



Critical Cover Crop-Free Period in Corn

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Interseeding cover crops in corn in Michigan

- Why?
 - Limited window to seed a cover crop following corn grain harvest
 - Provides a longer period to benefit from cover crops?
 - Soil health benefits
 - Weed suppression



Corn harvested 9 November

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Corn harvested 9 November

Research Questions

1. Can cover crops establish successfully in corn from V1-V7?
2. Do interseeded cover crops suppress weeds?
3. Are interseeded cover crops competitive with corn?
4. Can preemergence herbicides be used to suppress weeds in interseeded cover crops?

Interseeding cover crops in corn

- Previous studies have looked at late interseeding of cover crops in corn at V5-V7 growth stages (Roth et al., 2015; Baributsa et al., 2008)
 - No adverse effects on yield



Interseeding Cover Crops – Establishment, Competition, and Weed Suppression

- 2015 and 2016 in East Lansing, MI
- Annual ryegrass, Tillage Radish[®], and crimson clover were broadcast interseeded in corn at varying stages of corn development
- Glyphosate was applied at 0.84 kg ae/ha prior to each interseeding

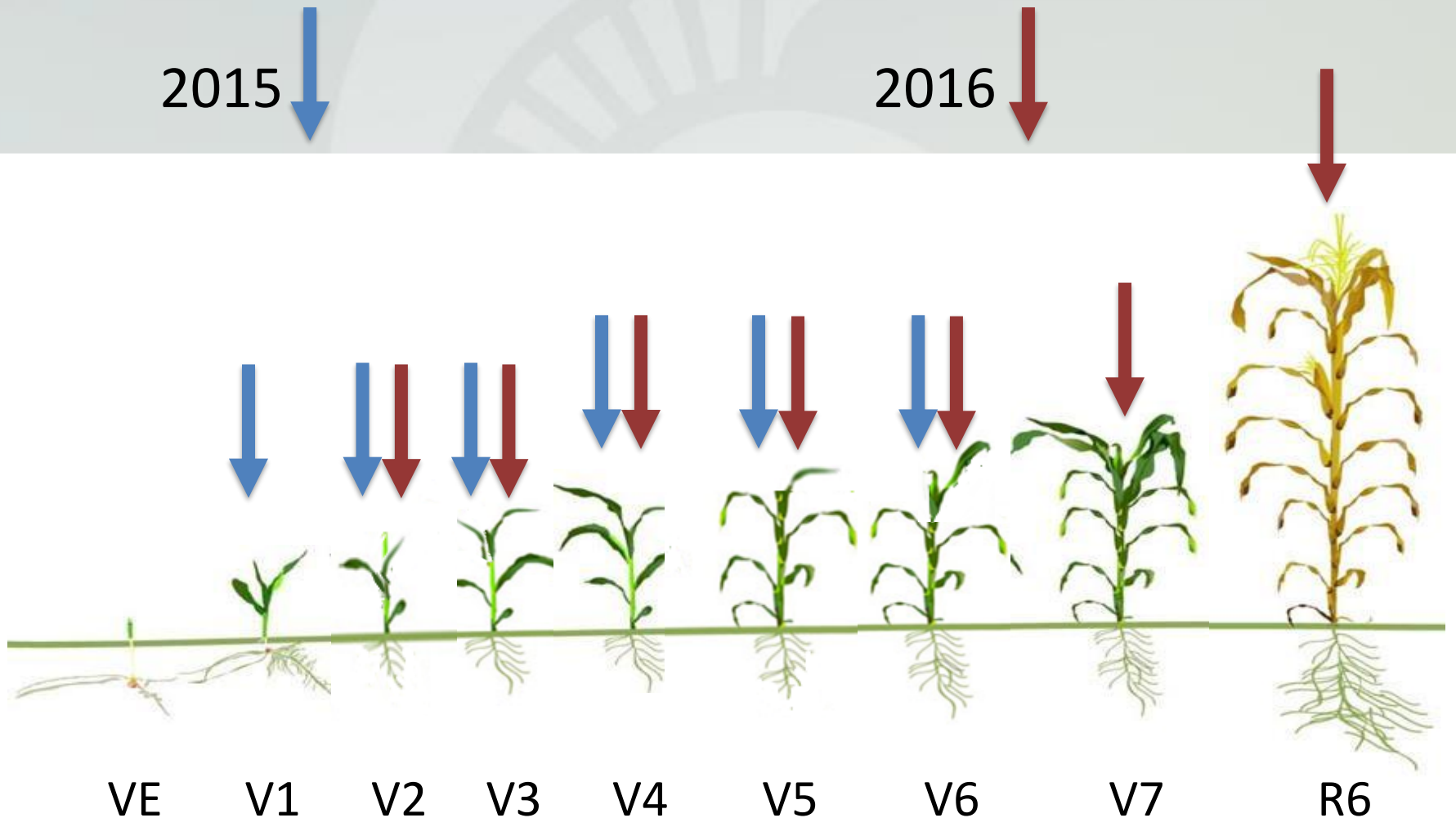
Cover Crop	Seeding Rate	
	(kg/ha)	Seeds/0.25 m ²
annual ryegrass	9	207
Tillage Radish [®]	9	19
crimson clover	17	89

Interseeding Cover Crops – Establishment, Competition, and Weed Suppression

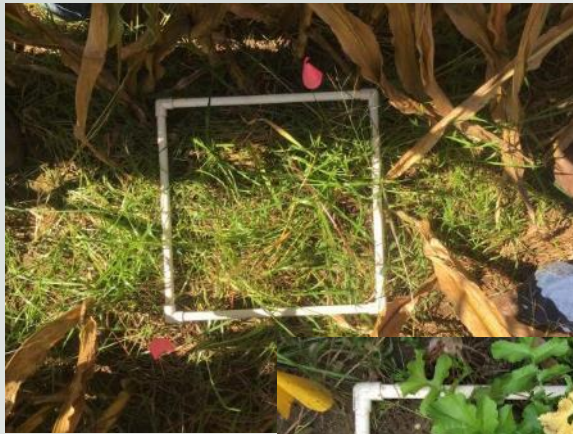
Interseeding timings

2015

2016



Data Collected



- Two 0.25 m² quadrats/plot
- Cover crop and weed density measurements:
 - 30 days after cover crop planting (DACP)
 - At peak cover crop biomass prior to corn harvest
 - Following spring (2015)
- Cover crop and weed biomass was harvested in fall at peak biomass and the following spring
- Corn grain harvested

Can preemergence herbicides be used with interseeded cover crops? – Greenhouse

Annual ryegrass,
Tillage Radish[®],
and crimson
clover planted:
10 cm² pots
16 seeds/pot



Pots sprayed
with
preemergence
herbicides



7, 14, 21, 28
DAP density
and injury
ratings



Biomass
harvested,
dried, and
weighed



Can preemergence herbicides be used with interseeded cover crops? – Greenhouse

Herbicide	Rates		
	<i>1 x</i>	<i>1/2 x</i>	<i>1/4 x</i>
	-----g ae/ha ⁻¹ -----		
<i>dimethenamid-P + saflufenacil</i> (Verdict)	657 + 74	329 + 37	165 + 19
<i>dimethenamid-P</i> (Outlook)	1005	503	251
<i>saflufenacil</i> (Sharpen)	75	38	19
<i>pyroxasulfone</i> (Zidua)	180	90	45
<i>isoxaflutole</i> (Balance Flexx)	105	53	26

Herbicide rates applied for greenhouse experiment
Pots were sprayed immediately after seeding

Can preemergence herbicides be used with interseeded cover crops? – Field experiments

- Campus (East Lansing, MI) ★
- On-Farm (Springport, MI) ★
- Annual ryegrass, Tillage Radish[®], and crimson clover
 - Campus (V3 and V6)
 - On-Farm (V3 only)
- Preemergence herbicides applied following corn planting

Herbicide Treatments	Rate g ae/ha ⁻¹
dimethenamid-P	1005
isoxaflutole	105
pyroxasulfone	180
saflufenacil	75



Campus hand broadcast seeders



On-Farm broadcast
interseeder
(36 rows)

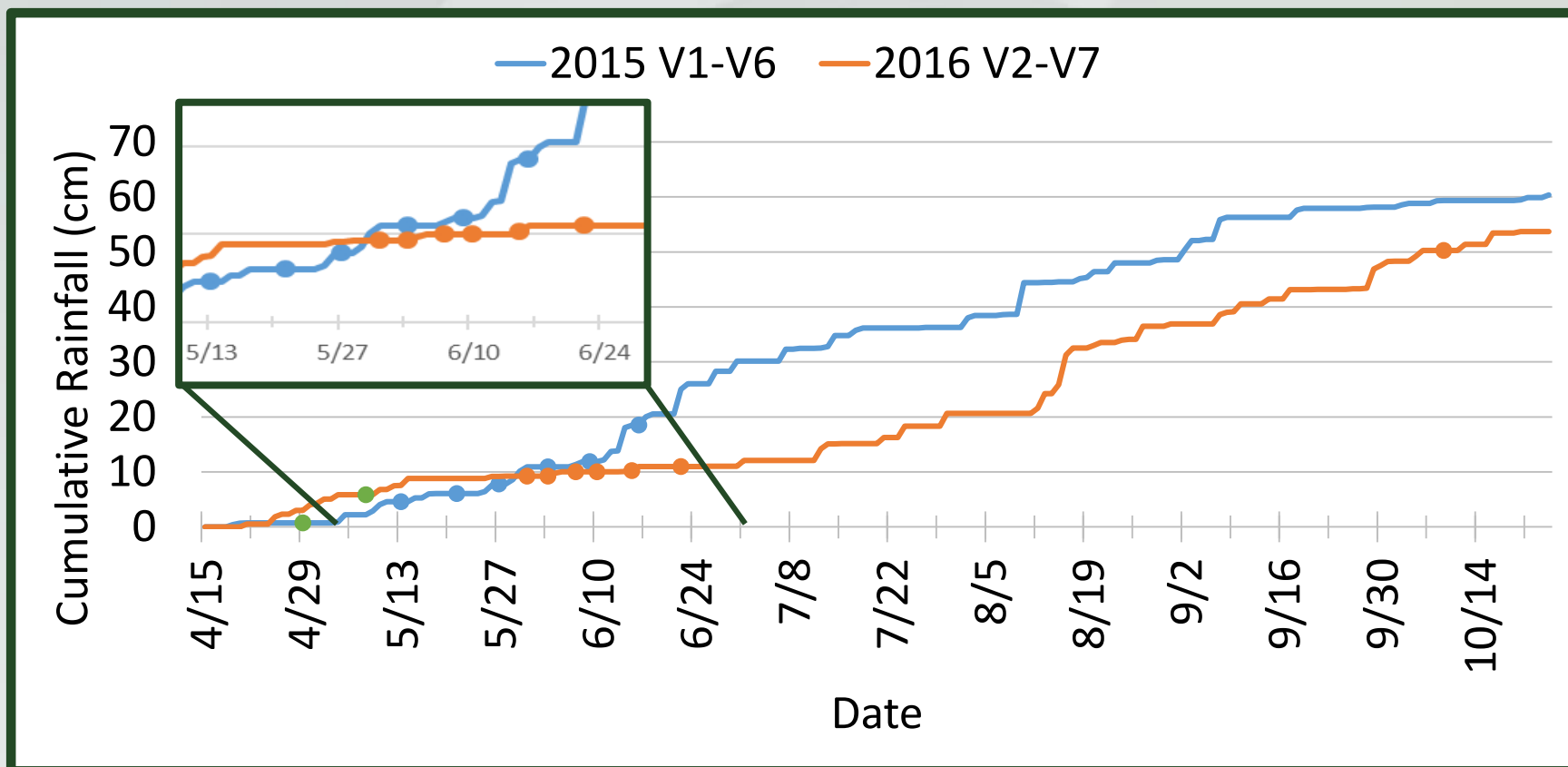
Statistical Analyses

- Data were analyzed using Proc Mixed in SAS
- Fisher's Protected LSD was used to determine differences between treatment means ($p < 0.05$)
- **Objectives 1-3.** Effects of interseeding timing x cover crop species on:
 - Cover crop density and biomass
 - Weed density and biomass
 - Corn grain yield
- **Objective 4.** Effects of herbicide x rate on:
 - Cover crop density, biomass, and injury



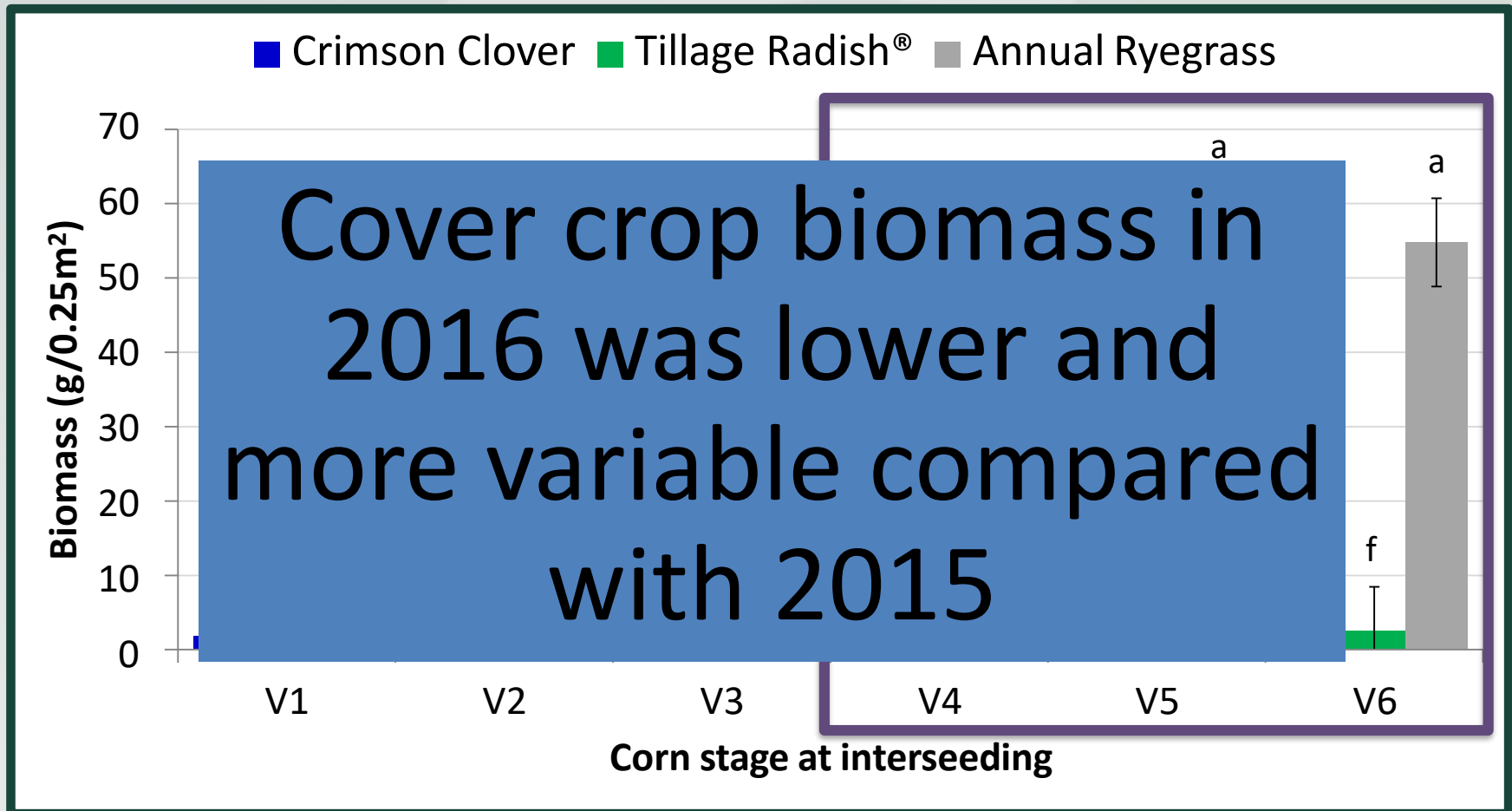
Did cover crops establish in corn?

Rainfall soon after interseeding affected cover crop establishment

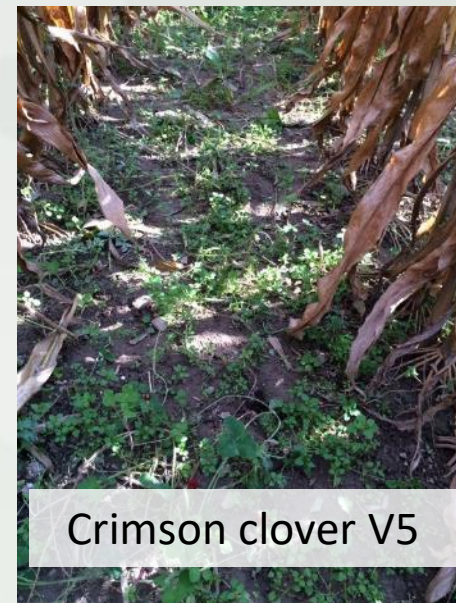
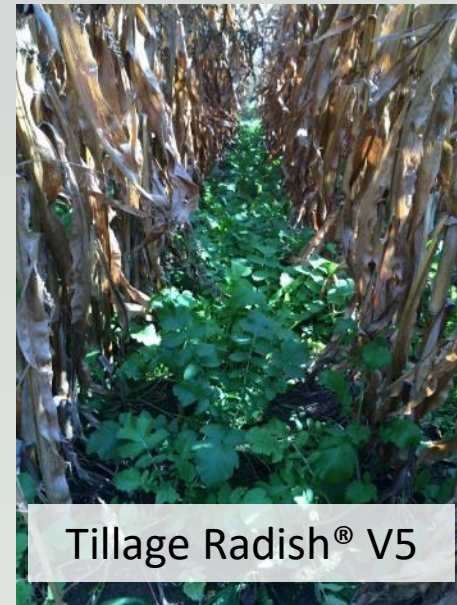
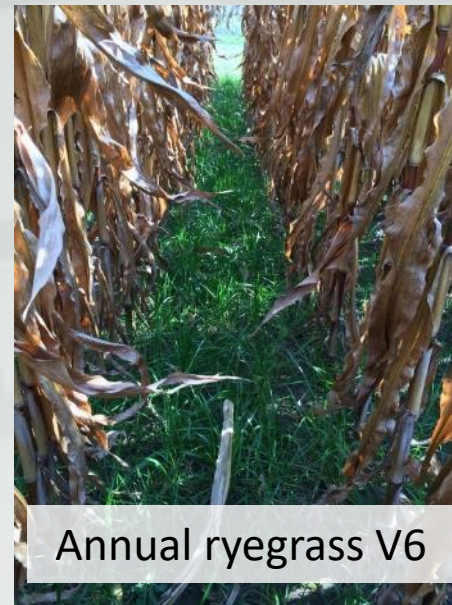


Green circles represent corn planting each year. Blue and orange circles represent interseeding dates.

Cover crop biomass was greatest for annual ryegrass at the V4-V6 interseedings – 2015

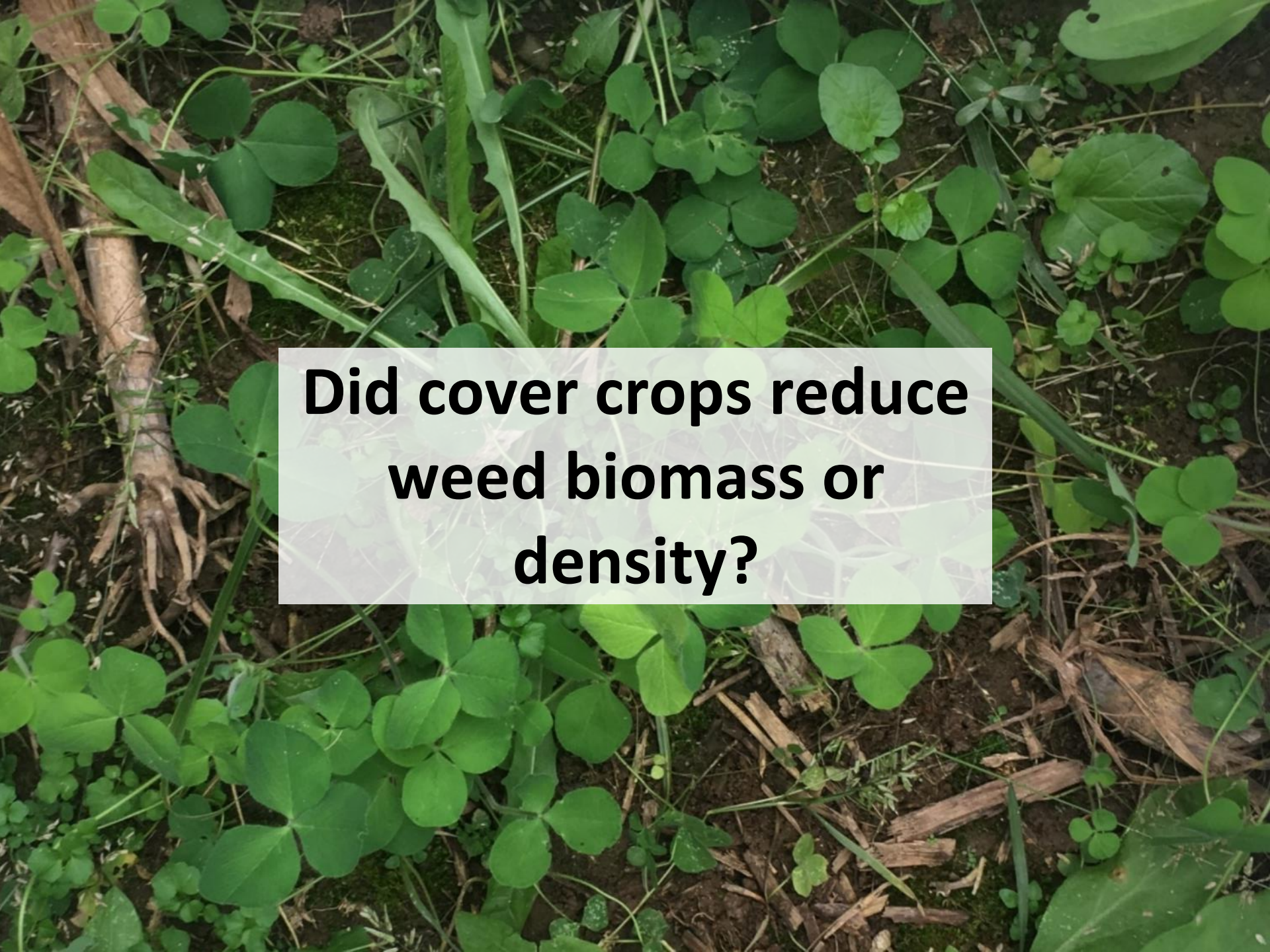


- **Cover Crop Density – 2015**
 - Annual ryegrass densities were greatest for the V5-V6 timings
 - Tillage Radish[®] densities were greatest at the V4-V5 timings
 - Crimson clover densities were greatest at the V5 timing



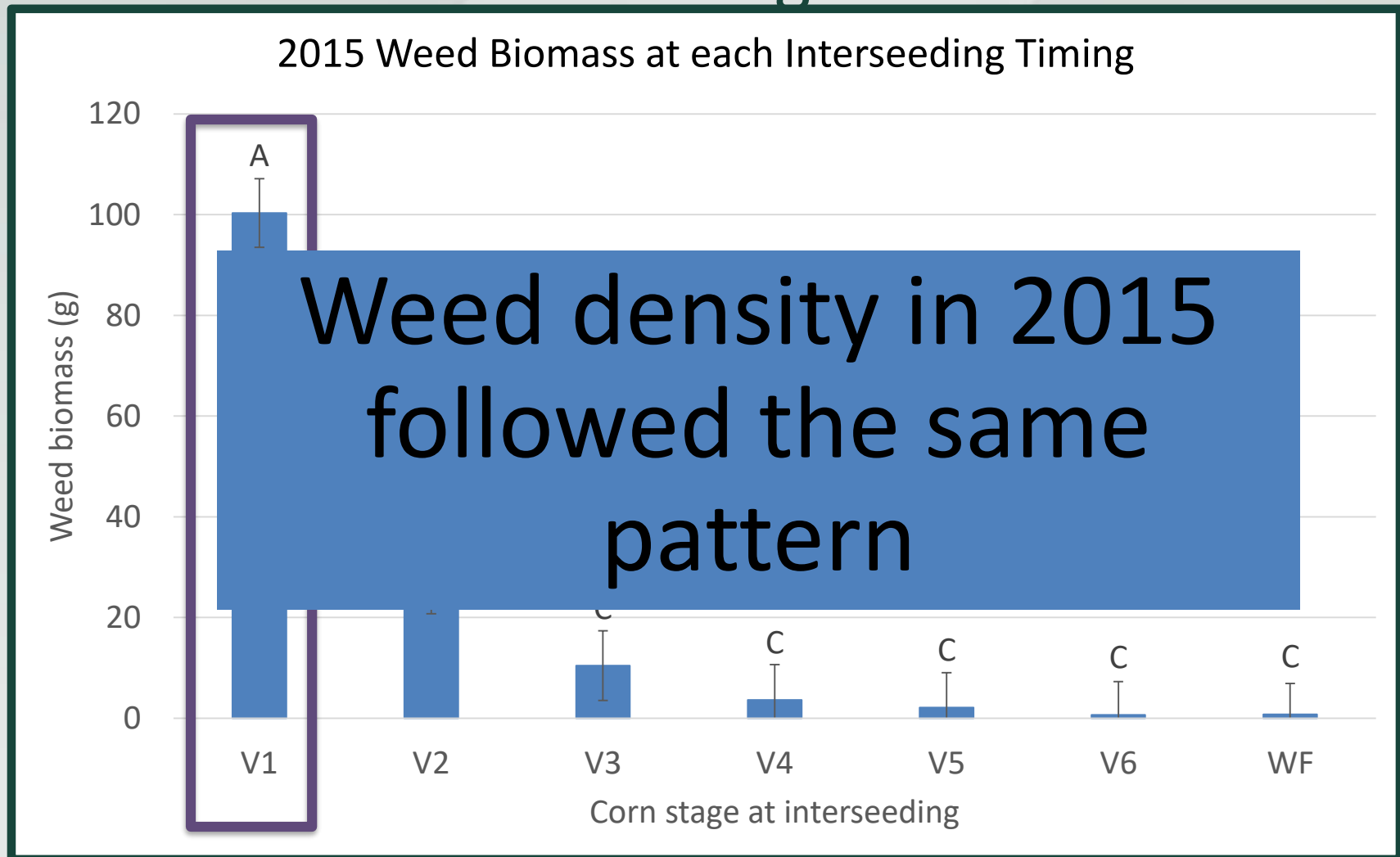
- Cover Crop Density – 2016
 - Densities for all three cover crops were greatest at the V7 interseeding timing



A photograph showing a field of green cover crops, likely vetch, with some weeds and dry plant matter. A semi-transparent white box is overlaid in the center, containing the text:

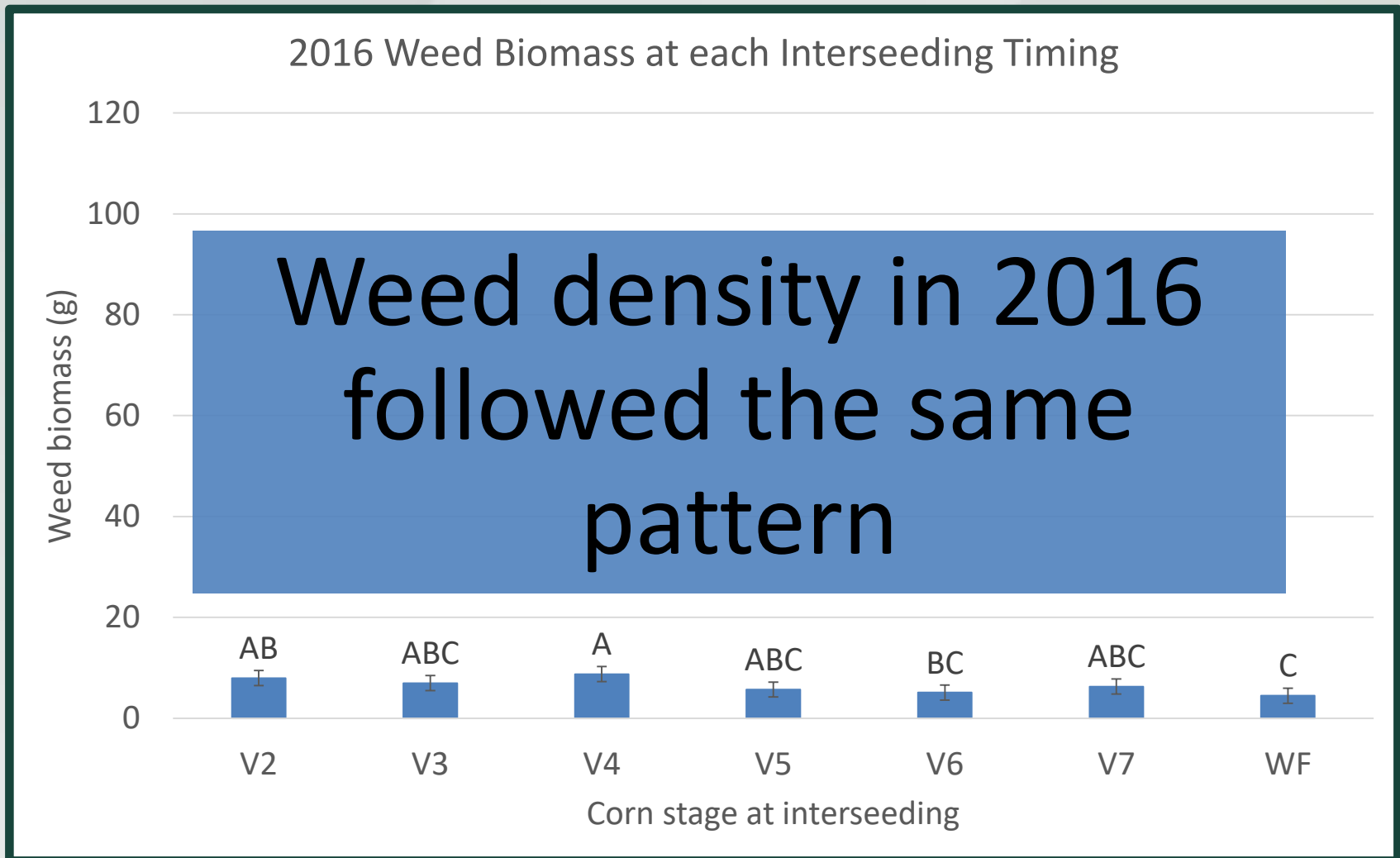
**Did cover crops reduce
weed biomass or
density?**

Weed biomass was greatest at the V1 interseeding - 2015



*Glyphosate was applied prior to each interseeding timing.

Weed biomass was more variable across interseeding timings – 2016



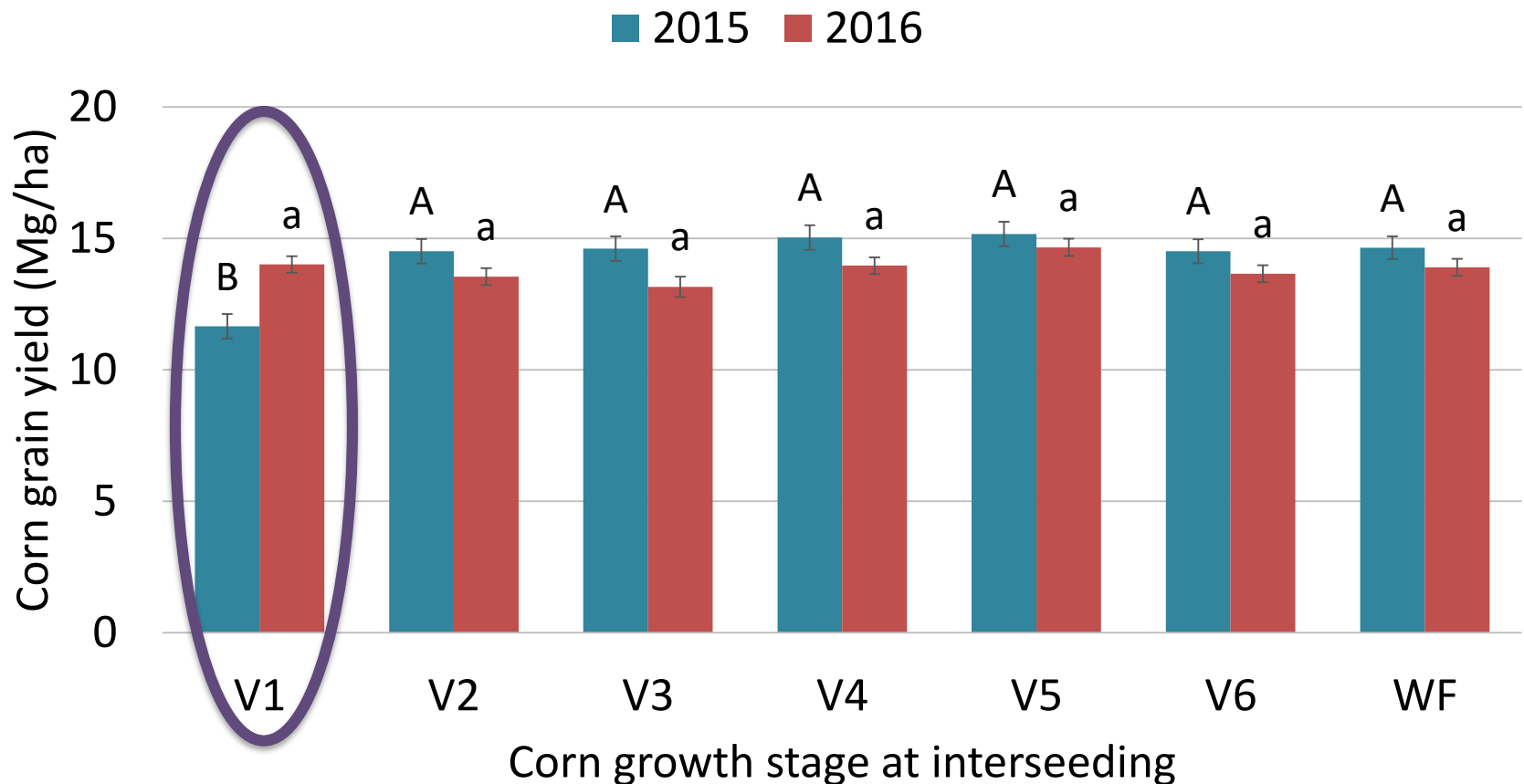
*Glyphosate was applied prior to each interseeding timing.



**Did cover crops
compete with corn?**

Grain yield was reduced at the V1 interseeding timing in 2015 only

2015 and 2016 Corn Grain Yield for each Interseeding Timing





**Did cover crops tolerate
preemergence herbicides?**

Annual ryegrass injury from PRE herbicides in 2016 - Greenhouse

<i>Herbicide</i>	<i>Rate</i>		
	1/4x	1/2x	1x
dimethenamid-P + saflufenacil	28 c	78 ab	89 a
dimethenamid-P	68 b	84 ab	95 a
saflufenacil	0 d	0 d	0 d
pyroxasulfone	37 c	78 ab	90 a
isoxaflutole	0 d	0 d	0 d

Green = 0-10%

Yellow = >10% and <50%

Red = 50-100%

Tillage Radish[®] injury from PRE herbicides in 2016 - Greenhouse

<i>Herbicide</i>	<i>Rate</i>		
	1/4x	1/2x	1x
dimethenamid-P + saflufenacil	0	1	0
dimethenamid-P	0	1	0
saflufenacil	0	0	1
pyroxasulfone	0	2	1
isoxaflutole	0	1	0

*Radish injury ratings were not significantly different from each other

Green = 0-10%
Yellow = >10% and <50%
Red = 50-100%

Crimson clover injury from PRE herbicides in 2016 - Greenhouse

<i>Herbicide</i>	<i>Rate</i>		
	1/4x	1/2x	1x
dimethenamid-P + saflufenacil	1 e	14 bcd	18 bc
dimethenamid-P	7 cde	17 bc	35 a
saflufenacil	1 e	0 e	1 e
pyroxasulfone	0 e	2 e	3 de
isoxaflutole	8 cde	19 b	23 b

Green = 0-10%

Yellow = >10% and <50%

Red = 50-100%

Crimson Clover
pyroxasulfone

UTC

0.25x

0.5x

1x



Crimson Clover
dimethenamid-P +
saflufenacil

UTC

0.25x

0.5x

1x



Crimson Clover
dimethenamid-P

UTC

0.25x

0.5x

1x



Crimson Clover
isoxaflutole

UTC

0.25x

0.5x

1x



A close-up, top-down view of a field. The ground is covered with a dense layer of dry, brown corn stalks and leaves, interspersed with patches of vibrant green grass. The lighting is bright, suggesting a sunny day, and the overall texture is rough and uneven.

What about in
the field?

Tolerance to PRE herbicides in 2016 – On-farm and Campus



- Tillage radish emergence was highly variable for the campus and on-farm sites
- Crimson clover emergence was poor at both locations

Annual ryegrass tolerance to PRE herbicides – 2016

	<i>Greenhouse</i>	<i>On-Farm (V3 Seeding)</i>	<i>Campus (V3 Seeding)</i>	<i>Campus (V6 Seeding)</i>
<i>Herbicide</i>	<i>Rate 1x</i>			
dimethenamid-P	95 a*	62.5 b	92.5 a	92.5 a
saflufenacil	0 b	7.5 c	25 b	17.5 b
pyroxasulfone	90 a	100 a	97.5 a	97.5 a
isoxaflutole	0 b	15 c	44 b	0 b

*Means within the column followed by the same letter are not different

Visual injury ratings for
greenhouse and on-
farm experiment:

-Green = 0-10%
-Yellow = >10% and <50%
-Red = 50-100%

Conclusions

- **Did cover crops establish in corn?**
 - **Cover crops established every year at all interseeding timings.**

Conclusions

- Cover crops established every year at all interseeding timings
- **Did cover crops compete with weeds?**
 - **Cover crops may have contributed to decreased weed densities in 2015 at the V4-V6 interseeding timings**
 - **At later interseeding timings, weeds were likely reduced by glyphosate and corn canopy closure as well**

Conclusions

- Cover crops established every year at all interseeding timings
- Cover crops may have contributed to decreased weed densities in 2015 at the V4-V6 interseeding timings
- **Did cover crops compete with corn?**
 - **Cover crops did not reduce corn grain yield**
 - **Weed pressure likely caused the yield reduction at V1 in 2015**

Conclusions

- Cover crops established every year at all interseeding timings
- Cover crops may have contributed to decreased weed densities in 2015 at the V4-V6 interseeding timings
- Cover crops did not reduce corn grain yield
- **Did cover crops tolerate preemergence herbicides?**
 - Annual ryegrass was tolerant to saflufenacil and isoxaflutole in the greenhouse
 - Tillage Radish[®] tolerated all herbicides in the greenhouse
 - Crimson clover was tolerant to saflufenacil and pyroxasulfone in the greenhouse

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Future Work

- **Continued evaluation of interseed cover crops in corn from V1-V7**

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- Continued evaluation of interseed cover crops in corn from V1-V7
- **Continued evaluation of interseeded cover crops on-farm**
 - **Fertility**
 - **Seeding rates**

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- Continued evaluation of interseeded cover crops on-farm
- **Determine the effects of varying cover crop interseeding rates on cover crop competitiveness with corn**

Future Work

- Continued evaluation of interseed cover crops in corn from V1-V7
- Continued evaluation of interseeded cover crops on-farm
- Determine the effects of varying cover crop interseeding rates on cover crop competitiveness with corn
- **Refine the integration of preemergence weed control practices in interseeded systems**

**Thank You!
Questions?**

Project **GREEN** 

 **center
seeds**

Michigan Corn Growers Association



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