Management of Frogeye Leaf Spot

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Acknowledgements

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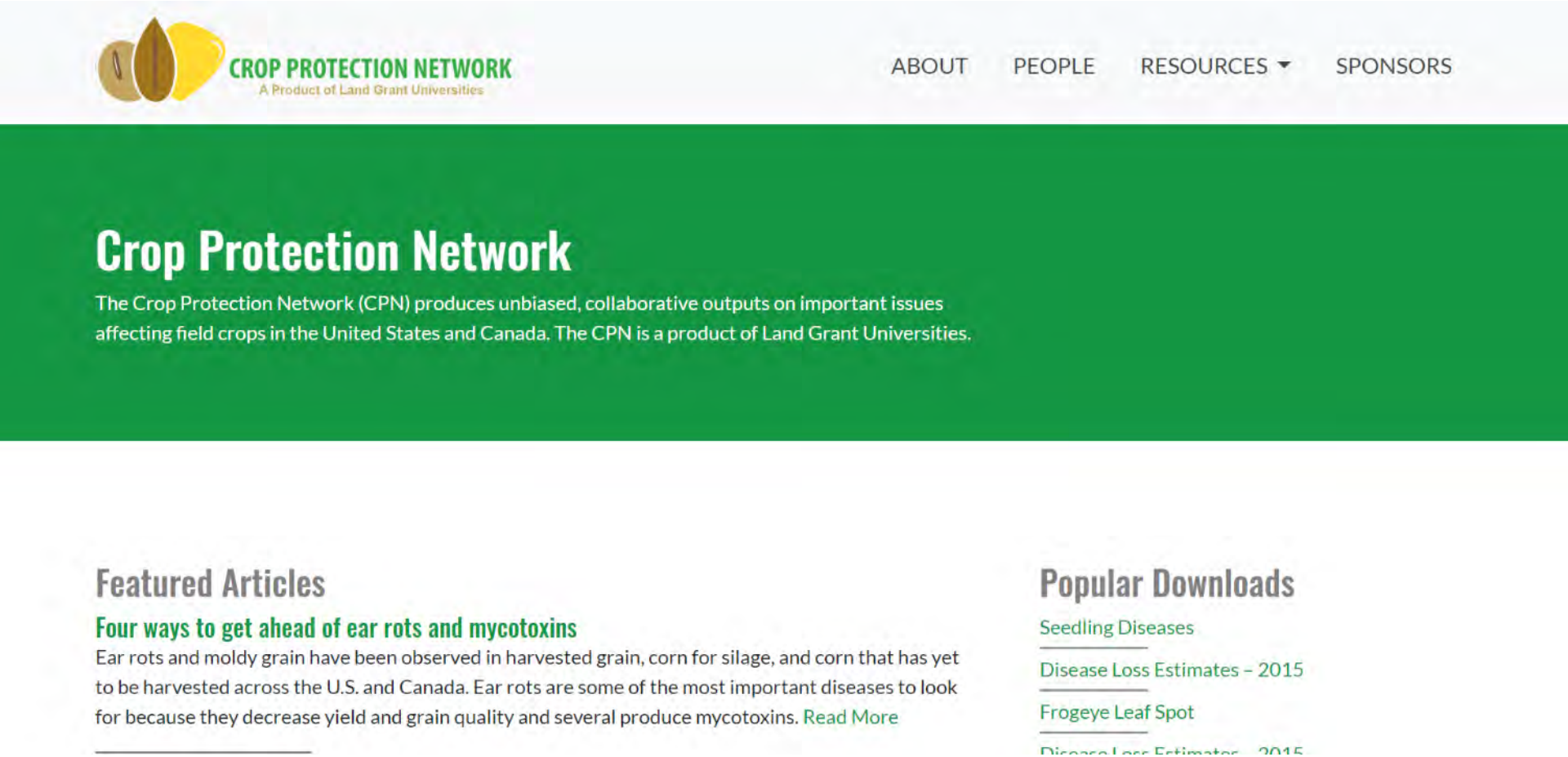
  - United Soybean Board
  - Kentucky Soybean Board
  - Illinois Soybean Association

- Appreciation also is given to many agrichemical companies and seed companies for providing fungicide products and soybean seed for the research trials

Crop Protection Network

cropprotectionnetwork.org



Frogeye leaf spot of soybean

- The most damaging foliar disease of soybean that regularly occurs in Kentucky, southern Illinois, and southern Indiana
  - Favorable conditions include, wet, warm, and humid weather

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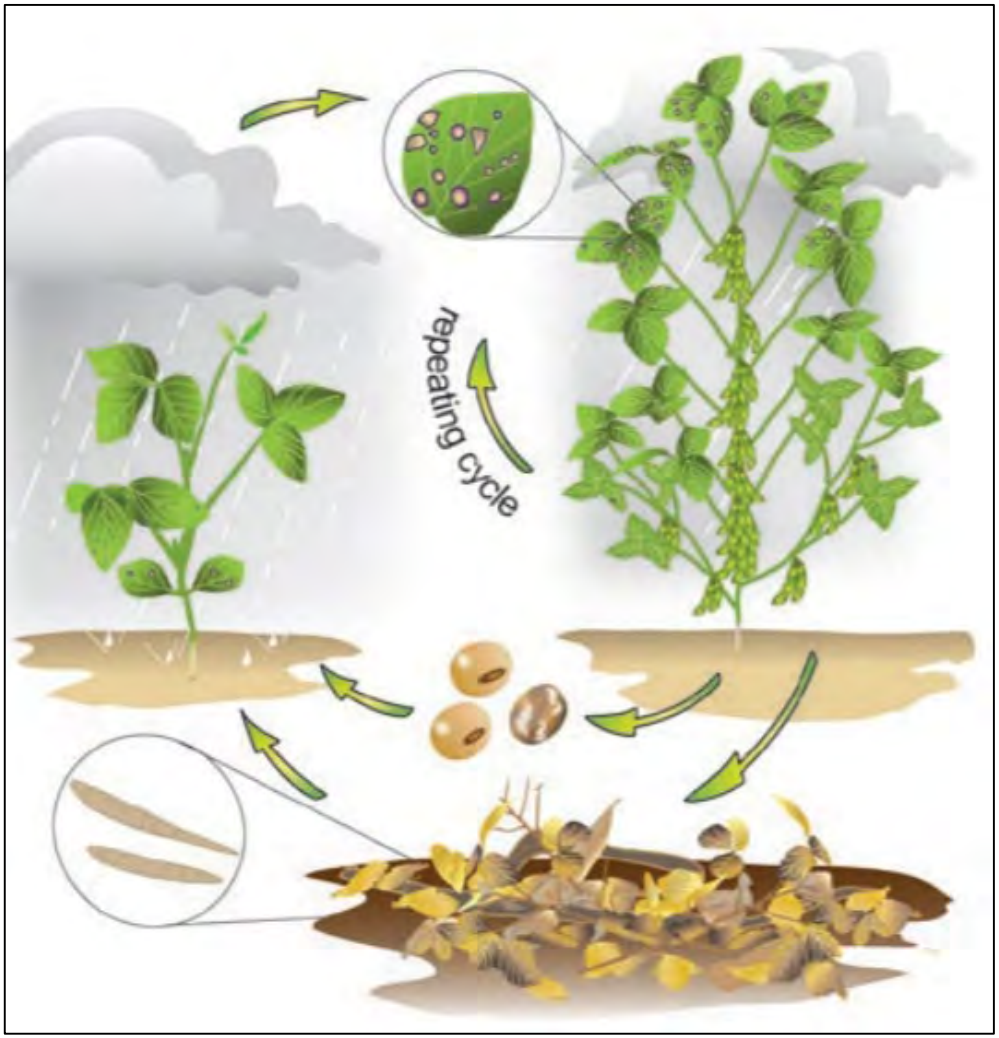
Frogeye leaf spot

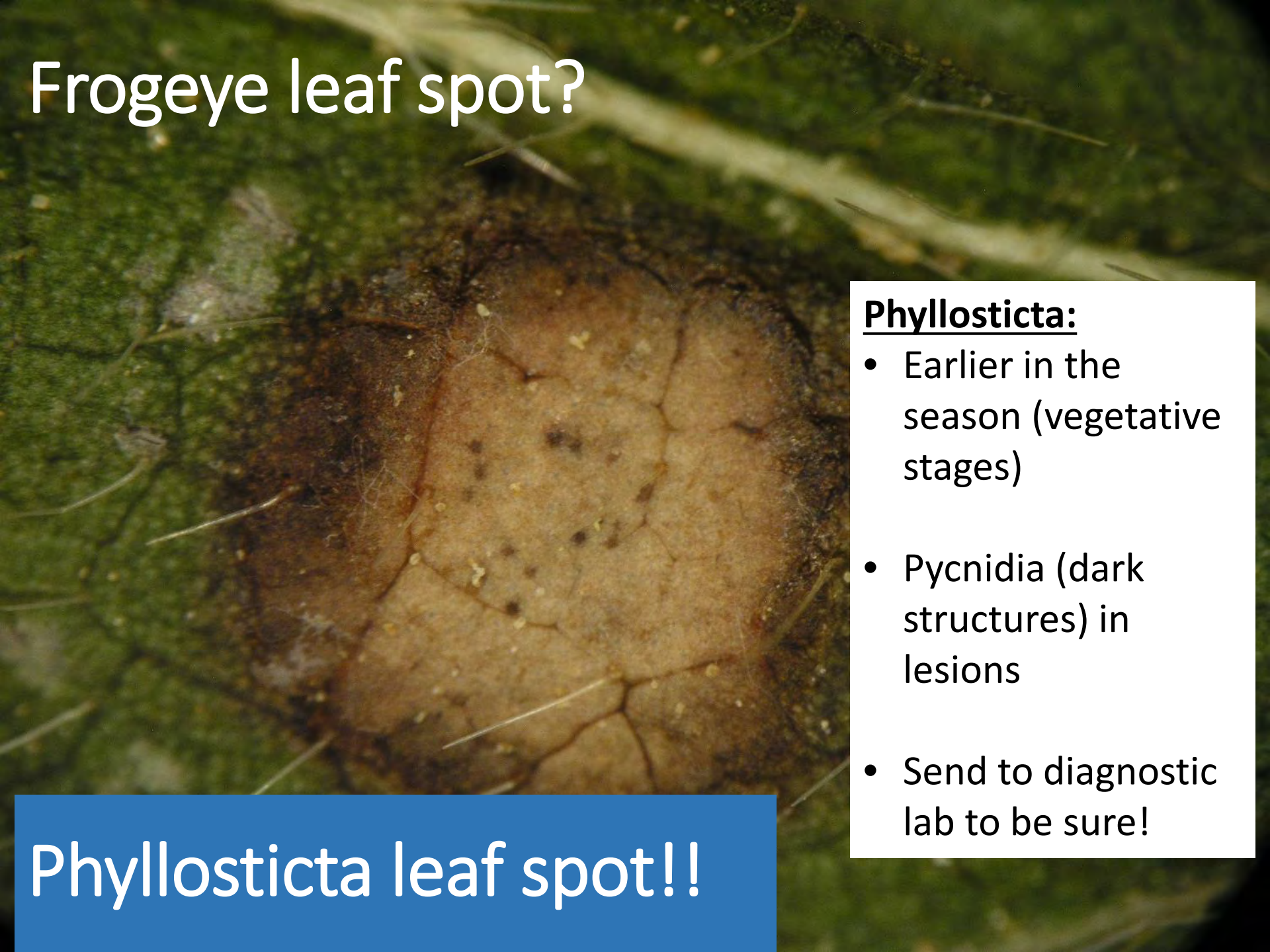
- Caused by the fungus *Cercospora sojina*
- Survives in soybean debris and seed
- Spores (conidia) are dispersed by wind and splashing rain
- Repeating cycle (polycyclic)
- Symptoms generally begin at R1 or later



Disease cycle picture from the Crop Protection Network (https://cropprotectionnetwork.org/)

“Sporulating” lesions

Frogeye leaf spot?



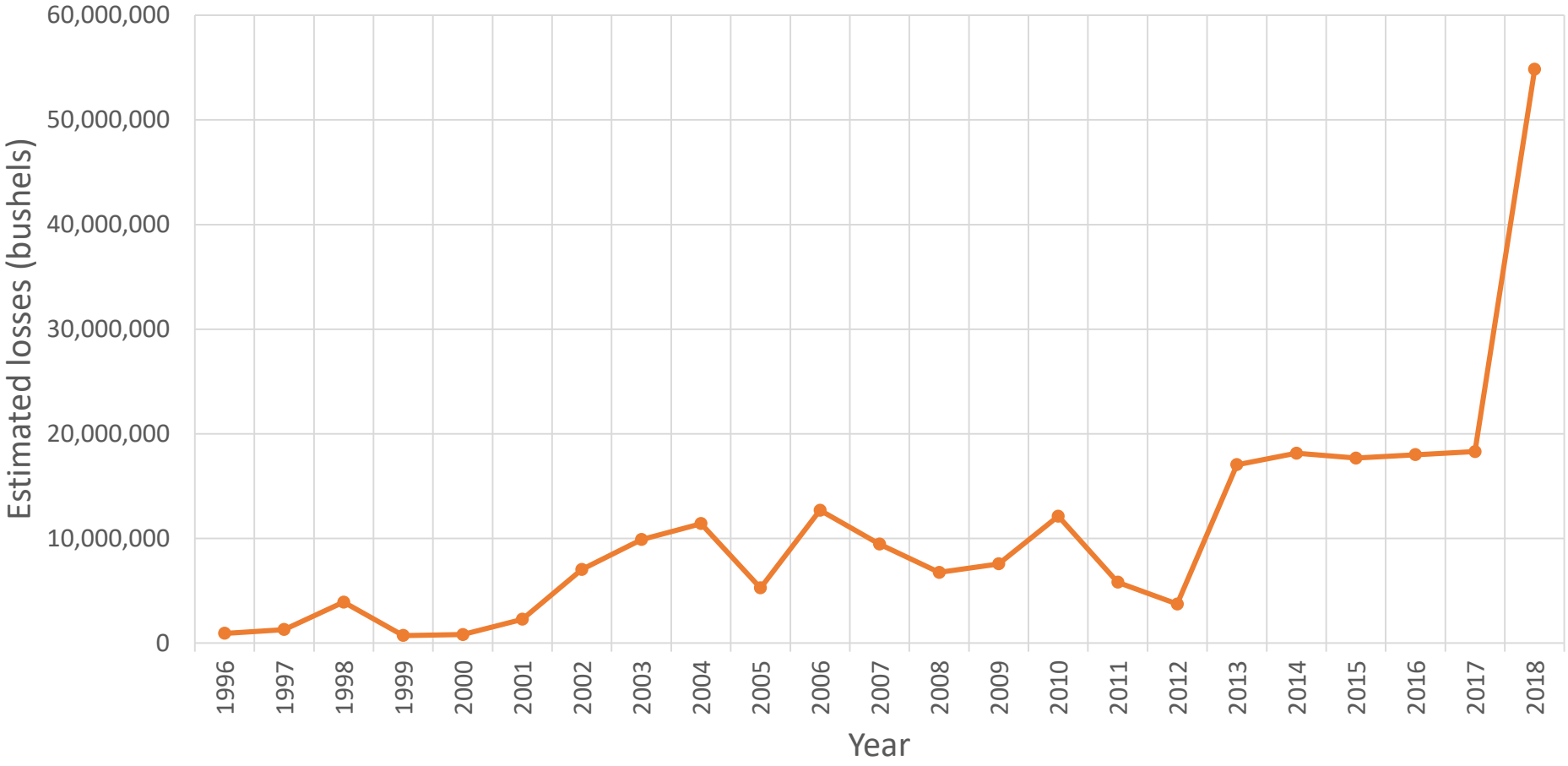
Phyllosticta:

- Earlier in the season (vegetative stages)
- Pycnidia (dark structures) in lesions
- Send to diagnostic lab to be sure!

Phyllosticta leaf spot!!

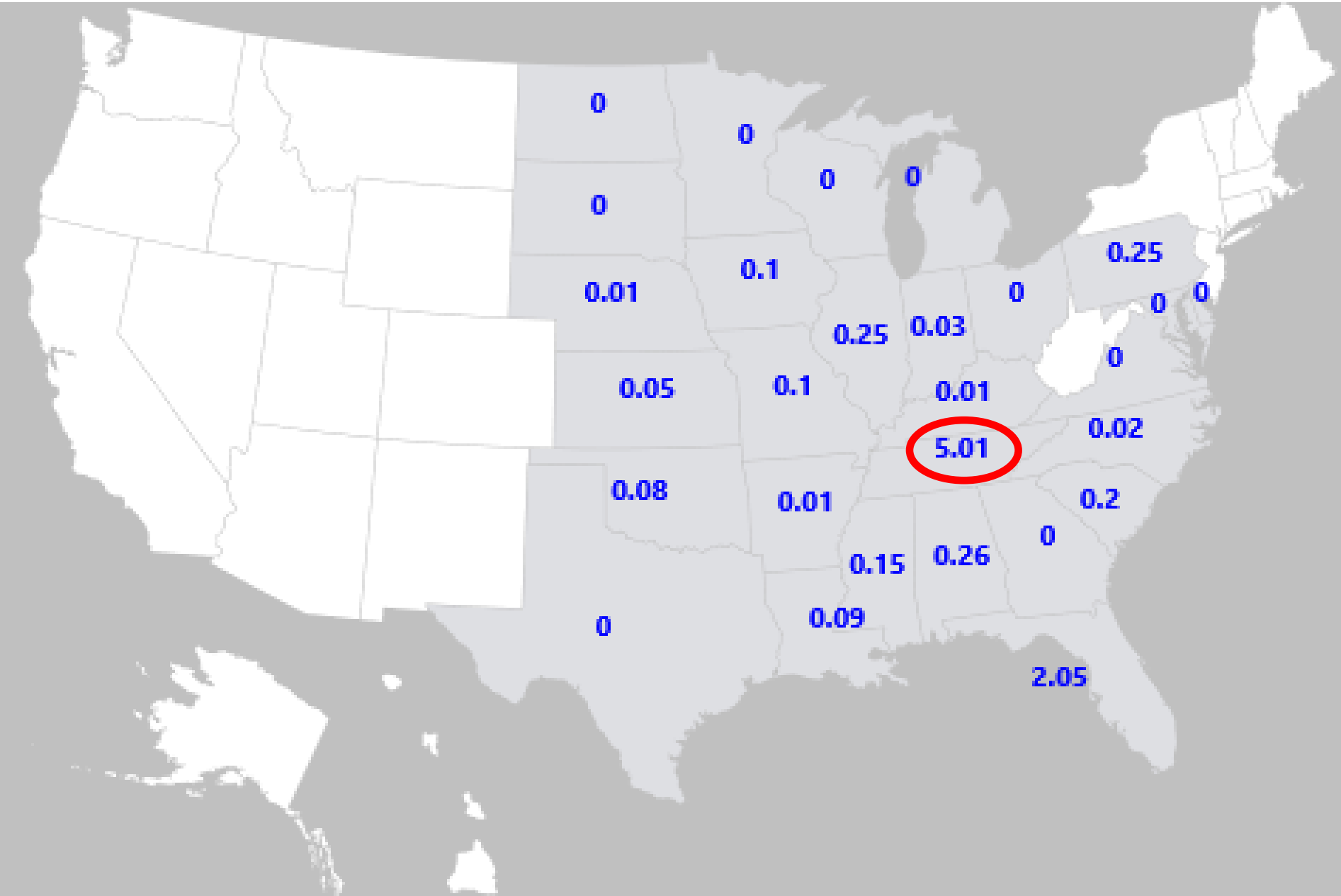
Phyllosticta – Not a concern!

Estimated yield losses due to frogeye leaf spot in the U.S. (1996-2018)

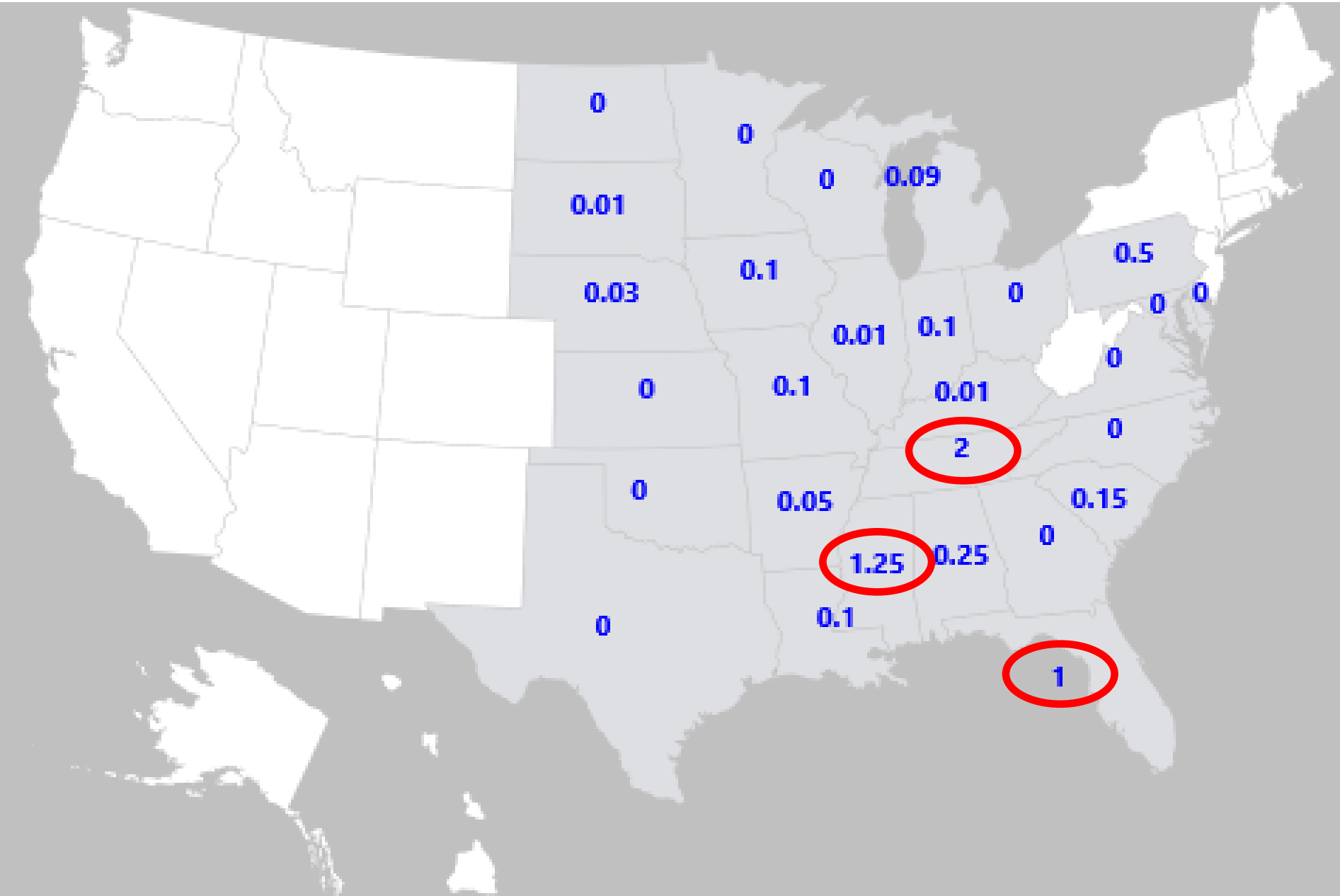


Soybean disease loss estimates available on-line at the Crop Protection Network (https://cropprotectionnetwork.org/)

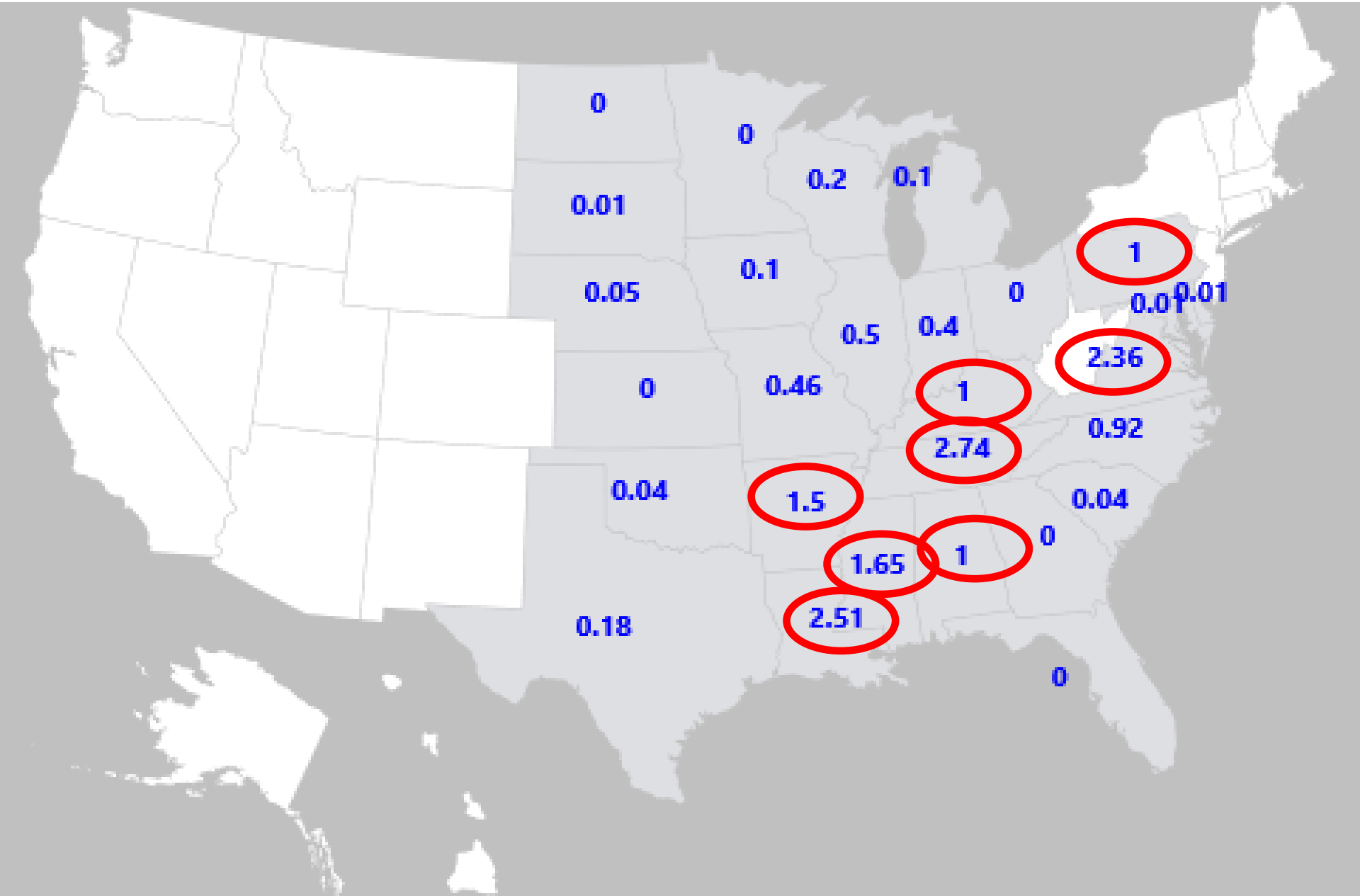
Yield loss estimates (%) to frogeye leaf spot - 2009



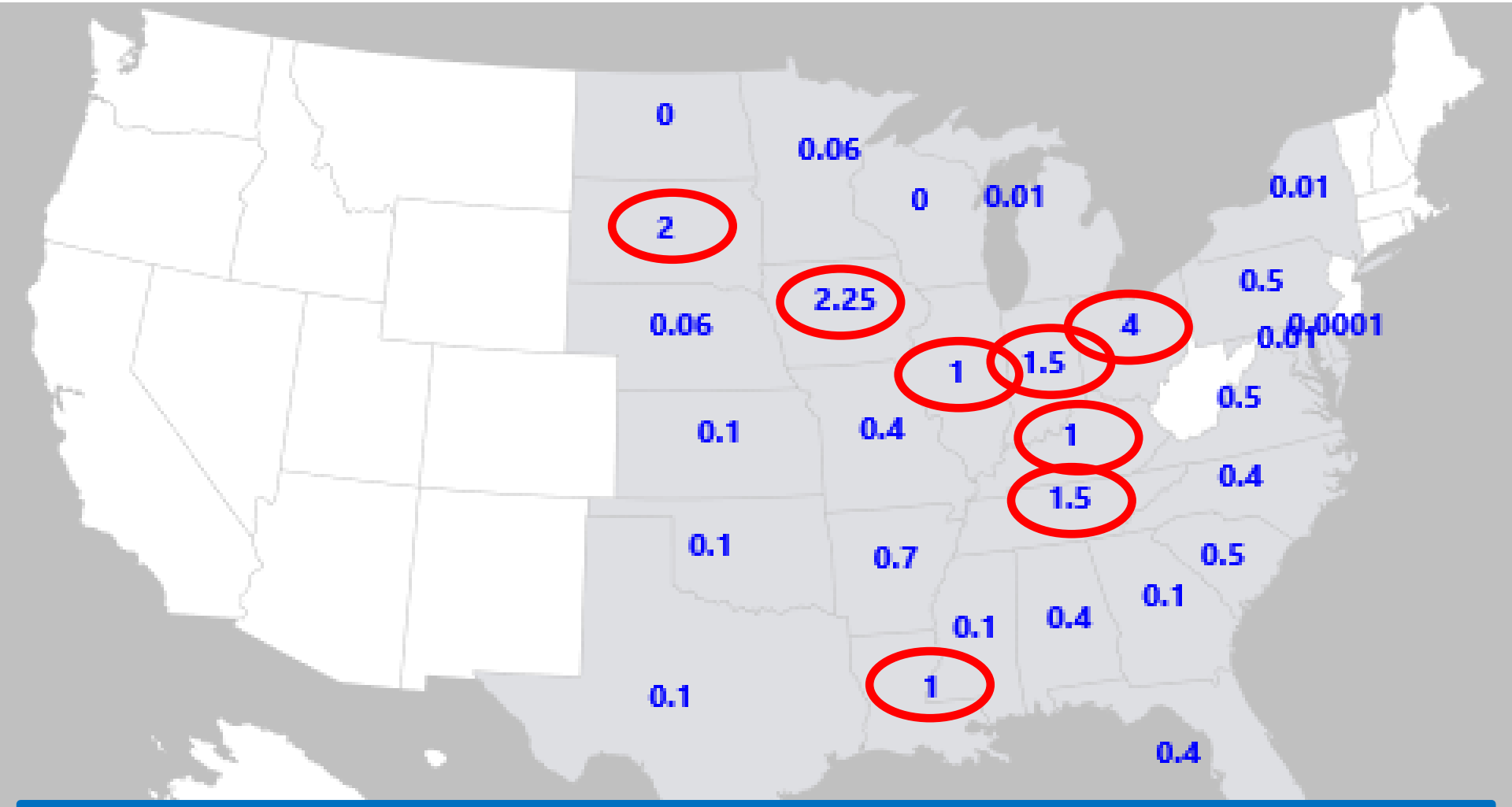
Yield loss estimates (%) to frogeye leaf spot - 2012



Yield loss estimates (%) to frogeye leaf spot - 2015



Yield loss estimates (%) to frogeye leaf spot - 2018



Is frogeye leaf spot now occurring frequently enough in northern areas to be considered a consistent threat?

Frogeye leaf spot management

- Crop rotation
- Resistant soybean varieties
- Foliar fungicides

Fungicide control of frogeye leaf spot

FUNGICIDE(S)				Aerial Web Blight	Anthrac-nose	Brown Spot[2]	Cercospora Leaf Blight[3]	Frogeye Leaf Spot[4]	Diaporthe (Pod and Stem Blight)
Class	Active Ingredient (%)	Trade Name	Rate/A fl. oz)						
QoI Strobilurins Group 11	azoxystrobin 22.9%	Quadris 2.08SC® multiple generics[1]	6.0-15.5	VG	VG	P-G	P	P	U
	fluoxastrobin 40.3%	Aftershock 480SC® Evito 480SC®	2.0-5.7	VG	G	P-G	P	P	U
	picoxystrobin	Aproach 2.08SC®	6.0-12.0	VG	G	P-G	P	P	U
	pyraclostrobin 23.6%	Headline 2.09EC/SC®	6.0-12.0	VG	VG	P-G	P	P	U
DMI Triazoles Group 3	cyproconazole 8.9%	Alto 100SL®	2.75-5.5	U	U	VG	F	F	U
	flutriafol 11.8%	Topguard 1.04SC®	7.0-14.0	U	VG	VG	P-G	VG	U
	propiconazole 41.8%	Tilt 3.6EC® multiple generics[1]	4.0-6.0	P	VG	G	NL	F	NL
	prothioconazole 41.0%	Proline 480SC®®	2.5-5.0	NL	NL	NL	NL	G-VG	NL
	tetraconazole 20.5%	Domark 230ME®	4.0-5.0	NL	VG	VG	P-G	G-VG	U
MBC Thiophanates Group 1	thiophanate-methyl	Topsin-M® multiple generics	10.0-20.0	U	U	U	F	VG	U
2,6-dinitro-anilines Group 29	fluazinam 40.0%	Omega 500DF®	0.75-1.0 pints	NL	NL	NL	NL	NL	NL
	boscalid 7.0%	Endura 0.7DF®	3.5-11.0	U	NL	VG	U	P	NL

ILLINOIS AGRINEWS

Science

www.agrinews-pubs.com

October 29, 2010 — F1

Soybean pathogen's resistance to fungicides confirmed

URBANA, Ill. — Research conducted by the University of Illinois and the University of Tennessee confirms that the fungus that causes frogeye leaf spot of soybean, Cercospora sojina, has shown resistance to strobilurin fungicides in a Tennessee soybean field.

"Strobilurin fungicides belong to the chemistry class known as the quinone outside inhibitors (QoIs), which are the most widely used group of foliar fungicides applied to field crops to manage plant diseases," said Carl Bradley, U of I Extension plant pathologist.

These fungicides can be sold as one-active ingredient products such as Headline (BASF Corp.) or Quadris (Syngenta Crop Protection) or in prod ucts that combine them with a fun cide in a different chemistry clas known as the demethylation inhibitors, sometimes referred to as triazoles, he said. Products that include a strobilurin-triazole combination of active ingredients include Quilt (Syngenta Crop Protection) and Stratego (Bayer CropScience).

Strobilurin fungicides have been deemed high risk for fungal pathogens developing resistance to them. This high-risk status has been determined by the Fungicide Resistance Action Committee, an international committee that evaluates fungicides' likelihood of developing resistance.

"Plant pathogenic fungi developing

Symptoms of frogeye leaf spot on soybean leaves are evident in this photo, courtesy of University of Illinois Extension plant pathologist Carl Bradley.

sure and the opportunity to select out individuals in the pathogen population that have resistance or reduced sensi-

bilurin fungicides but still continued to have high levels of FLS, which was an indication of potential fungicide resist-

strobilurin fungicides," he said. "Currently, Tennessee is the only state in which we have documented isolates like these, but we are continuing to perform tests on isolates collected from fields in Illinois and other states."

Research at the U of I will continue into the 2011 season with funding from the Illinois Soybean Association.

In the meantime, Bradley reminded growers that FLS can be controlled with other management tactics such as planting soybean varieties that have high levels of resistance to FLS or using effective triazole fungicides.

"Dr. Newman's work has shown that some triazole fungicides provide good control of FLS and can be used alone or tank-mixed with strobilurin fungicides if the grower is concerned with more than just FLS," he said.

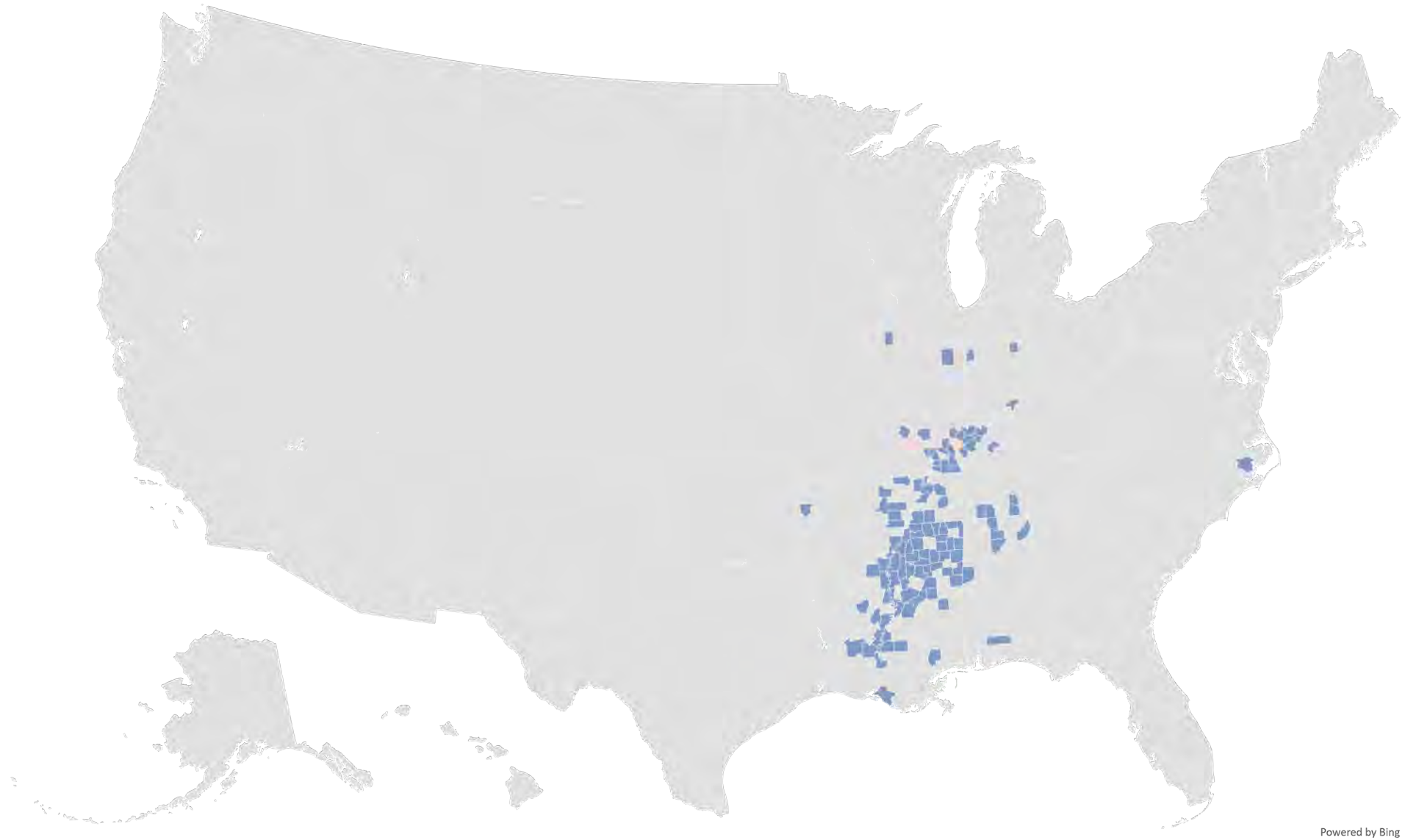
The most effective manner to slow the spread of resistant isolates is to only use a fungicide when needed.

"If we overuse fungicide products, we won't be able to use them for very long because we will select out resistant populations," Bradley said.

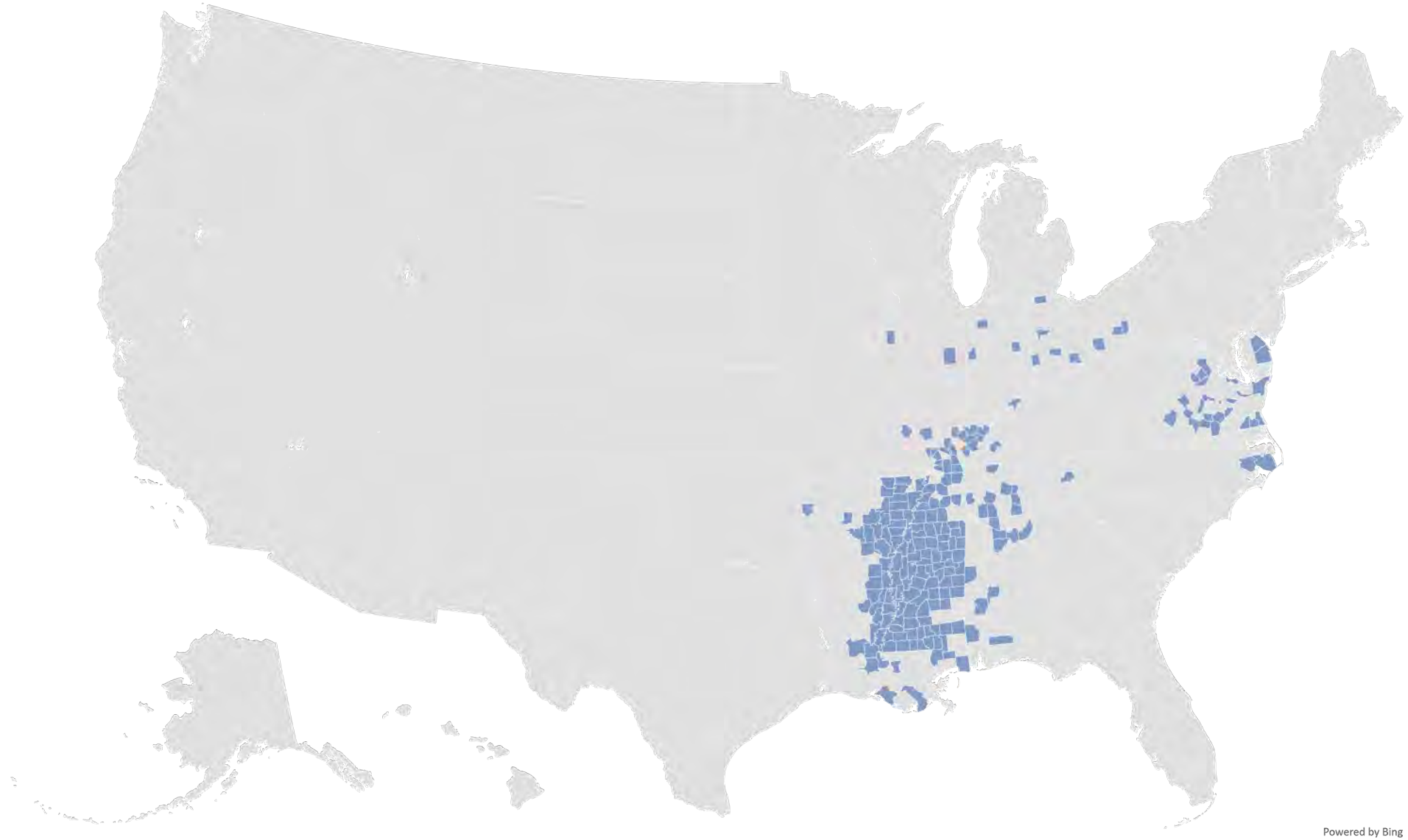
"There's a lot of marketing to use fungicides for yield increases, but little talk about where those increases come from. They come from protection of yield from diseases. In some cases they pay off because conditions have been favorable for diseases. But in years

Confirmed counties with QoI-resistant *C. sojina* (2010)

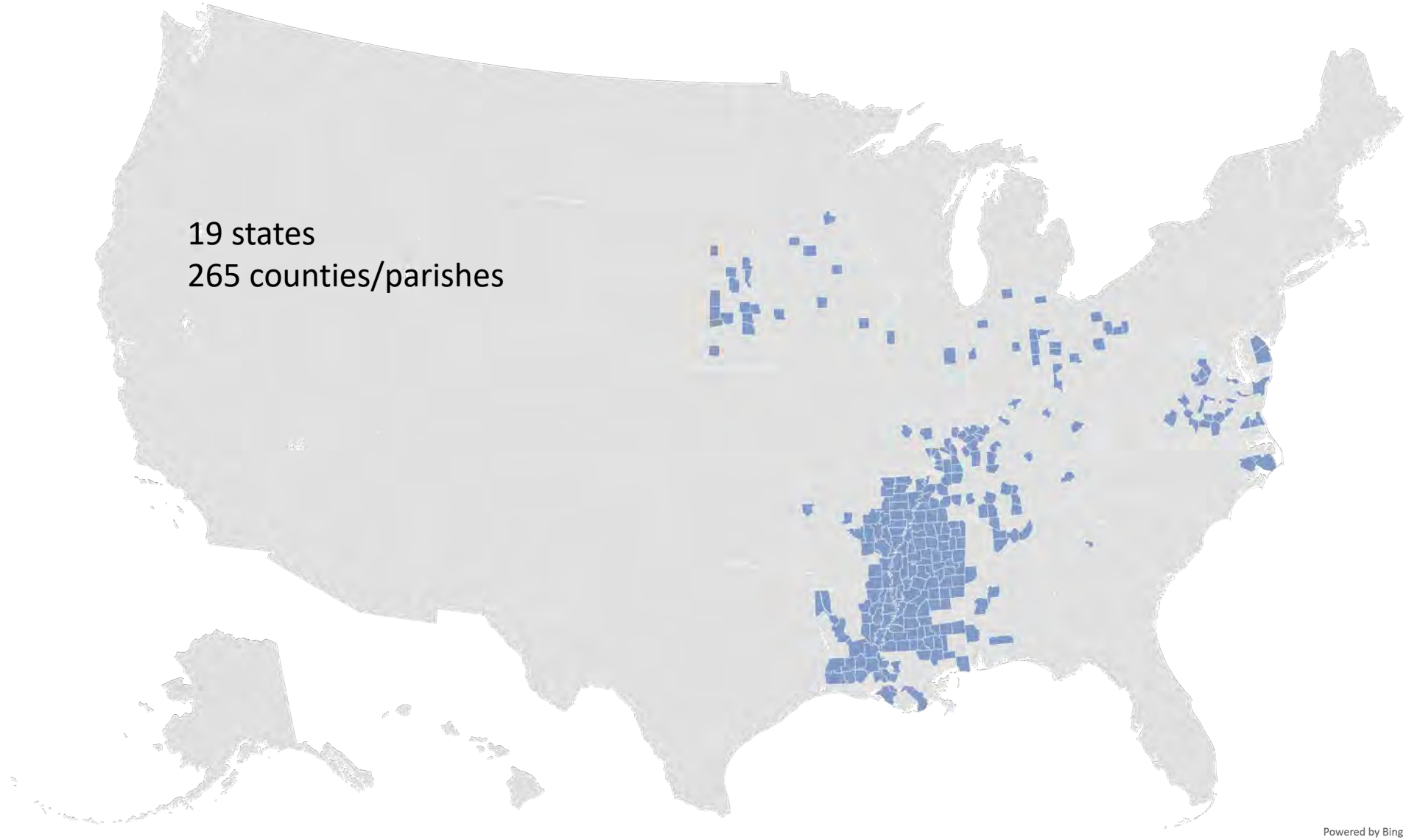
Confirmed counties with QoI-resistant *C. sojina* (2010-2013)



Confirmed counties with QoI-resistant *C. sojina* (2010-2016)

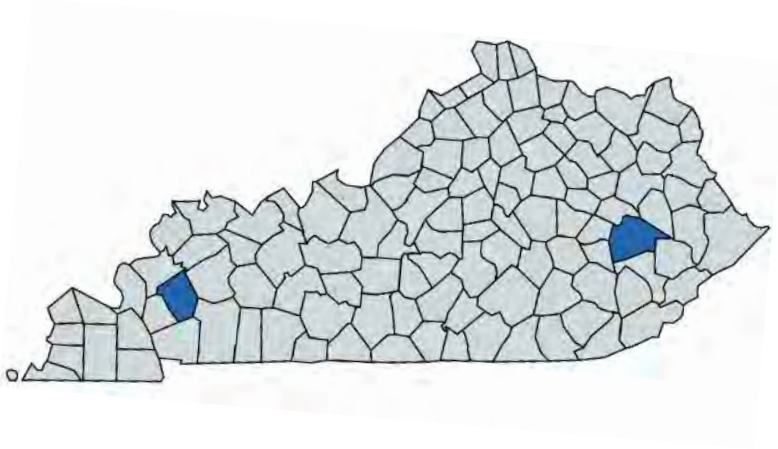


Confirmed counties with QoI-resistant *C. sojina* (2010-2019)

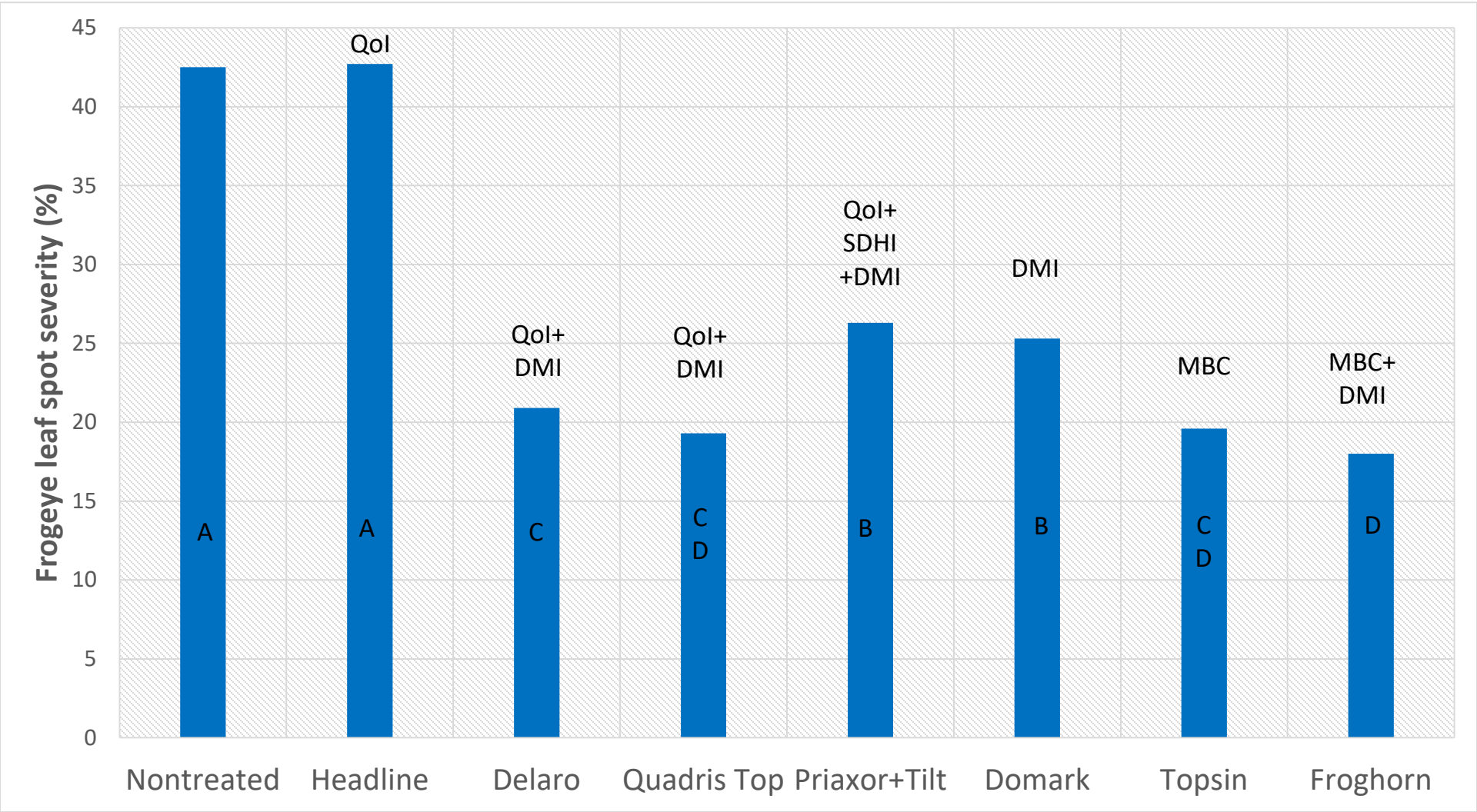


University of Kentucky foliar fungicide trials – 2016-2019

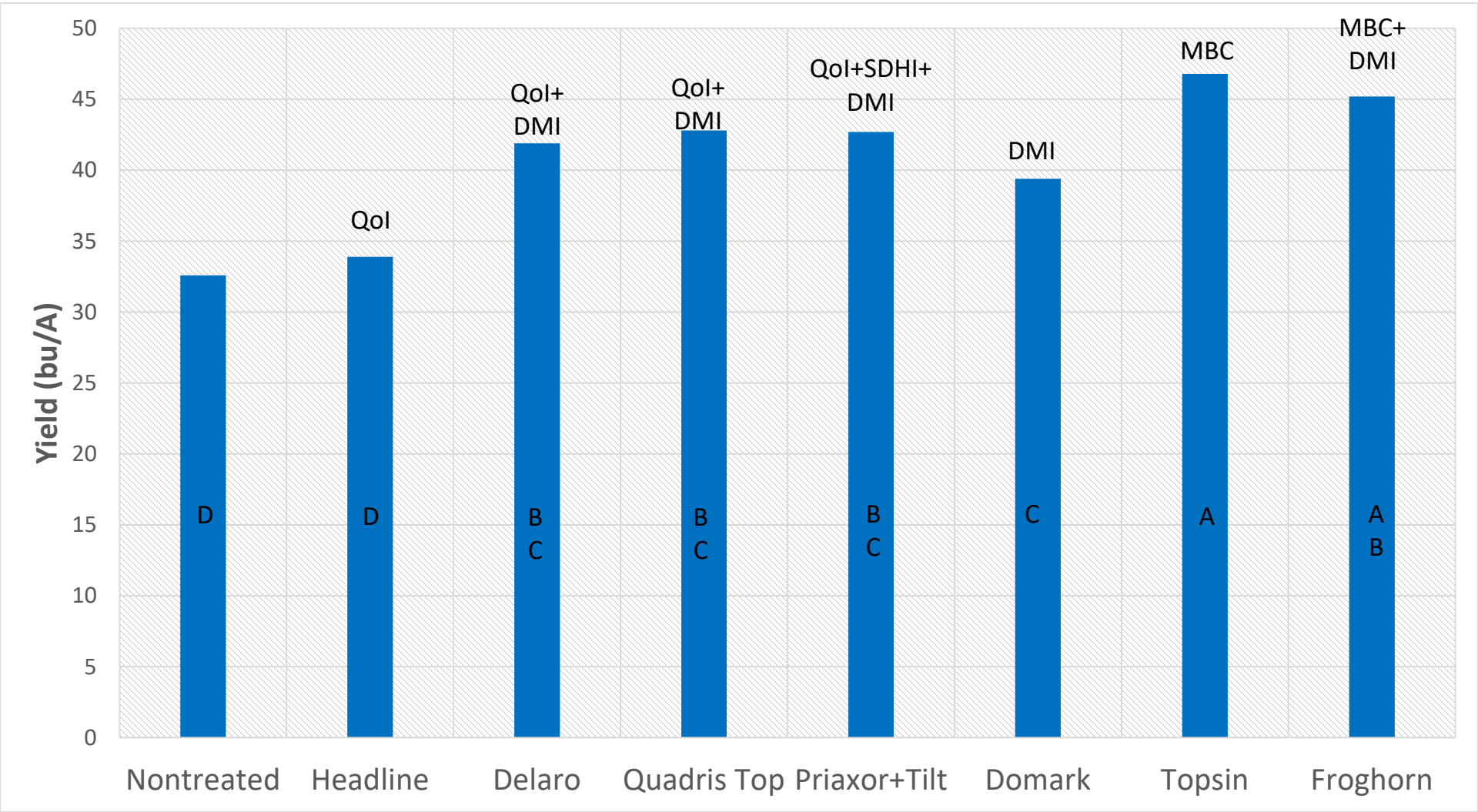
- Two locations (Breathitt and Caldwell Counties)
- Frogeye leaf spot – susceptible cultivar
- Soybean-on-soybean
- No-till planted
- Fungicides applied at R3 developmental stage



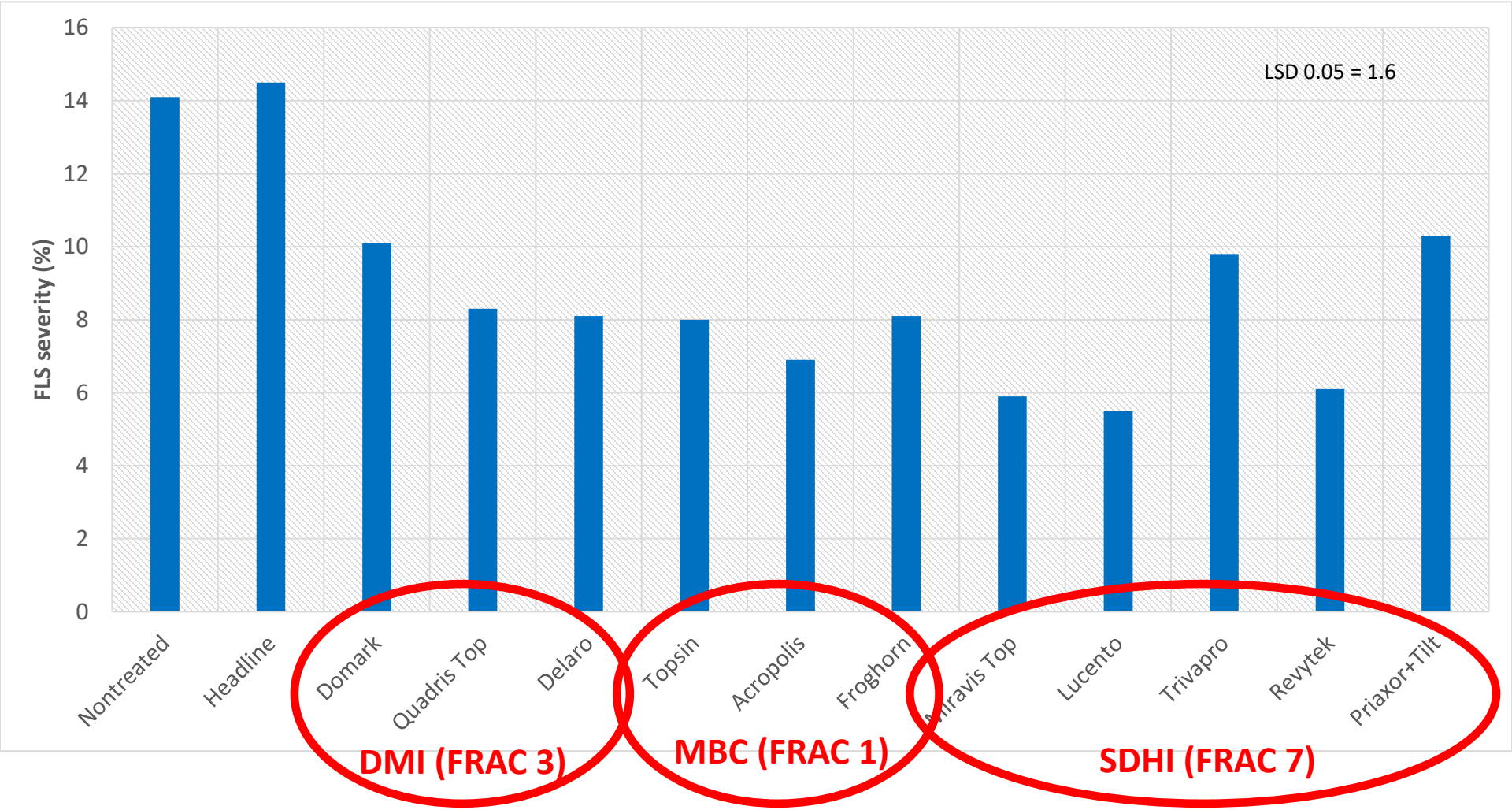
2016-18 University of Kentucky fungicide trials – FROGEYE LEAF SPOT SEVERITY



2016-18 University of Kentucky fungicide trials - YIELD



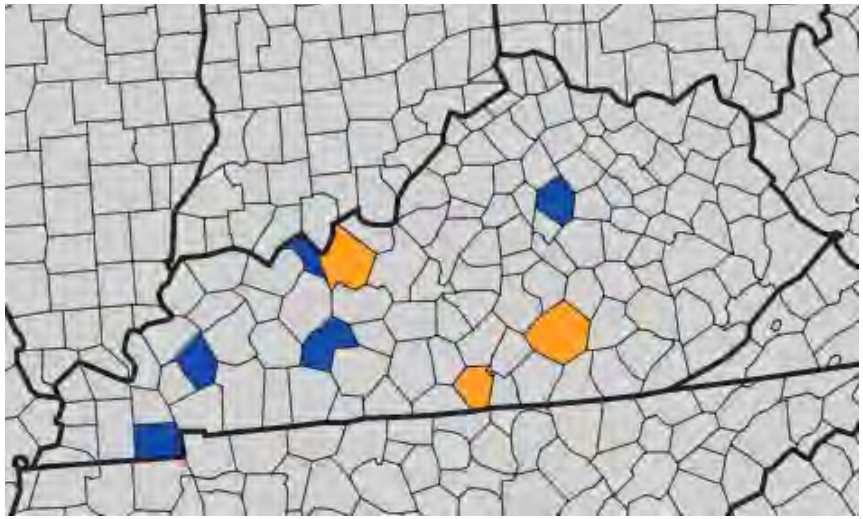
2019 Results – Frogeye leaf spot severity (2 locations)



Soybean Variety X Fungicide Trial

- *Funded by the Kentucky Soybean Board*

- Locations managed by Univ. KY Soybean Performance Variety Trials Coordinator – (Dr. Claire Venard)



  - 2016 & 2017 = Blue counties
  - 2017 only = Orange counties

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Soybean Variety X Fungicide Trial

- Three varieties:
  - Susceptible, moderately-resistant, and resistant to frogeye leaf spot
- Three fungicide treatments:
  - Non-treated
  - Headline (solo strobilurin product)
  - Quadris Top (strobilurin + triazole product)

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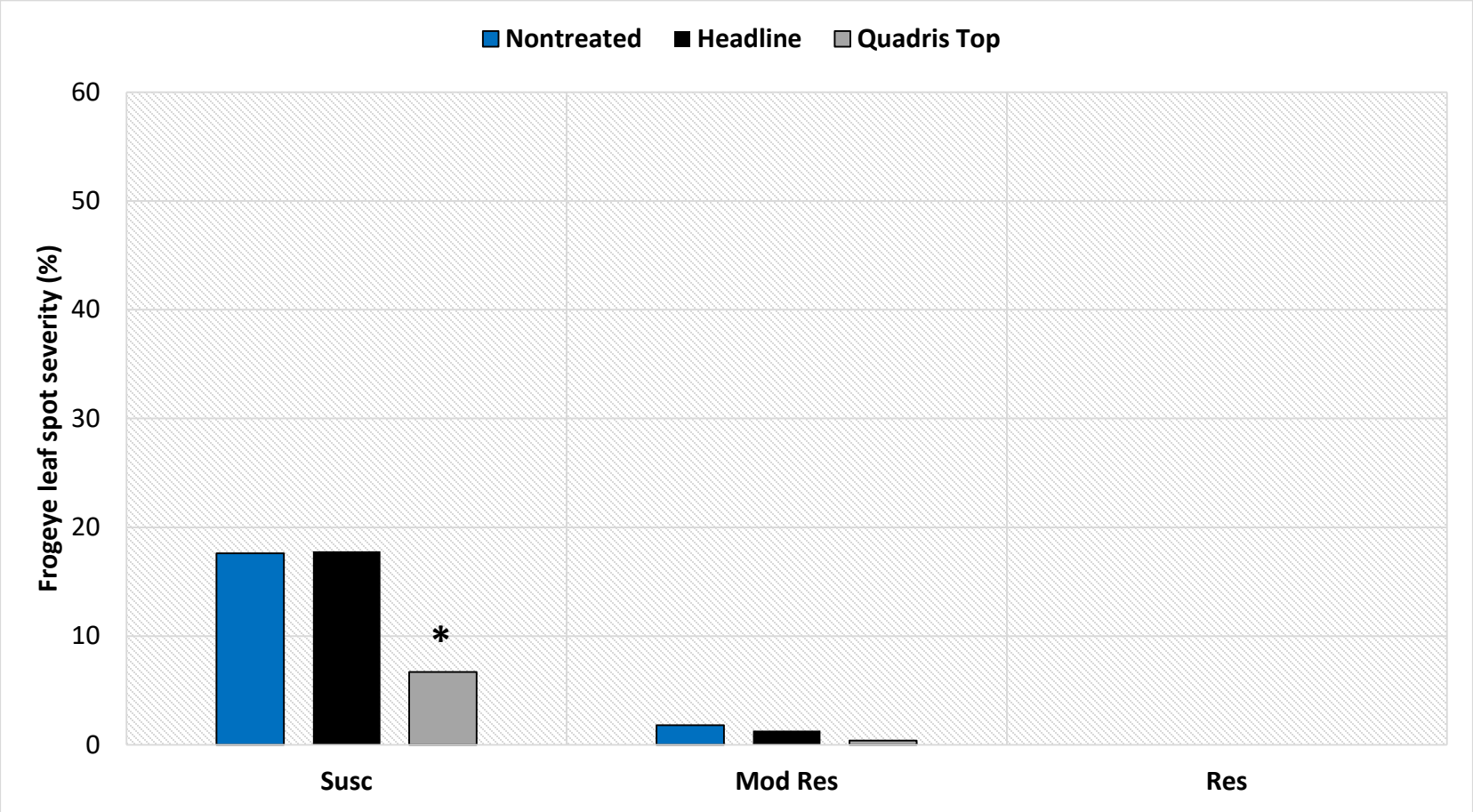
Frogeye leaf spot severity across all locations – 2016 and 2017 combined



Funded by the Kentucky Soybean Board

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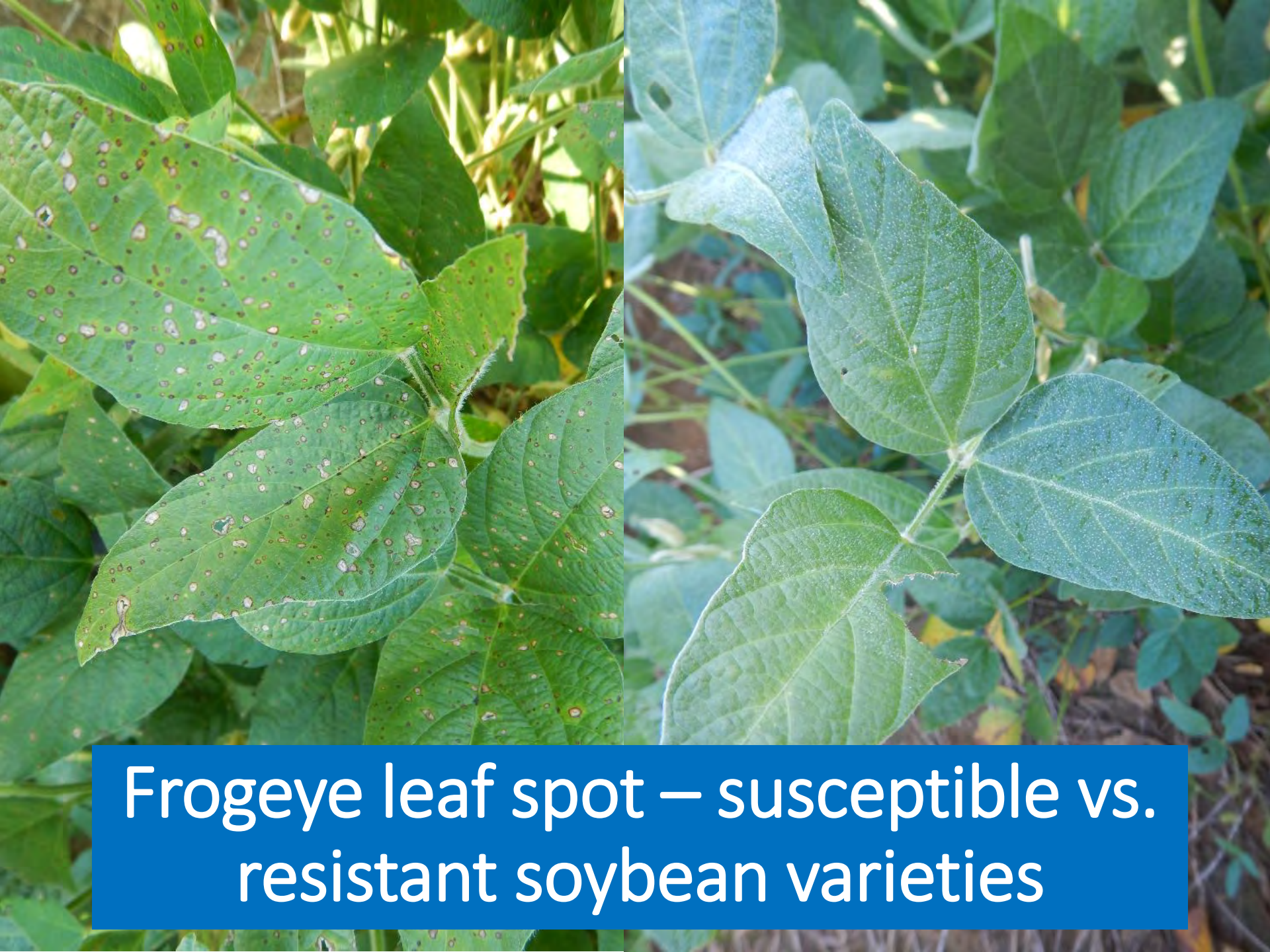
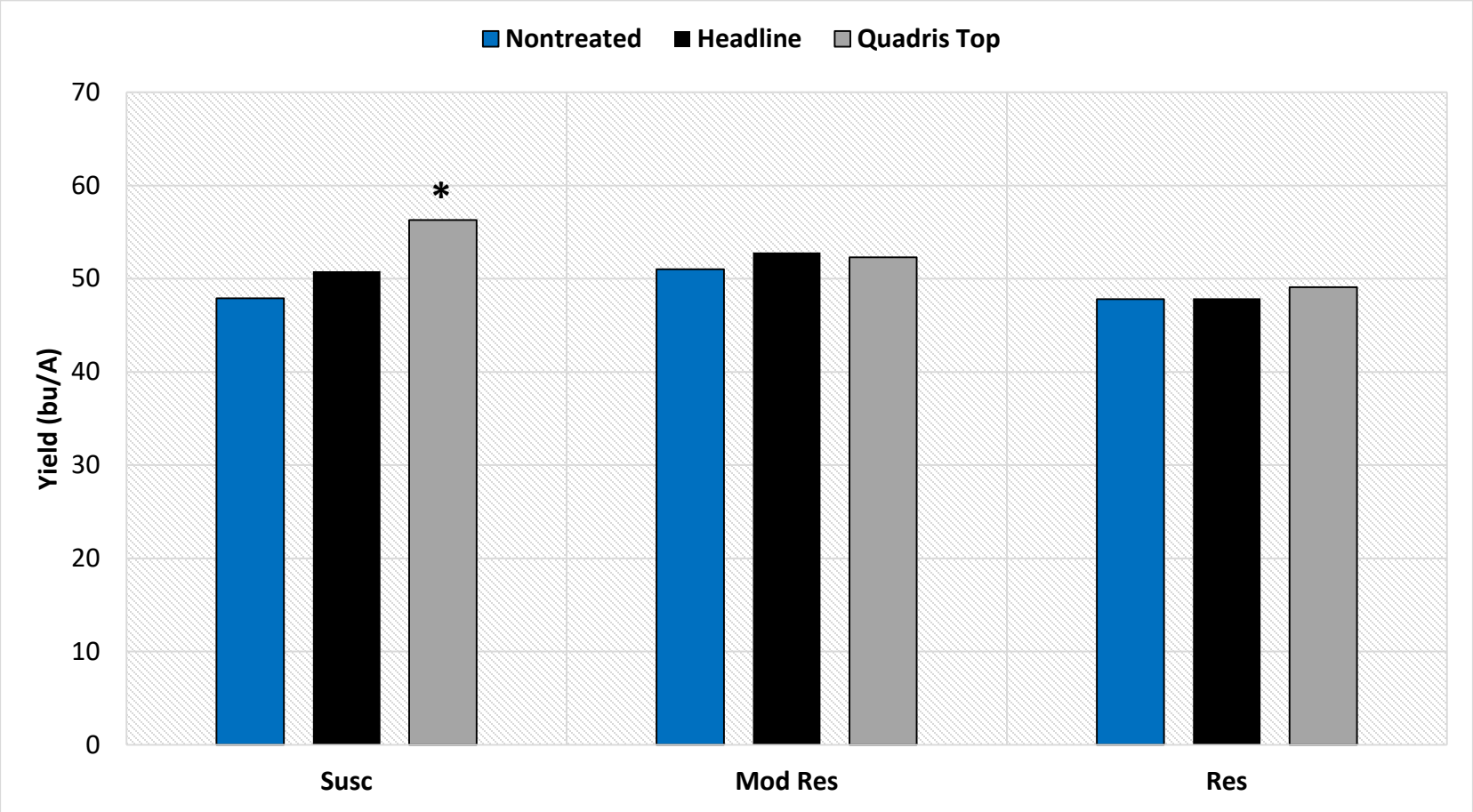


Frogeye leaf spot – susceptible vs. resistant soybean varieties

Yield across all locations – 2016 and 2017 combined



Funded by the Kentucky Soybean Board

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Summary

- The solo strobilurin product did not significantly reduce frogeye leaf spot compared to the nontreated control
  - Due to fungicide resistance

- In general, the largest yield response to fungicides occurred on frogeye leaf spot-susceptible varieties

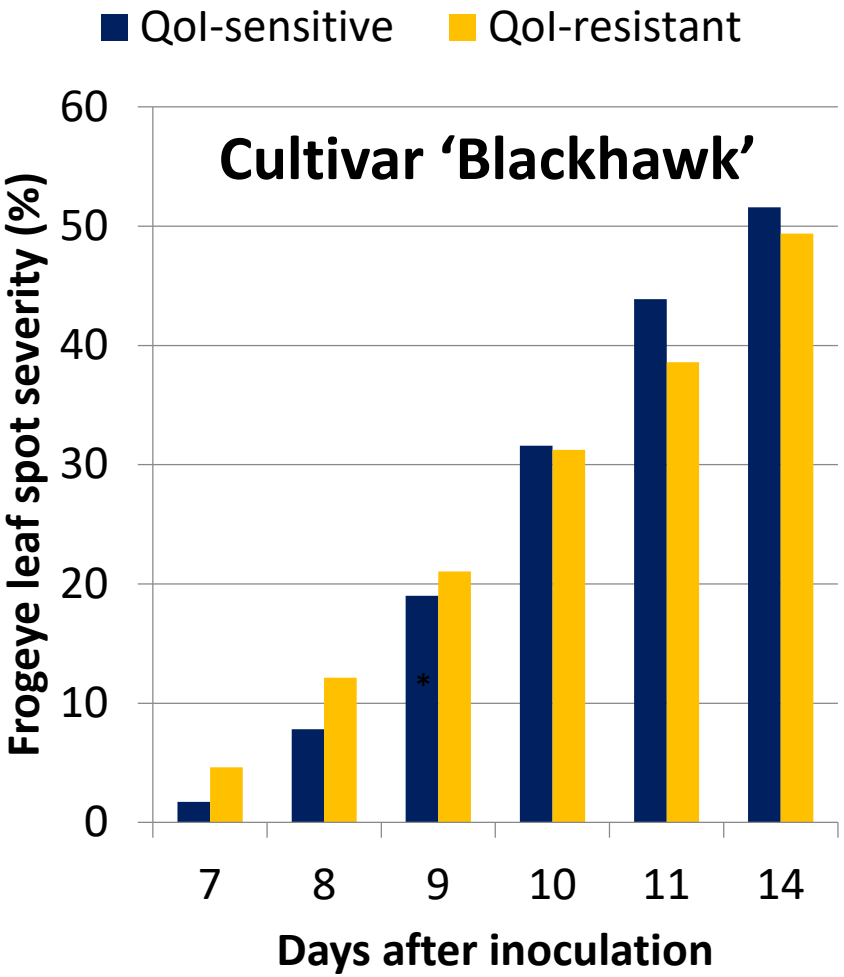
Comparisons of isolate aggressiveness

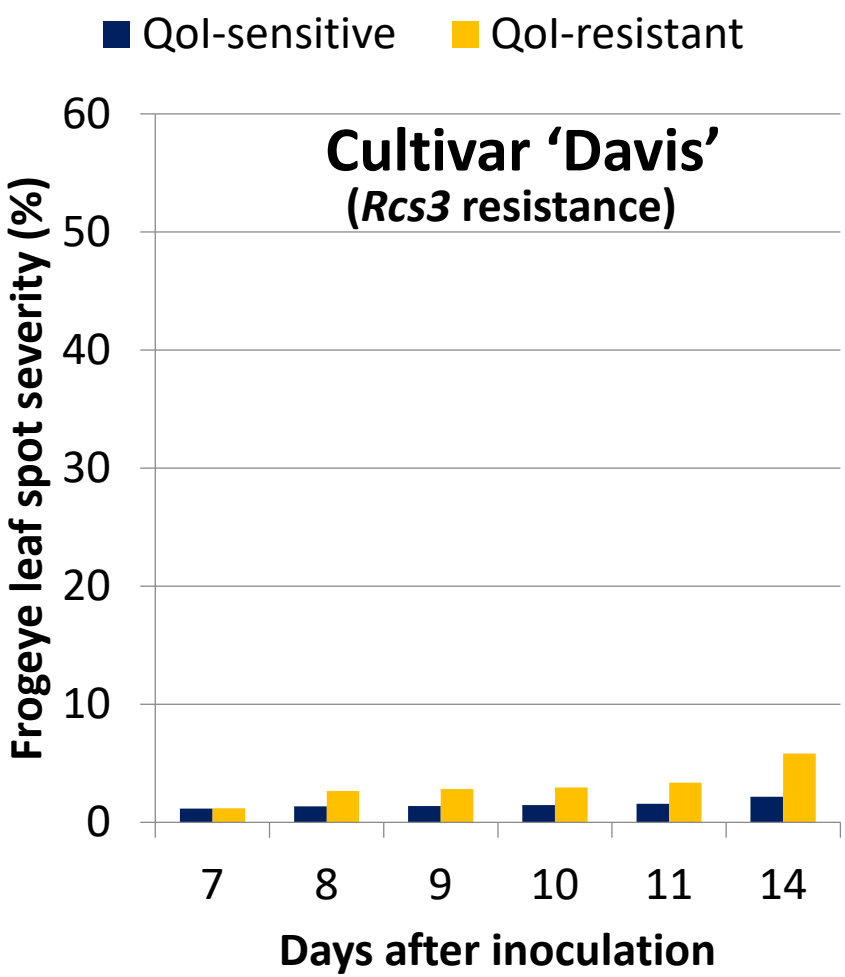
- *C. sojina* isolates
  - 5 isolates – sensitive to QoIs
  - 5 isolates – resistant to QoIs

- Cultivars
  - 'Davis' – *Rcs3* resistance
  - 'Blackhawk' – susceptible

- Disease severity evaluated daily from 7 to 14 days after inoculation

Resistant cultivars still effective





Zhang & Bradley (2017) Crop Protection 94:59-63

Summary - Aggressiveness

- QoI resistant isolates still controlled by *Rcs3* (Davis)
- QoI-resistant isolates appear to be able to cause symptoms slightly sooner than QoI-sensitive isolates on both 'Blackhawk' and 'Davis', but severity levels were similar on 'Blackhawk' at the end of the experiment
- Races of *C. sojina* have occurred that have rendered other sources of resistance useless, so the development of races that are virulent on *Rcs3* is a potential threat

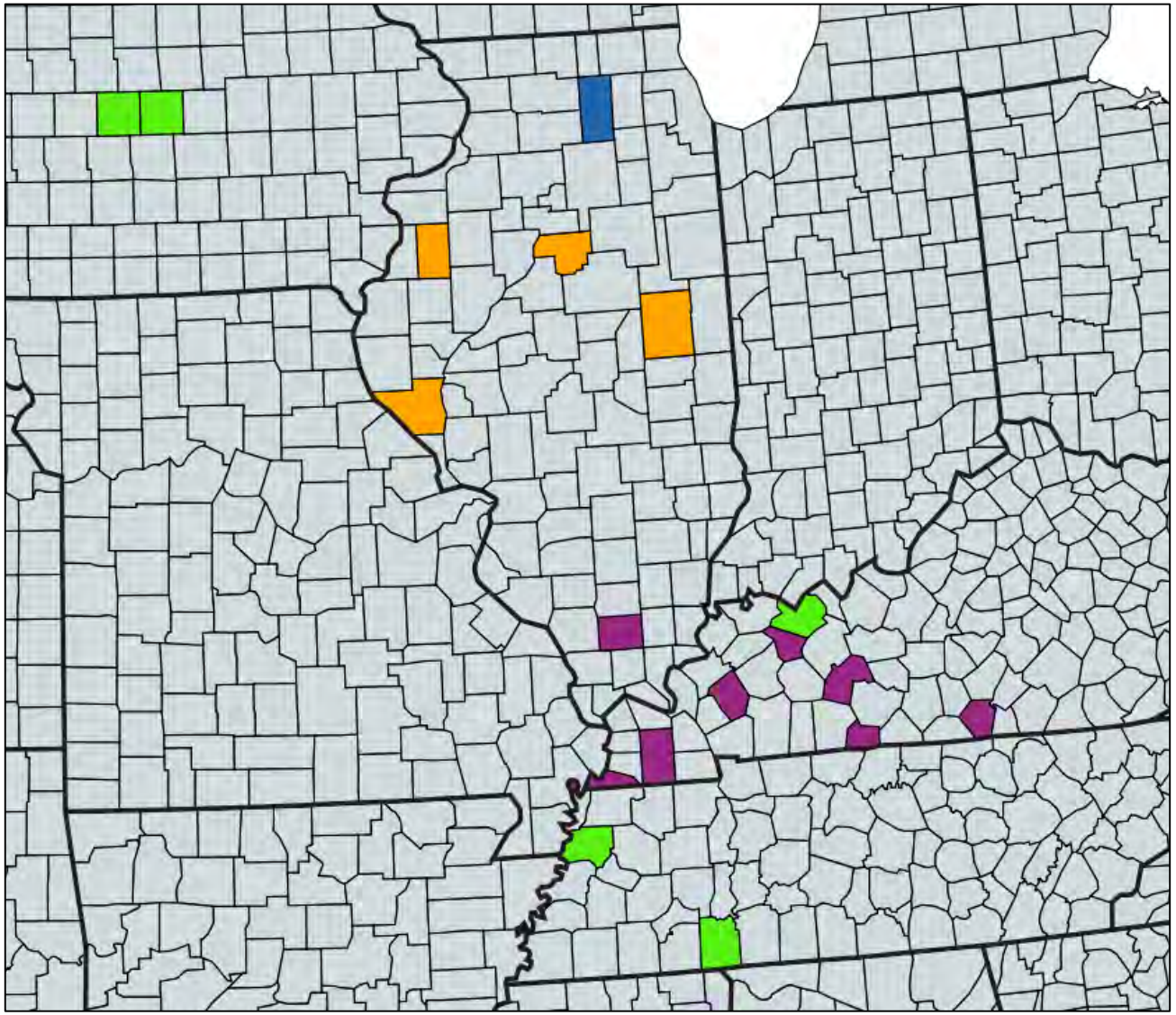
Frogeye leaf spot management summary

- Resistance to QoI (strobilurin; FRAC 11) fungicides is widespread
  - Must use a product that contains efficacious active ingredients from other classes (DMI, MBC, SDHI)
  - Resistance to these other classes is possible, so important to use products with 2 effective fungicide classes
- Host resistance (varieties) is still working
  - Fungicide may not be needed on highly resistant varieties, but the threat of new races that can overcome host resistance is present

Other potentially threatening foliar diseases of soybean

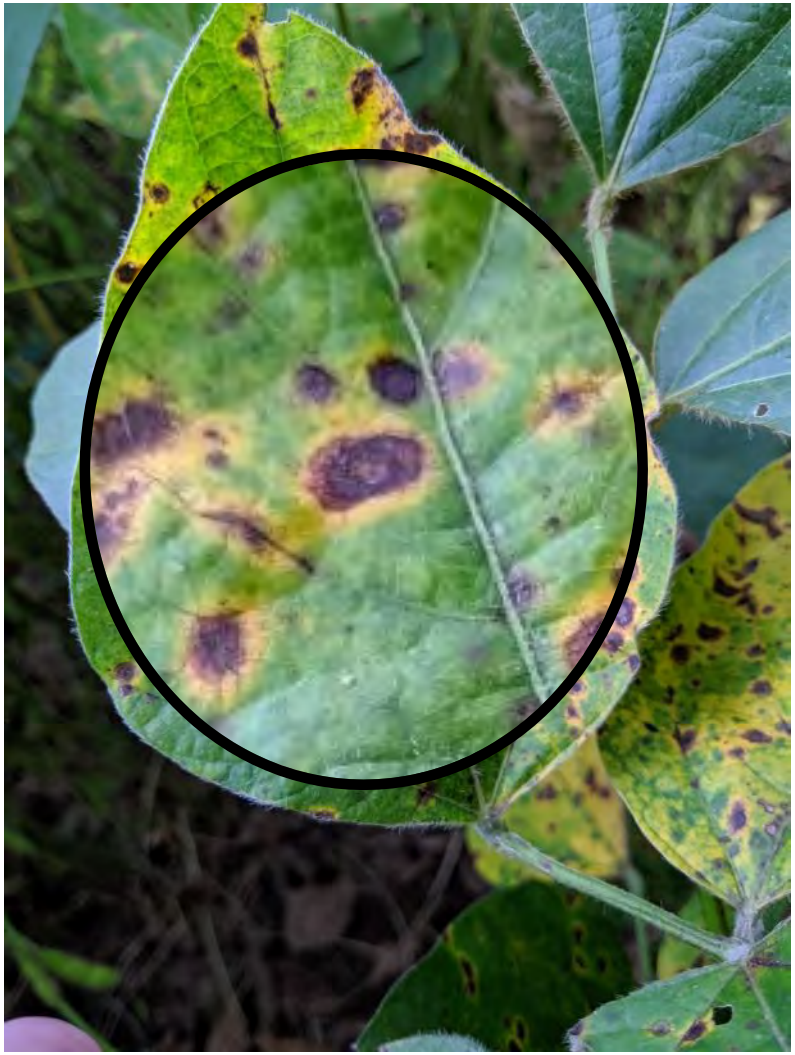
Septoria brown spot (*Septoria glycines*)

Septoria glycines (**brown spot**) resistance to strobilurin fungicides – 2013 to 2018



Funded by the United Soybean Board

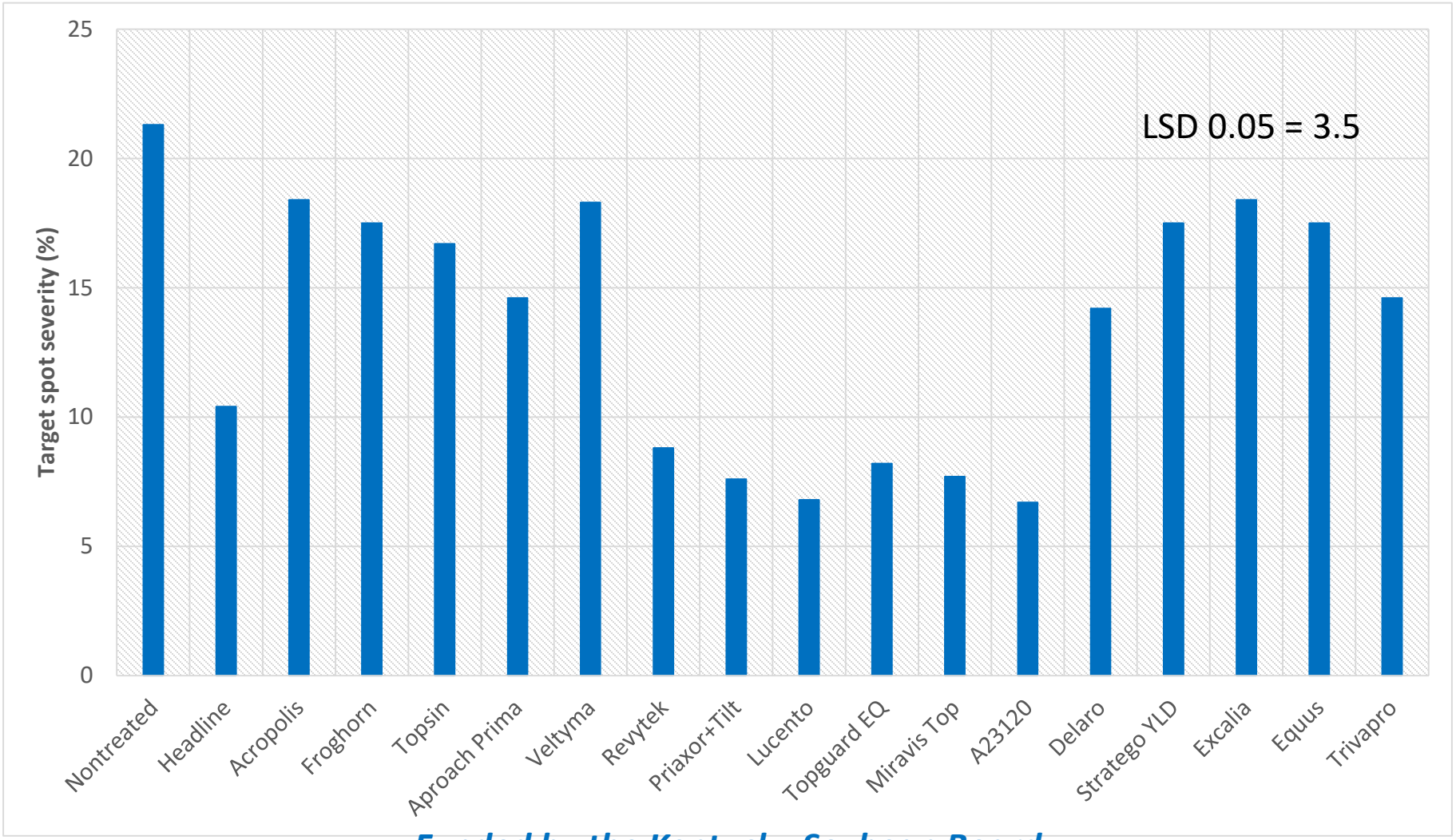
Target spot (*Corynespora cassiicola*)



Target spot

- Strobilurin fungicide-resistant isolates recently reported in Alabama, and preliminarily identified in Arkansas
  - We have not yet found strobilurin-resistant isolates in KY, but they are likely present
- Big differences in susceptibility among varieties occur

Effect of foliar fungicides on target spot severity on soybean , Princeton, KY 2019



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Thanks for your attention!