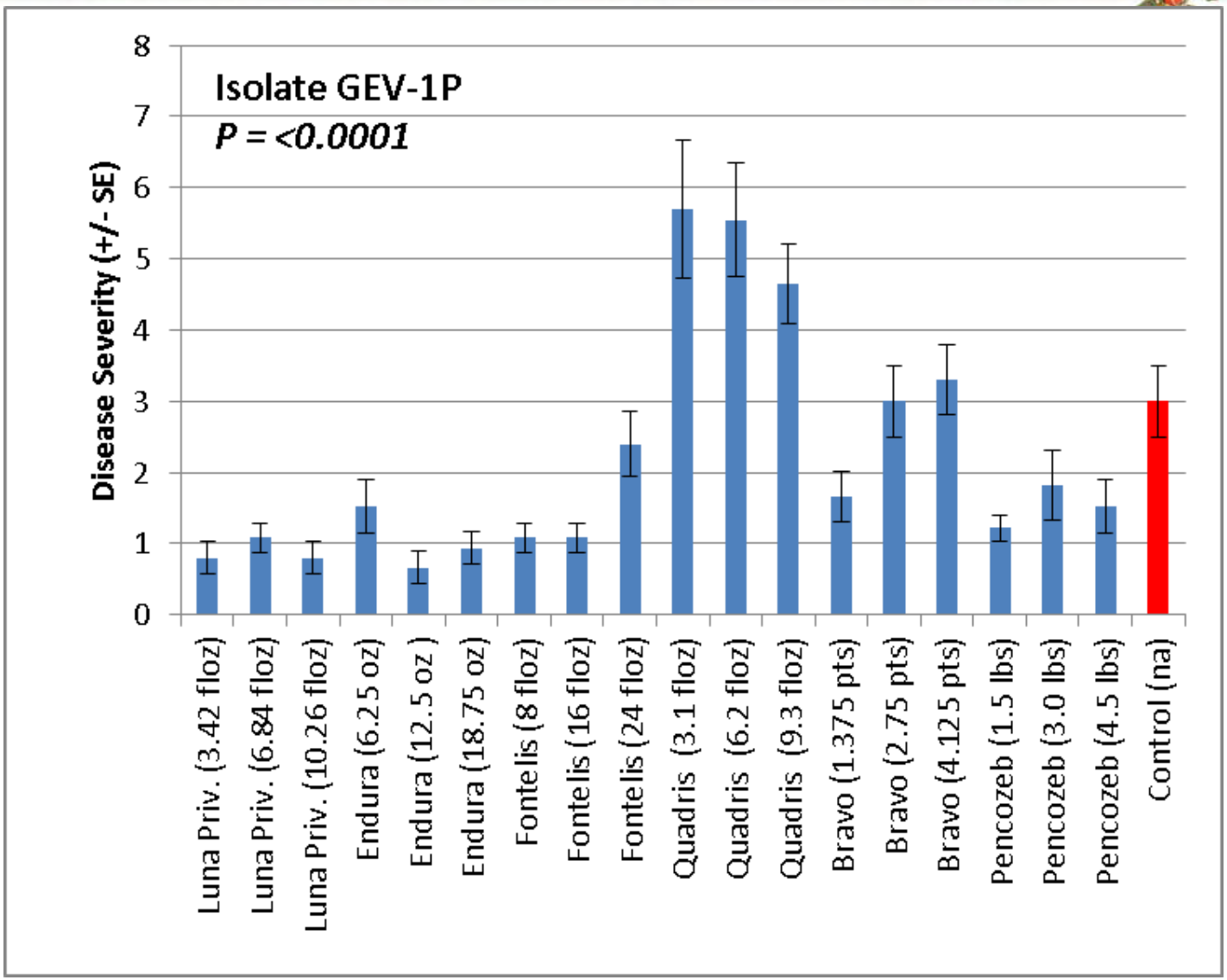
Isolate GEV-1P
P = <0.0001
Disease Severity (+/- SE)
0
1
2
3
4
5
6
7
8
Luna Priv. (3.42 floz)
Luna Priv. (6.84 floz)
Luna Priv. (10.26 floz)
Endura (6.25 oz)
Endura (12.5 oz)
Endura (18.75 oz)
Fontelis (8 floz)
Fontelis (16 floz)
Fontelis (24 floz)
Quadris (3.1 floz)
Quadris (6.2 floz)
Quadris (9.3 floz)
Bravo (1.375 pts)
Bravo (2.75 pts)
Bravo (4.125 pts)
Pencozeb (1.5 lbs)
Pencozeb (3.0 lbs)
Pencozeb (4.5 lbs)
Control (na)

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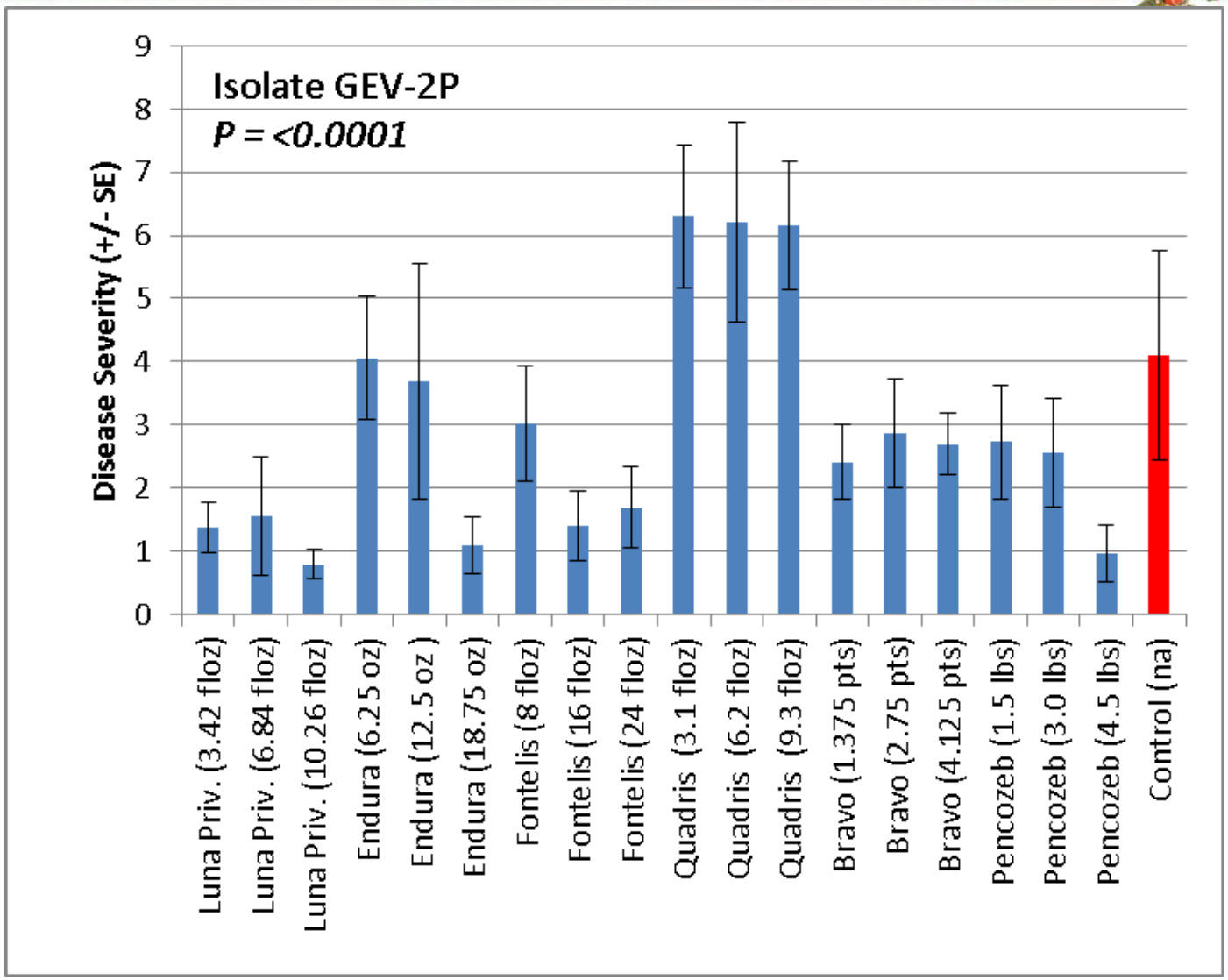

MOA (FRAC)	Fungicide	Commercial name
Multi-site, contact fungicide (M3)	Mancozeb	Dithane/Penncozeb
Multi-site, contact fungicide (M5)	Chlorothalonil	Bravo
~~QoI; strobilurins (11)~~ *??~~QoI; non strobilurins~~ (11)??*	~~Azoxystrobin~~ ~~Fluoxastrobin~~ ~~Pyraclostrobin~~ ~~Trifloxystrobin~~ *Fenamidone??* *Famoxidone??*	~~Quadris~~ ~~Evito~~ ~~Cabrio~~ ~~Flint~~ *Reason??* *Tanos (mix w/ cymoxanil)??*
SDHI; Succinate Dehydrogenase Inhibitors (7)	Boscalid Penthiopyrad* Fluopyram*	Endura Fontelis* (LEM-17) Luna*
DMI; Demethylase Inhibitors (3)	Difenoconazole	RevusTop (mix w/ mandipropamid) Inspire Super (mix w/ cyprodinil)
Methionine biosynthesis inhibitors (9)	Pyrimethanil Cyprodinil	Scala **(2ee label)** Switch (mix w/ fludioxonil) Inspire Super (mix w/difenoconazole)

SUMMARY:

- No evidence to support *A. solani* as cause of early blight on tomato in FL. Not an exhaustive survey.
- Of 11 C. cassiicola isolates tested:
  - All are highly resistant to azoxystrobin & pyraclostrobin
  - Strobilurin insensitive isolates exhibit hypervirulence on azoxystrobin treated plants.
  - 2 are resistant to boscalid; one cross-resistant to penthiopyrad; SDHI resistance is complex.
  - Not an exhaustive survey.

FURTHER WORK:

- Conduct a survey of isolates in FL (Early blight and Target Spot).
  - Identify frequency of SDHI resistance and cross-resistance among SDHIs.
- **Encourage companies to move away from pre-mixes with QoIs.**
- Rotate SDHIs with DMIs or Meth. inhib.
- Identify sources of resistance to *A. tomatophila* and *C. cassiicola* (need to identify common isolates)


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THANK YOU

Need more isolates…

Early Blight and Target Spot

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