Anthracnose disease of peach; its complicated

Guido Schnabel, Clemson University

CLEMSON UNIVERSITY

Caused by *Colletotrichum* spp

Anthracnose | Bitter rot | Ripe rot | Anthracnose

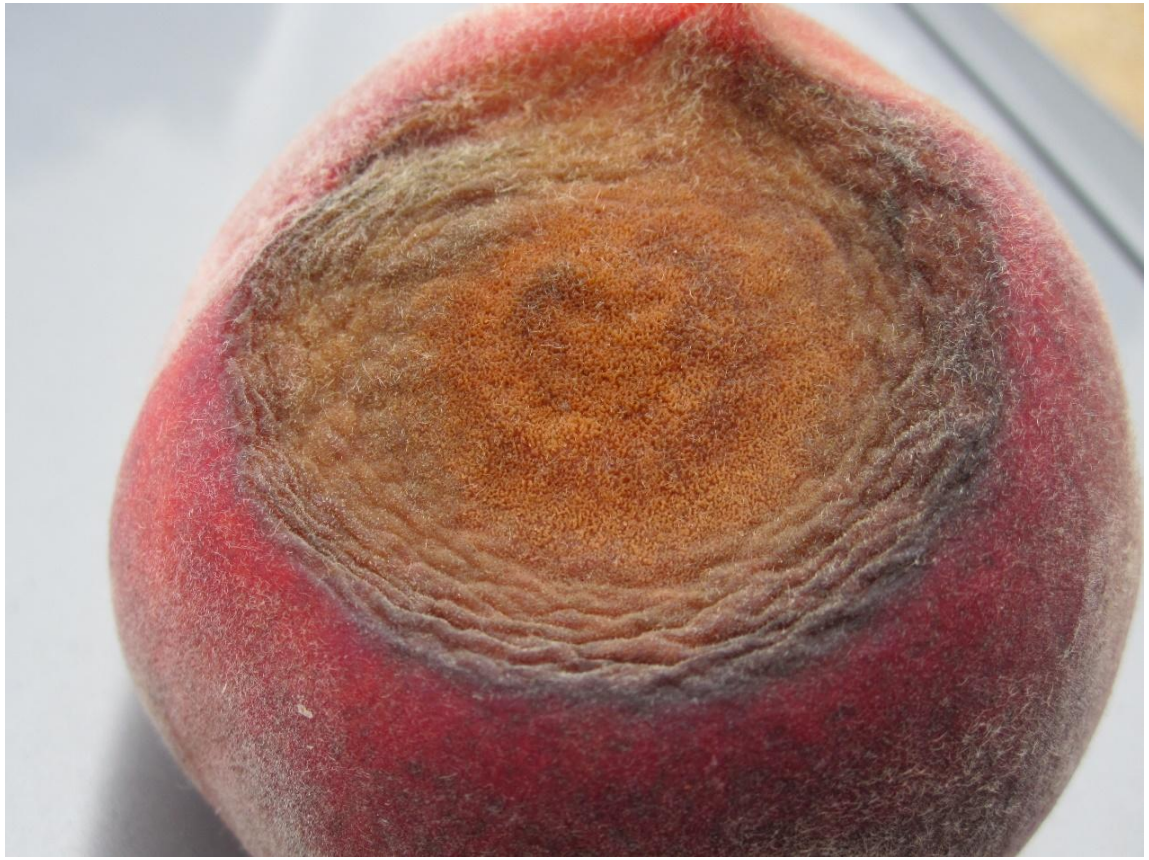
Outbreaks with significant economic damage

South Carolina

- 2004 Spartanburg county
  - Babybold peaches
- 2014, 2015, Saluda and Chesterfield counties
  - associated with fungicide resistance
- 2021 Chesterfield county
  - associated with nearby strawberry

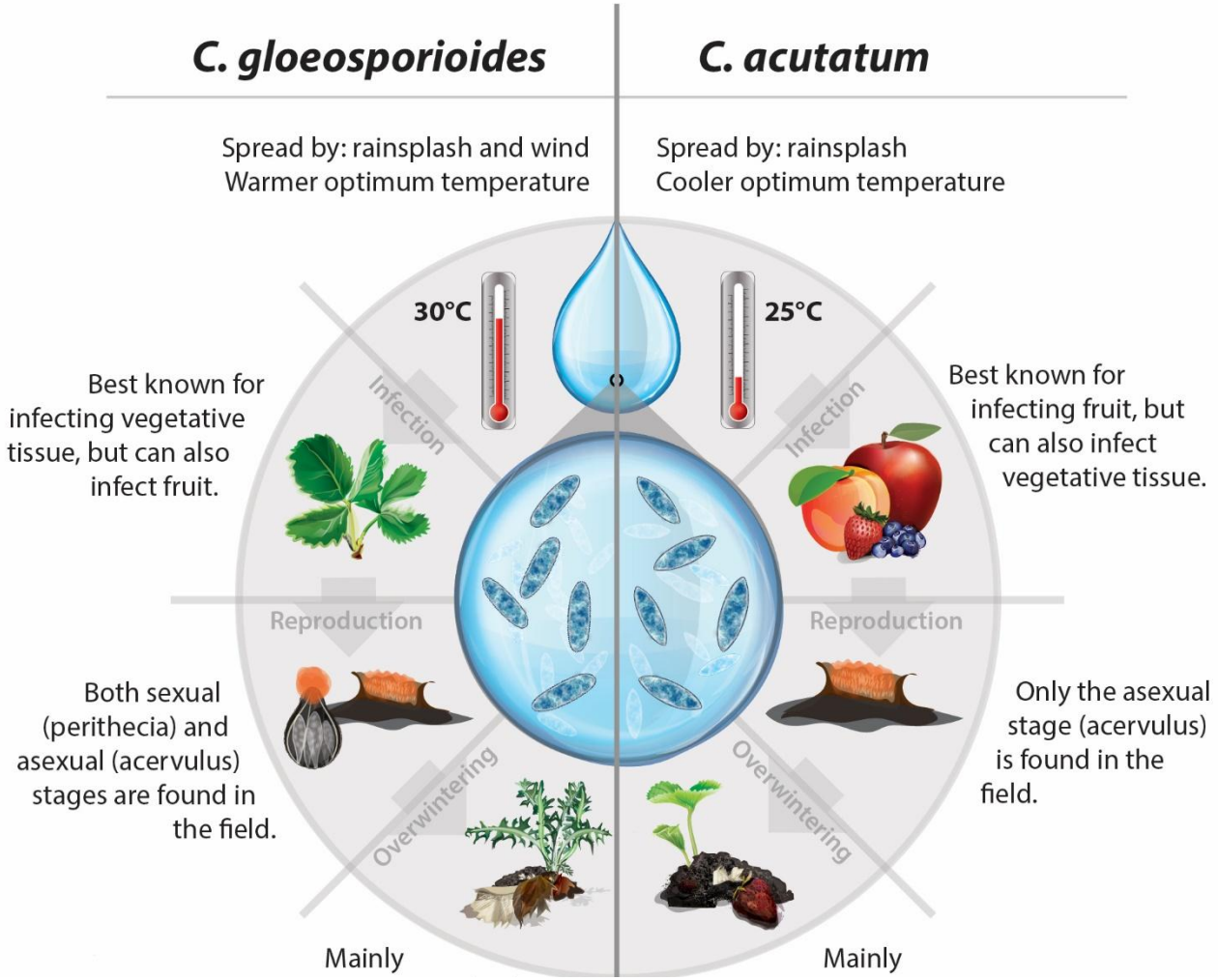
Georgia

- 1947, 1948, 1949
  - associated with nearby blue lupine
- 2021 ???



Circular depression, black or orange color in center

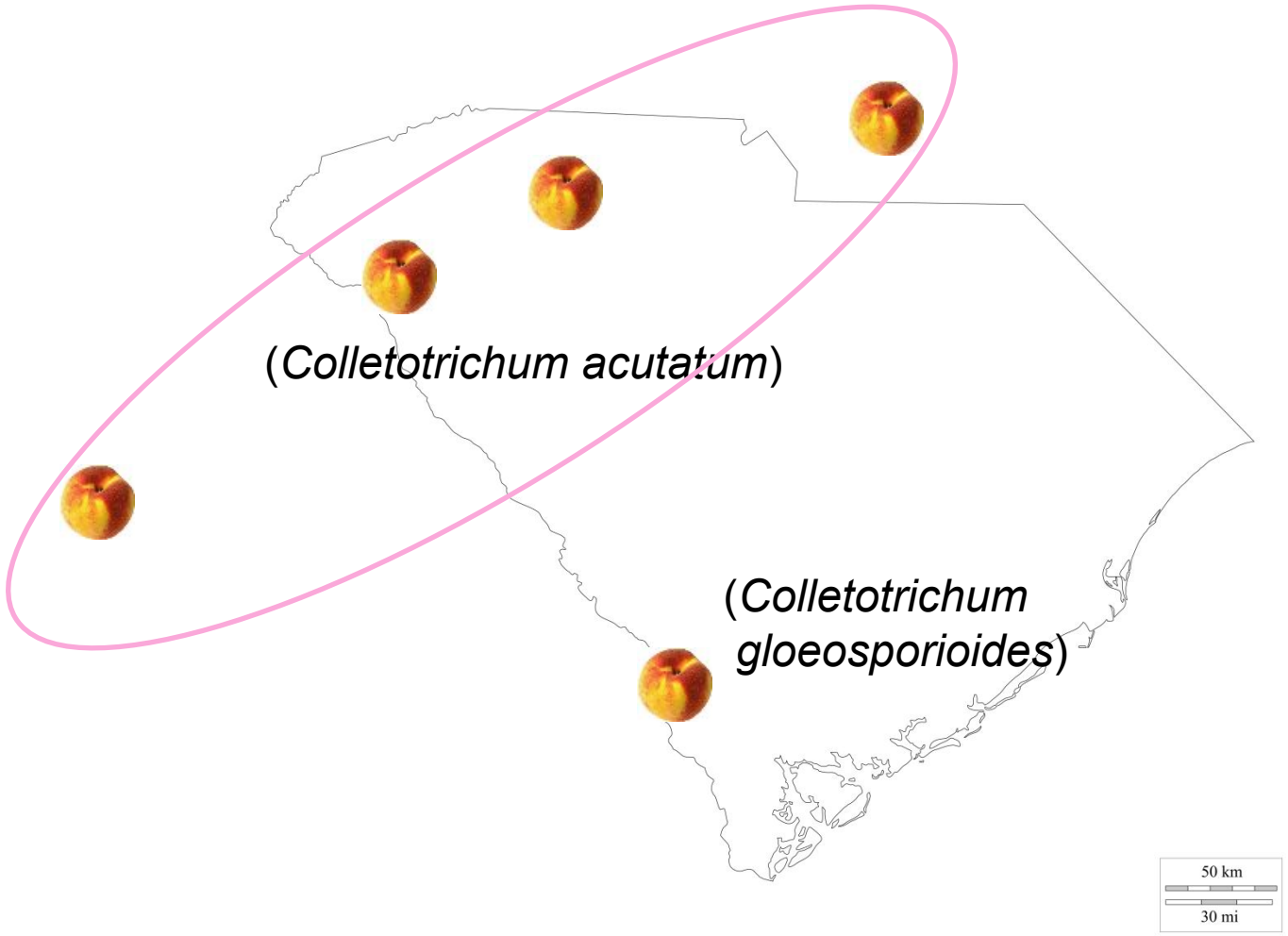
The species matters

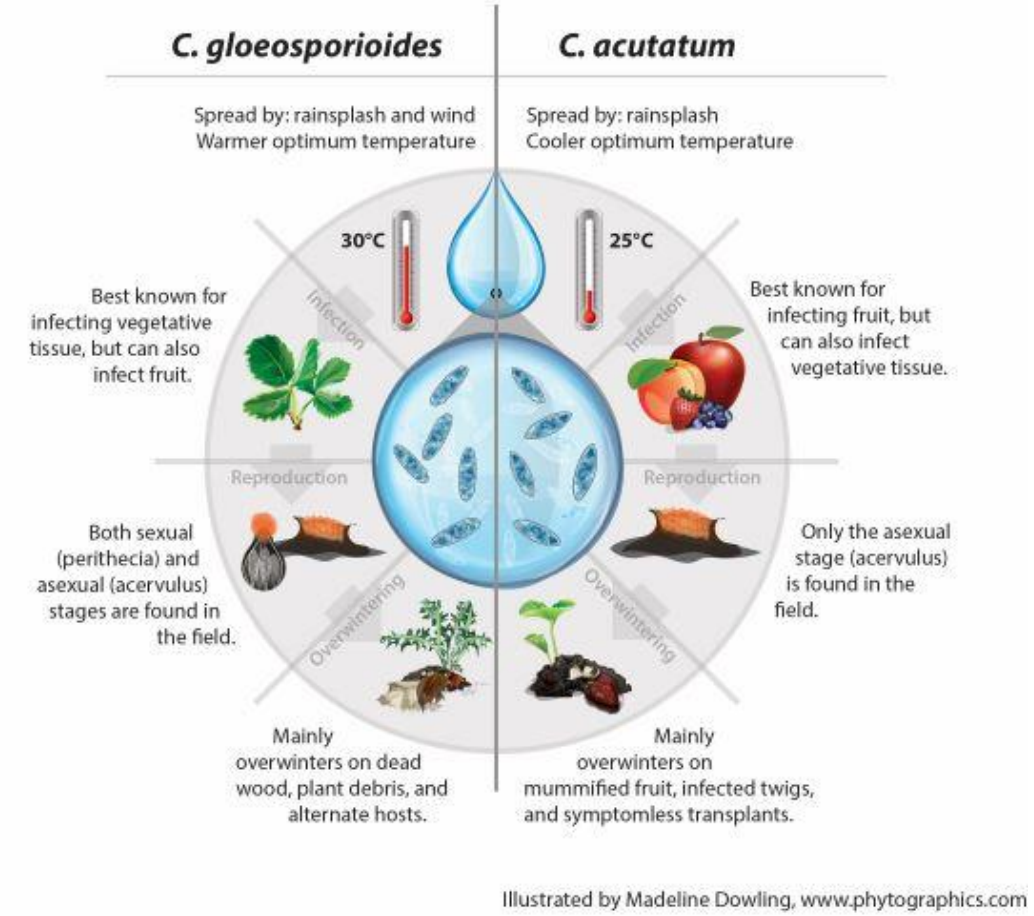


Fungicide sensitivity also varies

C. acutatum used to be most prevalent

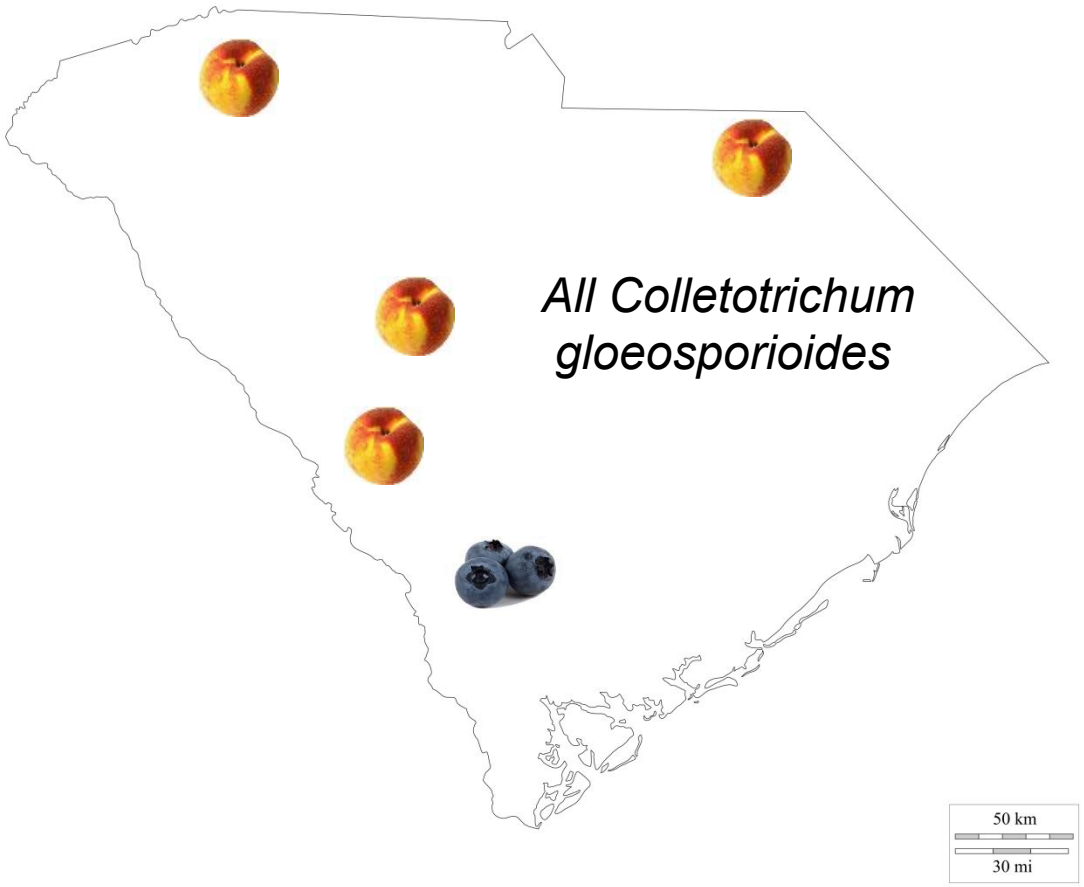
(Bernstein et al. 1995; Schnabel et al. 2006)





C. gloeosporioides appears to have taken over

(Hu *et al.* 2015)



Possible explanations for *C. glo's* takeover

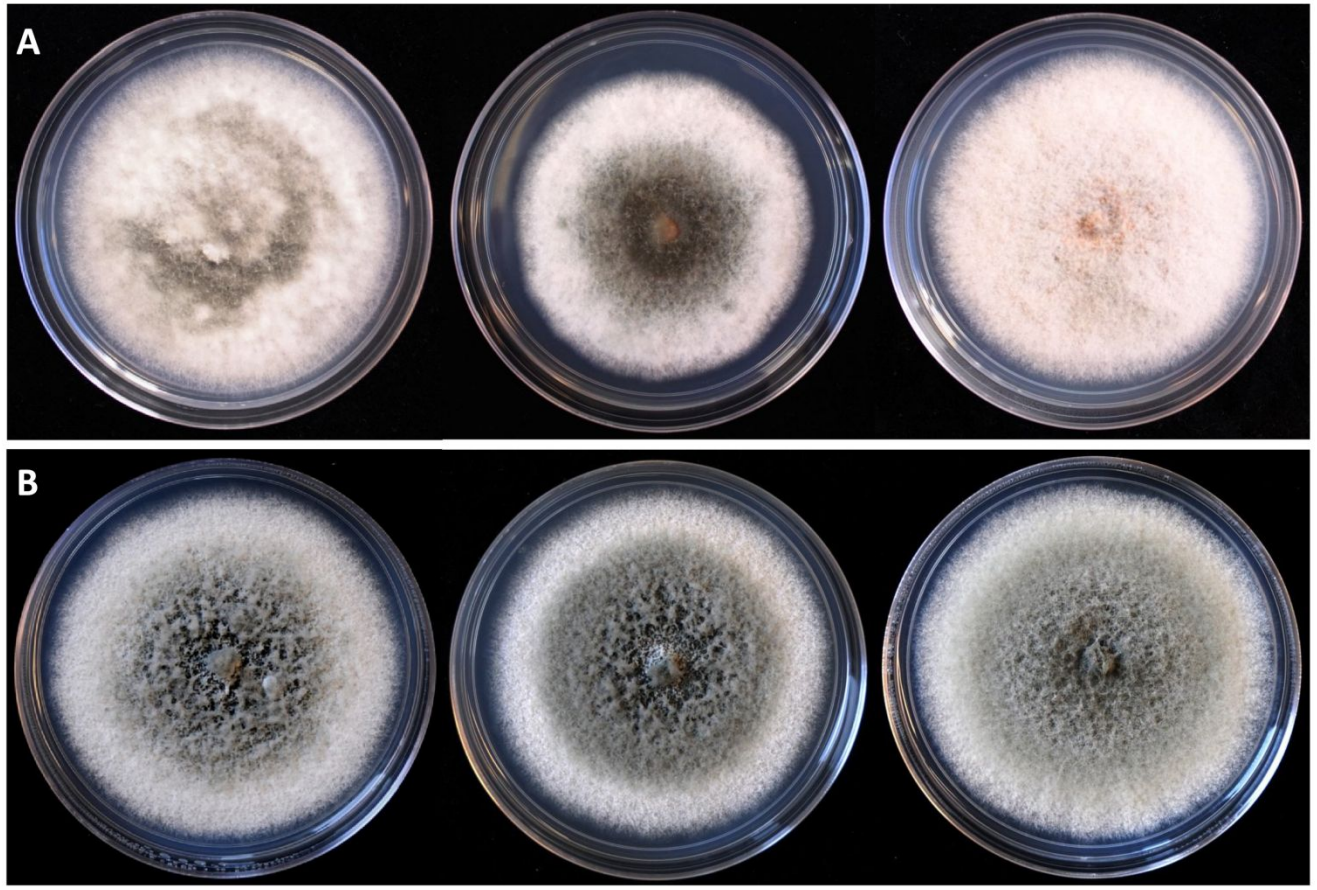
-*C. glo* was suppressed by FRAC 1s (Benomyl, Topsin M) in the 1980s and 1990s

-*C. acutatum* has been suppressed by FRAC 11s since 2000 (Pristine, Merivon, Luna Sensation, Abound)

-fungicide resistance development

-Climate change?

What *C. gloeosporioides* looks like in culture

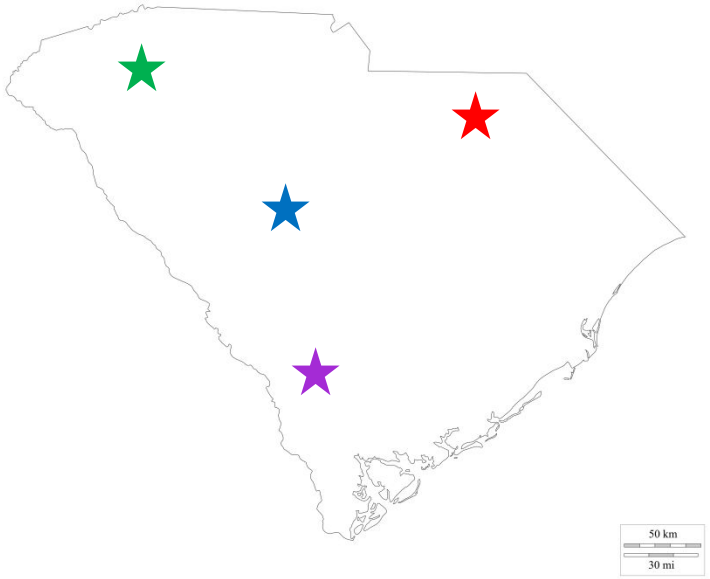


Colletotrichum siamense

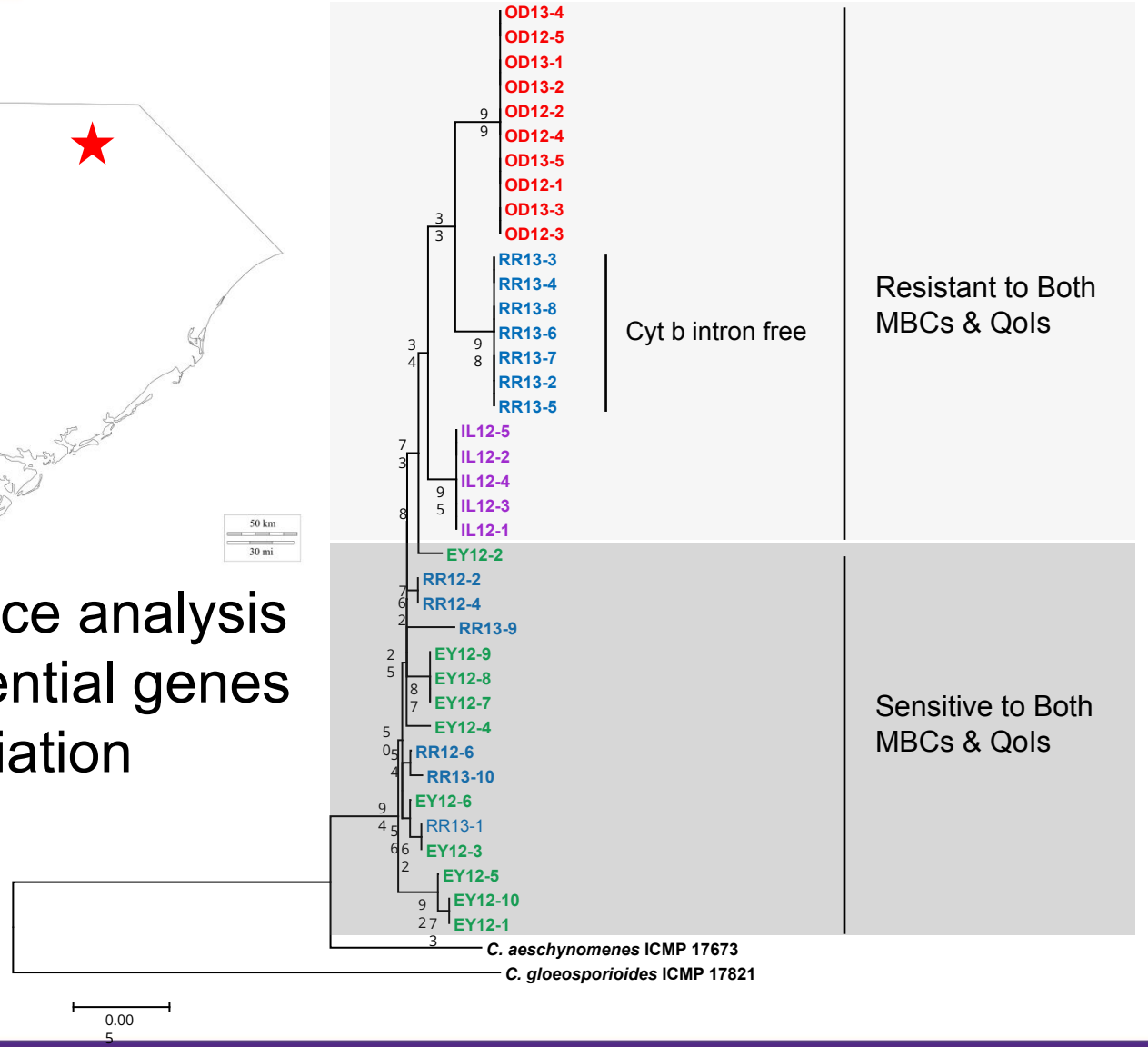
Colletotrichum fructicola

CLEMSON UNIVERSITY

Symptoms of infection by *Colletotrichum* spp. on peach fruit



DNA sequence analysis of three essential genes revealed variation



E198A in beta tubulin gene
-resistance to FRAC 1, Topsin M, MBCs

G143A in cytochrome b gene
-resistance to FRAC 11, Pristine, Merivon, Luna Sensation, QoIs

Maybe similar situation in GA

What if the FRAC 11s are no longer working?

FRAC 7 FRAC 11

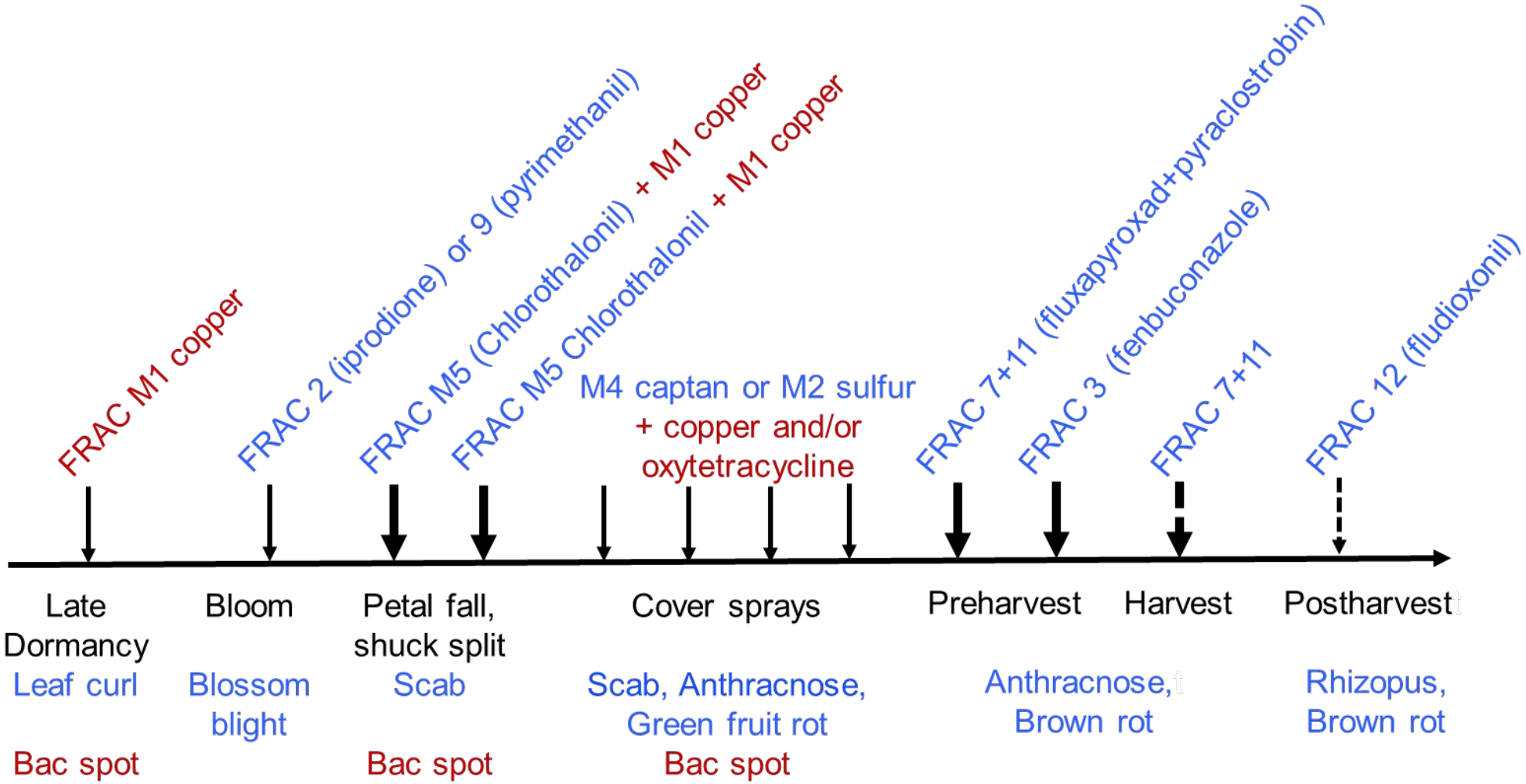
Pristine (boscalid + pyraclostrobin)
Merivon (fluxapyroxad + pyraclostrobin)
Luna S. (fluopyram + trifloxystrobin)

Can we count on the FRAC 7s then?

SDHIs (=FRAC 7) are not effective against *Colletotrichum* species
(only benzovindiflupyr (Aprovia) has activity against anthracnose diseases)

Example Merivon
FRAC 7 fluxapyroxad (intrinsically ineffective)
FRAC 11 pyraclostrobin (ineffective due to resistance)

Current recommendations do cover anthracnose; ….if there is no resistance



What if the FRAC7/11s are ineffective?

Ineffective

- Sulfur
- FRAC 1 (Topsin M)
- FRAC 2 (Rovral)
- FRAC 7 (Merivon, Pristine, Luna S)
- FRAC 11 Resistance-G143A (Merivon, Pristine, Luna S)
- FRAC 12 (postharvest in Chairman)

Effective?

- Captan!!!
- FRAC 3?
- FRAC 9?

CLEMSON UNIVERSITY

In vitro EC_{50} values (mg/L) for FRAC 3s (n=number of studies)

FRAC 3 (DMI)	Tradename	*C. gloeosporioides*	*C. acutatum*	Rank
Mefentrifluconazole	Cevya	0.4 (n=3)	0.1 (n=1)	1
Difenoconazole	Inspire Super	0.5 (n=15)	0.3 (n=13)	2
Propiconazole	Bumper, Tilt	0.4 (n=7)	0.9 (n=5)	3
Tebuconazole	Elite 45DF	1.2 (n=11)	0.4 (n=9)	4
Myclobutanil	Rally 40WSP	3.1 (n=4)	1.6 (n=1)	5
Fenbuconazole	Indar 2F	3.4 (n=5)	2.0 (n=4)	6
Flutriafol	Topguard SC	7.1 (n=5)	6.7 (n=4)	7

What are the other options?

Ineffective

- Sulfur
- FRAC 1 (Topsin M)
- FRAC 2 (Rovral)
- FRAC 7 (Merivon)
- FRAC 11 (Merivon)
- FRAC 12 (Chairman)

Effective

- **Captan**
- **FRAC 3 (DMIs)**
  - mefentrifluconazole (Cevya)
  - difenoconazole (Inspire Super)
  - Propiconazole (Bumber, Tilt, other)
- **FRAC 9 (APs)**
  - pyrimethanil (Vangard)
  - cyprodinil (Inspire Super)

Are the ‘in vitro’ data supported by field trials? Case study ‘bitter rot’ of apple

Efficacy of 'Inspire Super' against Bitter rot of apple caused by *C. glo* AND *C. acutatum* species

	Treatment	Efficacy
Rosenberger et al. 2015	Inspire Super 12 floz	100%
Villani and Nance 2016	Inspire Super 12 floz	0%
Brannen et al. 2016	Inspire Super 12 floz	100%
Brannen et al. 2017	Inspire Super 12 floz	0%
Villani et al. 2017	Inspire Super 12 floz	23%
Yoder et al. 2017	Inspire Super 12 floz	66%
Lalancette and Blaus 2018	Inspire Super 12 floz	75%

CLEMSON UNIVERSITY

Inspire Super efficacy is linked to disease pressure

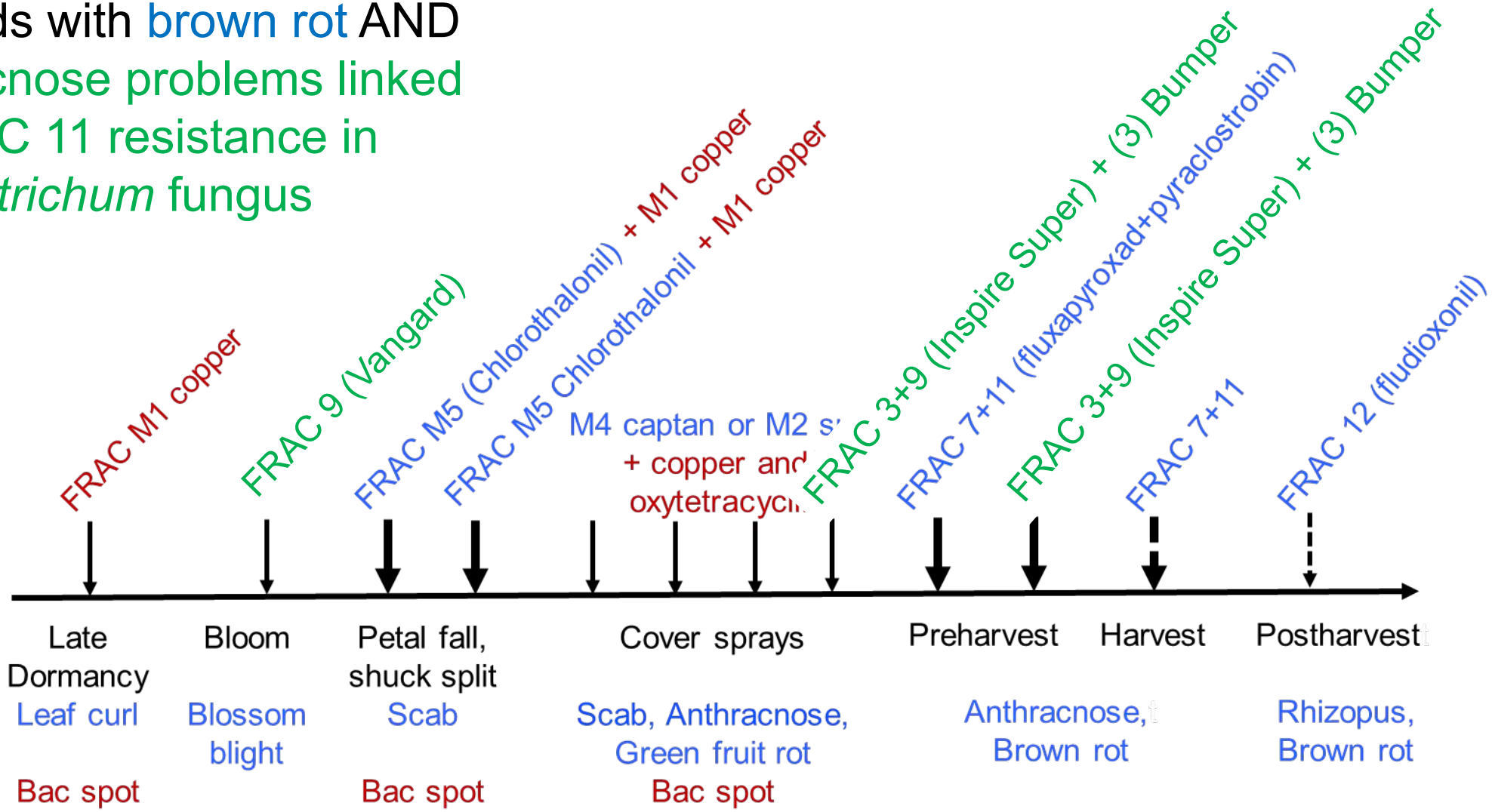
‘Inspire Super’ needs a ‘Booster’ for better performance; add

-propiconazole

or

-mefentrifluconazole

Suggested spray program for orchards with brown rot AND anthracnose problems linked to FRAC 11 resistance in *Colletotrichum* fungus



CLEMSON UNIVERSITY

Summary

- Multiple species of Colletotrichum can cause anthracnose of peach and the composition has changed over time.
- Anthracnose is typically a minor disease in SC and GA but has caused problems in the past when a new alternate host was introduced or when the pathogen had developed resistance to FRAC 11s (QoIs).
- The current spray recommendations are not effective against anthracnose if pathogen is resistant to FRAC 11s
- Managing FRAC 11 resistance could be accomplished by integrating ‘Inspire Super’ plus ‘Booster’ with current recommendations. But solid efficacy data is still not available.

CLEMSON UNIVERSITY

Acknowledgments

- South Carolina Department of Agriculture
- South Carolina Peach Council
- Collaborating peach growers
- Musser Fruit Research Center, Seneca

In vitro EC_{50} values (mg/L)

(Gelain and Schnabel, under review)

Fungicide (FRAC)	*Colletotrichum* sp.	EC_{50}	Rank
Cyprodinil (9)*	C. melonis	0.010	1
	C. nymphaeae	0.014	
Benzovindiflupyr (7)	C. melonis	0.040	2
	C. nymphaeae	0.054	
Tebuconazole (3)	C. melonis	0.077	3
	C. nymphaeae	0.139	
Iprodione (2)	C. melonis	12.216	4
	C. nymphaeae	13.952	

Ineffective against *C. fioriniae (2021 UFL paper)*