Herbicide options in corn interseeded with cover crops

Aaron Brooker

Christy Sprague, Karen Renner

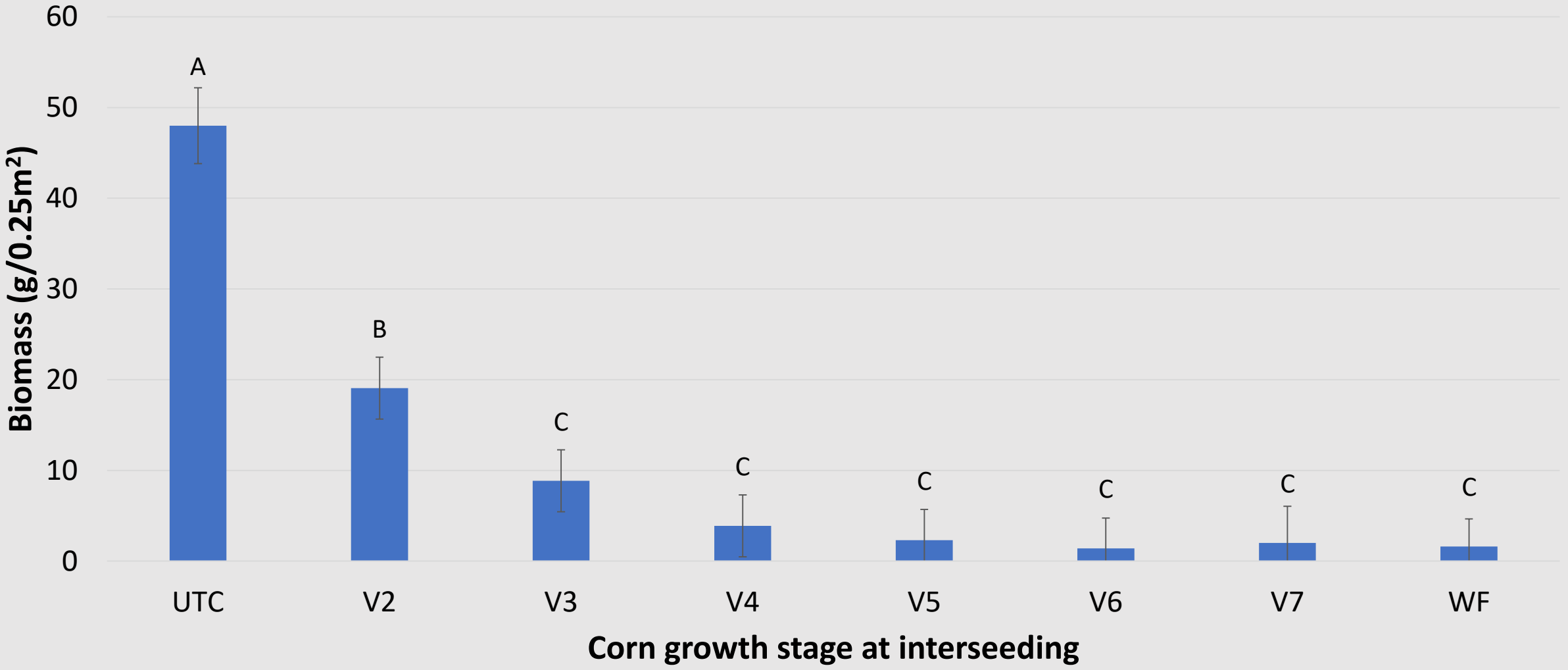
Michigan State University

Interseeding Cover Crops in Corn in Michigan

- Why?
  - Michigan climate prevents establishment of most cover crop species when seeded following corn grain harvest
  - Longer period to benefit from cover crops if interseeded in June

Fall Tillage Radish® seeded at V3

Weed biomass is greatest at the V2 interseeding timing



*Glyphosate applied prior to each interseeding event

Weeds must be controlled

- Prevent corn yield loss
- Glyphosate prior to interseeding:
  - No residual activity
  - Does not control glyphosate-resistant weeds
- Soil-applied and postemergence herbicides with residuals are needed

Common lambsquarters in annual ryegrass plot.

Objective

- Identify soil-applied and postemergence herbicides for interseeded corn systems:
  - Which cover crop single species and mixtures can be interseeded when herbicides are applied?

Current Information

- Carryover of herbicides to **fall-seeded** cover crops – Missouri and Wisconsin
  - Missouri – Silt loam; 2-2.3% SOM; 6.3-6.5 pH (Cornelius and Bradley, 2017)
  - Wisconsin – Silt loam; 3.3-3.4% SOM; 6.3-6.8 pH (Smith et al., 2015)
- Residual herbicide effects on cover crops seeded **V5 and later** – Pennsylvania (Roth et al., 2015)
- No information for earlier interseeding timings
- No information for Michigan climate and lighter soil textural classes

Soil-applied herbicides

	Active ingredient	SOA#	Rate (g ai/ha)		Active ingredient	SOA#	Rate
1	flumetsulam	2	56	7	dimethenamid-P	15	942
2	rimsulfuron	2	22	8	pyroxasulfone	15	179
3	clopyralid	4	105	9	s-metolachlor	15	1424
4	atrazine	5	1121	10	bicyclopyrone	27	50
5	saflufenacil	14	75	11	isoxaflutole	27	105
6	acetochlor	15	2455	12	mesotrione	27	210

Postemergence Herbicides

	Active ingredient	SOA#	Rate (g ai/ha)
1	atrazine	5	571
2	atrazine	5	1121
3	bromoxynil	6	421
4	fluthiacet	14	1.7
5	acetochlor	15	1262
6	mesotrione	27	105
7	tembotrione	27	92
8	topramezone	27	18

Postemergence Herbicides

	Active ingredient	SOA#	Rate (g ai/ha)
9	mesotrione + atrazine	27 + 5	105 + 285
10	mesotrione + atrazine	27 + 5	105 + 509
11	dicamba + diflufenzopyr (Status)	4 + 19	140 + 56
12	dimethenamid-P + topramezone (Armezon PRO)	15 + 27	920 + 17
13	thiencarbazone + tembotrione (Capreno)	2 + 27	37 + 77
14	s-metolachlor + mesotrione + glyphosate (Halex GT)	15 + 27 + 9	1068 + 105 + 1042

Field Experiments

- Soil-applied herbicides sprayed immediately after corn planting
- Postemergence herbicides sprayed at V2
- Cover crops broadcast interseeded at V3 and V6 ~ 2 and 5 weeks after herbicide application
  - Annual ryegrass
  - Tillage Radish®
  - Crimson clover
- Glyphosate sprayed prior to interseeding
- Evaluated for % injury and stand loss at 30 days after interseeding and after corn harvest (compared with no herbicide control)

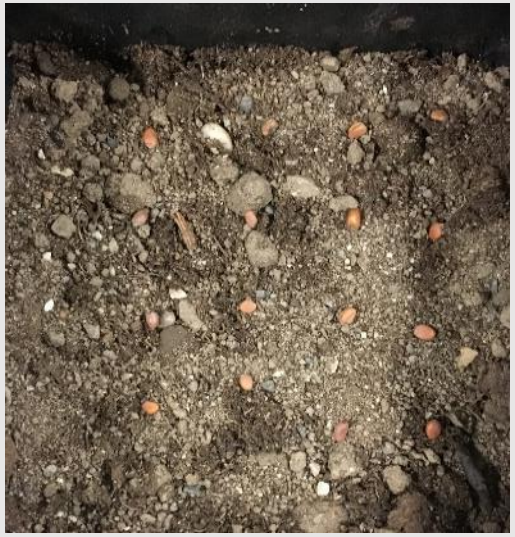
Locations

- Michigan State University Agronomy Farm, East Lansing, MI (Campus) ★
  - Soil-applied – 2016, 2017
  - Postemergence – 2017

- Hasenick Farms, Springport, MI (on-farm) ★
  - Soil-applied – 2016, 2017

Greenhouse Experiments

Annual ryegrass, Tillage Radish®, and crimson clover seeded: 16 seeds/pot



Biomass harvested, dried, and weighed

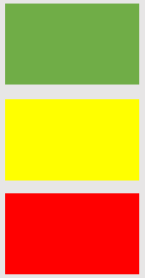
Herbicides applied at 0.25, 0.5, and 1 x the standard rates

28 DAP density and injury evaluations

Data Analysis

- Data were analyzed using PROC MIXED in SAS
  - Fisher's Protected LSD was used to determine differences between treatment means ($p<0.05$)

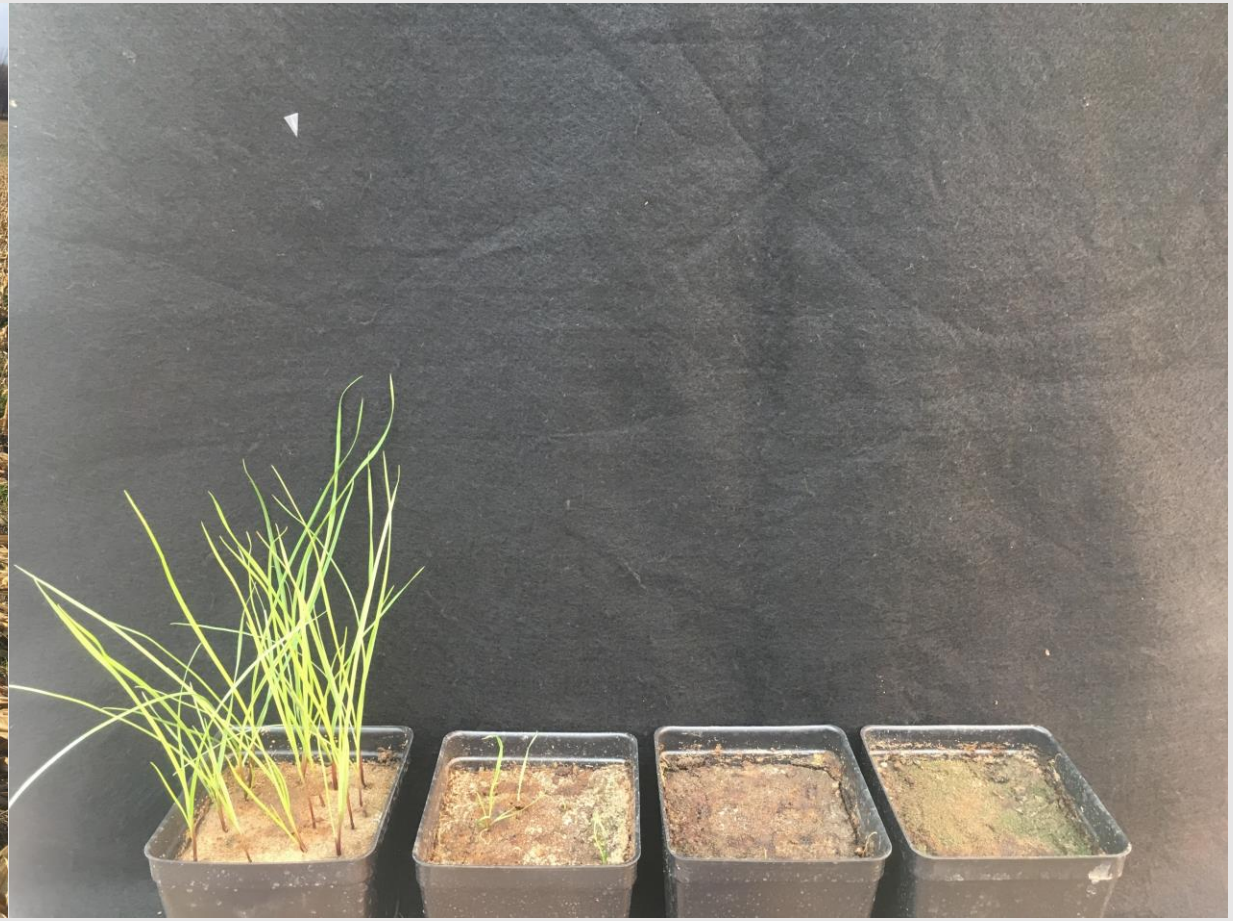
- Field Injury and Stand Loss Evaluations
  - Treatment means were categorized as follows



- <25% injury = tolerant
- 25 – 50% injury = moderately tolerant
- >50% injury = unsafe

Annual Ryegrass

Annual ryegrass + pyroxasulfone



Annual ryegrass + dimethenamid-P

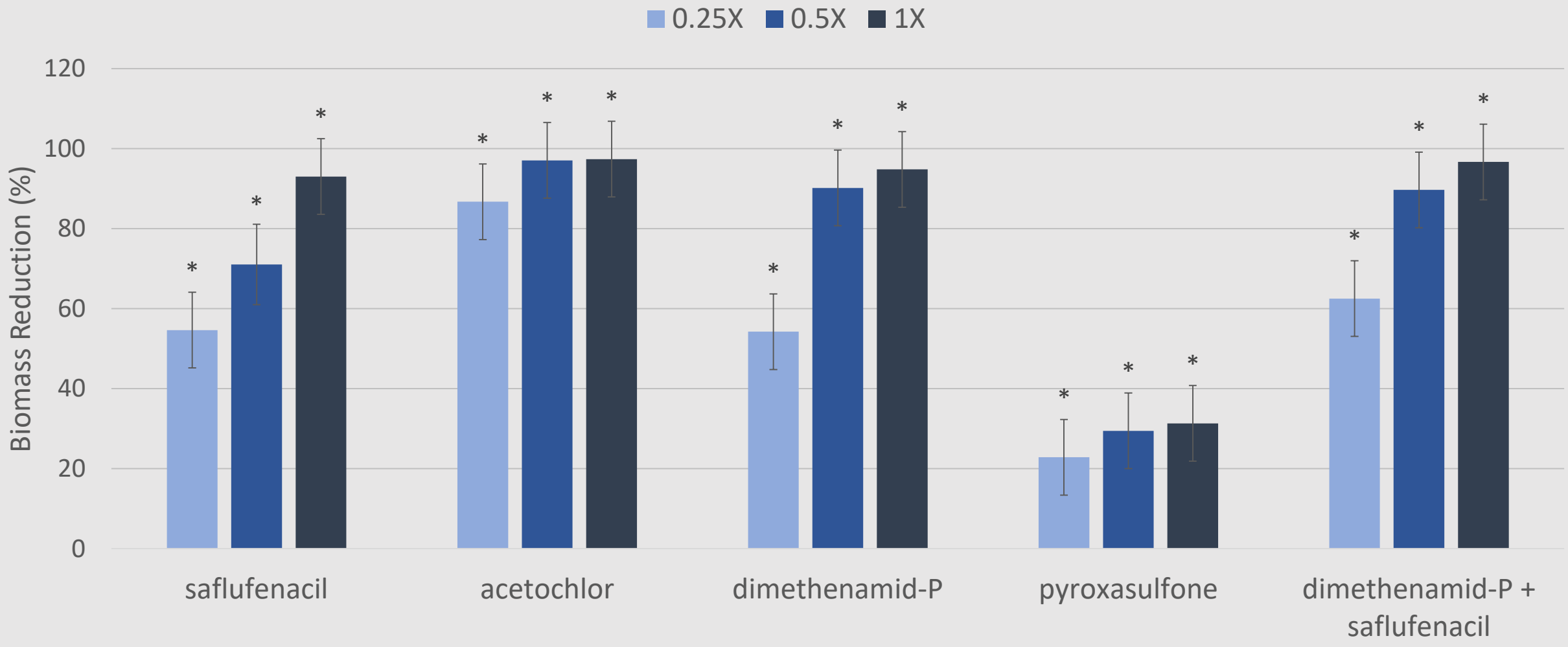
Annual ryegrass cannot be interseeded with Group 15 Herbicides -Field

Herbicide	Group	V3 Interseeding	V6 Interseeding
flumetsulam	2	17	9
rimsulfuron	2	37	19
clopyralid	4	13	14
atrazine	5	15	14
saflufenacil	14	8	14
acetochlor	15	47	56
dimethenamid-P	15	58	74
pyroxasulfone	15	86	90
s-metolachlor	15	53	74
bicyclopyrone	27	15	4
isoxaflutole	27	16	5
mesotrione	27	15	11

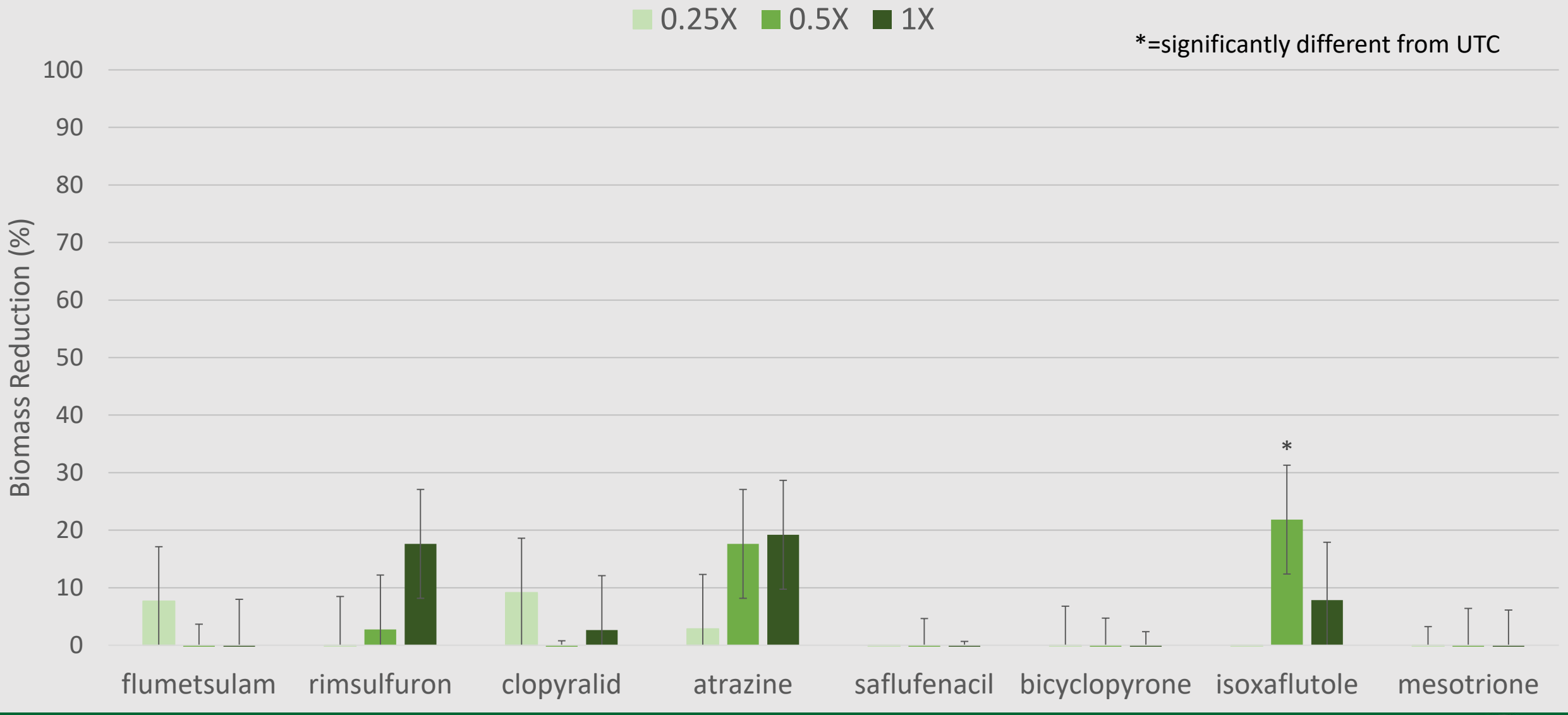
*Data from 4 site years

Annual ryegrass cannot be seeded with Group 15 herbicides - Greenhouse

*=significantly different from UTC



Annual ryegrass was tolerant to many herbicides - Greenhouse



Tillage Radish®

Tillage Radish®

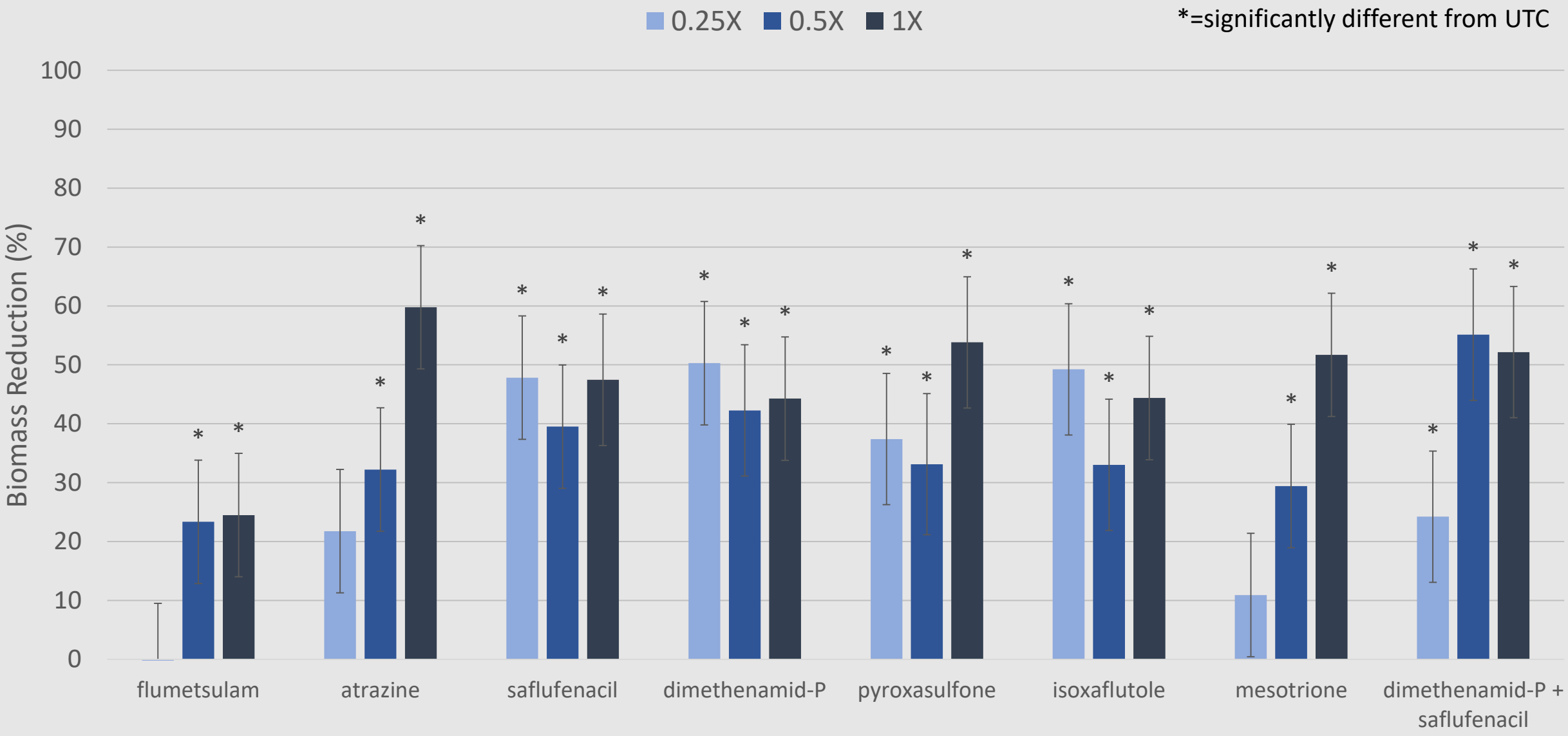
Tillage Radish® + isoxaflutole

Tillage Radish® was tolerant to Group 4 and 15 herbicides - Field

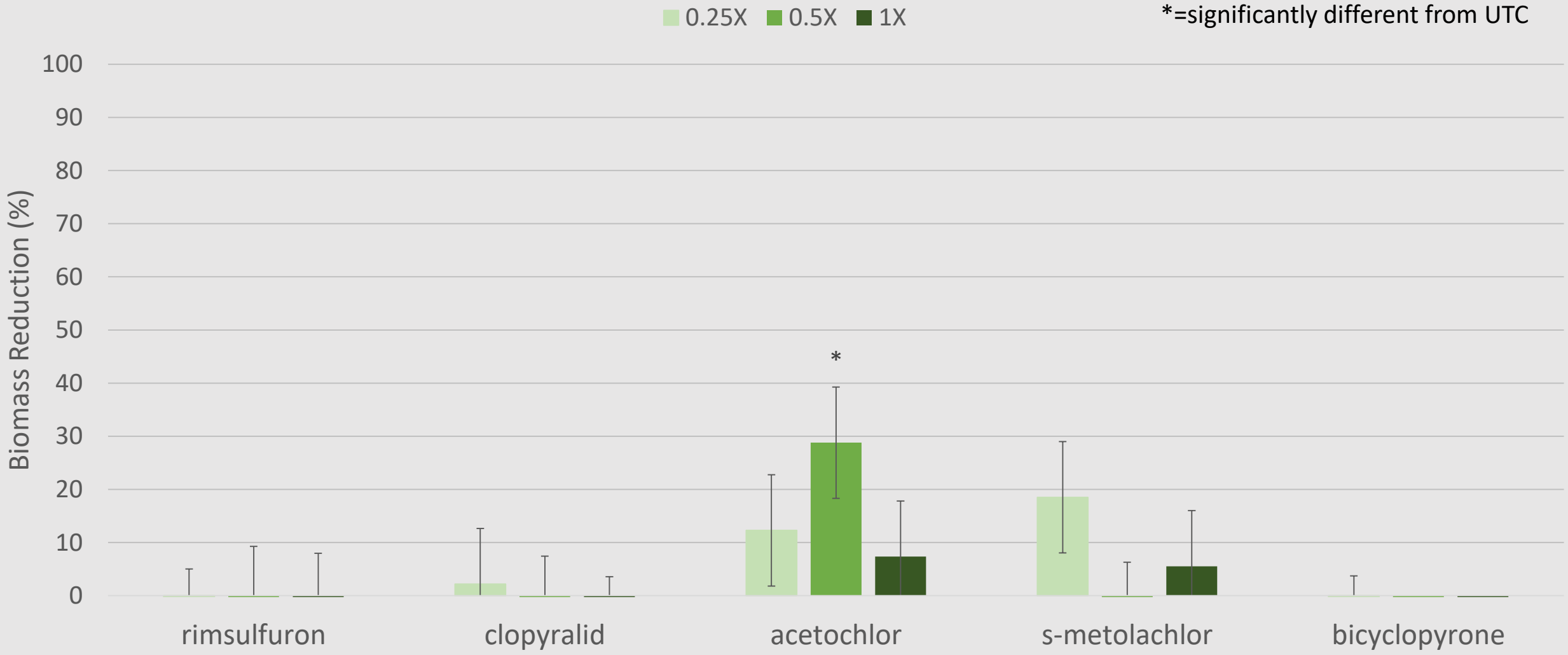
Herbicide	Group	V3 interseeding	V6 interseeding
flumetsulam	2	100	100
rimsulfuron	2	90	60
clopyralid	4	0	5
atrazine	5	50	45
saflufenacil	14	80	45
acetochlor	15	0	15
dimethenamid-P	15	0	10
pyroxasulfone	15	10	20
s-metolachlor	15	0	5
bicyclopyrone	27	5	35
isoxaflutole	27	50	20
mesotrione	27	80	35

*Data from on-farm 2017 only

Tillage Radish® was injured by more herbicides in the greenhouse



Tillage Radish® was tolerant to the following herbicides in the greenhouse



Crimson clover

Crimson clover

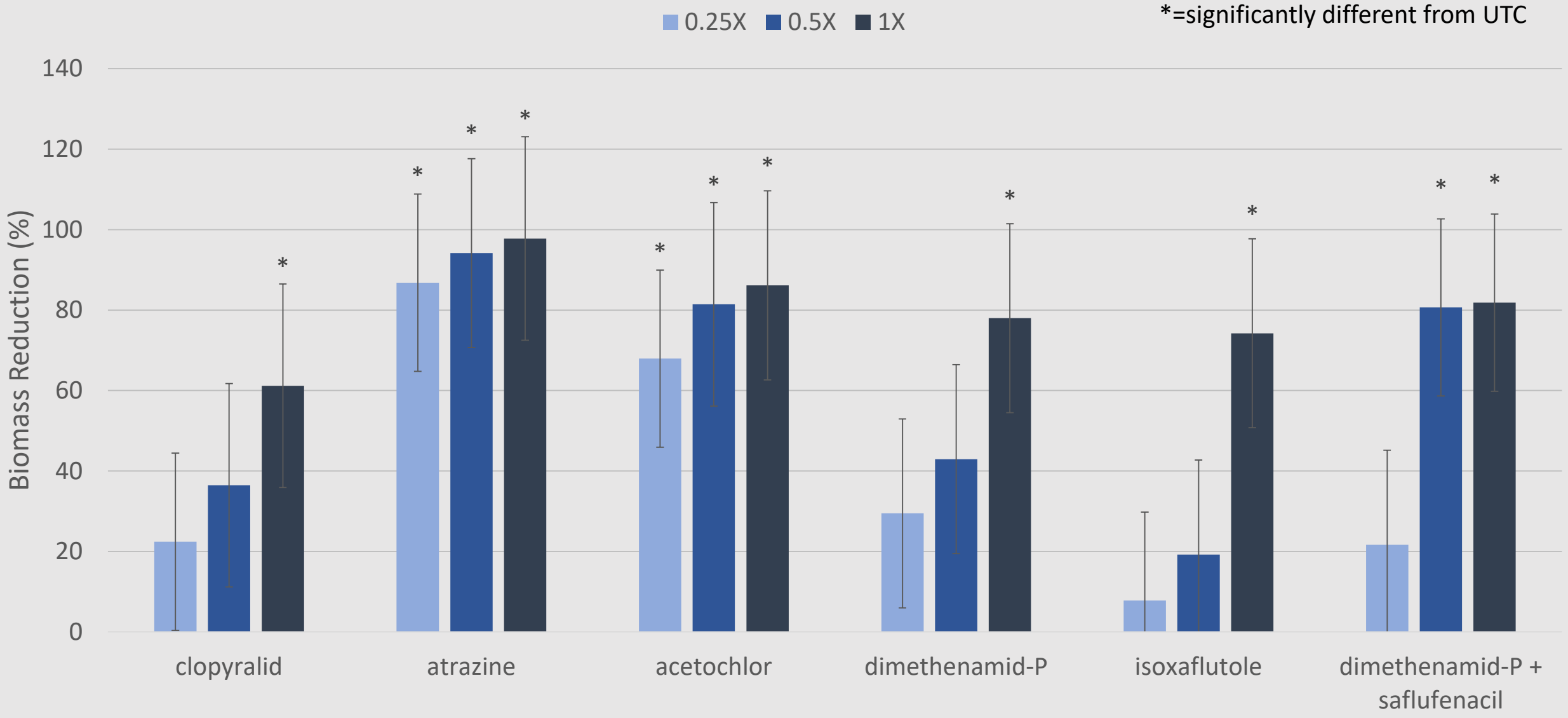
Crimson clover + isoxaflutole

Crimson clover was tolerant to group 14 and 15 herbicides - Field

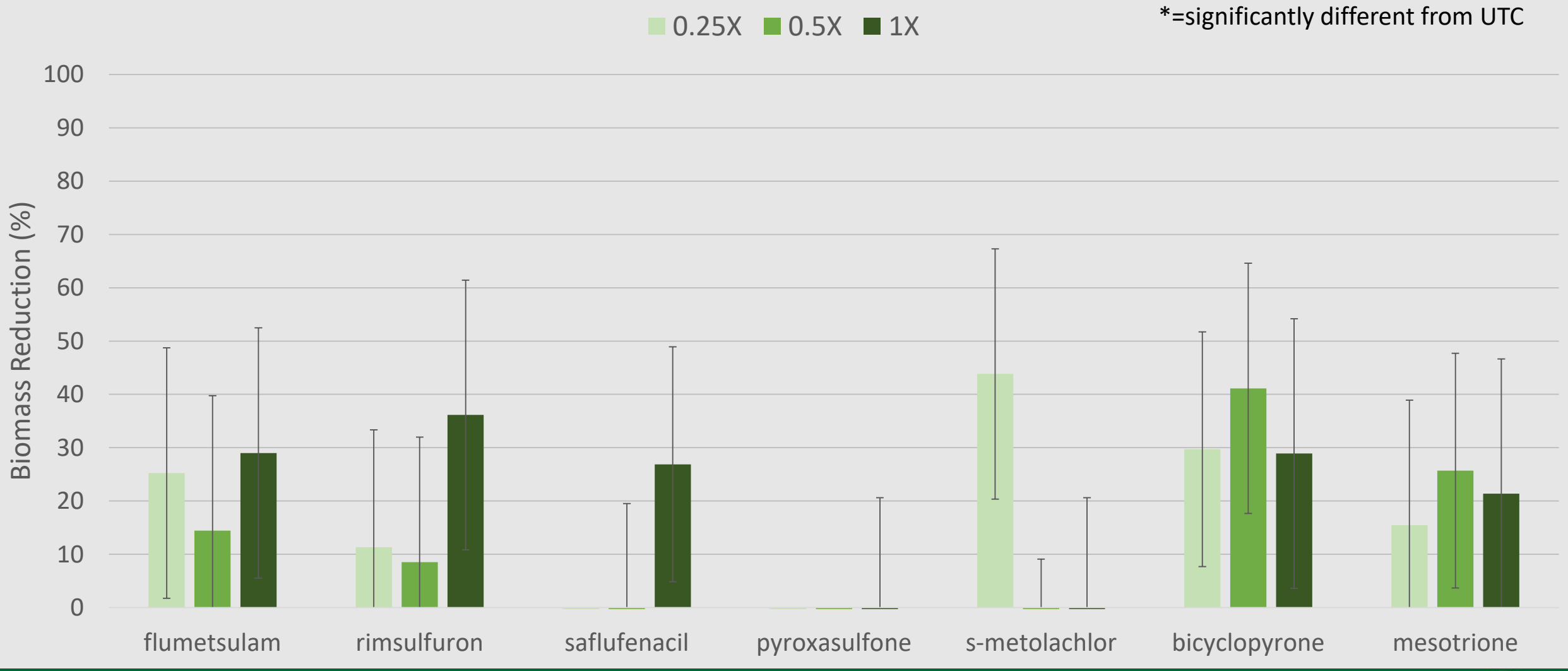
Herbicide	Group	V3 interseeding
flumetsulam	2	15
rimsulfuron	2	30
clopyralid	4	90
atrazine	5	100
saflufenacil	14	0
acetochlor	15	15
dimethenamid-P	15	0
pyroxasulfone	15	0
s-metolachlor	15	5
bicyclopyrone	27	60
isoxaflutole	27	80
mesotrione	27	20

*Data from on-farm 2017 only

Crimson clover responded differently in the greenhouse



Crimson clover was tolerant to the following herbicides in the greenhouse



Soil-Applied Herbicides Conclusions

Soil-applied herbicides can be used when interseeding

Herbicide	Annual Ryegrass	Tillage Radish®	Crimson Clover
flumetsulam			
rimsulfuron			
clopyralid			
atrazine			
saflufenacil			
acetochlor			
dimethenamid-P			
pyroxasulfone			
s-metolachlor			
bicyclopyrone			
isoxaflutole			
mesotrione			
dimethenamid-P + saflufenacil			

Postemergence herbicide evaluation continues

- Annual ryegrass:
  - Tolerant – atrazine, bromoxynil, fluthiacet, mesotrione, topramezone
  - Injurious – acetochlor, dimethenamid-P + topramezone, thiencarbazone + tembotrione, s-metolachlor + mesotrione + glyphosate
- Tillage Radish®
  - Tolerant – bromoxynil, fluthiacet, topramezone, tembotrione
  - Injurious – mesotrione + atrazine
- Crimson clover
  - Tolerant – bromoxynil, tembotrione
  - Injurious – atrazine, mesotrione + atrazine, thiencarbazone + tembotrione, s-metolachlor + mesotrione + glyphosate, dicamba + diflufenzopyr

Ongoing Research

- Field soil-applied herbicide experiments will be repeated in 2018
- Continue field and greenhouse postemergence herbicides research
- Combine herbicide data with interseeding timing and rate data to provide recommendations:
  - What cover crop?
  - What seeding rate?
  - What interseeding timing?
  - What herbicide?

Thank You!
Questions?

Project GREEEN

center seeds

Michigan Corn Growers Association

www.micorn.org

USDA

United States Department of Agriculture
National Institute of Food and Agriculture