

Fungicide Resistance Concerns in Soybean Production

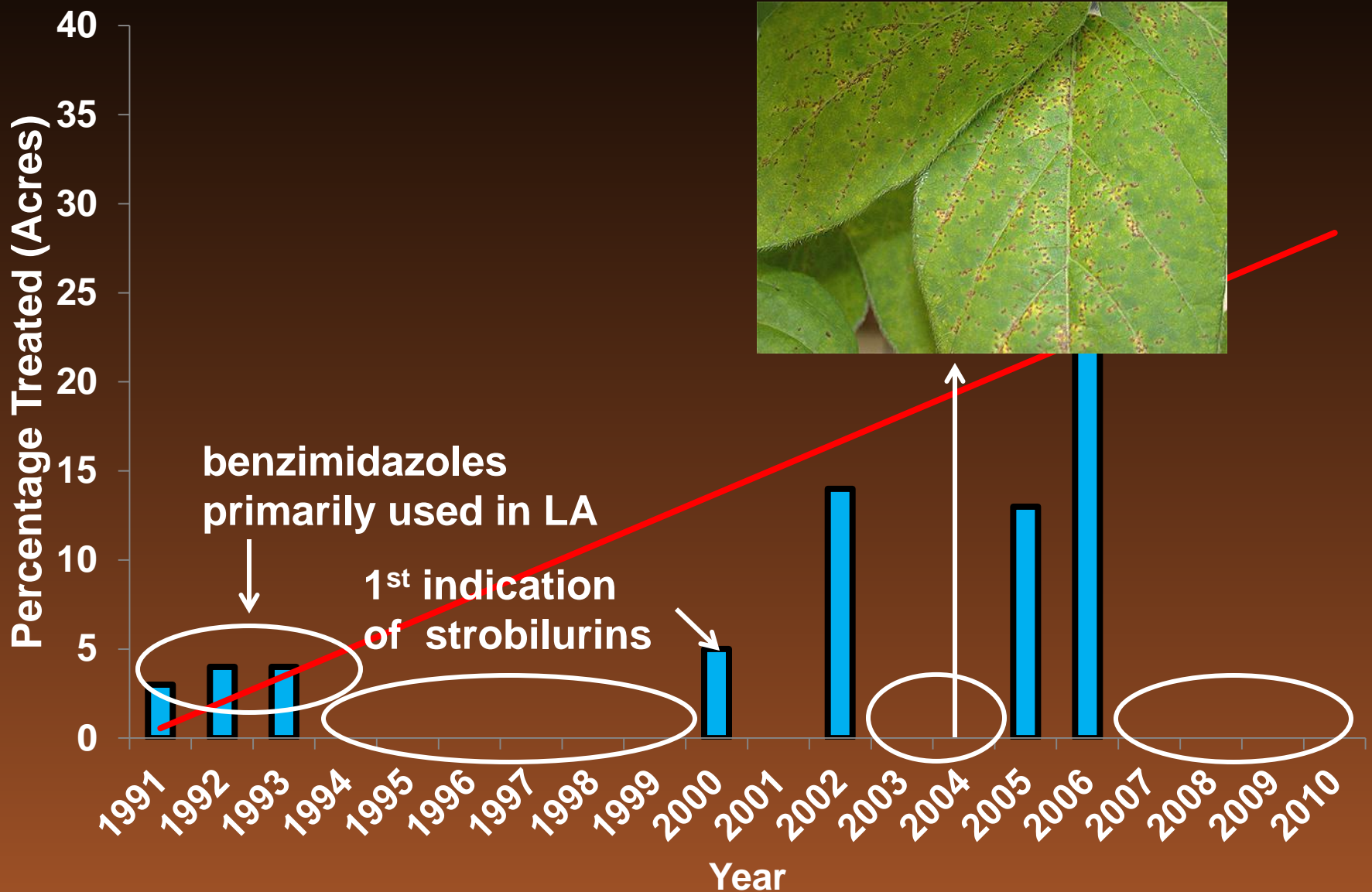
Trey Price

LATMC

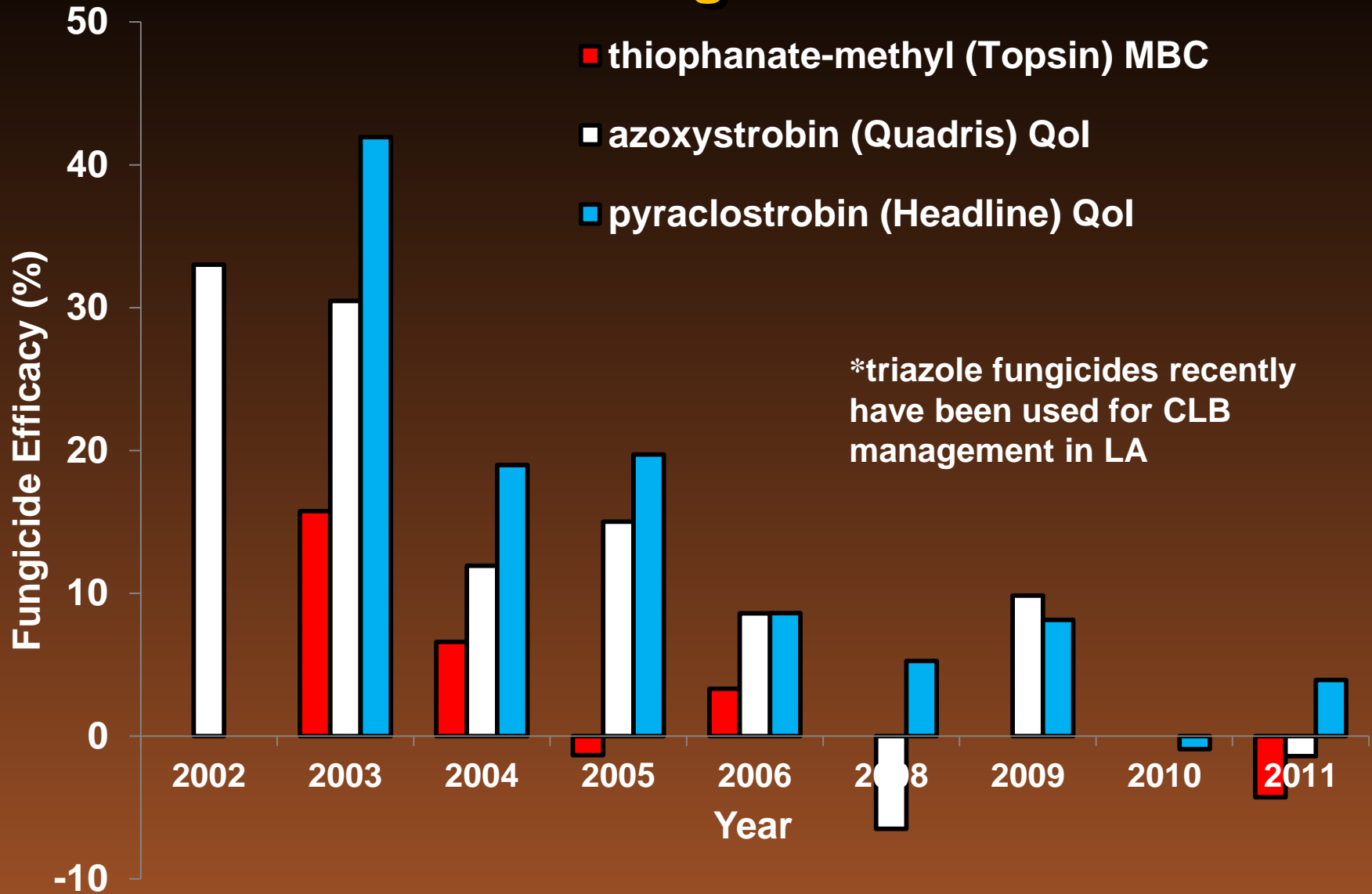
February 13, 2014



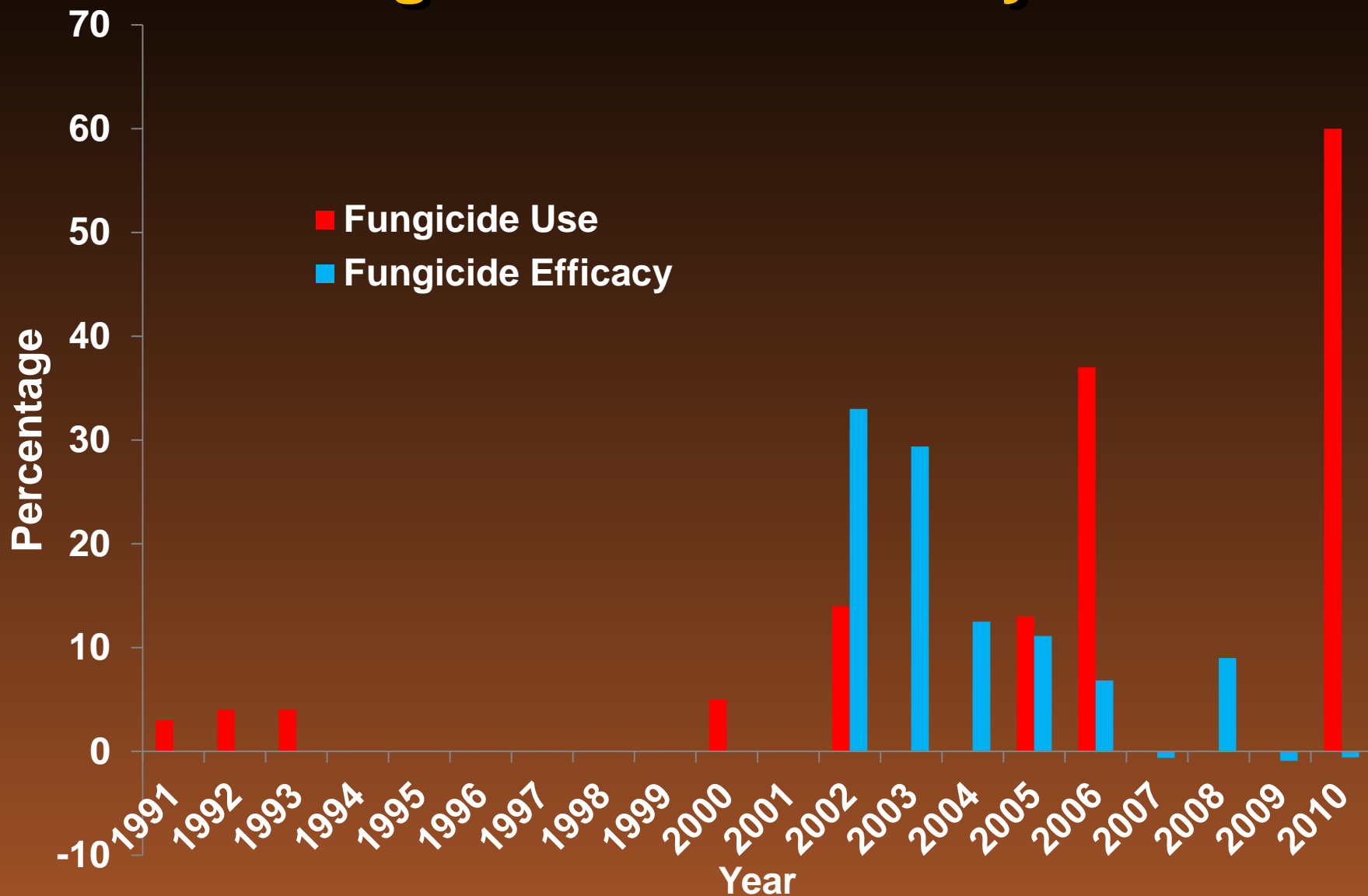
Fungicide Use in Louisiana Soybean



Declining Fungicide Efficacy on Cercospora leaf blight



Fungicide Use and Efficacy on Cercospora leaf blight in Louisiana Soybean



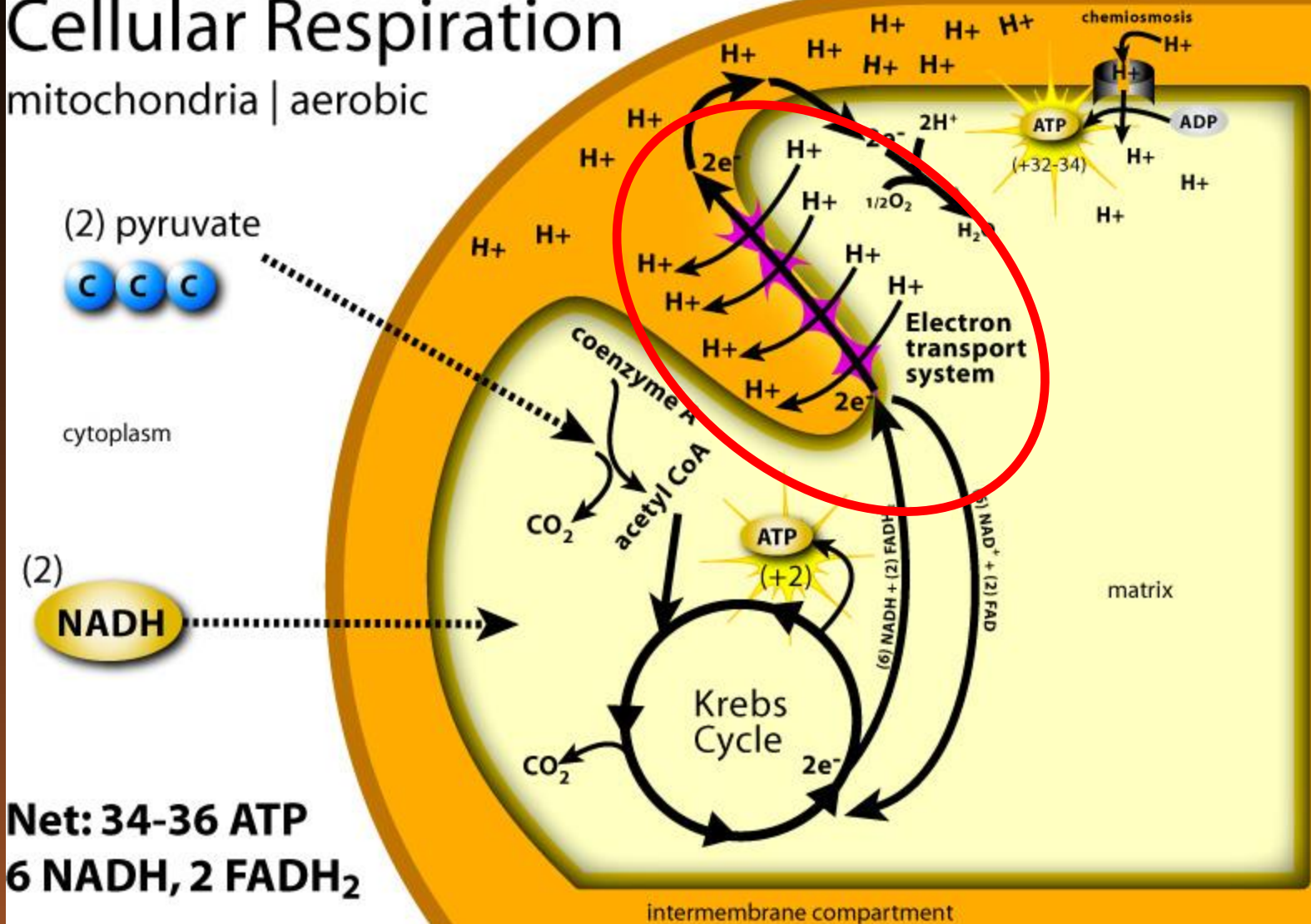
Foliar Fungicides

Class	Active Ingredient	Trade Name	Resistance Risk
QoI (strobilurins) Group 11	azoxystrobin	Quadris (Generics)	HIGH
	trifloxystrobin	Gem	
	pyraclostrobin	Headline	
DMI (triazoles) Group 3	flutriafol	Topguard	MEDIUM
	propiconazole	Tilt (Generics)	
	tetraconazole	Domark	
MBC Thiophanates (benzimidazoles) Group 1	thiophanate- methyl	Topsin-M Incognito (Generics)	HIGH
SDHI Carboximides Group 7	boscalid	Endura	HIGH
	fluopyram	Luna	
	sedaxane	Vibrance	
	fluxapyroxad	Priaxor	

Strobilurins – Group 11

Cellular Respiration

mitochondria | aerobic



(2) pyruvate



cytoplasm

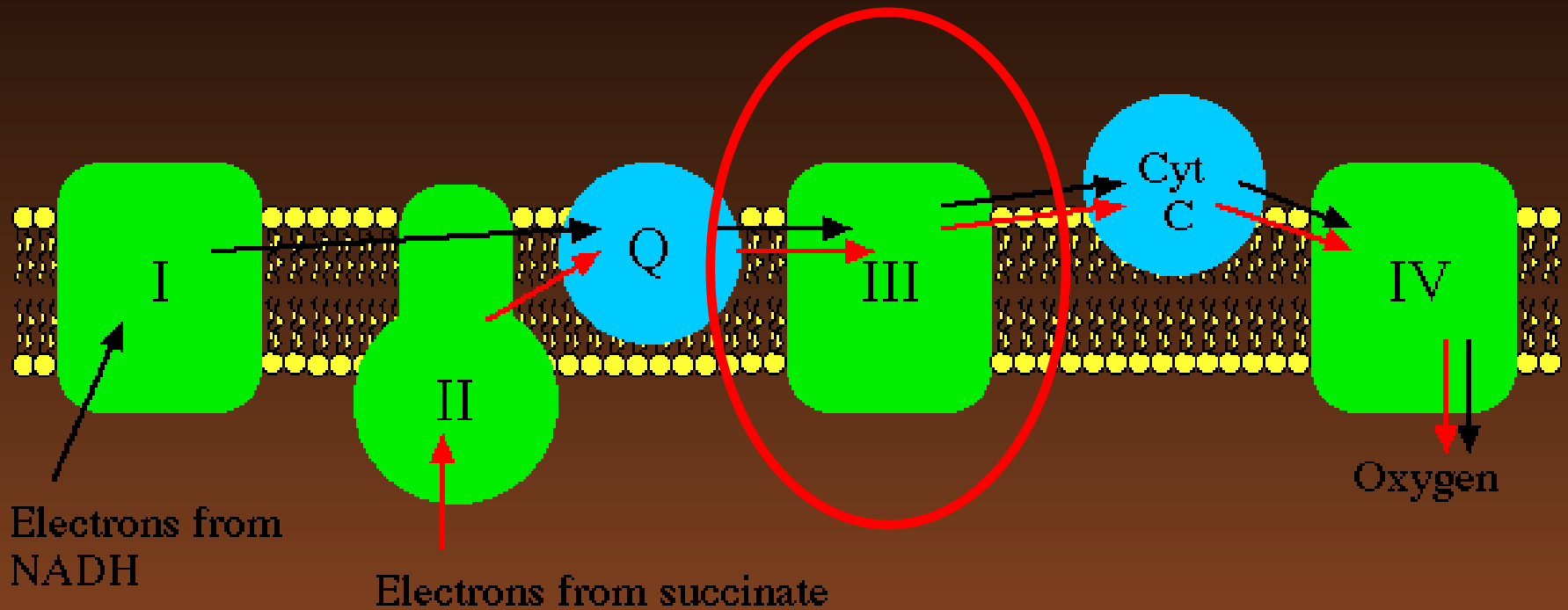
(2)



Net: 34-36 ATP
6 NADH, 2 FADH₂

intermembrane compartment

Strobilurins – Group 11



Fungicide Resistance is not new...

Class	Number of Species	Number of Crops
Qol (strobilurins) Group 11	56	20
DMI (triazoles) Group 3	29	20
MBC Thiophanates (benzimidazoles) Group 1	130	Many
SDHI Carboximides Group 7	12	12

Fungicide Resistance Found In Soybean Field

October 20, 2010



4 States Find Fungicide-Resistant Frogeye Leaf Spot In Soybeans

Source: University of Illinois

By Carl A. Bradley

In 2010, Tennessee soybeans were documented with frogeye leafspot that was resistant to strobilurin fungicides. Following that report, similar resistance was also found in southern Illinois.

Frogeye leaf spot resistance identified in N.C.

Rod Gurganus, North Carolina Cooperative Extension | Updated: 10/11/2013

ShareThis Resize text PRINT THIS

Resistance of the frogeye leaf spot fungus (*Cercospora sojina*) on soybean to strobilurins has now been identified in North Carolina.

Resistance of the frogeye leaf spot fungus (*Cercospora sojina*) to strobilurin fungicides (Headline, Quadris, Evito, and Approach) has been reported from the Mississippi Delta and other areas in the past several years. Most finds of resistant fungus strains have been confined to the Mississippi river valley as far north as Illinois.

Some growers are reporting that management of frogeye leaf spot with fungicides in North Carolina is poor this year.

Fungicide-resistant soybean disease found in La.

News Release Distributed 07/26/13

PALMETTO, La. – An LSU AgCenter plant pathologist warned farmers at the St. Landry Parish rice and soybean field day on July 25 that fungicide-resistant disease has been found in soybeans in some areas of the state.

The soybean disease aerial blight has developed resistance to fungicides, said LSU AgCenter plant pathologist Clayton Hollier. "That's very troubling."

Fungicide resistance in *Cercospora kikuchii*, a major pathogen of Louisiana soybean.

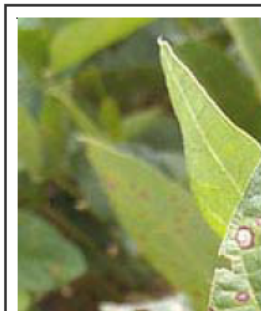
P. P. PRICE (1), M. A. Purvis (1), G. B. Padgett (1), C. L. Robertson (2), R. W. Schneider (2)
(1) Louisiana State University, Winnsboro, LA, U.S.A.; (2) Louisiana State University, Baton Rouge, LA, U.S.A.

To determine if resistance to fungicides has occurred in *C. kikuchii*, evaluations were conducted using Louisiana populations from 2000, 2011, and 2012. Baseline fungicide sensitivities, derived from EC₅₀ values from radial growth assays, were determined in

MSU conducting survey to find resistant fungus

By Bonnie Coblentz
Ag Communications

MISSISSIPPI STATE – A statewide survey that Mississippi State University began this summer will continue next year as researchers look for a particular disease that is developing resistance to chemical



Fungicide Resistance: Will It Happen In Corn Diseases?

DR. PAUL VINCELLI AND DR. DON HERSHMAN

LEXINGTON, KY. PRINCETON, KY.

The simple answer: Almost certainly, it will happen. No one knows where or when it

will occur in a field, so a fungicide application will select for resistance towards that disease, though the disease is present at low levels and cause yield loss.

Fungicide Resistance – How does it happen?

SELECTION PRESSURE

SPRAY

SPRAY

SSSSSSSSSSSSSS
SSSSSS
SSSSSS
R
SSSSSS
SSSSSS
SSSSSSSSSSSSSS

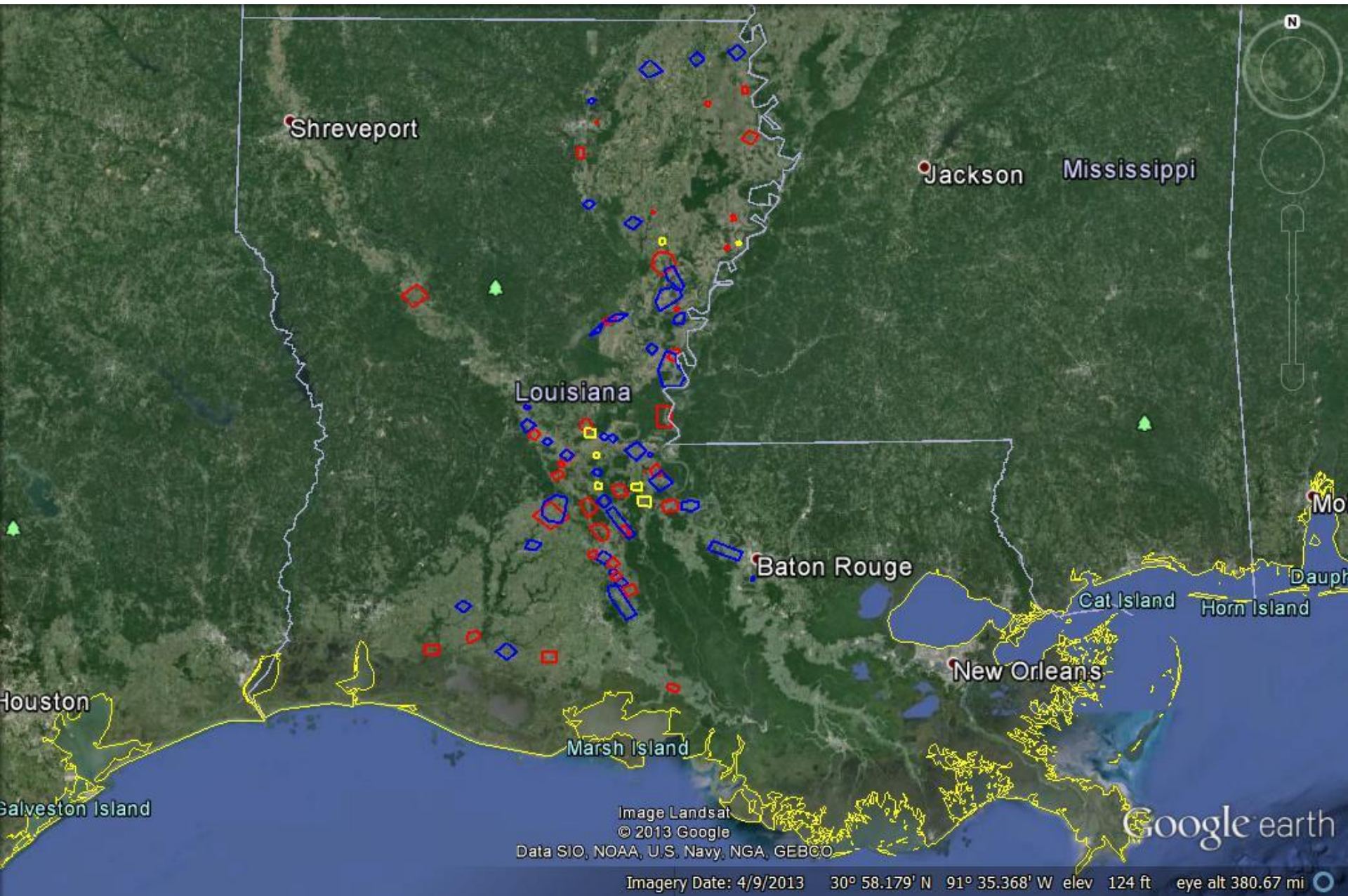
~~SSSSSSSSSSSSSS~~
~~SSSSSS~~
~~SSSSSS~~
RRR
~~SSSSSS~~
~~SSSSSS~~
~~SSSSSSSSSSSSSS~~

RRRRRRRRRR
RRRRRR
RRRRRRRRRR
SSSS
RRRRRRRRRR
RRRRRR
RRRRRRRRRR



**RESISTANCE IN THE
CERCOSPORA
LEAF BLIGHT
PATHOGEN**





Shreveport

Jackson Mississippi

Louisiana

Baton Rouge

New Orleans

Marsh Island

Cat Island

Horn Island

Dauphin Island

Houston

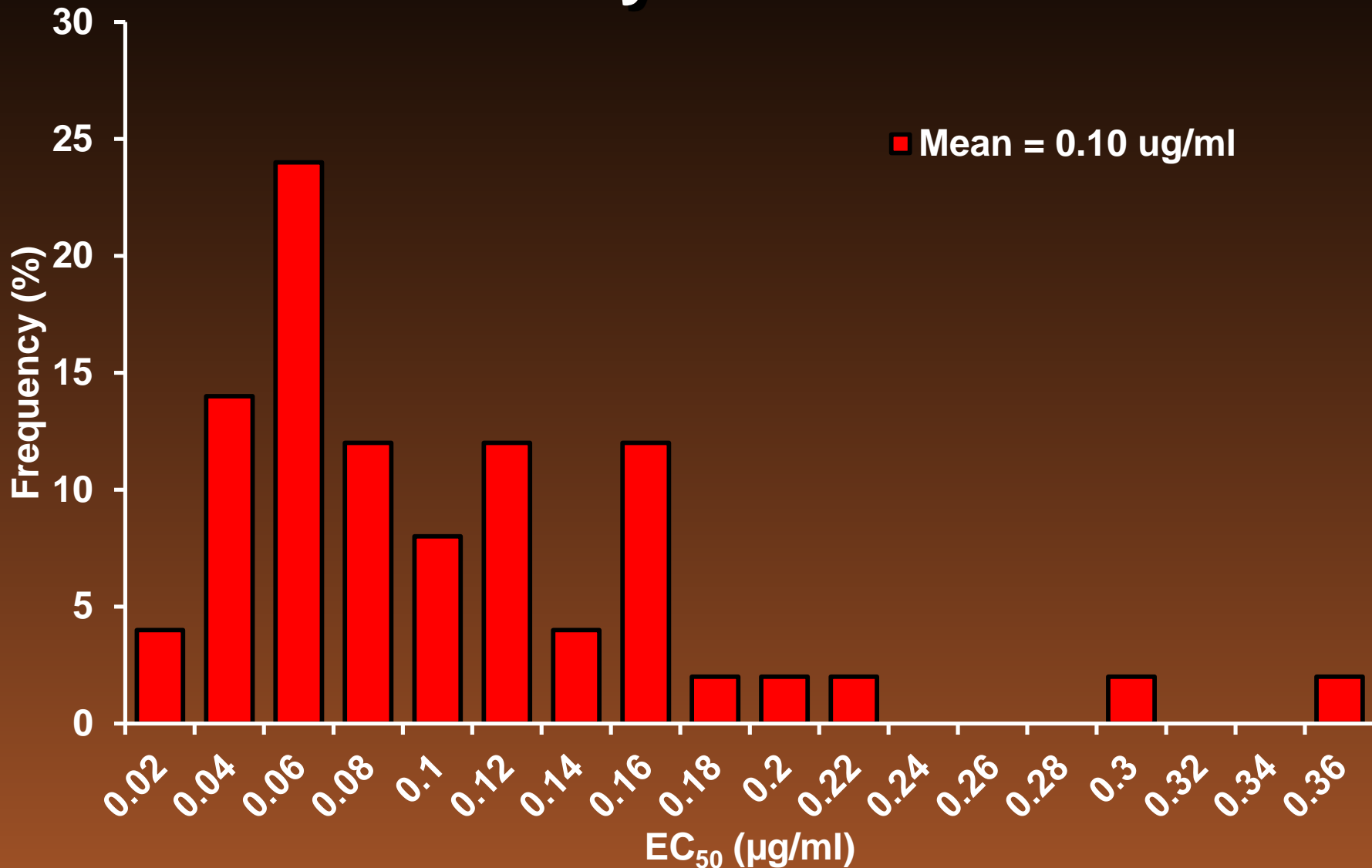
Galveston Island

Image Landsat
© 2013 Google
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

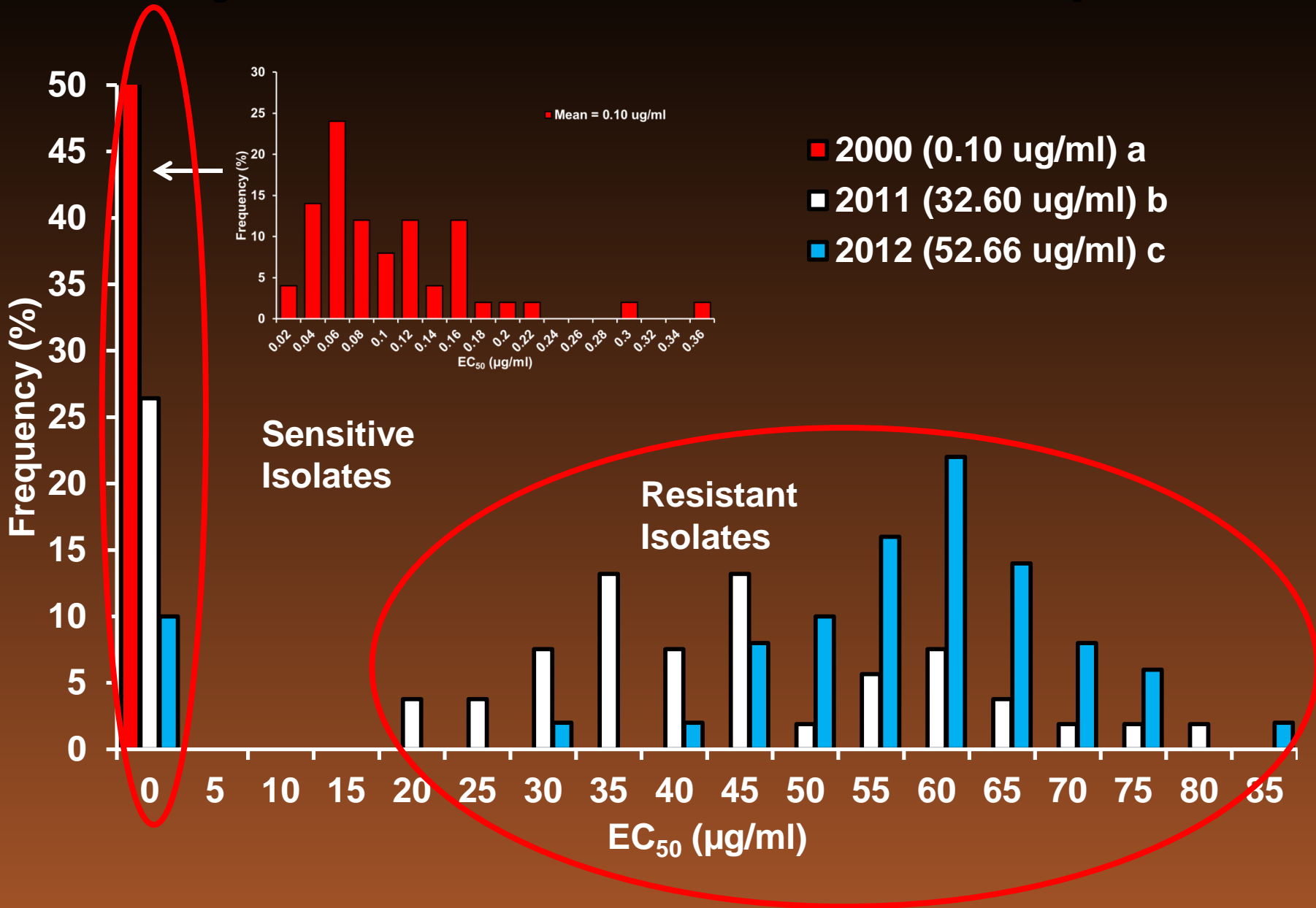
Google earth

Imagery Date: 4/9/2013 30° 58.179' N 91° 35.368' W elev 124 ft eye alt 380.67 mi

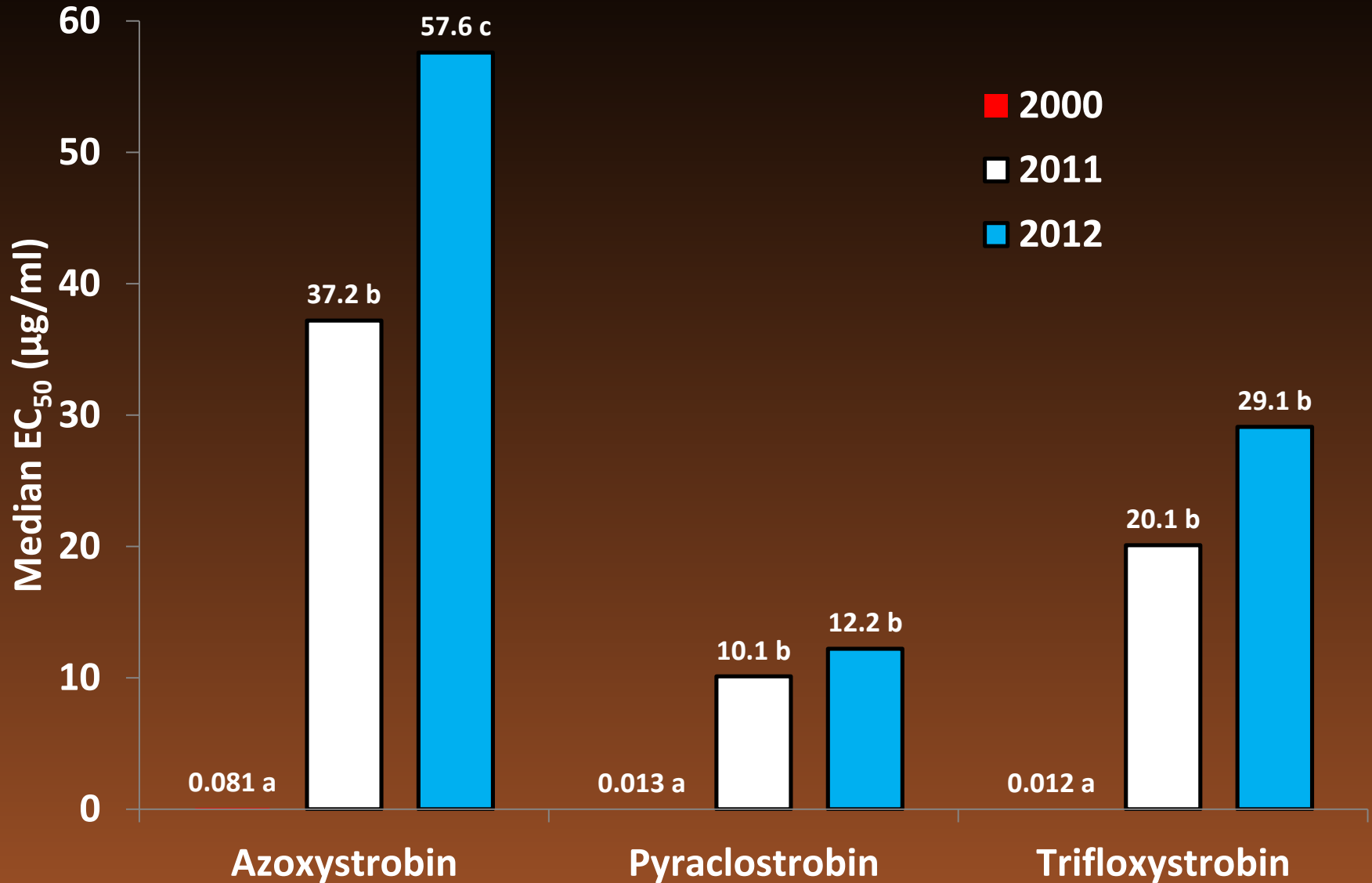
Baseline Sensitivity of Cercospora to azoxystrobin



azoxystrobin Resistance - Cercospora



Strobilurin Summary

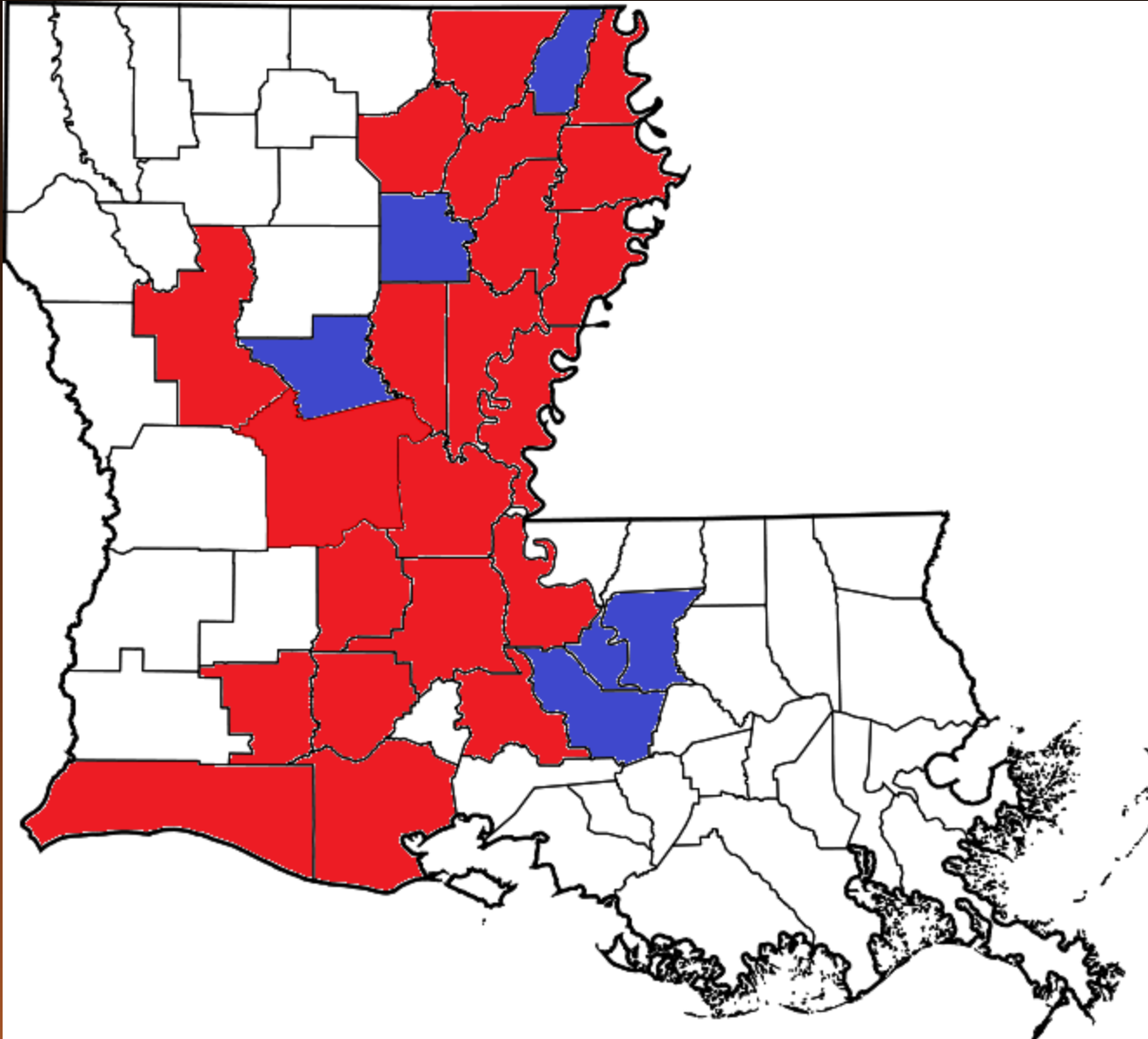


100% Cross resistance to strobilurins

<u>isolate</u>	<u>az</u>	<u>py</u>	<u>tri</u>	<u>isolate</u>	<u>az</u>	<u>py</u>	<u>tri</u>
1	1	1	1	43	1	1	1
3	1	1	1	44	1	1	1
6	1	1	1	47	1	1	1
10	1	1	1	49	1	1	1
13	1	1	1	50	1	1	1
14	1	1	1	52	1	1	1
17	1	1	1	58	1	1	1
21	1	1	1	60	1	1	1
22	0	0	0	61	1	1	1
23	0	0	0	62	1	1	1
25	1	1	1	73	1	1	1
29	1	1	1	74	1	1	1
30	1	1	1	75	1	1	1
31	1	1	1	78	0	0	0
35	1	1	1	81	0	0	0
36	0	0	0	82	1	1	1
39	1	1	1				

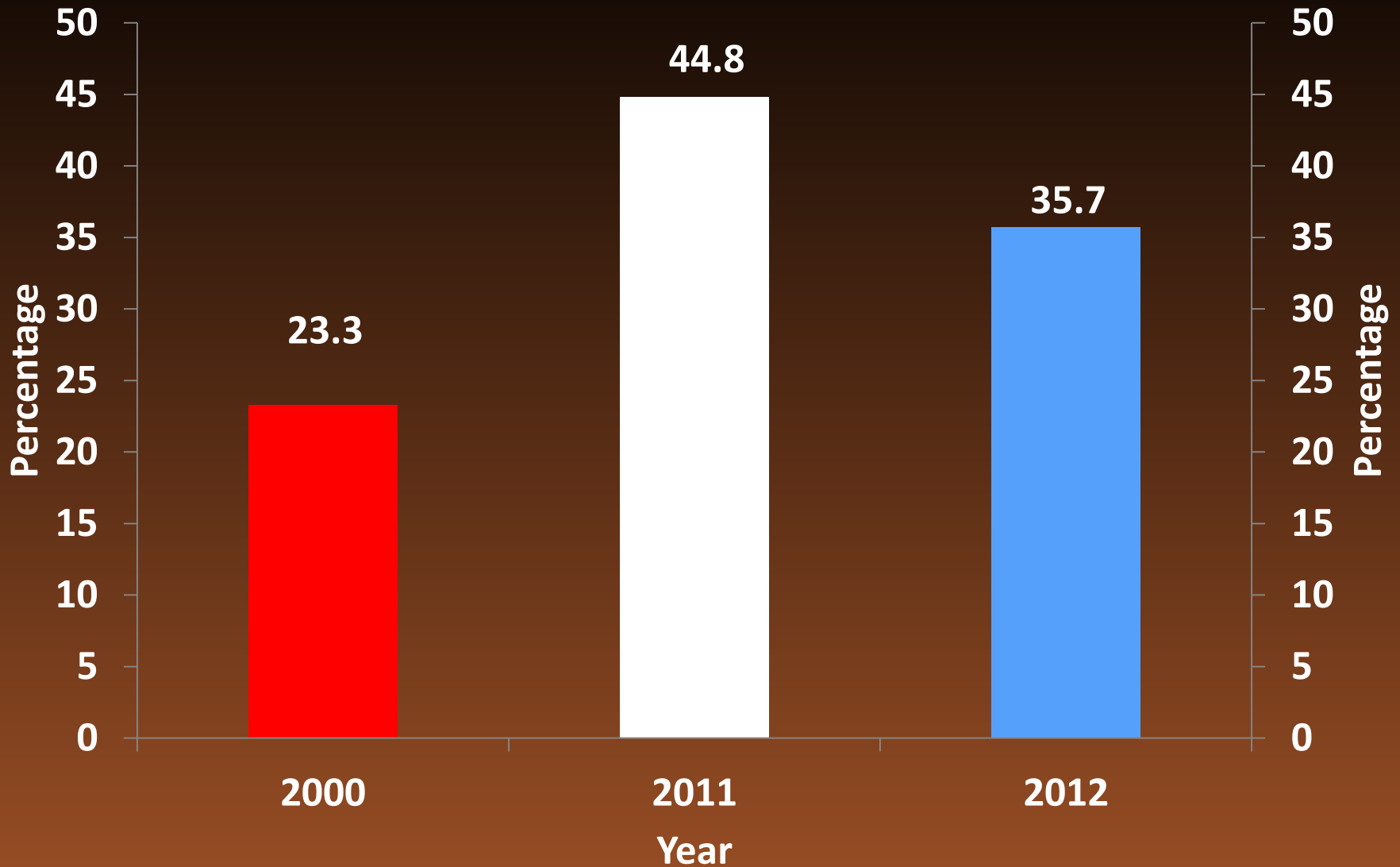
1=Resistant 0=Sensitive

Extent of strobilurin resistance in LA - Cercospora leaf blight

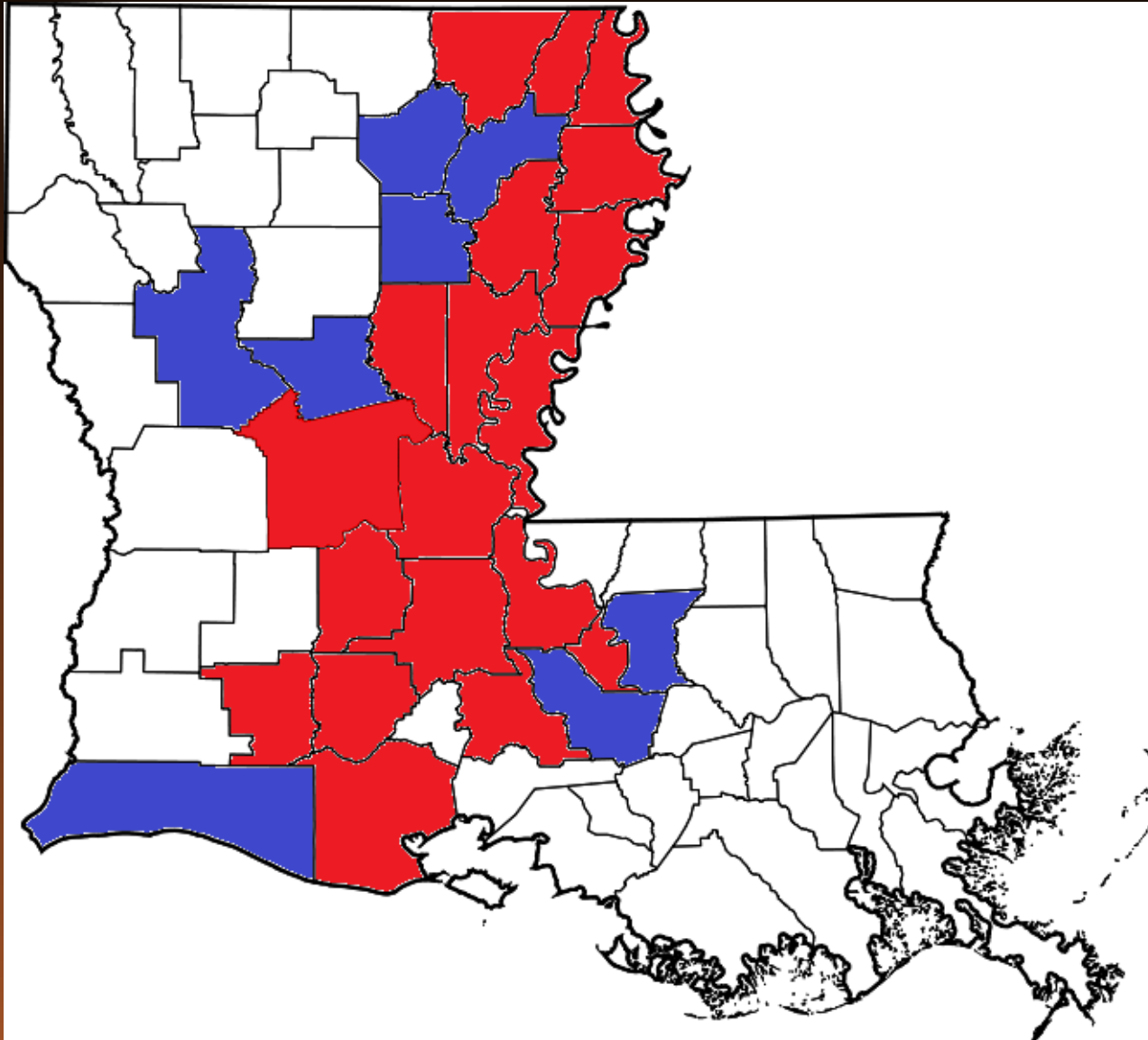


- 21 of 27 parishes confirmed so far
- ~85% of tested isolates were resistant to strobilurins

Thiophanate methyl resistance in Cercospora

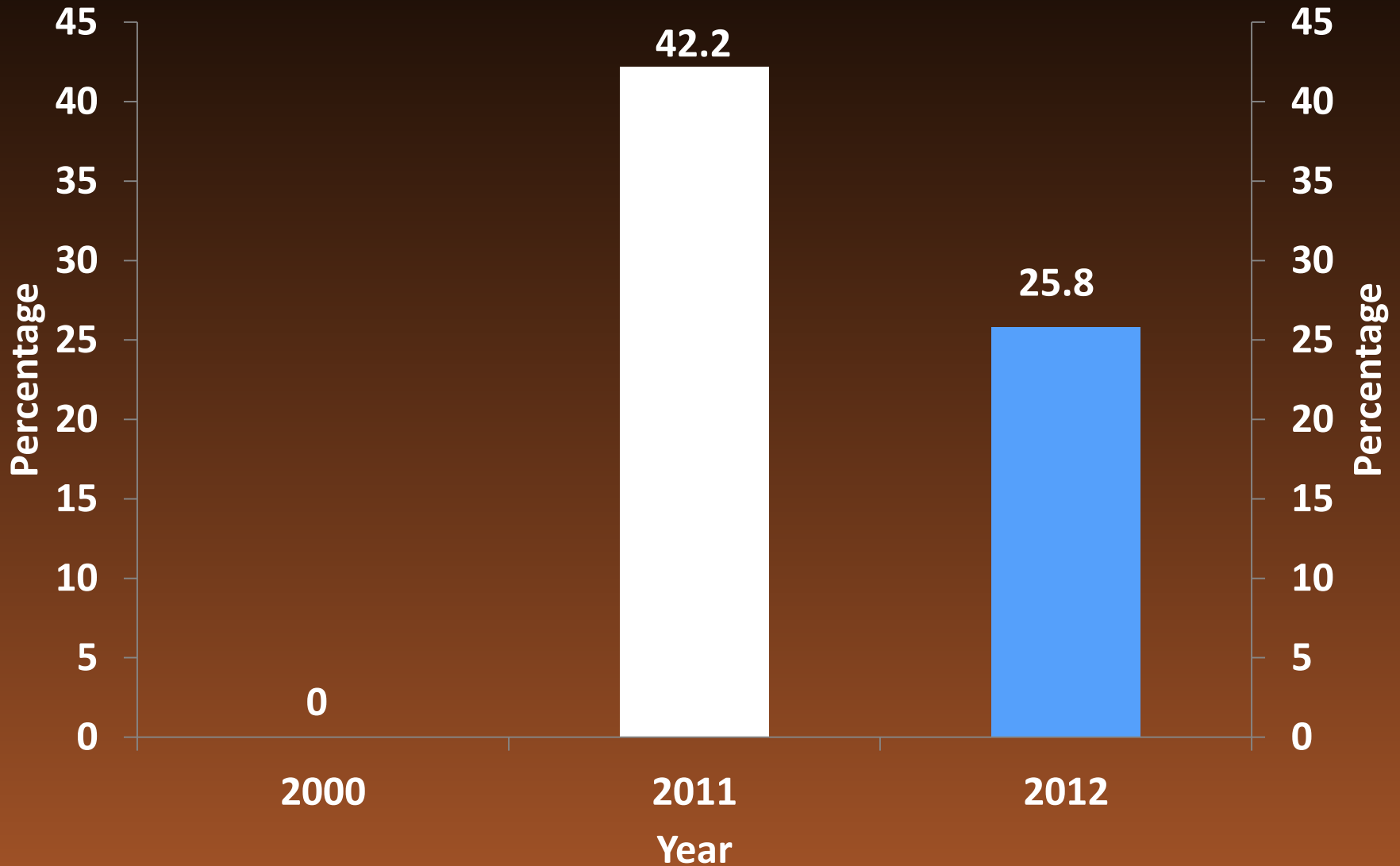


Extent of thiophanate-methyl resistance in LA

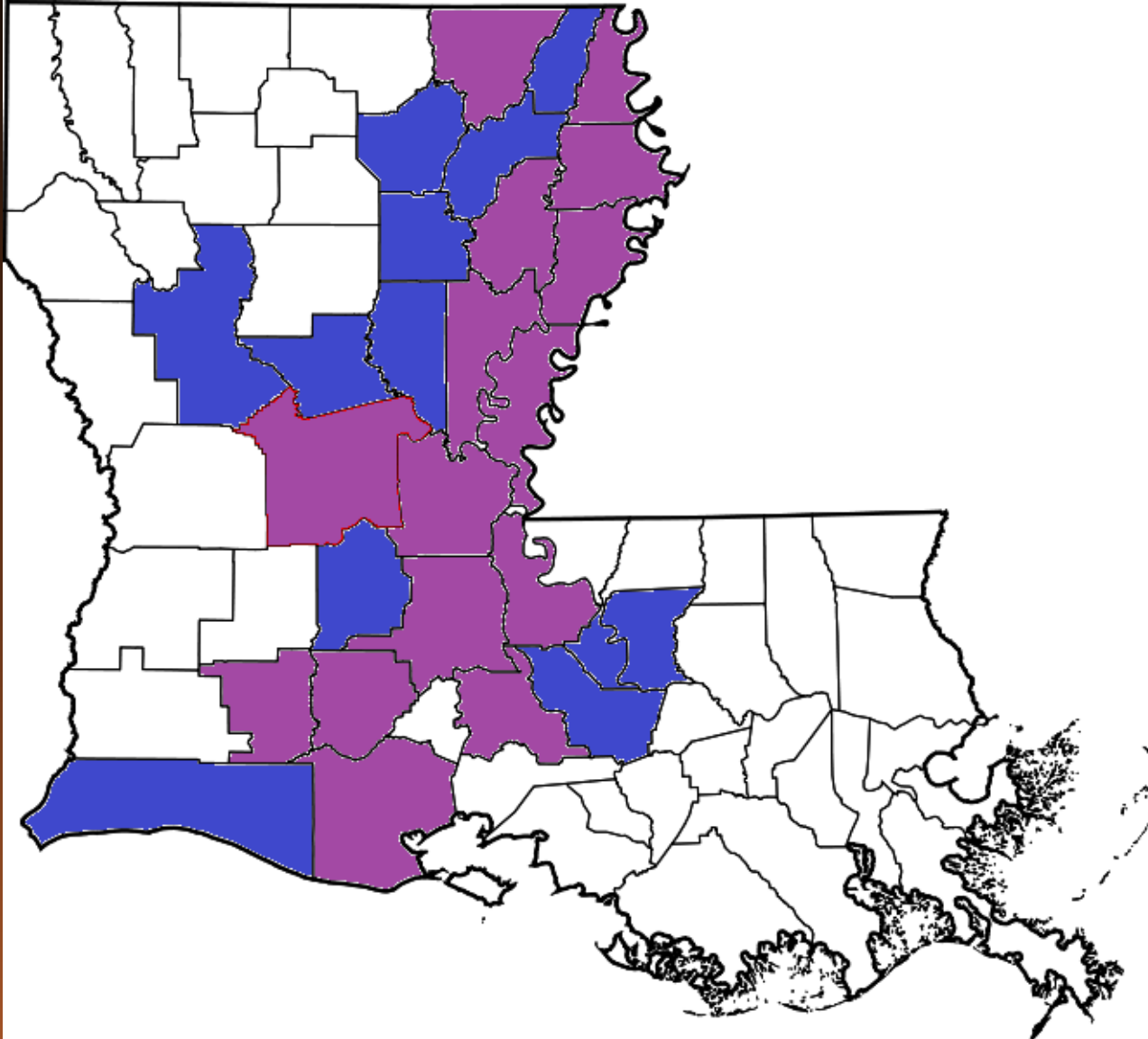


- 19 of 27 parishes confirmed so far
- ~30% of tested isolates were resistant.

Multiple resistance to thiophanate-methyl and strobilurins

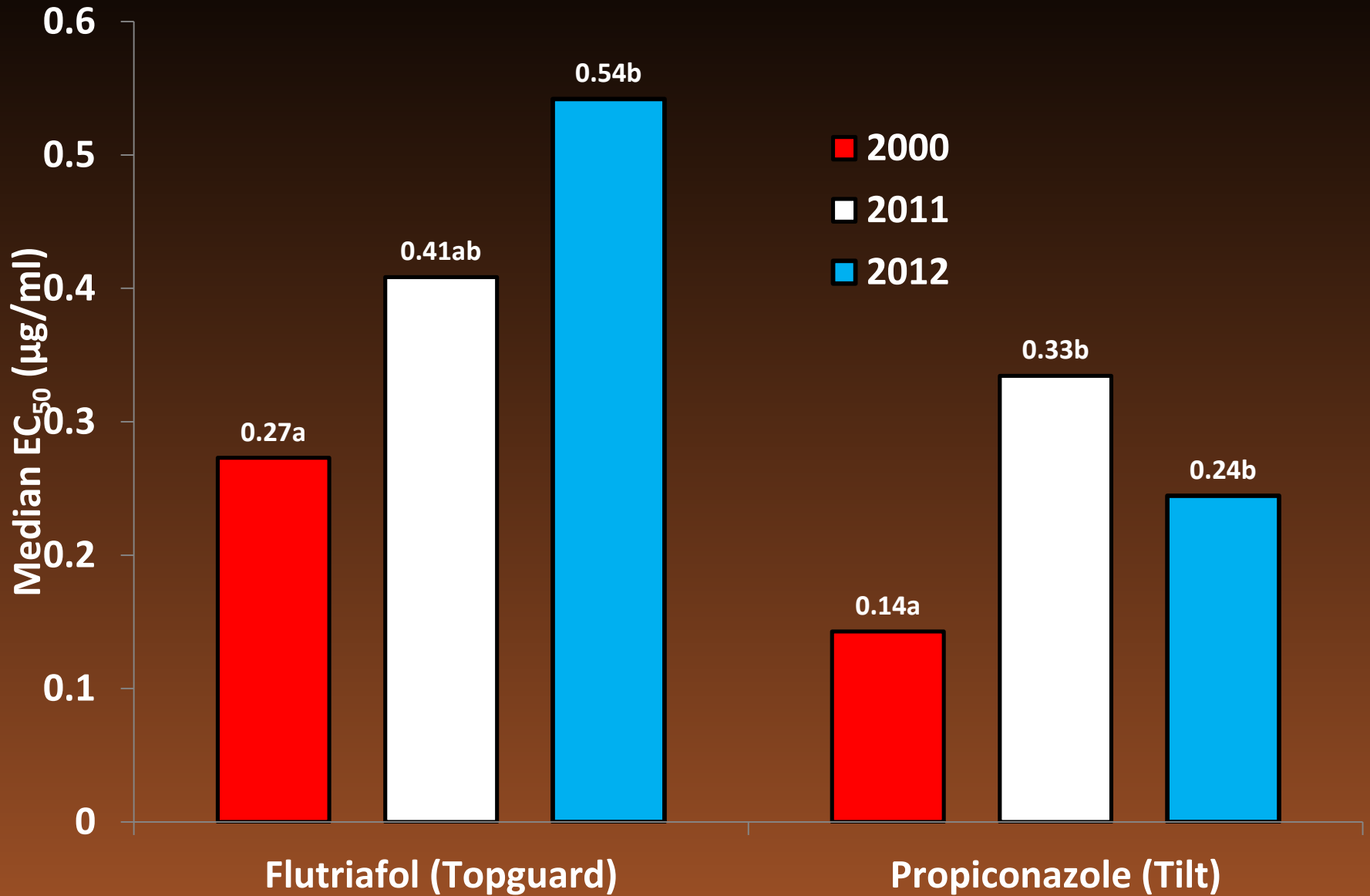


Multiple resistance to thiophanate-methyl and strobilurins



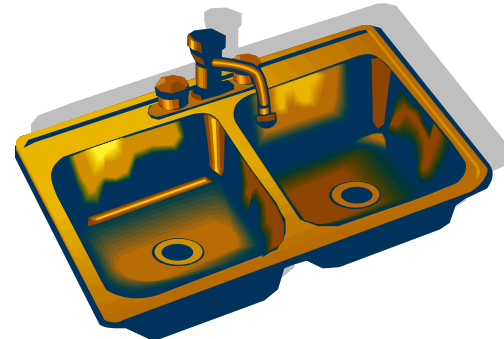
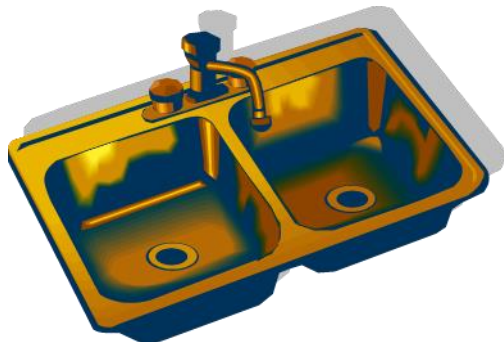
- 15 of 27 parishes confirmed
- ~30% of isolates in 2011 and 2012 exhibited multiple-resistance
- MBC-resistant isolates appear to have a tendency to also be QoI-resistant

Triazole Summary



Observations in Fungicide Trials – MRRS, NERS, and DLRS - 2008-Present

- Estimated 125 field trials
- Application rate and timing trials
 - Multiple applications
- Multiple chemistry types, commercial and experimental
- Marginal fungicide efficacy on CLB



Effect of Fungicide Application on PSS, CLB, and Yield

IV – DLRS CERCOSPORA LEAF BLIGHT

- 20 Varieties
- Topguard (10) @ R1 fb Topguard (7) + Quadris (6) @ R3

	%Purple Stain	Cercospora (1-9)	Yield (bu/A)
Non- Treated ¹	18.0 a ²	5.8 a	64.2 a
Treated	17.0 a	5.2 b	66.0 b
Pr>F	0.2204	<0.0001	<0.0001

Effect of Fungicide Application on PSS, CLB, and Yield

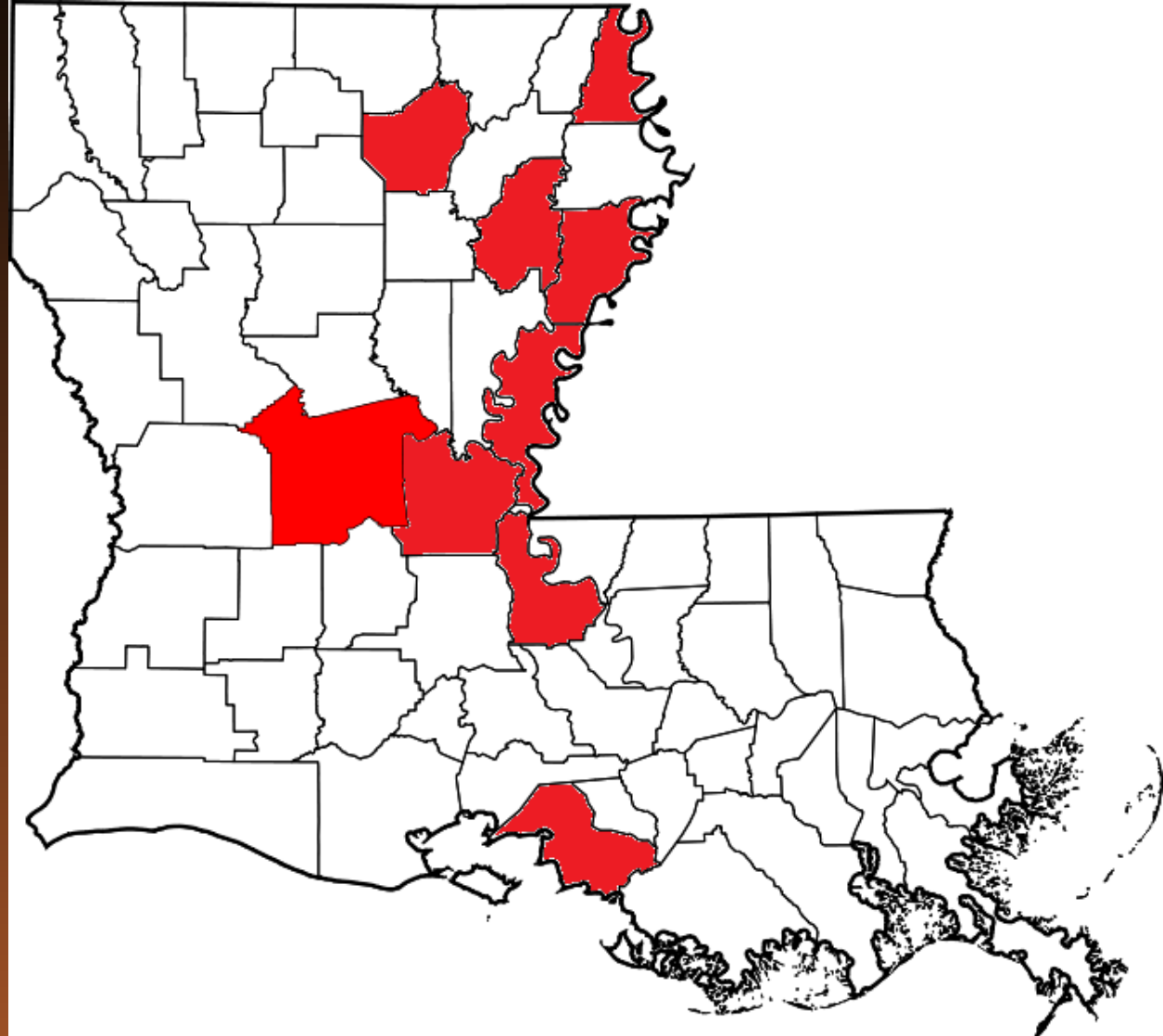
V – DLRS CERCOSPORA LEAF BLIGHT

- 17 Varieties
- Topguard (10) @ R1 fb Topguard (7) + Quadris (6) @ R3

	%Purple Stain	Cercospora (1-9)	Yield (bu/A)
Non- Treated ¹	4.63 a ²	7.2 a	63.6 a
Treated	3.65 b	6.2 b	65.5 b
Pr>F	0.0043	<0.0001	<0.0001

Strobilurin Resistance in *C. sojae* - (Frogeye leaf spot)

Cooperator – Carl Bradley, University of Illinois



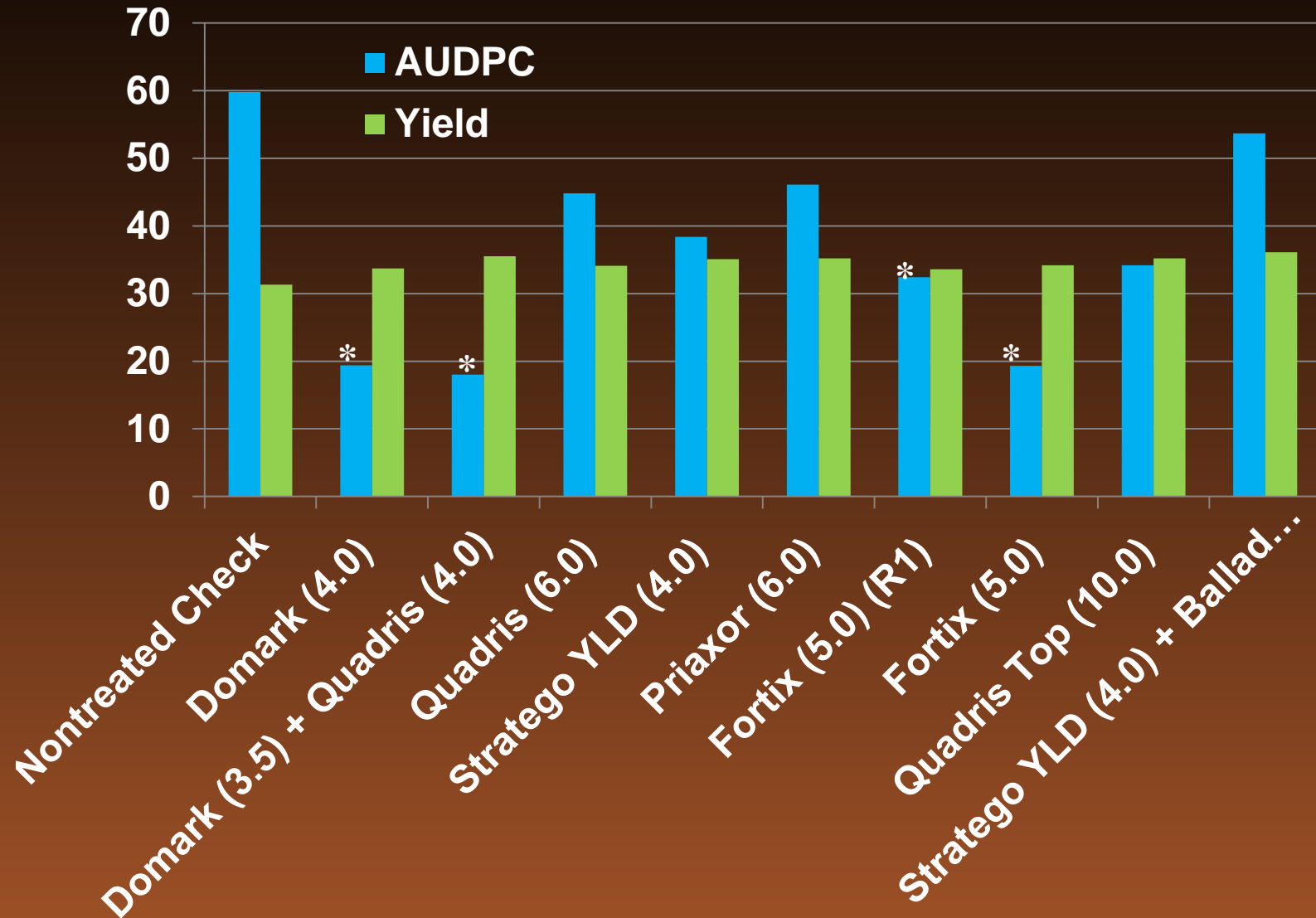
Group IV FELS Susceptible Varieties 2013 DLRS Alexandria

- Many options for resistant varieties (Group IV & V)

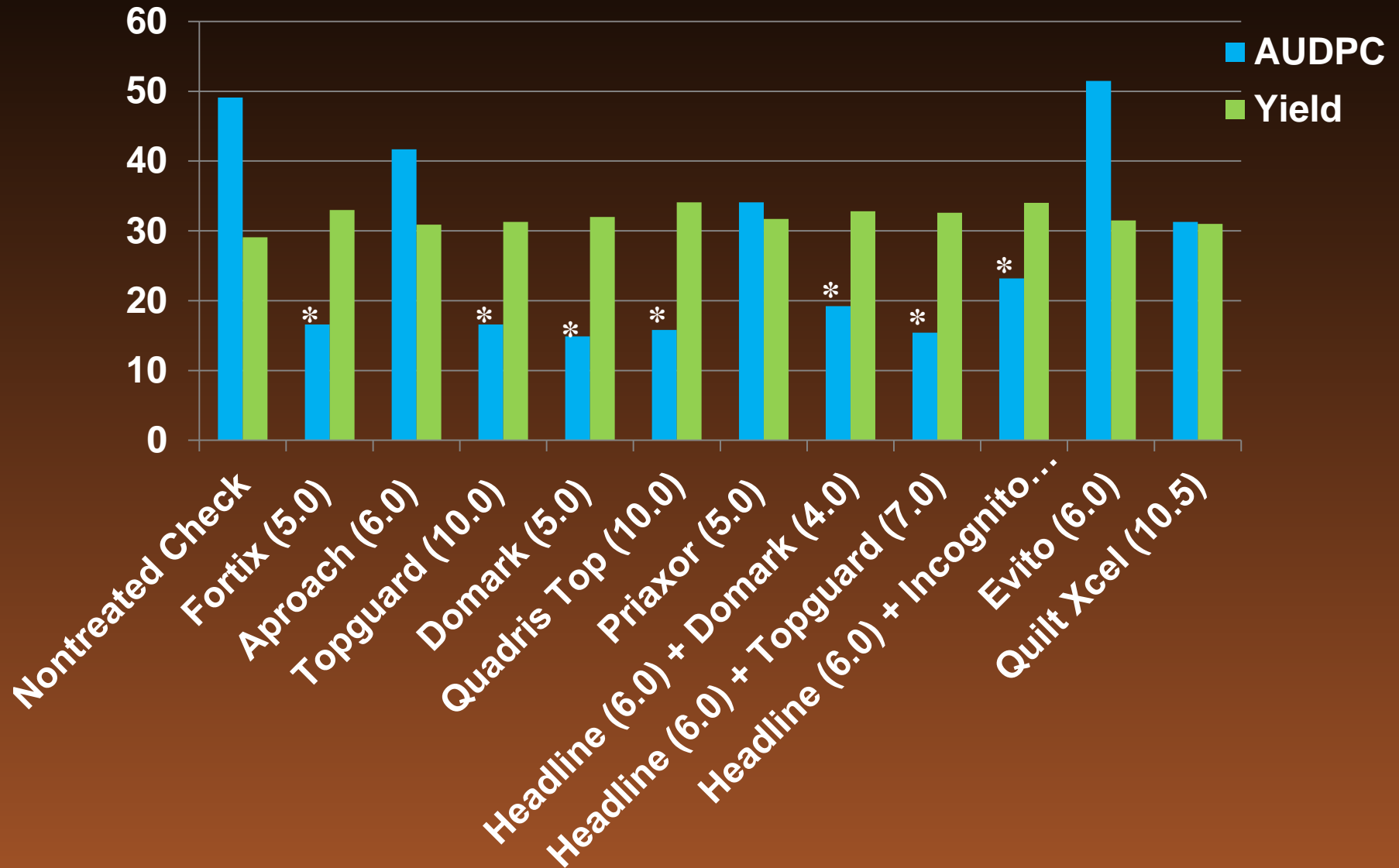
- CHECK ONLINE!

Variety	FELS 1-9	Yield (bu/A)
AG 4531	7	59
AG 4831	7.5	56
AG 4832	6.5	53
AG 4934	5.5	66
Armor 4744	7.5	49
Armor 47R13	5	53
DT 4755 RR2	7.5	61
GoSoy 4812LL	8	53
Halo 4:95	5.5	57
HBK RY 4620	5	49
P 4510RY	8	59
REV 46R64	8	60
Schillinger 478.RC	5.3	54

Fungicide Trial, Dean Lee Research Station, Alexandria, LA 2013 FROGEYE



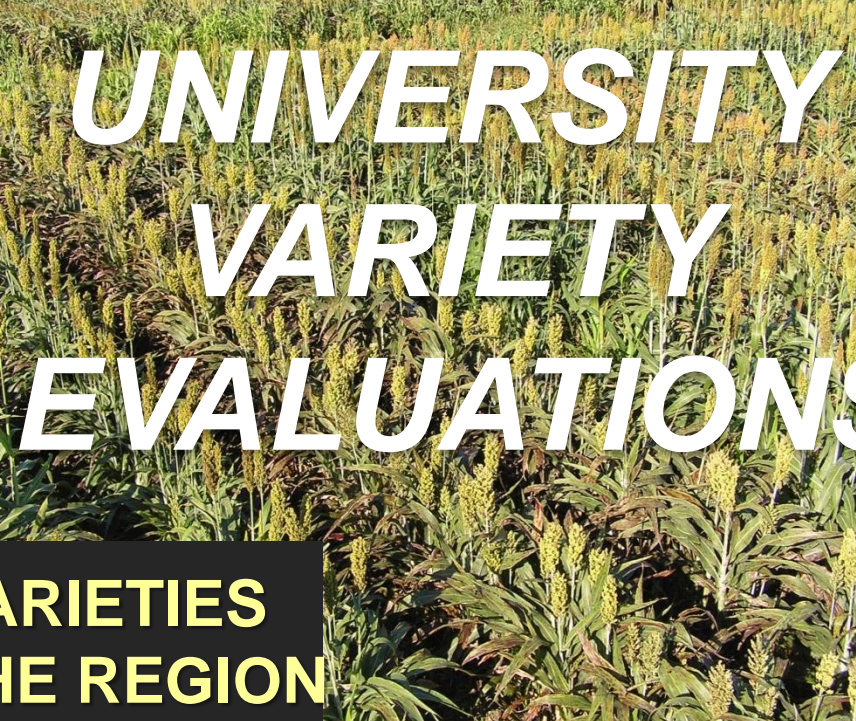
Fungicide Trial, Dean Lee Research Station, Alexandria, LA 2013 FROGEYE




Resistance Management



**#1 DEFENSE AGAINST
DISEASE IS A RESISTANT
VARIETY!**



**UNIVERSITY
VARIETY
EVALUATIONS**



**CHOOSE VARIETIES
TESTED IN THE REGION
OF THE STATE
WHERE YOU FARM !!!!**

AVAILABLE ONLINE
www.lsuagcenter.com

**LOCAL EXTENSION OFFICE
NEARBY RESEARCH STATION**



**Naturally-Occurring
Diseases**

2013 CLB Tolerant Varieties?

Group V

MRRS

NERS

DG 5461 LL	16.25 h		Halo X530	23.00 p
GoSoy 5410 LL	19.50 gh		Halo 5:01-5	23.00 p
P5460LL	19.50 gh		DG 5461 LL	25.00 p
Halo X530	19.50 gh		S09-13635	25.00 p
AG 5332	19.50 gh		P5460LL	27.00 p
Stine 5200-4 RY!1	22.75 fgh		P50T64R	27.00 p
Halo 5:01-5	22.75 fah		DG 5481 LL	27.00 p
AG 5233				27.75 p
DG 5130 RR				29.00 p
DG 5481 LL				29.75 op
	Variety	AUDPC (CLB 1-9)	Average Yield (bu/A)	
	DG5461LL	20.6	63	
	Halo X530	21.3	64	
	Halo 5:01-5	22.9	68.5	
	P5460LL	23.3	73	
	DG5481LL	24.9	62	
	DG5130RR2	25.3	69	
	Stine 5200-4RY!1	26.3	69.5	

Most CLB Susceptible Varieties 2013

MRRS

Group V

NERS

	Variety	AUDPC (CLB 1-9)	Average Yield (bu/A)	
Dyna-Gro S54				2.00 abc
Armor 53-R88				2.00 abc
DG 5480 RR2				2.00 abc
UA 5213C	R2C 5081	71.7	68.5	2.00 abc
P5610LL	Experimental	69.7	71.5	2.00 abc
AG 5533	Experimental	69.3	68	2.00 abc
R04-1268RR				2.00 abc
Morsoy Xtra F	P5160LL	67.9	69	2.00 abc
Armor X1316	DG S54RY43	67.5	66	5.25 ab
Halo 5:45				5.25 ab
AG 5831	AG 5532	66.7	66.5	5.25 ab
AG 5532	Armor 53-R88	65.9	58.5	8.50 a
P5960LL	MorSoy Xtra R2	65.7	66	8.50 a
Armor X1414	53X82			8.50 a
R2C 5081	UA 5213C	64.3	67.5	8.50 a
	DG 5480 RR2	64.3	73.5	

2012 PSS Tolerant Varieties NERS Group IV



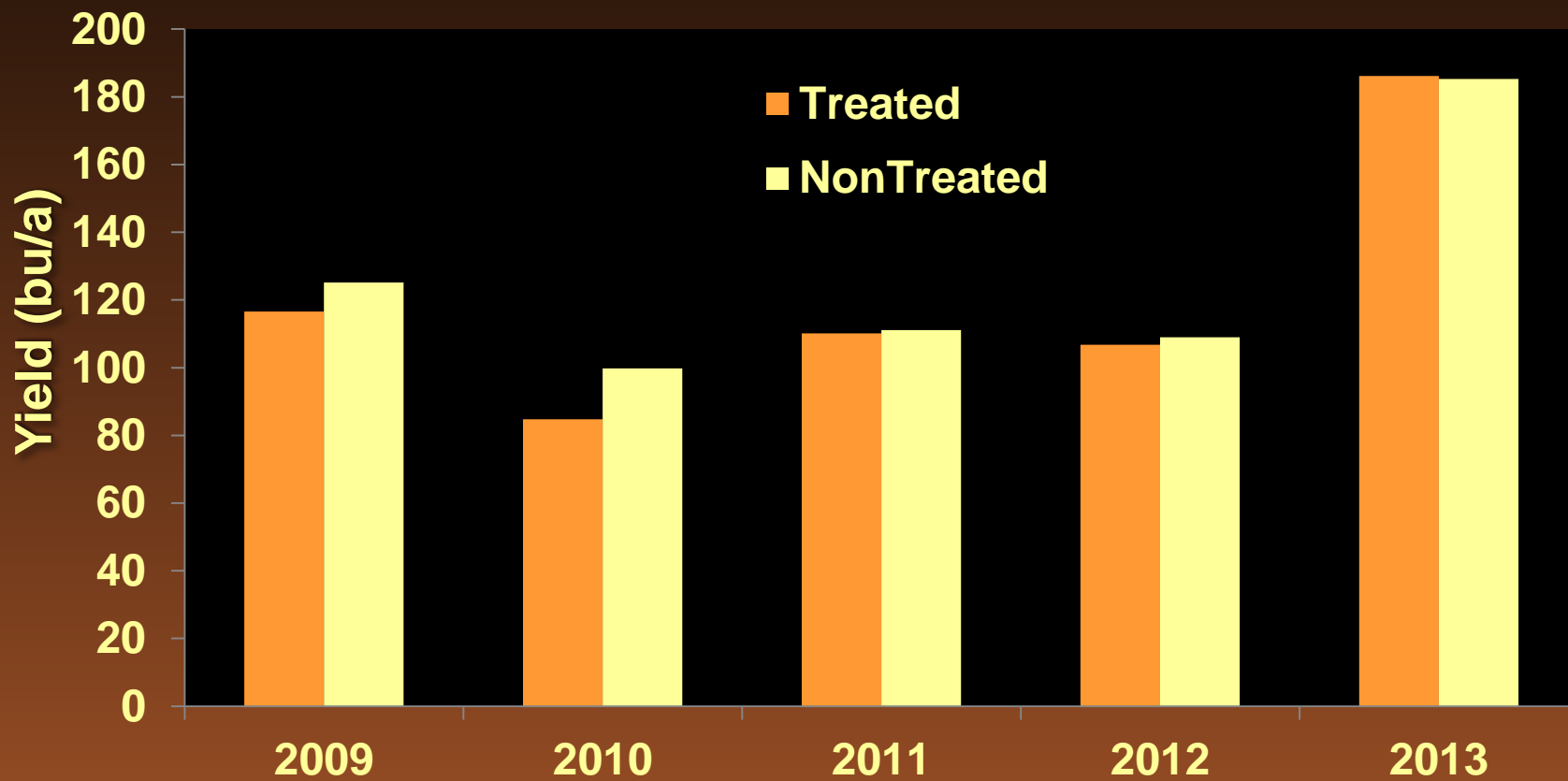
Variety	Trait	%PS
DeltaGrow 4967LL	LL	1.3
GoSoy 4912 LL	LL	1.8
Halo X49	LL	2.5
P4819LL	LL	4.8
Schillinger 478.RCS	RR	6.0
GoSoy 4812 LL	LL	6.8
Halo X478	LL	7.3
REV@49R22TM	RR	7.3
HBK 4924	RR	7.8
HBK RY 4620	RR	8.5
DeltaGrow 4990LL	LL	9.0
REV@48R10TM	RR	9.3
P4920RY	RR	9.3
Asgrow AG4932	RR	9.5
S08-X2499	RR	9.5
DeltaGrow 4867LL	LL	10.0
GoSoy 4411 LL	LL	10.0
Halo X48	LL	10.5
S46-A1 Brand	RR	11.0
P4928LL	LL	11.0

Fungicides – Foliar Applications

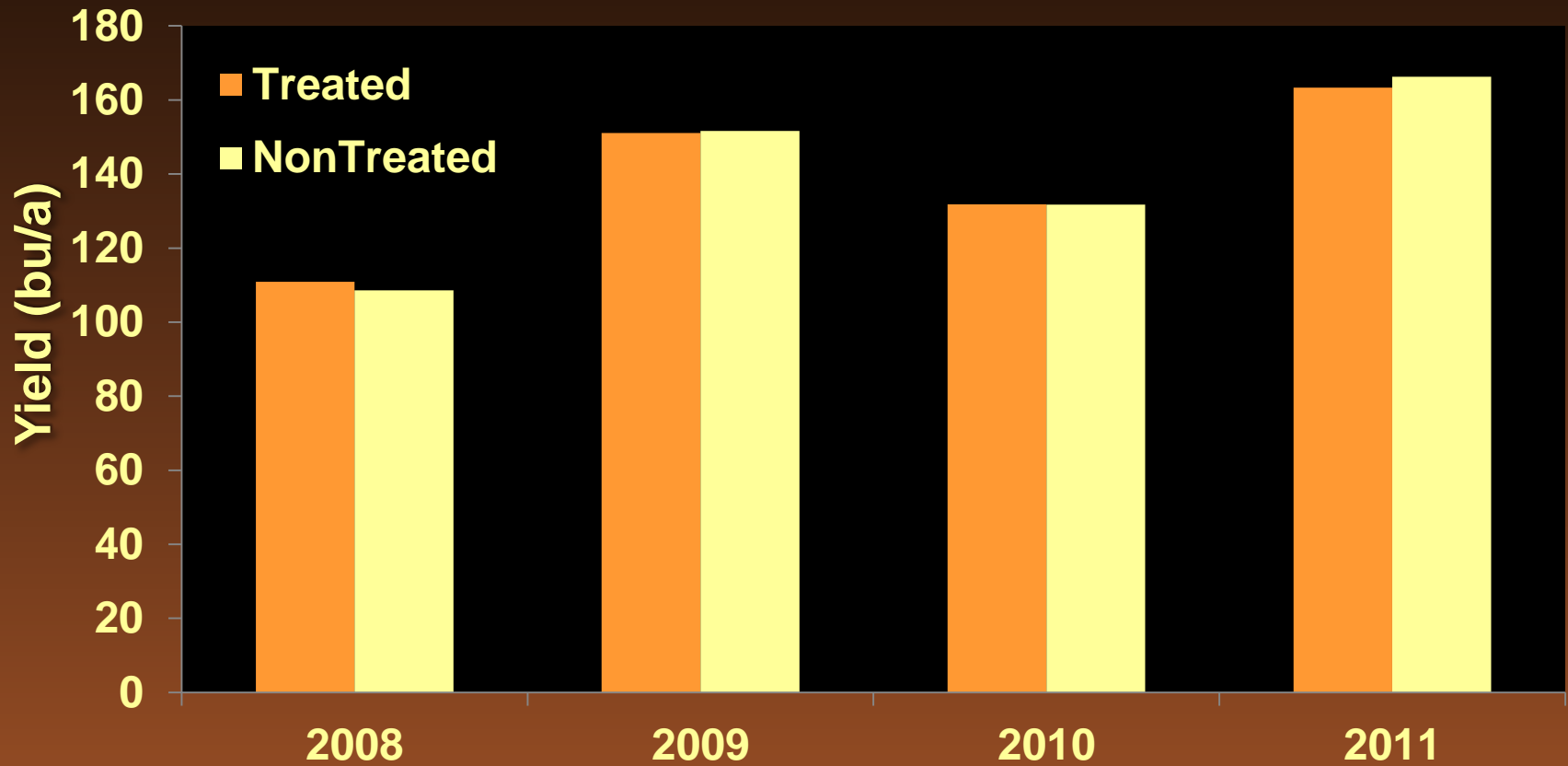
- ✓ USE FUNGICIDES SPARINGLY
- ✓ DO NOT USE REDUCED RATES
- ✓ USE APPROPRIATE APPLICATION TIMING
- ✓ GOOD COVERAGE IS KEY (nozzles important)
 - ✓ MOST FUNGICIDES REQUIRE 10 GPA MINIMUM
- ✓ ROTATE CHEMISTRY TYPES
- ✓ AVOID UNECESSARY APPLICATIONS!!!!

Corn Summary 2009-2013

Macon Ridge Research Station



Corn Summary 2008-2011 Northeast Research Station



Fungicide Resistance: Will It Happen In Corn Diseases?

DR. PAUL VINCELLI AND DR. DON HERSHMAN

LEXINGTON, KY.

PRINCETON, KY.

The simple answer: Almost certainly, it will happen. No one knows where or when it

ent in a field, so a fungicide application creates selection pressure towards resistance, even though the disease is present at low levels and may not cause yield loss.

- Gray Leaf Spot?
- Northern Corn Leaf Blight?

“Plant Health” Applications will apply Selection Pressure at low levels of disease.

Not a matter of “if”, a matter of WHEN

Questions?

Thank you!

318-235-9805

pprice@agcenter.lsu.edu

