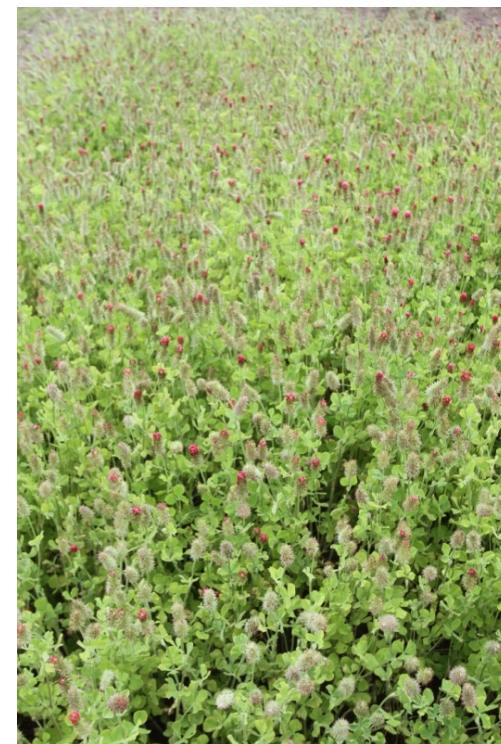


# Cover Crop and Herbicide Interactions

**Kevin Bradley**  
**University of Missouri**





A photograph of a field with cover crops, likely radishes, growing in sandy soil. The plants are green but show signs of stress, with some leaves turning yellow and having irregular holes. Dried, broken plant matter from a previous crop is scattered on the ground. A white text box with a black border is centered over the image.

# **The Effects of Herbicide Carryover on Cover Crops**



# Influence of Soybean Herbicide Treatments on Fall Cover Crop Stand/Biomass (2013-2015)

■ No reduction in any year

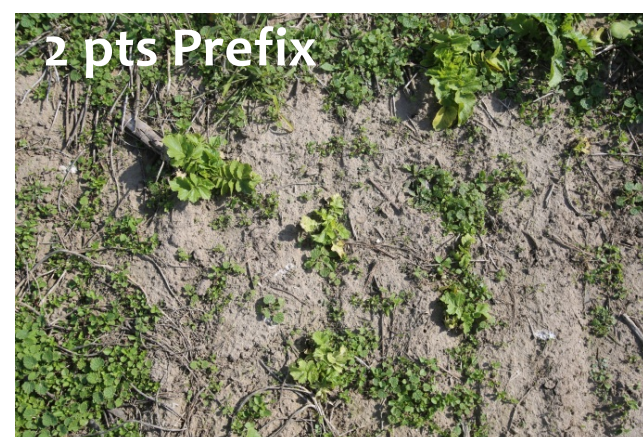
■ Reduction in 1 of 3 years

■ Reduction in  $\geq 2$  of 3 years

Herbicide Treatment	Rate	Cover Crop Species							
		Winter Wheat	Tillage Radish	Cereal Rye	Crimson Clover	Winter Oat	Austrian Pea	Annual Ryegrass	Hairy Vetch
		-----% Stand/Biomass Reduction, 28 days after emergence-----							
Spartan	8 fl ozs								
Valor	2.5 ozs								
Sencor	0.5 lb								
Authority First	6.4 ozs								
Classic	1.5 ozs								
Flexstar	20 fl ozs								
Cobra	12.5 fl ozs								
Pursuit	4 fl ozs								
Firstrate	0.6 oz								
Synchrony XP	0.375 oz								
Dual II Magnum	1.33 pts								
Warrant	1.5 qts								
Zidua	3 ozs								
Prefix	2 pts								



# Carryover of POST Soybean Treatments to Tillage Radish





# Carryover of POST Soybean Treatments to Cereal Rye

Non-treated



20 ozs Flexstar



12.5 ozs Cobra



4 ozs Pursuit



0.6 oz Firstrate



0.375 oz Synchrony XP



1.5 qts Warrant



3 ozs Zidua



2 pts Prefix





# Non-treated, Annual Ryegrass

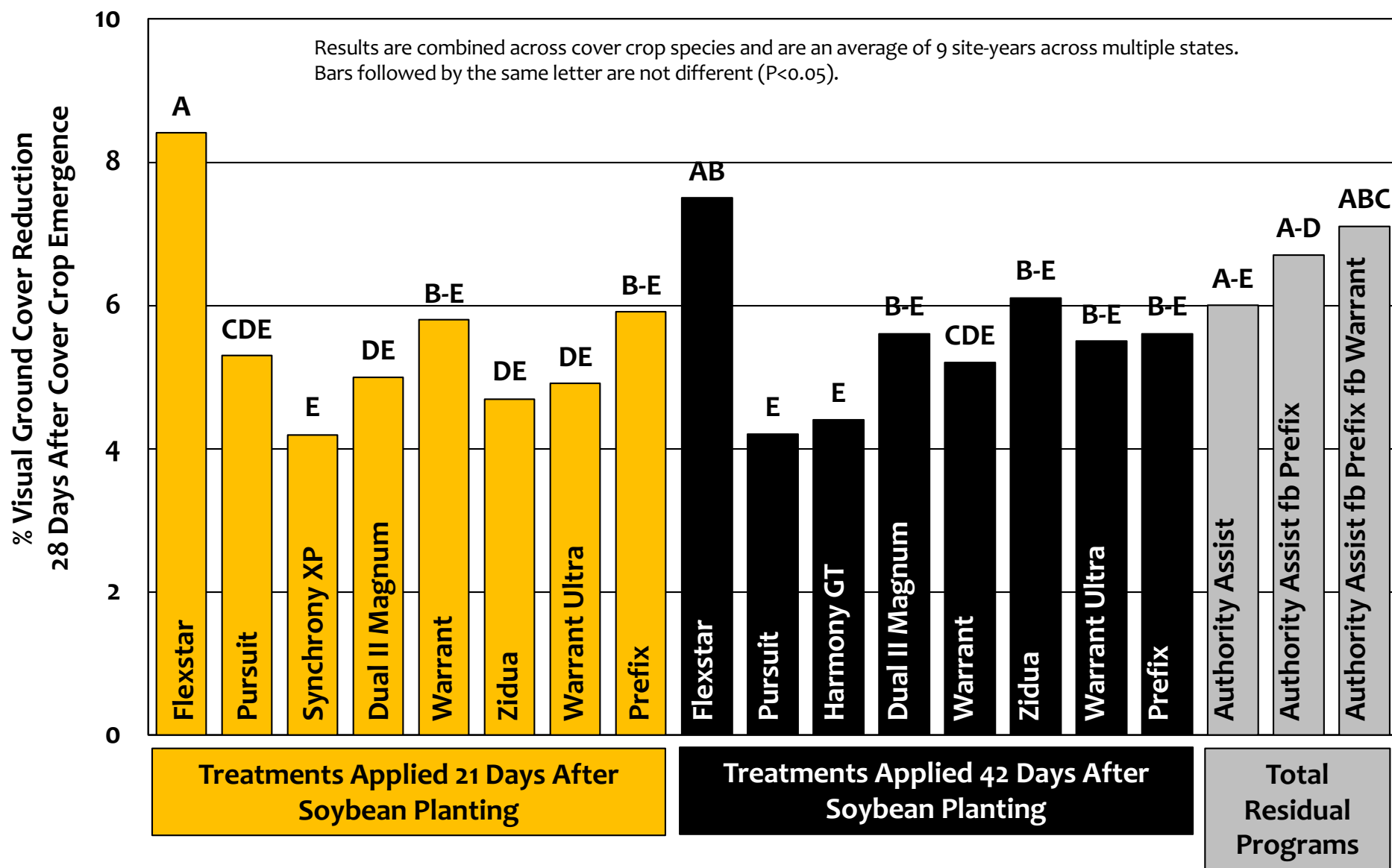




# 3 ozs Zidua, Annual Ryegrass



# Cover Crop Groundcover Reduction in Response to Residual Herbicides Applied in the Previous Soybean Crop (2016/17)





# Influence of Corn Herbicide Treatments on Fall Cover Crop Stand/Biomass (2013-2015)

■ No reduction in any year
 ■ Reduction in 1 of 3 years
 ■ Reduction in ≥ 2 of 3 years

Herbicide Treatment	Rate	Cover Crop Species							
		Winter Wheat	Tillage Radish	Cereal Rye	Crimson Clover	Winter Oat	Austrian Pea	Annual Ryegrass	Hairy Vetch
--product/A--		----- % Stand/Biomass Reduction 28 days after emergence -----							
Atrazine	2 qts	Yellow	Green	Green	Yellow	Green	Green	Yellow	Green
Callisto	3 fl ozs	Green	Green	Green	Green	Green	Yellow	Green	Yellow
Laudis	3 fl ozs	Green	Green	Green	Yellow	Green	Green	Green	Green
Impact	3/4 fl oz	Red	Yellow	Green	Green	Red	Green	Yellow	Green
Balance Flexx	5 fl ozs	Yellow	Red	Yellow	Yellow	Green	Green	Green	Green
Stinger	½ pt	Green	Green	Green	Red	Green	Yellow	Green	Yellow
Python	1 oz	Yellow	Yellow	Green	Green	Green	Yellow	Green	Yellow
Resolve	1 oz	Green	Yellow	Green	Green	Green	Green	Yellow	Green
Accent Q	0.9 oz	Red	Green	Green	Yellow	Yellow	Green	Yellow	Green
Surestart + Atrazine	1.75 pt + 1 qt	Yellow	Yellow	Green	Yellow	Green	Yellow	Green	Yellow
Halex GT + Atrazine	4 pt + 1 qt	Green	Yellow	Green	Yellow	Green	Yellow	Red	Yellow
Capreno	3 fl ozs	Green	Green	Green	Green	Yellow	Green	Yellow	Green
Zidua	3 ozs	Green	Green	Green	Green	Red	Green	Red	Green



# Carryover of POST Corn Treatments to Tillage Radish

Non-treated



2 qts Atrazine



3 ozs Callisto



5 ozs Balance Flexx



½ pt Stinger



1 oz Python



4 pts Halex Gt + 1 qt Atr



3 ozs Capreno



3 ozs Zidua





# Conclusions

---

Herbicide carryover injury on cover crop species is going to vary from year to year, largely due to rainfall and time of application

The general order of sensitivity of cover crops to herbicide carryover, from greatest to least sensitive: **tillage radish > Austrian winter pea > crimson clover = annual ryegrass > winter wheat = winter oats > hairy vetch = cereal rye**

Some of the most injurious soybean herbicide treatments that have higher potential to carry over to cover crops: **fomesafen (Flexstar/Prefix/etc.), pyroxasulfone (Zidua), acetochlor (Warrant)**

Some of the most injurious corn herbicide treatments that have some potential to carry over to cover crops: **topramezone (Impact), mesotrione (Callisto, Halex GT, etc.) clopyralid (Stinger, SureStart), isoxaflutole (Balance Flexx), pyroxasulfone (Zidua, etc.)**



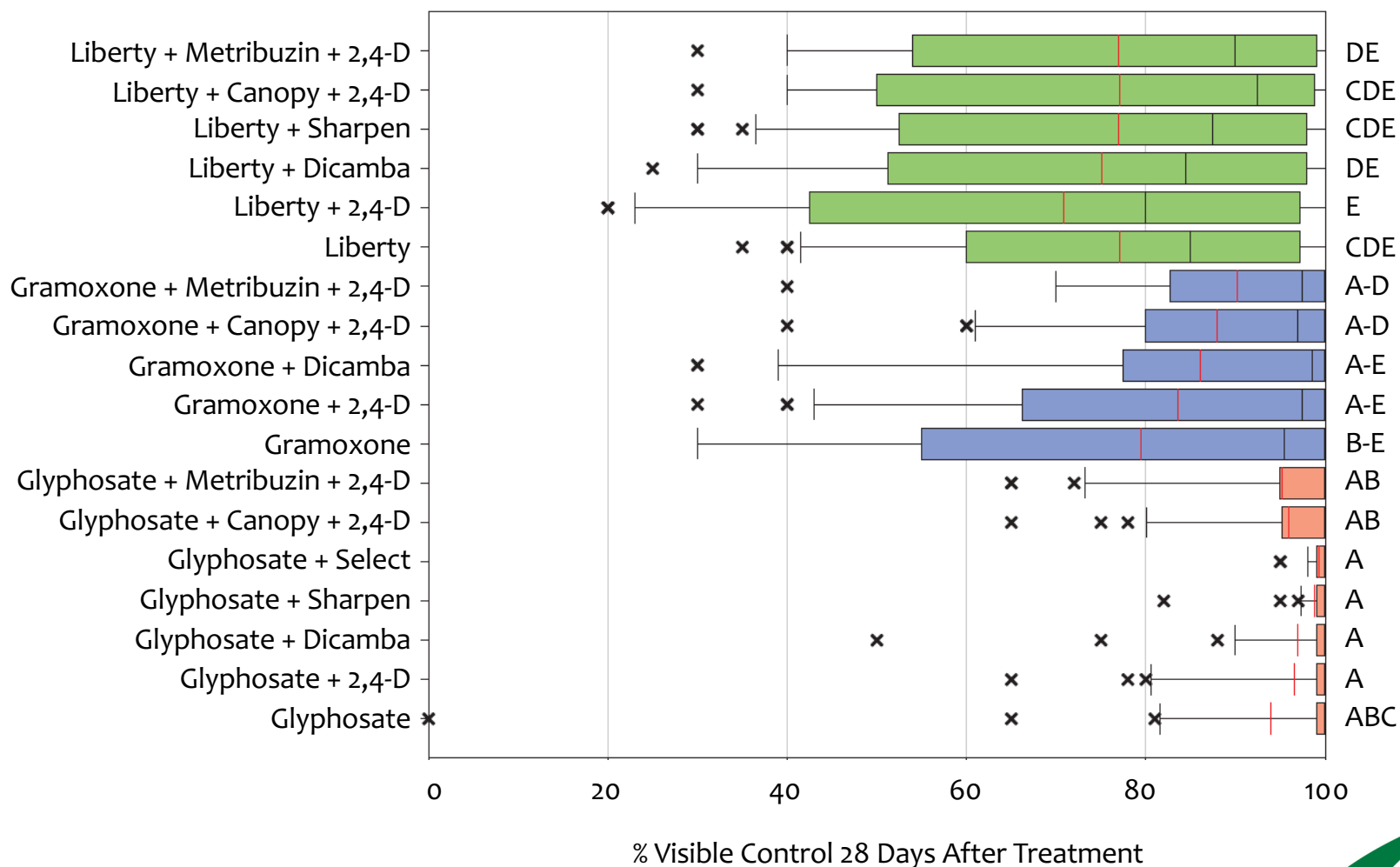
# **Herbicide Programs for the Termination of Cover Crop Species in the Spring**





# Influence of Herbicide Treatments on the Control of a Cereal Rye Cover Crop

Whalen et al. 2020. Weed Technology 34: In press.



Results are an average of 8 site-years across 5 States (AR, IN, MO, MS, and WI).  
Treatments made between 4/10- 4/29 on cereal rye from 6 to 50" in height, depending on location.  
Mean control lines (in each box in red) are not different if followed by the same letter (P<0.05).  
Boxes represent the middle 50% of the data; left and right whiskers represent 25 to 75% of the data set.  
An "X" denotes an outlier; black bars within the boxes denotes the median control for that treatment.





# Glyphosate vs. Glufosinate Programs on Cereal Rye

**Glyphosate**



**+ 2,4-D**



**+ dicamba**



**+ Sharpen**



**Glufosinate**



**+ 2,4-D**



**+ dicamba**



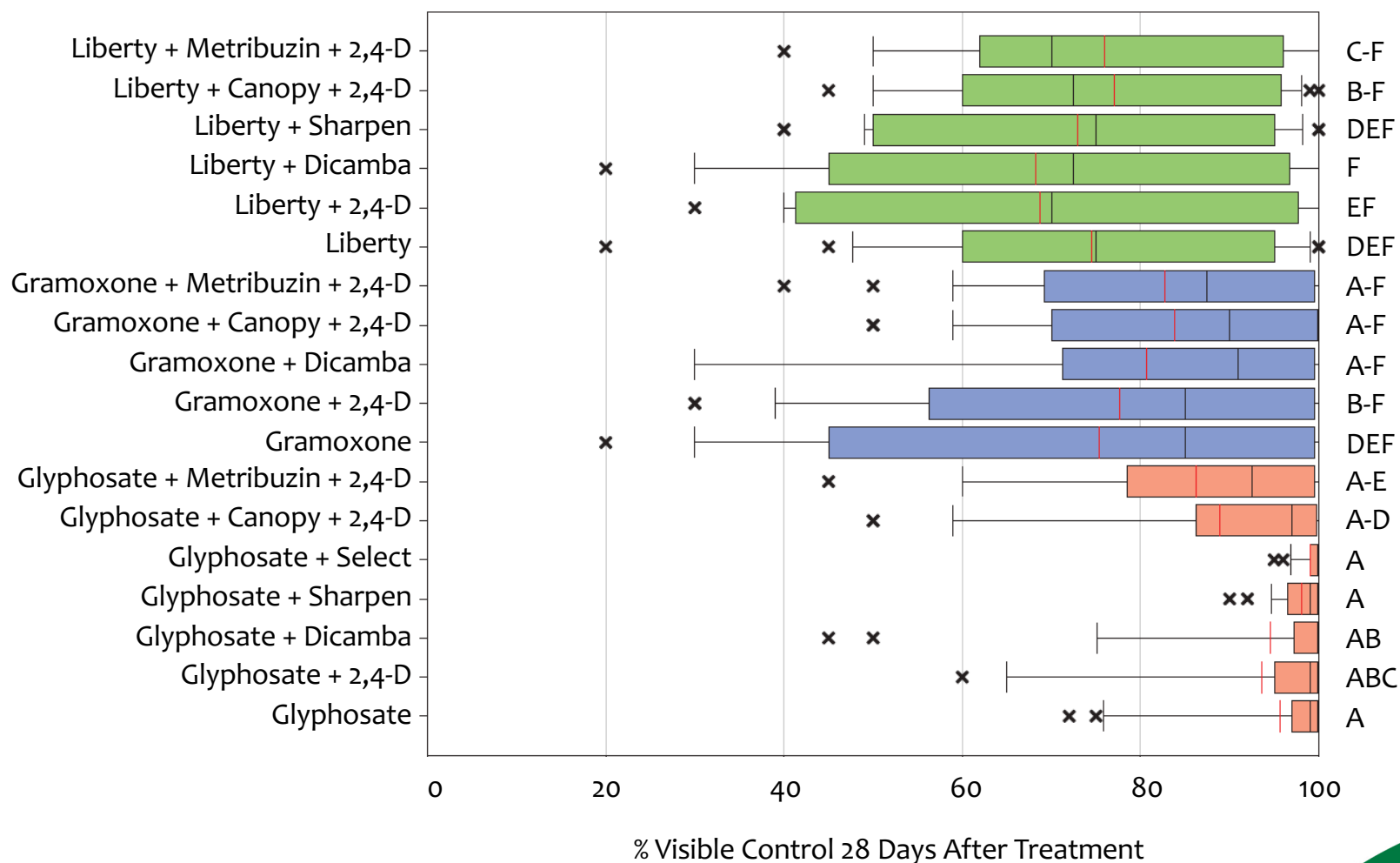
**+ Sharpen**





# Influence of Herbicide Treatments on the Control of a Wheat Cover Crop

Whalen et al. 2020. Weed Technology 34: In press.



Results are an average of 7 site-years across 3 States (AR, IN, MO).

Treatments made between 4/10- 4/29 on wheat from 11 to 24 inches in height, depending on location.

Mean control lines (in each box in red) are not different if followed by the same letter ( $P < 0.05$ ).

Boxes represent the middle 50% of the data; left and right whiskers represent 25 to 75% of the data set.

An "X" denotes an outlier; black bars within the boxes denotes the median control for that treatment.





Some species will winter kill....

Tillage Radish 12/3/2013  
Columbia, Missouri

© Kevin Bradley, Univ. Missouri

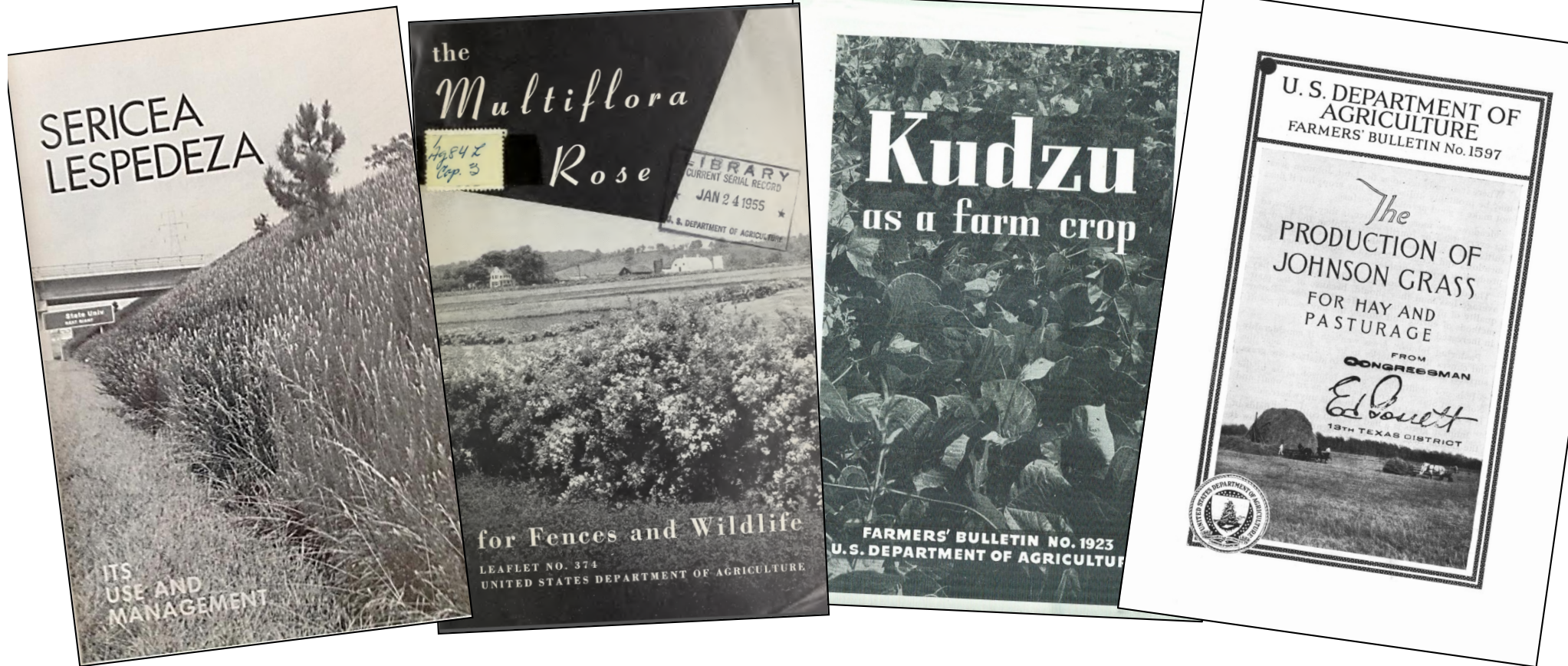


All cover crops should not be viewed equally...





# What do all of these have in common?







# Annual Ryegrass

*Lolium perenne ssp. multiflorum*

a.k.a. “Italian Ryegrass” or just “Ryegrass”

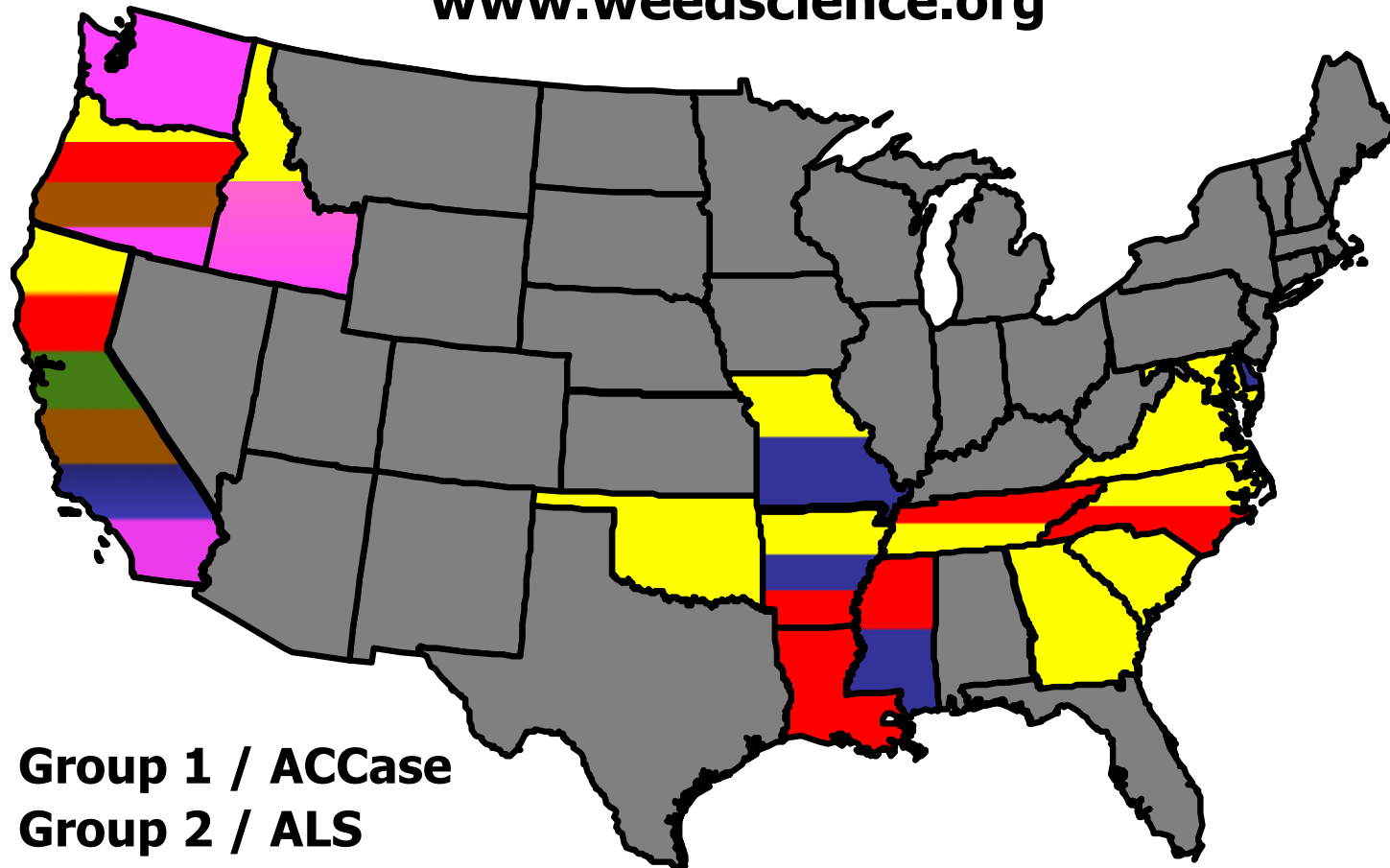
**NOT Annual Rye NOT Cereal Rye**





# Herbicide Resistance in Annual Ryegrass, 2020

**www.weedscience.org**



- **Group 1 / ACCase**
- **Group 2 / ALS**
- **Group 9 / Glyphosate**
- **Group 10 / Liberty**
- **Group 15 / Chloroacetamides**
- **Group 22 / Paraquat**

© Dr. Kevin Bradley





**Glyphosate-resistant ryegrass has become one of the most significant weed problems in several southern states**

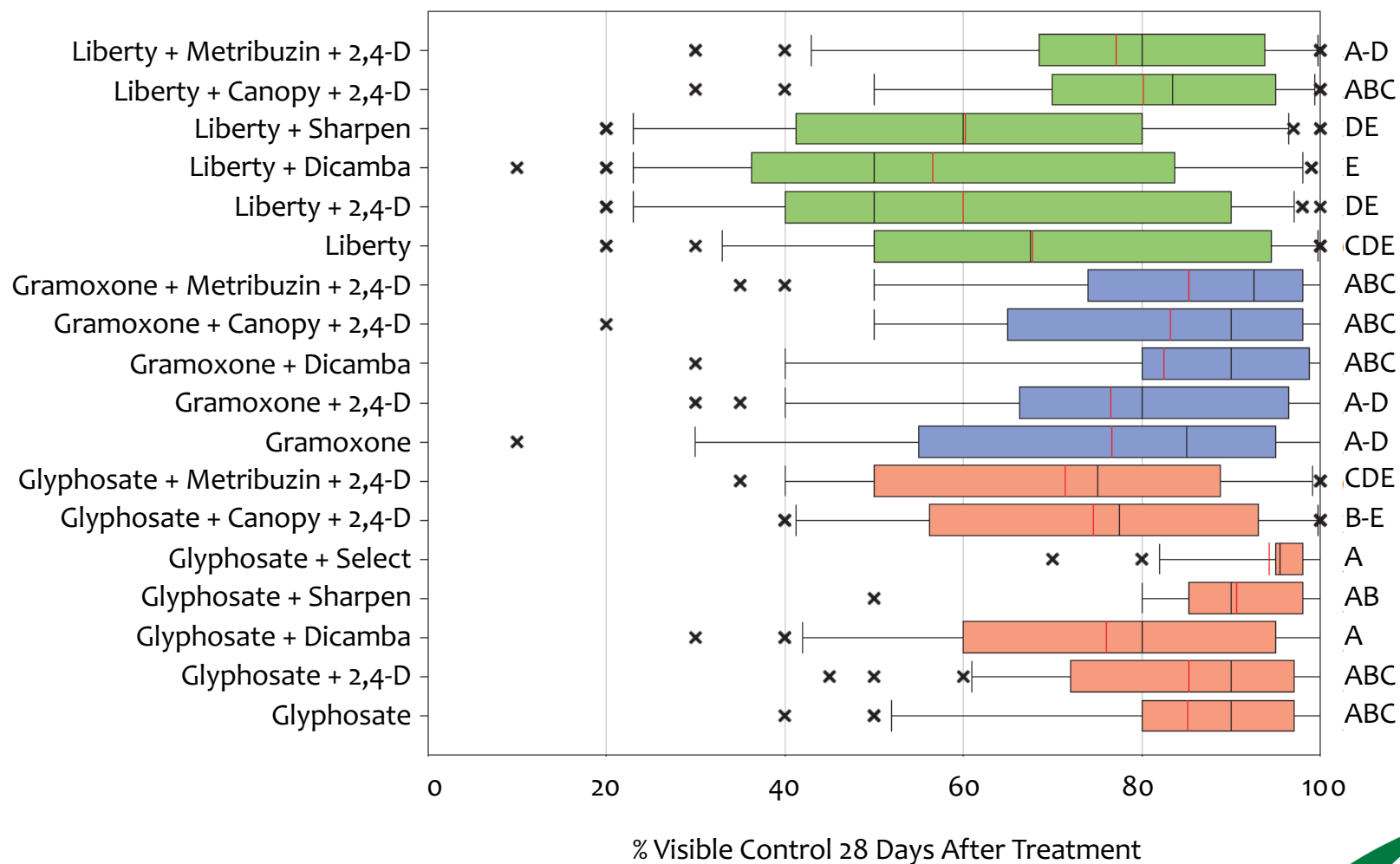


Photo courtesy of Dr. Larry Steckel



# Influence of Herbicide Treatments on the Control of an Annual Ryegrass Cover Crop

Whalen et al. 2020. Weed Technology 34: In press.



Results are an average of 8 site-years across 5 States (AR, IN, MO, MS, and WI).  
Treatments made between 4/10- 4/29 on ryegrass from 5 to 15 inches in height, depending on location.  
Mean control lines (in each box in red) are not different if followed by the same letter ( $P < 0.05$ ).  
Boxes represent the middle 50% of the data; left and right whiskers represent 25 to 75% of the data set.  
An "X" denotes an outlier; black bars within the boxes denotes the median control for that treatment.





# Influence of Herbicide Treatments and Timings on the Control of an Annual Ryegrass Cover Crop (2013-2015; Columbia, MO)

Herbicide Treatment	Rate	Application Timing		
		Early (5-9’')	Mid (12-20’)	Late (28-36’)
		Tillering	Pre-boot	Boot/Heading
---product/A---		--% Ann. Ryegrass Biomass Reduction 28 DAT--		
Roundup PowerMax	22 fl ozs	85	62	70
Roundup PowerMax	36 fl ozs	92	81	87
Roundup PowerMax + 2,4-D	36 fl ozs + 1 pt	94	81	89
Roundup PowerMax + Clarity	36 fl ozs + 1 pt	91	64	87
Roundup PowerMax + Sharpen	36 fl ozs + 1 fl oz	95	79	91
Roundup PowerMax + Aatrex	36 fl ozs + 1 qt	83	71	74
Roundup PowerMax + Canopy	36 fl ozs + 4 ozs	85	66	77
Roundup PowerMax + Basis Blend	36 fl ozs + 1.25 ozs	94	86	91
Roundup PowerMax + Select Max	36 fl ozs + 10 ozs	99	91	88
Roundup PowerMax + Select Max	36 fl ozs + 16 ozs	99	98	98
Gramoxone Inteon	4 pts	56	53	78
Gramoxone Inteon + 2,4-D	4 pts + 1 pt	63	52	78
Gramoxone Inteon + Aatrex	4 pts + 1 qt	68	64	74
Gramoxone Inteon + Sencor + 2,4-D	4 pts + 4 ozs + 1 pt	69	65	84
Liberty	29 fl ozs	14	27	41
LSD <sub>0.05</sub> (treatments x timings):		----- 7 -----		

\*numbers in red indicate antagonistic tank mixes compared to applying 36 fl ozs Roundup PowerMax alone



# Glyphosate vs. Glufosinate Programs on Annual Ryegrass

**Glyphosate**



**+ 2,4-D**



**+ Sharpen**



**+ clethodim**



**Glufosinate**



**+ 2,4-D**



**+ Sharpen**





You decide.  
Is it worth the Risk?

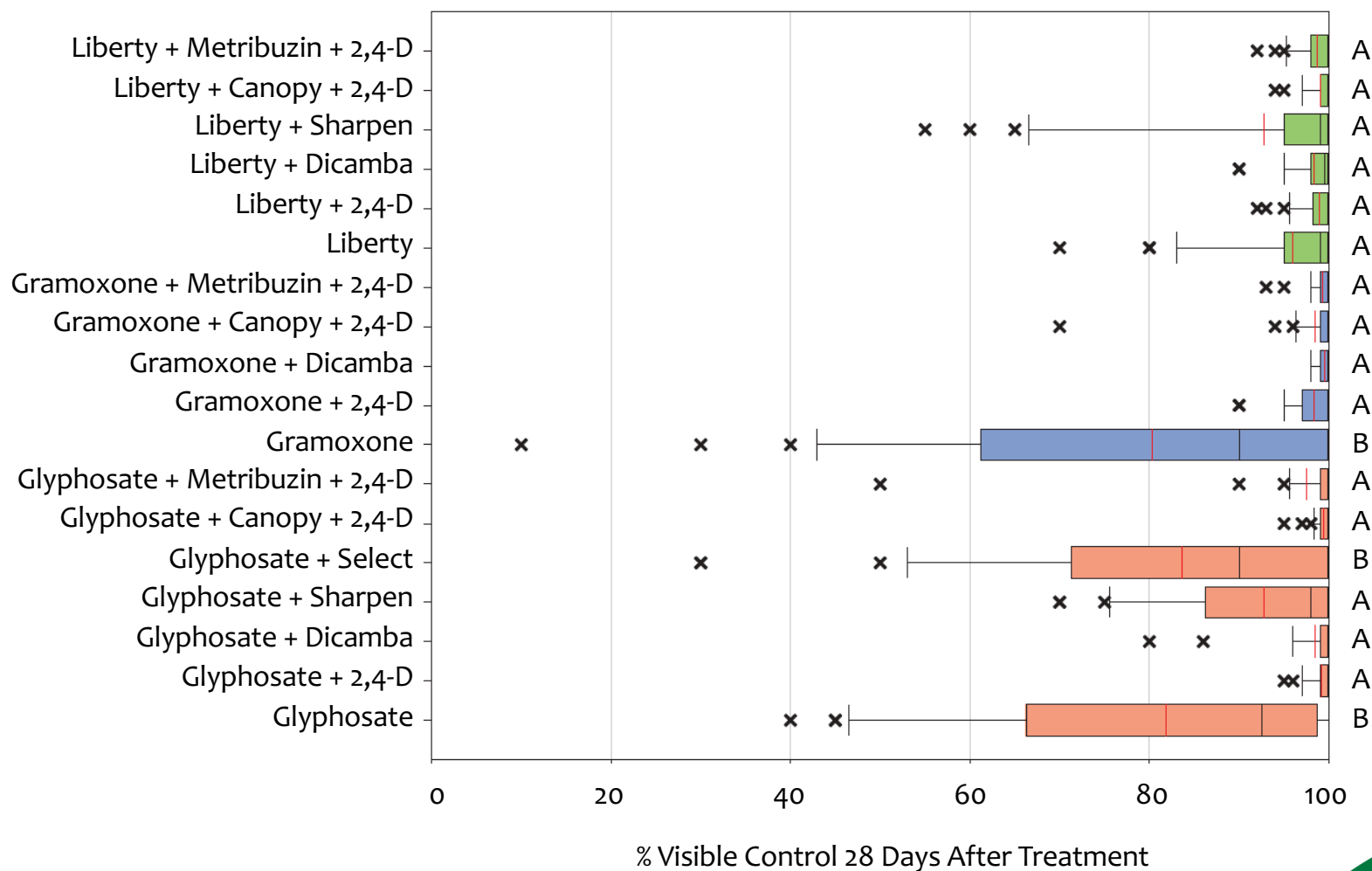
© Kevin Bradley, Univ. Missouri





# Influence of Herbicide Treatments on the Control of a Hairy Vetch Cover Crop

Whalen et al. 2020. Weed Technology 34: In press.



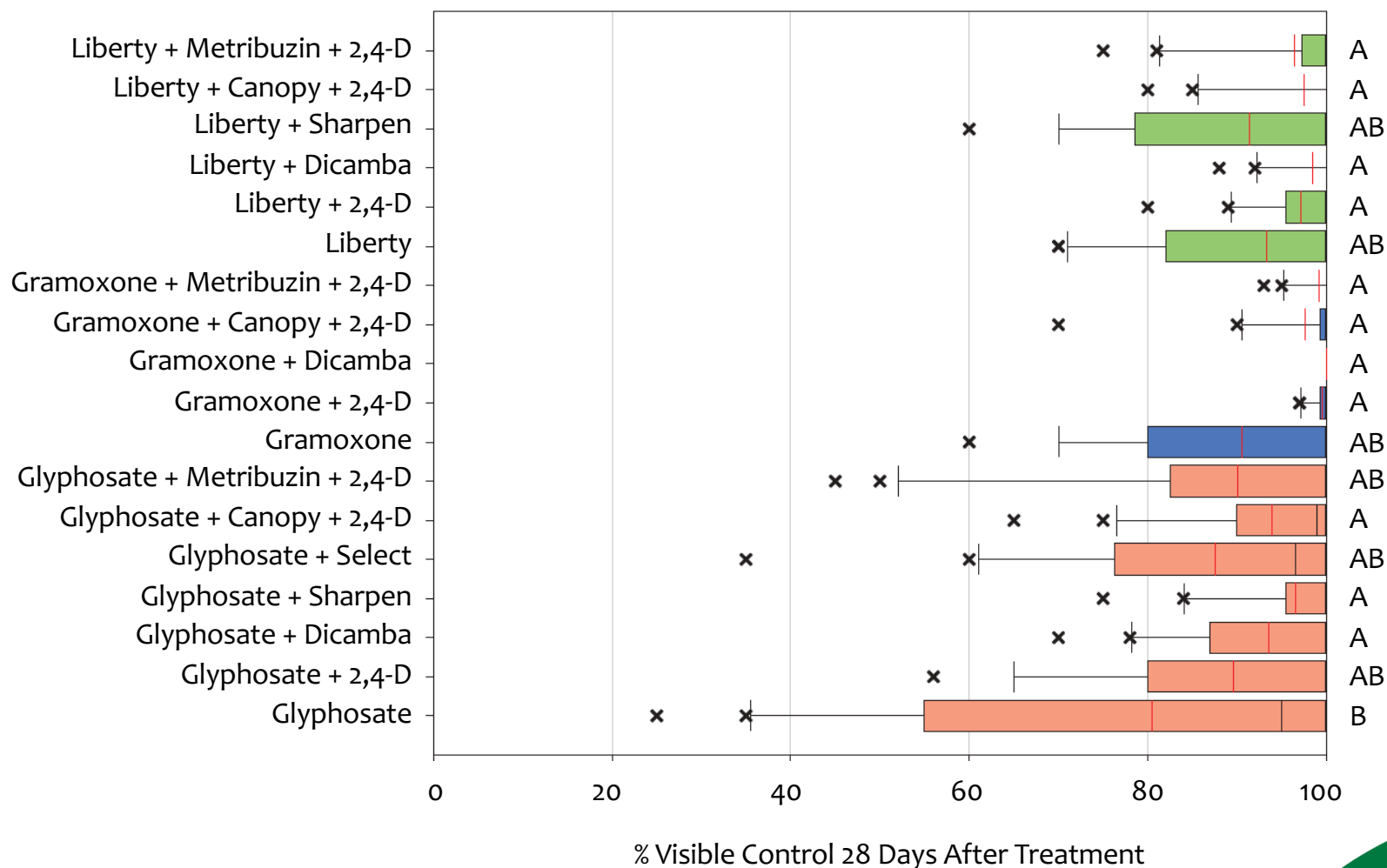
Results are an average of 8 site-years across 4 States (AR, IN, MO, MS).  
Treatments made between 4/10- 4/29 on wheat from 3 to 18 inches in height, depending on location.  
Mean control lines (in each box in red) are not different if followed by the same letter ( $P < 0.05$ ).  
Boxes represent the middle 50% of the data; left and right whiskers represent 25 to 75% of the data set.  
An "X" denotes an outlier; black bars within the boxes denotes the median control for that treatment.





# Influence of Herbicide Treatments on the Control of an Austrian Winter Pea Cover Crop

Whalen et al. 2020. Weed Technology 34: In press.



Results are an average of 5 site-years across 4 States (AR, MO, MS).  
Treatments made between 4/10- 4/29 on wheat from 8 to 22 inches in height, depending on location.  
Mean control lines (in each box in red) are not different if followed by the same letter ( $P < 0.05$ ).  
Boxes represent the middle 50% of the data; left and right whiskers represent 25 to 75% of the data set.  
An "X" denotes an outlier; black bars within the boxes denotes the median control for that treatment.





# Effective Termination of Cover Crop Species

- Proper timing is important; proper temperature/environment before and after application may be just as important
- Species that have proven difficult to control = annual ryegrass; sometimes wheat; crimson clover, vetch, Austrian pea if they get too much growth
- Glyphosate + 2,4-D, dicamba, or Sharpen combinations provided the most consistent control of all species except annual ryegrass
- Annual ryegrass requires careful timing; most consistent treatment across numerous years/states has been glyphosate + clethodim





# What difference does the timing of your burndown + residual herbicide make?

cereal rye cover crop terminated with glyphosate + 2,4-D + Authority Maxx



terminated 21 days before planting

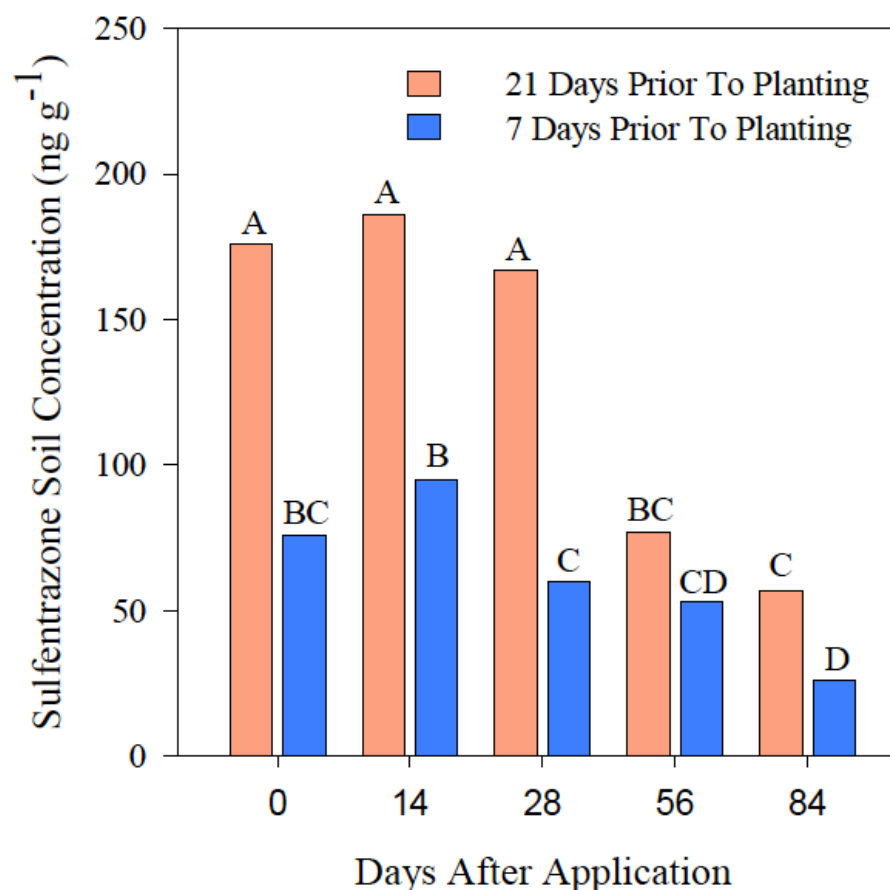


terminated 7 days before planting



# Should you include your PRE residual herbicide when terminating cover crops?

- PRE herbicides were included with the burndown herbicide either 21 or 7 days prior to planting.
- Soils were sampled to determine concentrations of sulfentrazone (Authority) in the soil.
- Less sulfentrazone concentration occurred where cover crop biomass was highest (inverse relationship to biomass accumulation).
- **\*Take-home:** The closer you get to planting, and/or the more biomass your cover crop accumulates, the greater the likelihood that your PRE residual herbicide will not make it to the soil and will not be available for uptake by weed seeds.





# Mizzou<sup>®</sup> Weed science

Email: [bradleyke@missouri.edu](mailto:bradleyke@missouri.edu)



[weedsience.missouri.edu](http://weedsience.missouri.edu)

**id weeds**  
App: ID Weeds (free download)

**facebook**  
Facebook: Mizzou Weed Science

**twitter**  
Twitter: @ShowMeWeeds



App: Herbicide InjuryID