



How competitive are interseeded cover crops in corn?

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Objectives:

- 1) Evaluate the competitiveness of three cover crops, annual ryegrass, crimson clover, and Tillage Radish® when interseeded into corn at the V2, V3, V4, V5, V6, V7 and R6 growth stages.
- 2) Evaluate the tolerance of three cover crops, annual ryegrass, crimson clover, and Tillage Radish®, interseeded at V2-3 and V5-6, to common soil-applied herbicide active ingredients in corn.
- 3) Determine the soil health benefits the year following interseeding annual ryegrass, crimson clover, and Tillage Radish® at the V1- V6 growth stages in corn.
- 4) Provide information on interseeding cover crops to Michigan corn producers.

2017 FIELD RESEARCH

Competitiveness of Cover Crops Trials:

Field experiments were conducted at the MSU Agronomy Research Farm (Campus; East Lansing, MI) and the Saginaw Valley Research and Extension Center (SVREC; Richville, MI) to evaluate the competitiveness of cover crops interseeded in corn. Annual ryegrass, crimson clover, and Tillage Radish® were interseeded into corn at six timings from the V2 through V7 growth stages and at corn senescence. Annual ryegrass at 15 lb/A, Tillage Radish® at 8 lb/A, crimson clover at 15 lb/A, and a mixture of the three crops (annual rye 10 lb/A; radish and crimson clover each at 2 lb/A) were broadcast interseeded in corn planted in 30-inch rows. Plots were sprayed with glyphosate at V1 and then prior to each interseeding timing except the V7 and senescence plots, which were all sprayed at V6 due to corn height. Cover crop and weed density counts were taken in two 0.25 m² quadrats at 30 days after cover crop interseeding (DACP) and again at peak biomass prior to corn harvest. Cover crop and weed biomass was collected from the quadrats at the time of final density counts. Plots measured 10 feet wide by 40 feet long and each treatment was replicated 4 times. Plots were harvested and corn grain moisture, test weight, and yield were measured.

Corn Herbicide Effects of Cover Crops Trials:

Field experiments were conducted on campus and at one on-farm location in Springport, MI to evaluate interseeded cover crop tolerance to corn preemergence herbicides. At both locations 12 preemergence herbicides were applied (Table 1). On campus, annual ryegrass, crimson clover, Tillage Radish®, Dwarf Essex Rape, red clover, and cereal rye were broadcast interseeded at the V3 and V6 corn growth stages. In Springport, annual ryegrass, crimson clover, and Tillage Radish® were interseeded at the V3 and V6 growth stages. An additional trial was conducted on campus to evaluate cover crop tolerance to 14 corn postemergence herbicides (Table 1). Herbicides were applied at the V2 growth stage. Annual ryegrass, Tillage Radish®, and crimson clover were interseeded at the V3 and V6 corn growth stages. Visual injury and density ratings for cover crops were completed 30 days after cover

crop planting (DACP) for all plots. Cover crop density was assessed also following corn harvest in the fall.

Greenhouse experiments evaluated the effects of the preemergence herbicides on cover crop density and injury. Cover crops were seeded into pots containing field soil, covered with a small layer of soil, and sprayed with each herbicide. Pots were watered by sub-irrigation to prevent herbicide leaching. Density counts and injury ratings were taken at 7, 14, 21, and 28 days after planting/spraying.

Table 1. Cover crops planted and herbicides applied at the Campus and Springport locations.

Campus and Springport PRE Herbicides	Campus POST Herbicides	MSU Cover Crops	Springport Cover Crops
Atrazine	Glyphosate	Annual Ryegrass	Annual Ryegrass
Bicyclopyrone	Laudis	Tillage Radish®	Tillage Radish®
Python	Impact	Crimson Clover	Crimson Clover
Resolve SG	Buctril	Dwarf Essex Rape	
Balance Flexx	Callisto	Cereal Rye	
Callisto	Atrazine (0.56 lb)	Red Clover	
Sharpen	Atrazine (1.1 lb)		
Dual II Magnum	Status		
Harness	Armezon PRO		
Outlook	Capreno		
Zidua	Halex GT		
Stinger	Cadet		
	Callisto + Atrazine (3 fl oz + 0.28 lb)		
	Callisto + Atrazine (3 fl oz + 0.5 lb)		
	Warrant		

COMPETITIVENESS OF COVER CROPS RESULTS:

SVREC

- Weed density and biomass were very low and likely did not affect cover crop establishment (data not shown).
- Annual ryegrass percent emergence 30 DACP was greatest at the V4-V7 timings (Figure 1).
- Tillage Radish® emergence was greatest at the V7 timing (Figure 1).
- Crimson clover emergence was similar across all interseeding timings (Figure 1).
- Ryegrass emergence was usually greater than Tillage Radish® which was greater than crimson clover (Figure 1).
- There was little rainfall following the V2-V5 interseedings. There were large rainfall events (>1-inch) following the V6 and V7 interseedings which may have resulted in increased emergence.
- Tillage Radish® biomass was greatest at the V2 interseeding timing. There were no other significant differences in cover crop biomass by interseeding timing. (Figure 2)
- Corn grain yield was reduced at the V2-V4 interseeding timings, when averaged over cover crop species. (Figure 5).

CAMPUS

- Weed densities were highest for V4-V7 compared with V2 and V3. Weed density was much higher compared with SVREC (data not shown).
- On campus, annual ryegrass and crimson clover percent emergence was greater from V2-V5 compared with V6 and V7.
- Tillage Radish® emergence, though not statistically significant, was generally greater at V2-V5 compared with V6 and V7.
- Species emergence ranked as follows: Tillage Radish® > annual ryegrass > crimson clover (Figure 3).
- Cover crop biomass was significantly reduced at the V6 and V7 timings for crimson clover, but also reduced for annual ryegrass and Tillage Radish®. This is likely due to the poor emergence at those timings (Figure 4).
- Corn grain yield was not reduced by interseeding of cover crops at any timing.

Figure 1. SVREC percent emergence of annual ryegrass, Tillage Radish®, and crimson clover interseeded in corn from the V2-V7 corn growth stages. Data with the same letter are not statistically different. Comparisons were made within the same crop, not across all crops.

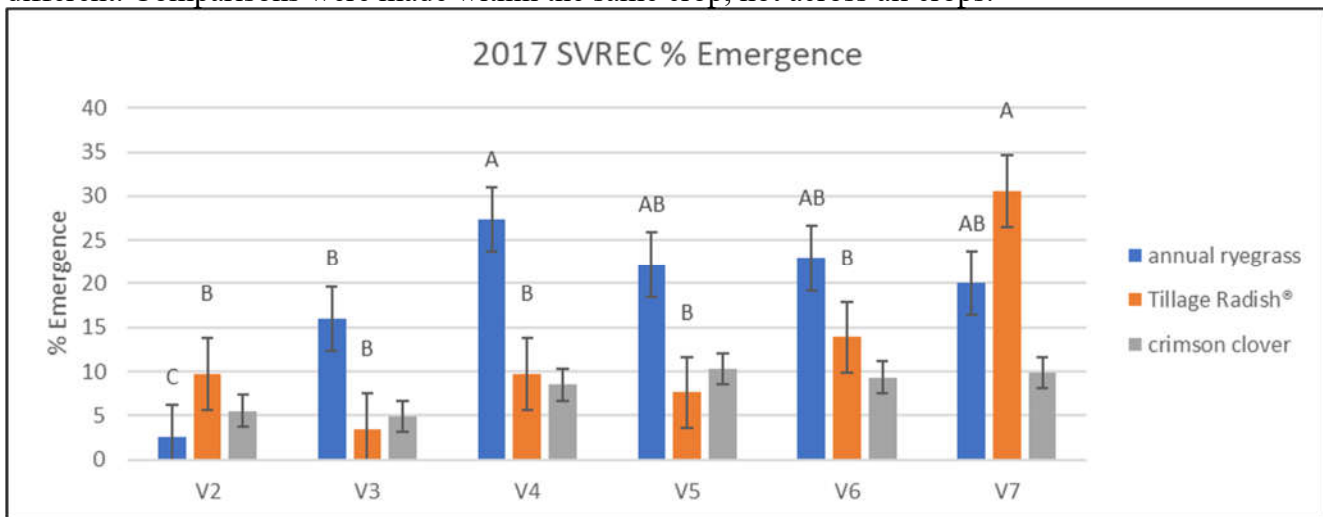


Figure 2. SVREC annual ryegrass, Tillage Radish®, and crimson clover dry biomass collected just prior to corn harvest. Data with the same letter are not statistically different. Comparisons were made within the same crop, rather than across all crops.

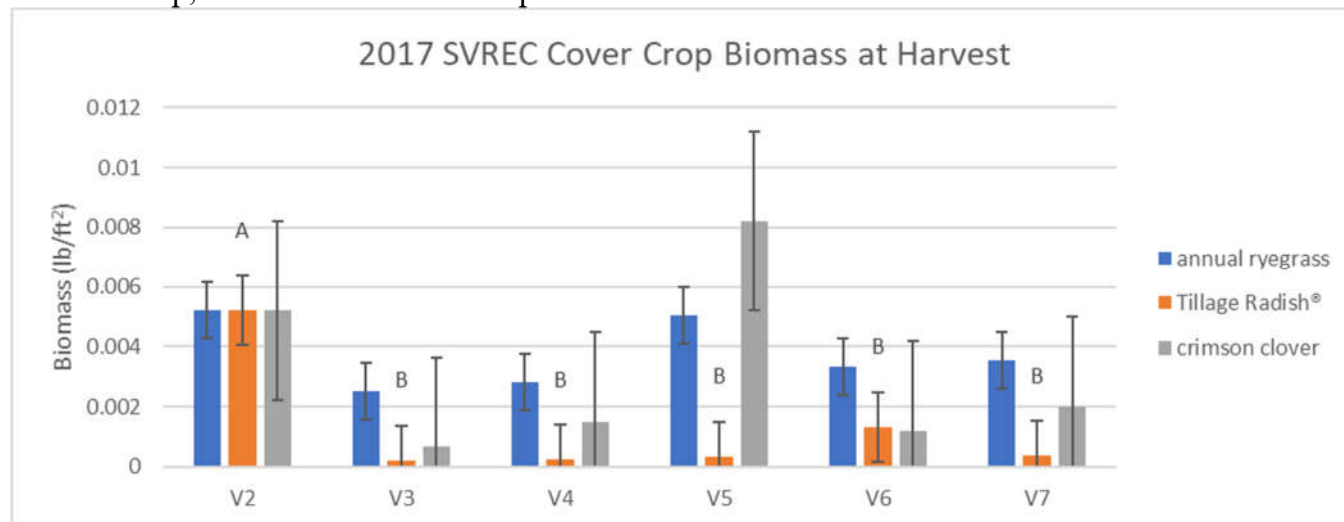


Figure 3. Campus percent emergence of annual ryegrass, Tillage Radish®, and crimson clover interseeded in corn from the V2-V7 corn growth stages. Data with the same letter are not statistically different. Comparisons were made within the same crop, not across all crops.

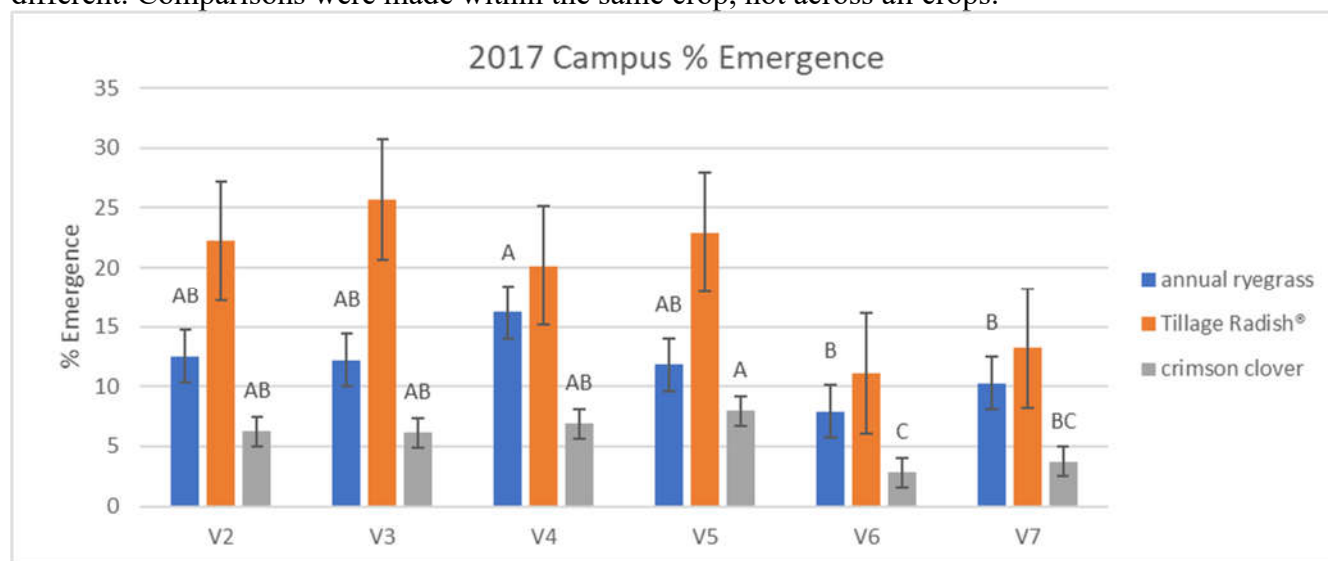


Figure 4. Campus annual ryegrass, Tillage Radish®, and crimson clover dry biomass collected just prior to corn harvest. Data with the same letter are not statistically different. Comparisons were made within the same crop, rather than across all crops.

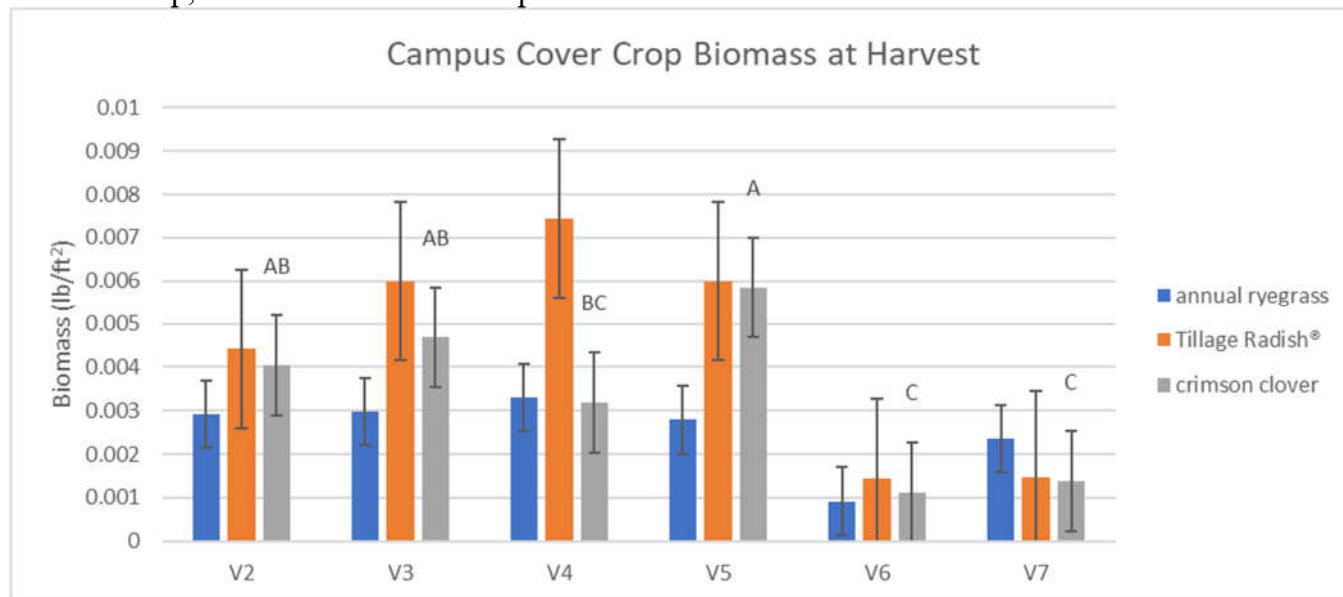
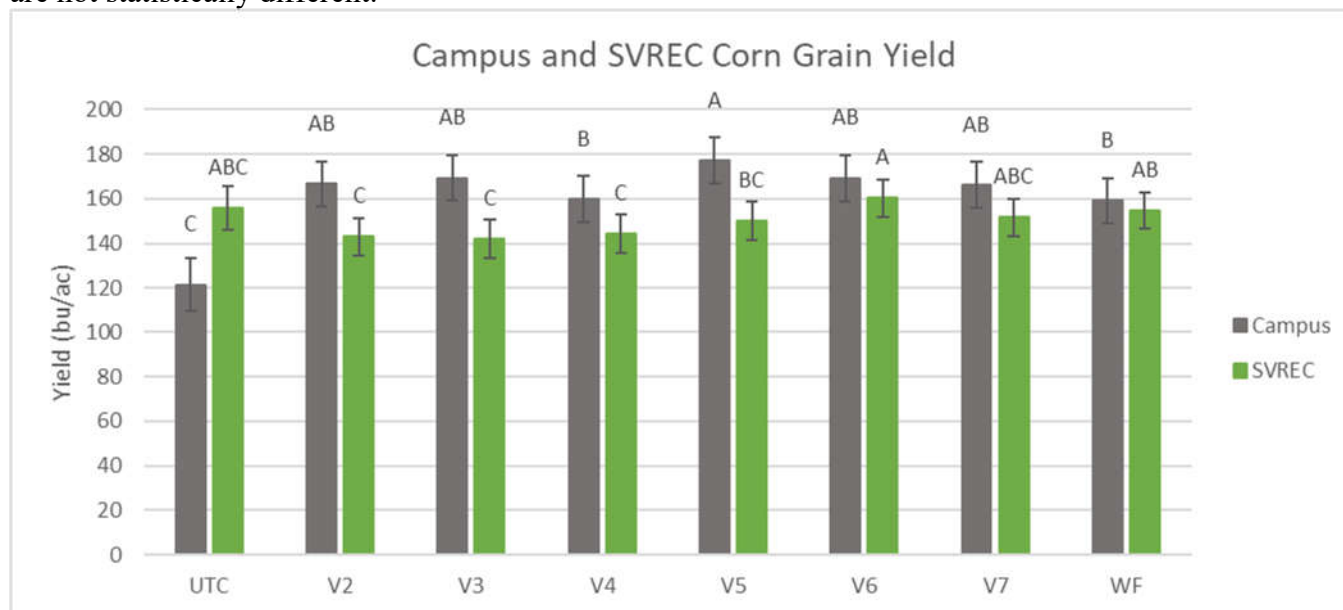


Figure 5. Campus and SVREC corn grain yields at each interseeding timing. Data with the same letter are not statistically different.



TOLERANCE TO HERBICIDES INITIAL RESULTS:

- Combining data from the greenhouse and all four site years (including 2016, 2 sites), preliminary results for the PRE herbicide evaluation are shown in Table 2.
- BIR is the only PRE herbicide included in the trial that was safe to use on all cover crops. This experiment will be repeated again in 2018. BIR is a component of Acuron and is a Group 27,

HPPD inhibitor herbicide. Alone, it does not provide broad-spectrum weed control. This experiment will be repeated in 2018

- Postemergence herbicide experiments will be repeated in 2018.

Table 2. Injury potential for annual ryegrass, Tillage Radish®, and crimson clover from corn preemergence herbicides. Cells in green indicate an herbicide x cover crop combination that is safe to use. Cells in red indicate an herbicide x cover crop combination that is likely to cause stand reduction and injury. More information is required for cells in white.

Herbicide	Annual Ryegrass	Tillage Radish®	Crimson Clover
Python			
Resolve			
Stinger			
Atrazine			
Sharpen			
Harness			
Outlook			
Zidua			
Dual II Magnum			
Bicyclopyrone			
Balance Flexx			
Callisto			
Verdict			

SOIL HEALTH IN CORN INITIAL RESULTS:

- Soil samples will be collected in the spring of 2018 from the 2017 crops. These will be analyzed in 2018.
- Results from the spring sampling in 2016 and 2017 show that there are no differences in soil aggregation following one year of cover crops.
- Annual ryegrass plots had less nitrate and ammonium in soil samples collected in spring 2016 compared with crimson clover and Tillage Radish®. Since annual ryegrass was still living at the time of sampling, the living biomass still held the nitrogen.

2015-2017 COMBINED RESULTS

- Weed density and biomass were highest at V2 and V3. Weed control is important in interseeded cover crop systems.
- Annual ryegrass, crimson clover, and Tillage Radish® emerged in every year at each interseeding timing (data not shown).
- Annual ryegrass and Tillage Radish® emergence and fall densities were higher compared with crimson clover (Figure 6).

- Annual ryegrass produced the greatest biomass compared with crimson clover and Tillage Radish®. For all cover crops, the V5 interseeding timing generally produced the greatest biomass.
- Corn yield was not affected by cover crops at any interseeding timing (Figure 7). Yield was only reduced when weeds were not controlled.

Figure 6. Cover crop density measured at corn harvest for each interseeding timing. All site years are included except 2016 due to poor conditions for cover crop establishment. Data with the same letter are not statistically different.

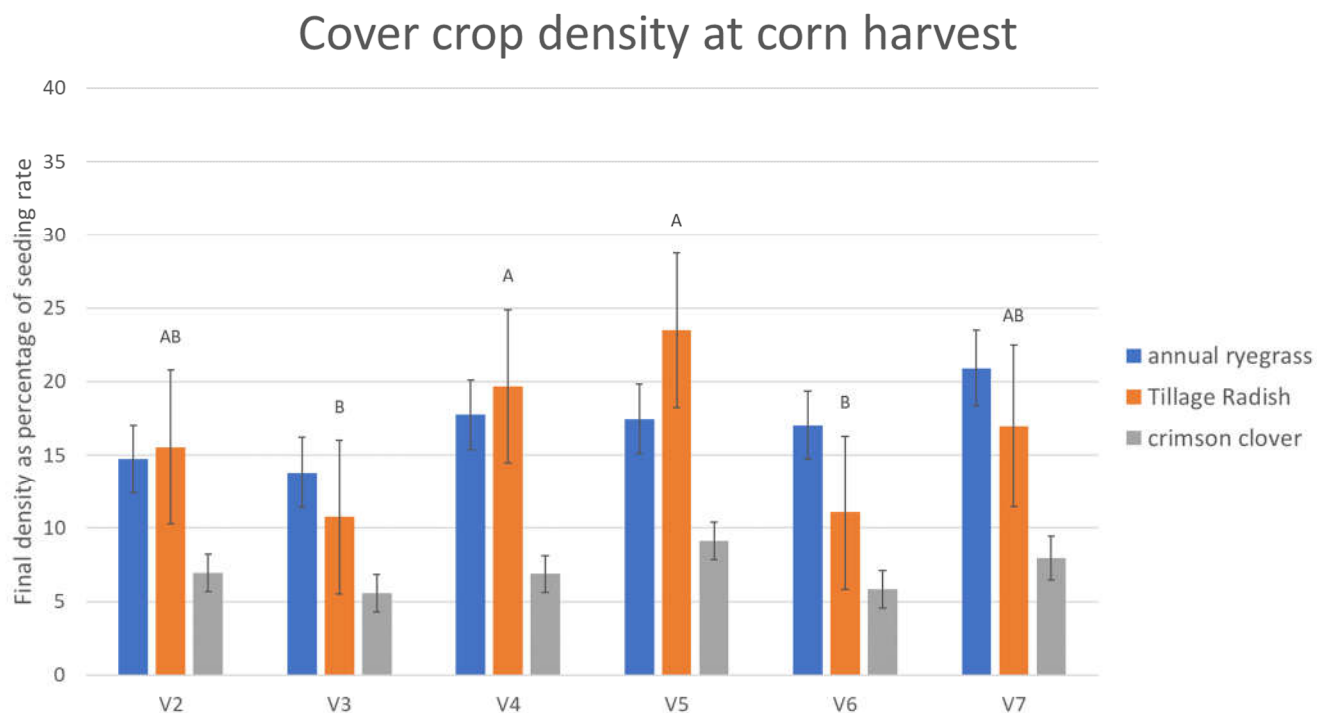


Figure 7. Cover crop biomass for each interseeding timing. All site years are included except 2016 due to poor conditions for cover crop establishment. Data with the same letter are not statistically different.

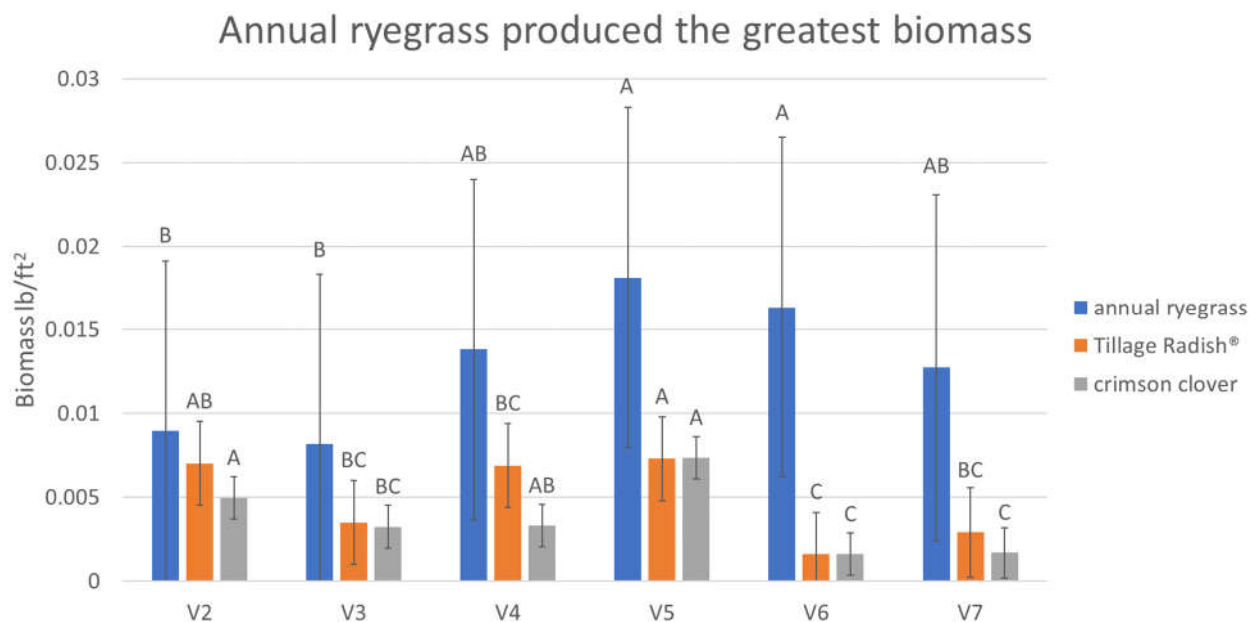
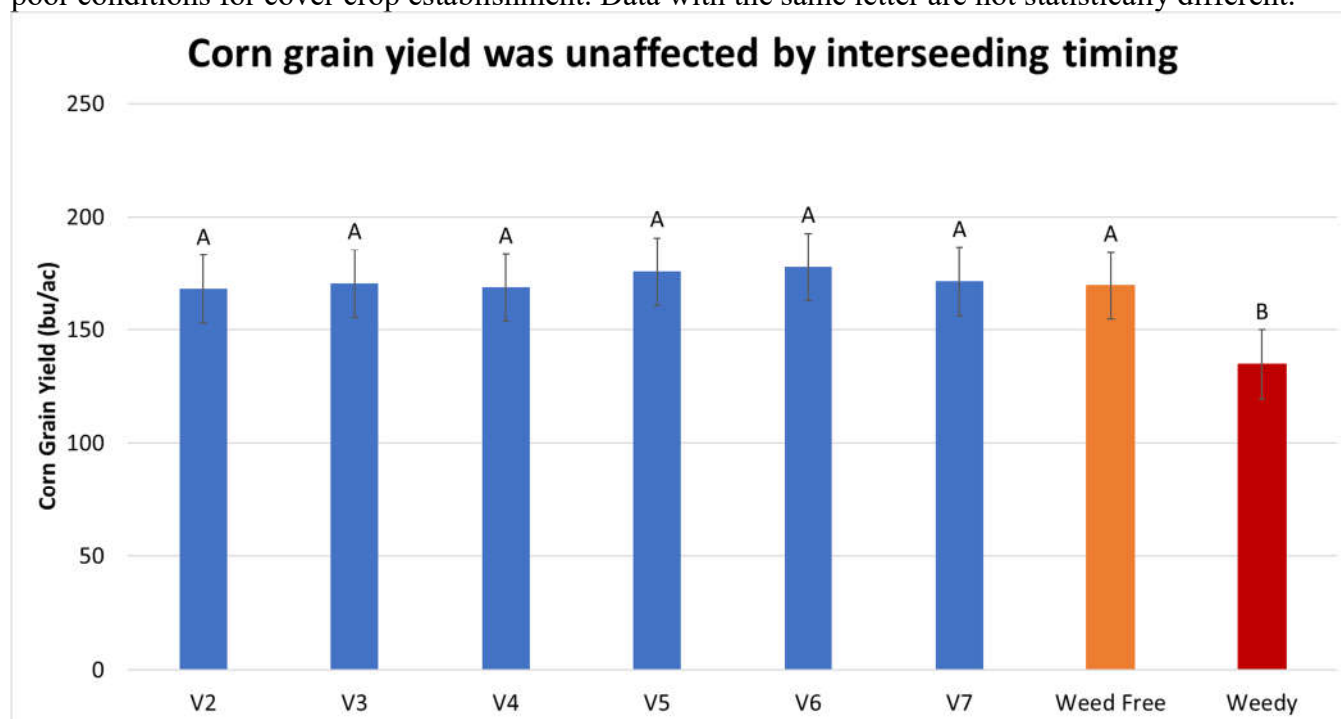


Figure 8. Corn grain yield for each interseeding timing. All site years are included except 2016 due to poor conditions for cover crop establishment. Data with the same letter are not statistically different.



CORN INDUSTRY BENEFITS:

- If weeds are controlled, farmers can interseed cover crops from V2-V7 without causing a corn yield reduction. Weeds were never an issue at the V5 interseeding timing or later.
- Cover crop establishment and biomass was generally highest at the V4 interseeding timing or later.
- There are soil-applied herbicide options for single species, but more research is needed to fine-tune these results.
- Farmers will adopt interseeded cover crops in corn rotations and increase Michigan farmer profitability by improving cover crop stand establishment, suppressing weeds, improving nutrient utilization, and enhancing soil health



Research reports for all projects funded by the
Corn Marketing Program of Michigan are available
online at www.micorn.org.