Evaluation of Cover Crop Programs in Field Corn at Rochester, MN in 2018.

Miller, Ryan P., Stahl, Lizabeth A.B., Goplen, Jared J., Behnken, Lisa M., and Fritz R. Breitenbach

The objective of this trial was to evaluate the influence of preemergence herbicides and mechanical incorporation on cover crop establishment and grain yield in field corn in southeastern Minnesota. The research site was a loamy sand series with a pH of 6.2, O.M. of 2.2%, and soil test P and K levels of 16 ppm and 117 ppm, respectively. Fertilizer was also applied in the spring, ahead of a planting, on April 30, 2018 at a rate of 120-52-120-24 (N-P-K-S) lbs/A. The field was disked and field cultivated once prior to planting. The previous crop was soybean. The corn hybrid, DEKALB DKC51-38RIB, was planted May 7, 2018 at a depth of 2 inches in 30-inch rows at a rate of 32,000 seeds per acre. A split-plot randomized complete block design with four replications was utilized for this trial. The main plot treatment was either incorporation or no incorporation of the cover crop seed. Subplots consisted of preemergence (PRE) herbicides treatments including: no preemergence herbicide; dimethenamide-P (Outlook) at 16 fl oz a^{-1}; saflufenacil (Sharpen) at 3 fl oz a^{-1}; dimethenamide-P and saflufenacil (Verdict) at 15 fl oz a^{-1}. All preemergence treatments were followed by a postemergence (POST I) treatment of glyphosate (Roundup Powermax) at 32 fl oz a^{-1}. A cover crop blend consisting of *Secale cereale* (cereal rye) at 50 lb a^{-1} , *Brassica napus* (dwarf 'essex' rape) at 6 lb a^{-1} , and *Trifolium alexandrinum* (berseem clover) at 8 lb a^{-1} was hand seeded 6 days after application (DAA) of the Roundup Powermax into V5 corn. After hand seeding the cover crop, a Lilliston rolling cultivator was used to incorporate the seed on plots receiving an incorporation treatment (POST II). The Lilliston rolling cultivator was run at 7-8 MPH and was set to cultivate soil away from the base of the corn stalk. All herbicide applications were made at 4 MPH with a tractor-mounted sprayer delivering 15 GPA at 40 PSI using 110015 TTI nozzles. Herbicide evaluations of the plots were taken May 31 and June 7. On June 28 cover crop density was determined by counting plants in three 1.0 ft^2 quadrats per subplot. The center two rows of each plot were machine harvested on November 1, 2018. Application dates, environmental conditions and weed stages are reported in Table 1. Cover crop components are in Table 2. Performance ratings for common lambsquarters, common waterhemp, and grass control, can be found in Table 3. Cover crop densities by cultivation and herbicide treatment are in Tables 4 and 5 respectively. Crop yield data are Tables 6 and 7.

DISCUSSION

Preemergence herbicide applications generally resulted in greater than 90% weed control at 17 DAA, the exception was Sharpen herbicide which provided no grass weed control. In general, cultivation/incorporation resulted in better overall cover crop establishment. When averaged across all PRE treatments, incorporation of the cover crop blend resulted in stands with 64% more plants than non-incorporated. Components of the cover crop blend had varied response to cultivation and PRE herbicides (Tables 4 and 5). For example, cultivation or preemergence herbicide treatment did not affect cereal rye establishment. Berseem clover establishment was greatest with cultivation and preemergence herbicide effects were inconsistent. Dwarf 'essex' rape establishment was better where cultivation was implemented and with either Outlook or no preemergence herbicide treatments. *Amaranthus tuberculatus* (waterhemp) and *Chenopodium album* (common lambsquarters) populations, which were evaluated the same time as cover crop establishment, were not affected by cultivation or preemergence herbicide. Cover crop densities declined during August and were almost nonexistent at the time of harvest. The exception was Dwarf 'Essex' Rape, which had a substantial number of surviving plants in the plots that were cultivated and had no preemergence herbicide applied. Cover crop density will be evaluated again in spring 2019.

Incorporation of the cover crop seemed to be the most important factor for successfully establishing a cover crop stand in V5 corn. However, incorporation of the cover crop seed or enhanced cover crop density due to incorporation had a negative impact on corn yield, reducing yield by 11 bu/a (Table 6). Results suggest that attempting to establish a cover crop in V5 corn could be a high-risk endeavor. Further study is needed regarding cover crop establishment and interactions with weed management and cash crop yield. (University of Minnesota Extension Regional Office, Rochester.)

Table 1. Application timing, plant stage, environmental conditions.

Date	**5/8**	**6/1**	**6/7**
Treatment	PRE	POST I	POST II
	(A)	(B)	(C) Cultivation
Temperature (F)			
Air	72	76	
Soil	59.5		
Relative Humidity (%)	37	74	
Wind (mph)	17	10	
Soil Moisture	Normal	Normal	
Corn			
Stage			
Height (in)			
Giant Ragweed			
Weed Density (ft^2)			
Height (in)	0.0	0.0	0.0
Common Waterhemp			
Weed Density (ft^2)			
Height (in)	0.0	3.75	0.0
Common Lambsquarter			
Weed Density (ft^2)			
Height (in)	0.0	2.75	0.0
Grass			
Weed Density (ft^2)			
Height (in)	0.0	4.25	0.0
Rainfall after each application (inch)			
Week 1	2.33	0.51	0.93
Week 2	0.35	0.42	1.87
Week 3	0.77	2.63	2.89

Table 2. Cover Crop Varieties and Seeding Rate

Secale cereale (cereal rye)	50 lb per acre
Brassica napus (Dwarf 'Essex' rape)	6 lb per acre
Trifolium alexandrinum (berseem clover)	8 lb per acre

Table 3. Percent weed control 17 days after application.

HERBICIDE	RATE		TIME of APPLICATION	Common Lambsquarter		Common Waterhemp		Grasses	
SHARPEN	3	fl oz/a	A	99.0	a	93.8	b	0.0	b
OUTLOOK	16	fl oz/a	A	91.4	b	99.0	a	99.0	a
VERDICT	15	oz/a	A	99.0	a	99.0	a	98.4	a
NO PRE CHECK			A	0.0	c	0.0	c	0.0	b
LSD P=.10				0.70		1.08		0.77	

Table 4. Influence of cultivation on cover crop and weed density per square foot 21 days after seeding.

TREATMENT	RYE		CLOVER		RAPE		WATERHMP		COLQ	
CULTIVATION	8.9	ns	7.5	a	11.9	a	0.8	ns	4.2	ns
NO CULTIVATION	7.4	ns	4.2	b	5.6	b	0.9	ns	3.4	ns
LSD P=.10	2.2		2.2		1.7		0.5		3.7	

Table 5. Influence of PRE herbicide on cover crop and weed density per square foot 21 days after seeding.

HERBICIDE	RATE		APPLICATION	RYE		CLOVER		RAPE		WATERHMP		COLQ	
SHARPEN	3	fl oz/a	A	9.0	ns	7.9	a	7.3	b	1.2	ns	2.5	ns
ROUNDUP POWERMAX	32	fl oz/a	B										
N-Pa-K AMS	3	qt/a	B										
OUTLOOK	16	fl oz/a	A	6.8	ns	4.8	b	10.5	a	0.1	ns	2.4	ns
ROUNDUP POWERMAX	32	fl oz/a	B										
N-Pa-K AMS	3	qt/a	B										
VERDICT	15	oz/a	A	8.6	ns	6.5	ab	7.0	b	0.7	ns	3.2	ns
ROUNDUP POWERMAX	32	fl oz/a	B										
N-Pa-K AMS	3	qt/a	B										
NO PRE CHECK			A	8.1	ns	4.3	b	10.4	a	1.4	ns	7.0	ns
ROUNDUP POWERMAX	32	fl oz/a	B										
N-Pa-K AMS	3	qt/a	B										
LSD P=.10				2.24		2.19		2.22		1.50		3.83	

Table 6. Corn yield as influenced by incorporation of cover crop with cultivation.

TREATMENT	MOISTURE (%)		BU/A	
CULTIVATION	15.3	ns	189	b
NO CULTIVATION	15.3	ns	200	a
LSD P=.10	0.16		5.5	

Table 7. Corn yield as influenced by preemergence herbicide program.

HERBICIDE	RATE		APPLICATION TIMING	MOISTURE (%)		BU/A	
SHARPEN	3	fl oz/a	A	15.3	ns	194	ab
ROUNDUP POWERMAX	32	fl oz/a	B				
N-Pa-K AMS	3	qt/a	B				
OUTLOOK	16	fl oz/a	A	15.2	ns	191	b
ROUNDUP POWERMAX	32	fl oz/a	B				
N-Pa-K AMS	3	qt/a	B				
VERDICT	15	oz/a	A	15.4	ns	209	a
ROUNDUP POWERMAX	32	fl oz/a	B				
N-Pa-K AMS	3	qt/a	B				
NO PRE CHECK			A	15.2	ns	184	b
ROUNDUP POWERMAX	32	fl oz/a	B				
N-Pa-K AMS	3	qt/a	B				
LSD P=.10				0.38		15.6	

The Influence of Preemergence Herbicides and Mechanical Incorporation on Cover Crop Establishment and Grain Yield in *Zea mays*

UNIVERSITY OF MINNESOTA | EXTENSION

Lizabeth A.B. Stahl, Ryan P. Miller, Jared J. Goplen, Lisa M. Behnken,
University of Minnesota Extension

Introduction

There is considerable interest in using cover crops in MN, but there are many questions and very few answers. For example, will cover crops work with the use of residual preemergence herbicides in the cash crop? If they do work, which species will perform best? Should I incorporate the cover crop seed? Is seeding and/or incorporation of cover crops into V5 corn detrimental? In 2018, we initiated a project to gain experience with cover crops and to begin addressing some of these questions.

Methods

Field research was conducted at Rochester, MN in 2018 to determine the influence of preemergence herbicides and incorporation on cover crop establishment and grain yield in *Zea mays.* A split-plot randomized complete block design with four replications was used. No incorporation or incorporation with a Lilliston rolling cultivator (Figure A) were assigned randomly to each whole plot. Pre-emergence herbicides (PRE) were randomly assigned to subplots, Table 1. Cover crops and seeding rate are listed in Table 2. Corn hybrid variety 'DKC 51-38' was planted 2 inches deep in 30-inch rows at a rate of 32,000 seeds per acre on May 7, 2018. Herbicide applications were made at 4 MPH with a tractor-mounted sprayer delivering 15 GPA at 40 PSI using 110015 TTI nozzles. Treatments were made according to label instructions and adequate rainfall was received after each treatment. Common lambsquarters, tall waterhemp and grasses were visually rated for percent control. Cover crop density was determined by counting plants in three 1.0 ft^2 quadrats per plot, 21 days after seeding. Plots were machine harvested and yields were calculated and adjusted to 15% moisture.

Table 1. Preemergence Herbicide Treatments	
dimethenamide-P (Outlook)$_a$	16 fl oz a^{-1}
saflufenacil (Sharpen)$_a$	3 fl oz a^{-1}
dimethenamide-P + saflufenacil (Verdict)$_a$	15 fl oz a^{-1}
no preemergence herbicide$_a$	

a. All preemergence treatments were followed by a postemergence treatment (POST) of glyphosate (Roundup Powermax) at 32 fl oz a^{-1}

Table 2. Cover Crop Varieties and Seeding Rate	
Secale cereale (cereal rye)$_a$	50 lb a^{-1}
Brassica napus (Dwarf 'Essex' rape)$_a$	6 lb a^{-1}
Trifolium alexandrinum (berseem clover)$_a$	8 lb a^{-1}

a. Component in cover crop blend, hand seeded into V5 corn, 6 days after POST

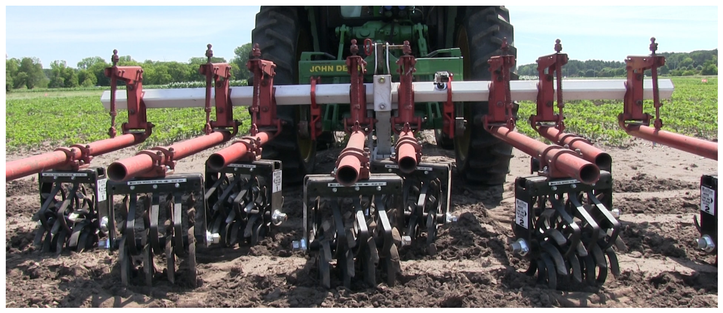
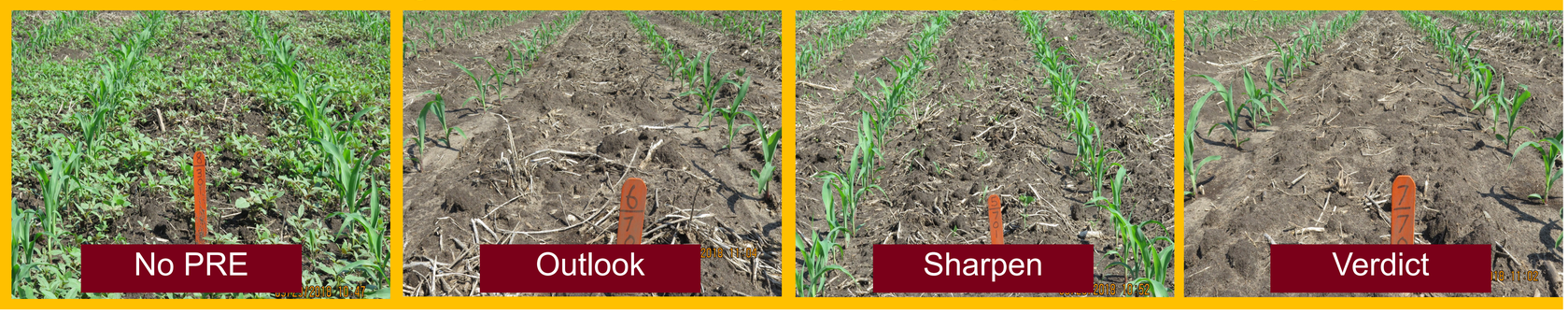


Figure A. Lilliston cultivator used to incorporate cover crop seed 6 days after POST. Cultivator ran at 7-8 MPH and set to move soil away from corn plants.

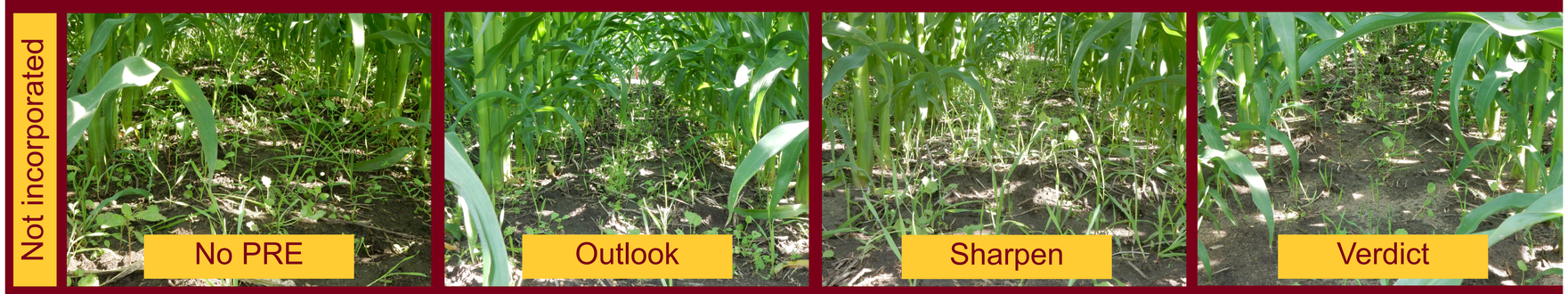
Results

Preemergence weed control 17 days after application (DAA)

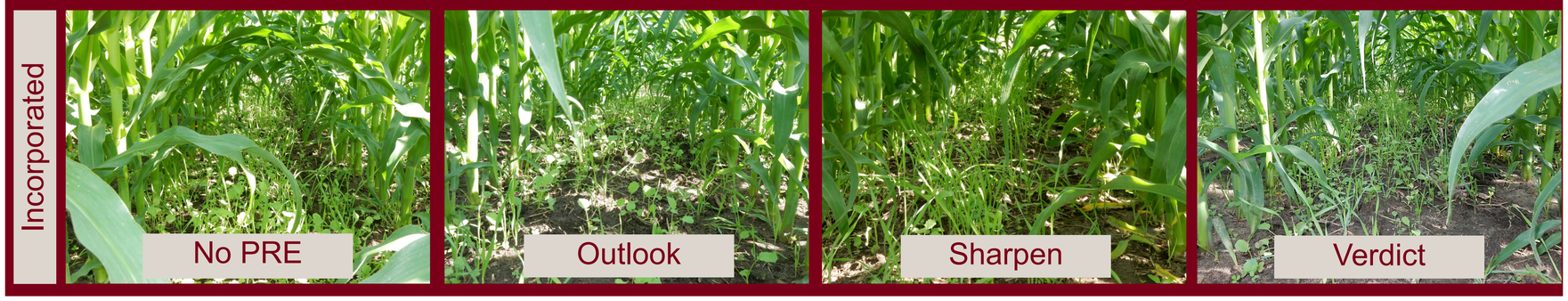


- Where PRE was applied, over 90% broadleaf weed control was observed 17 DAA and prior to POST herbicide.
- Waterhemp control with Sharpen was slightly lower at 94% compared to 99% for Outlook and Verdict. Also, Sharpen gave no grass control.
- Common lambsquarters control with Outlook was 93% compared to 99% for Sharpen and Verdict.

Cover crop establishment with no incorporation 18 days after seeding



Cover crop establishment after incorporation with Lilliston cultivator 18 days after seeding



- Incorporation of cover crop blend resulted in stands with 64% more plants than non-incorporated, when averaged across all PRE treatments.
- Rye establishment was not affected by incorporation or herbicide treatment.
- Dwarf 'Essex' rape establishment was better (more plants per square foot) when incorporated. It also established more successfully with either Outlook or no PRE. Whereas, Verdict and Sharpen adversely affected its establishment.
- Berseem clover establishment was greatest with incorporation and preemergence herbicide effects were inconsistent.

Summary

- Cover crop densities declined during the month of August and were mostly nonexistent at harvest time.
- The exception, Dwarf 'Essex' rape had a substantial number of surviving plants at harvest in plots with incorporation and without a PRE herbicide. Plots will be further evaluated in spring 2019.
- Of the PRE herbicides, Outlook resulted in the best initial rape establishment but had the lowest corn yield (191 bu/a).
- Verdict provided the best weed control, poorest cover crop establishment and highest corn yield (209 bu/a).
- Incorporation was the most important factor in successful cover crop establishment into V5 corn.
- However, incorporation of the cover crop seed into V5 corn or enhanced cover crop density due to incorporation, had a negative impact on corn yield (reduced by 11 bu/a).
- Results suggest that establishing cover crops in V5 corn could be a high risk endeavor.
- Further study is needed regarding cover crop establishment, weed management and cash crop interactions.