Summary

Weed Management in Corn 2024.

Michael Flessner. Virginia Tech.

Weeds remain a constant challenge in Virginia corn production. In an effort to provide research-based information on the most effective herbicides and other weed management techniques, 31 herbicide treatments were evaluated. Notable herbicides evaluated included Reviton, Rapidicil, and Voraxor (all new PPO inhibiting herbicides used in the preplant burndown). Several comparisons were made with these herbicides and tank-mixes thereof to established standards. Additionally, herbicide programs in corn were compared. Accordingly, the Virginia Cooperative Extension Pest Management Guide for Field Crops (http://pubs.ext.vt.edu/456/456-016/456-016.html) and the Mid-Atlantic Field Crop Weed Management Guide (https://extension.psu.edu/mid-atlantic-field-crop-weed-management-guide) were updated with the latest findings from herbicide evaluation research conducted in the Mid-Atlantic region.

Cover crop studies were conducted to examine new species and approaches for corn production. Black oats was overall comparable to cereal rye, having similar biomass, C:N, and weed suppression while having a lower lignin content. Famers have reported that black oats is easier to plant through than cereal rye, although that was not evaluated in this research. Another study examined planting green into hairy vetch after cereal rye was terminated about a month before planting. This approach allows farmers to capitalize on financial (extra subsidy for cereal rye) and agronomic (fall erosion protection and nutrient scavenging) benefits. Results indicate that while cereal rye did reduce hairy vetch biomass production and to a lesser extent, nitrogen accumulation, the system was successful in providing similar levels of weed suppression. Nitrogen accumulation was still 89 kg/ha (about 80 lbs/a) in the worst performing hairy vetch. Other cover crop research was conducted, but analysis of results is ongoing and will be completed prior to this project's end on June 30, 2025.

From these results as well as results obtained from previously funded research by the Virginia Corn Board, Dr. Flessner's weed science extension program delivered 17 presentations reaching an audience of >900 in 2024 that included information obtained through Virginia Corn Board sponsored research to producers, agronomists, industry groups, and other stakeholders, in addition to other communications.

VIRGINIA CORN BOARD
PROJECT REPORT – 2024

Title: **Weed Management in Corn 2024**

Objectives:
1) Evaluate various preemergent and postemergent herbicides and programs for weed control in corn and burndown control of cover crops.
2) Capitalizing on cereal rye cost share and winter protection for hairy vetch before corn.
3) Determining reduced herbicide inputs with hairy vetch before corn.
4) Evaluate black oats as a cover crop for weed suppression in corn.
5) Disseminate findings and best practices through Extension.

Objective 1: Evaluate various preemergent and postemergent herbicides and programs for weed control in corn and burndown control of cover crops.

Background

The Weed Science Society of America considered corn yield in the US from 2007 to 2013 in the absence of herbicides. Without effective herbicides, they estimated that weeds would cause a 52% corn yield loss (https://doi.org/10.1614/WT-D-16-00046.1). In 1992, it was estimated that weeds caused a 1 to 15% loss in corn yield (http://www.jstor.org/stable/4045287). Among the most problematic weeds are those which are herbicide resistant. Clearly, effective weed management is necessary to maximize corn yield (https://pubs.ext.vt.edu/content/dam/pubs_ext_vt_edu/PPWS/ppws-101/PPWS-101.pdf). Notably, these include glyphosate (group 9) and ALS-inhibiting herbicide (group 2) resistant Palmer amaranth and common ragweed in Virginia.

In an effort to provide research-based information on the most effective herbicides, the Virginia Cooperative Extension Pest Management Guide for Field Crops (http://pubs.ext.vt.edu/456/456-016/456-016.html) and the Mid-Atlantic Field Crop Weed Management Guide (https://extension.psu.edu/mid-atlantic-field-crop-weed-management-guide) are updated annually with the latest findings from herbicide evaluation research conducted in the Mid-Atlantic region. Additionally, Dr. Flessner's extension program delivers numerous presentations per year to various stakeholder groups across Virginia. As new herbicides are introduced to the market and weeds' response to herbicides changes as resistance develops to existing herbicides, research must be conducted to evaluate and corroborate information provided in the guide.

One way to help manage herbicide resistant weeds is through the use of cover crops, which have been shown to reduce summer annual weeds (https://doi.org/10.1017/S0890037X00040859). Research previously funded by the Virginia Corn Board indicates that approximately 7500 lbs of cover crop biomass per acre can result in 75% weed suppression for approximately 6 weeks after cover crop termination. This level of biomass means farmers must maximize cover crop biomass, which generally does not occur until approximately May 1. Since most grain corn is planted in April, corn farmers are not able to fully utilize cover crops for weed management. Planting into actively growing cover crops, known as "planting green," allows cover crop to continue to grow and acquire additional biomass until terminated by herbicides. Thus, weed suppression from cover crop residue should increase relative to termination prior to corn planting. Previous research funded by the Virginia Corn Board indicated exactly that by delaying termination of cover crops from 2 weeks prior to planting until at or 2 weeks after planting, cover crop biomass increased resulting in improved weed suppression while, importantly, maintaining corn yield. There are potential drawbacks to planting green, the most obviously of which is the cover crop competing with corn in the sensitive early establishment phase. Most farmers are planting green and terminating the cover crop at the same time as planting such that by the time corn emerges, the cover crop is dead. This approach mitigates many of the potential drawbacks to planting green while capitalizing on the additional time for cover crop growth and associated benefit accumulation. Anecdotally, farmers are reporting reduced herbicide inputs and associated cost savings with cover crops. Replicated research is needed verify this and supply validated results to farmers.

Expansion of cover crop species utilized in Virginia continues to increase, notably black oats and berseem clover. To provide up-to-date recommendations, evaluation of these species in Virginia needs to be conducted. Pertinent to weed management, assessing preplant herbicide control options (i.e. burndown herbicides) and weed suppression of cover crop residues are needed.

Procedures:

In April 2024, experiments were established at Kentland farm in Blacksburg, Virginia and at the Southern Piedmont Agricultural Research and Extension Center in Blackstone, Virginia. The experimental area had endemic populations of weeds of interest for each experiment. In Blacksburg and Blackstone, prior to planting field corn, the area was tilled with a disk harrow followed by a roto-tiller and fertilized with 56 kg ha^{-1} of each nitrogen, phosphorus, and potassium. Gramoxone was applied at 840 g ai ha^{-1} with 1% crop oil concentrate by volume prior to planting. Field corn was planted in early May at 72,376 seeds ha^{-1} using a 2-row plot planter with 76 cm (30 inch) row spacing. An additional 112 kg ha^{-1} of nitrogen was applied when the corn was at growth stage V4.

Each experiment was a randomized complete block design with four replications. Herbicide treatments were made using handheld spray equipment and four TeeJet 11002XR (Spraying Systems Co.; Wheaton, IL) nozzles for all treatments. Spray equipment was calibrated to apply 140 L ha^{-1} (15 GPA) at 207 kPa. All preemergence (PRE) herbicides were applied immediately after planting. Postemergence (POST) herbicides were applied when corn was 30 cm tall. For all experiments in this objective evaluating PRE and POST herbicides, the area was weed free at planting. Preplant "burndown" herbicide applications were made to emerged weed populations.

Data collected included: visual crop injury on a scale from 0 – 100% relative to the untreated check, where 0 means no visible crop injury and 100 means complete plant necrosis; weed control by species on a scale from 0 – 100% relative to the untreated check, where 0 means the treatment neither injured the weed nor reduced its pressure and 100 means the treatment killed all weeds present; and grain yield, where grain weight in grams per plot was transformed to metric tons per hectare (Mg ha^{-1}) accounting for plot size and grain moisture. Visible crop injury and weed control data were taken 2 and 4 weeks after PRE herbicide application and 2, 4, and 6 weeks after POST herbicide application. Grain yield was measured at the end of the season for some experiments.

Additionally, more data are needed for some cover crop species such as red clover and crimson clover for the Virginia Cooperative Extension Pest Management Guide: Field Crops. Therefore, the following treatments will be evaluated for control of red clover, crimson clover, black oats, berseem clover, rapeseed, orchardgrass, and tall fescue.

Results:

Experiment 1-3: Evaluate various burndown programs for weed control in corn and burndown control of cover crops.

Expansion of cover crop species utilized in Virginia continues to increase, prompting questions on preplant herbicide control options (i.e. burndown herbicides) for newer cover crop species (i.e. black oats and berseem clover). Additionally, more data are needed to for some cover crop species such as red clover and crimson clover for the Virginia Cooperative Extension Pest Management Guide: Field Crops. Therefore, the following treatments were evaluated for control of red clover, crimson clover, black oats, berseem clover, rapeseed, orchardgrass, and tall fescue.

Table 1. Treatments evaluated in Experiment 1.

Treatment No.	Herbicide Product	Product rate
1	Untreated Check	
2	Roundup Powermax3	30 fl oz/a
3	Roundup Powermax3	30 fl oz/a
	2,4-D LV4	1 pt/a
4	AMS	3 lb/a
	Liberty 280 SL	32 fl oz/a
5	AMS	3 lb/a
	Roundup Powermax3	30 fl oz/a
	Liberty 280 SL	32 fl oz/a
6	AMS	8.5 lb/a
	Roundup Powermax3	30 fl oz/a
	Sharpen	1 fl oz/a
	MSO	1 % v/v
7	AMS	8.5 lb/a
	Roundup Powermax3	30 fl oz/a
	Reviton	1 fl oz/a
	MSO	1 % v/v
8	AMS	8.5 lb/a
	Roundup Powermax3	30 fl oz/a
9	AMS	3 lb/a
	Rapidicil	5 fl oz/a
	Roundup Powermax3	32 fl oz/a
	COC	1 % v/v

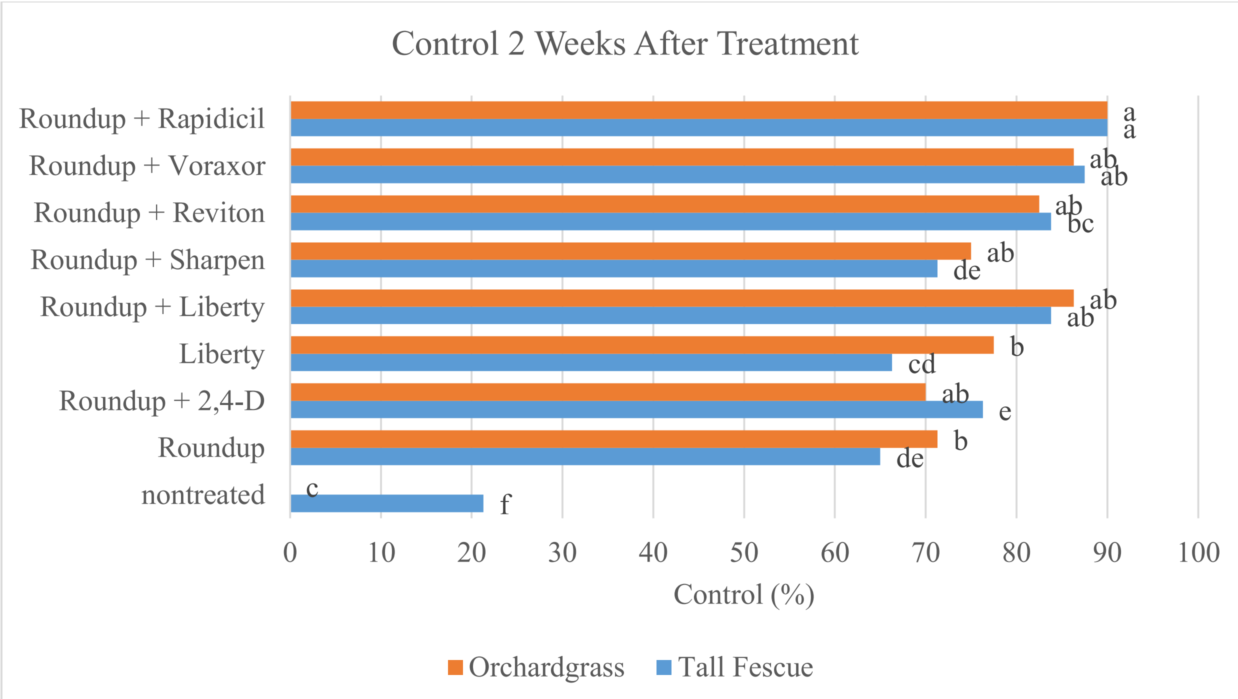


Figure 1. Control of orchardgrass and tall fescue 2 weeks after treatment with various preplant burndown herbicides. Bars sharing a letter are not significantly different according to Fisher's Protected $LSD_{(0.05)}$ withing weed species.

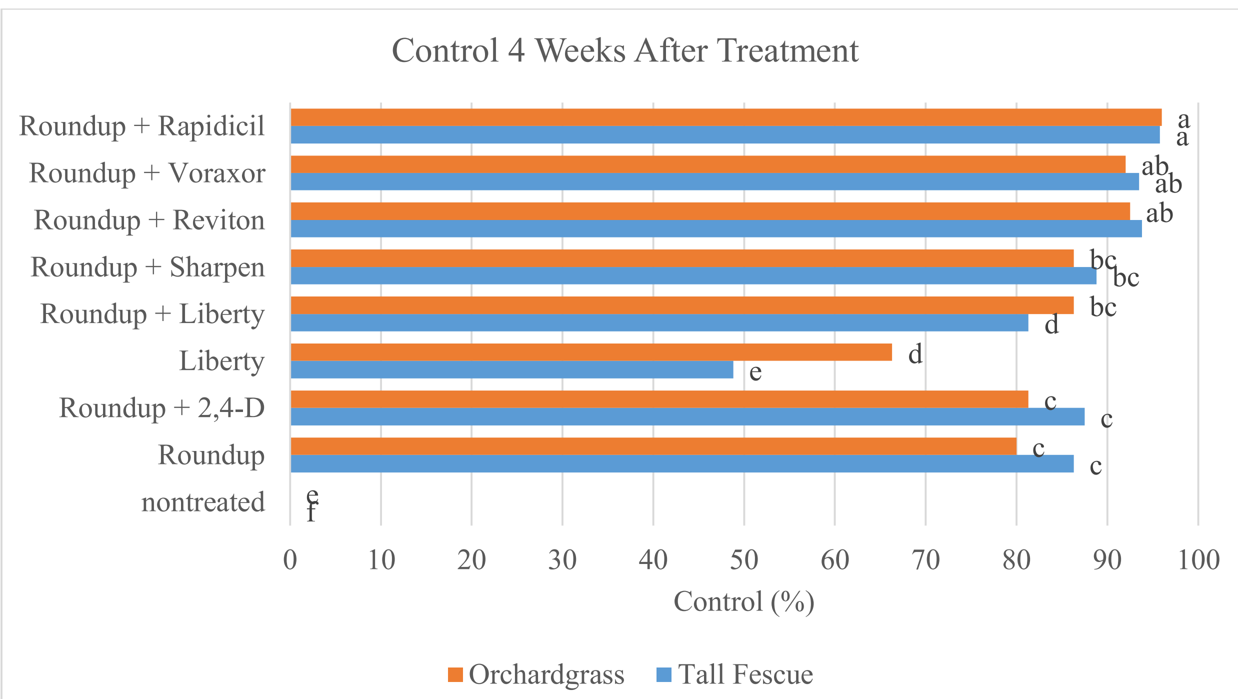


Figure 2. Control of orchardgrass and tall fescue 4 weeks after treatment with various preplant burndown herbicides. Bars sharing a letter are not significantly different according to Fisher's Protected $LSD_{(0.05)}$ withing weed species.

Results: Newer PPO-inhibiting herbicides (Rapidicil, Voraxor, and Reviton) improved control of orchardgrass and tall fescue when applied with glyphosate compared to when glyphosate was applied alone (Figures 1 and 2). Liberty did not result in commercially acceptable control (50 to 70%). Glyphosate + 2,4-D and glyphosate + Liberty resulted in 80 to 90% control, but this control was less than top performing treatments.

Table 2. Treatments evaluated in Experiment 2.

Trt No.	Treatment Name	Rate	Rate Unit
1	Untreated Check		
2	Roundup Powermax3	30	fl oz/a
3	Roundup Powermax3	30	fl oz/a
	2,4-D LV4	1	pt/a
4	AMS	3	lb/a
	Liberty 280 SL	32	fl oz/a
5	AMS	3	lb/a
	Roundup Powermax3	30	fl oz/a
	Liberty 280 SL	32	fl oz/a
6	AMS	8.5	lb/100 gal
	Roundup Powermax3	30	fl oz/a
	Sharpen	1	fl oz/a
	MSO	1	% v/v
7	AMS	8.5	lb/100 gal
	Roundup Powermax3	30	fl oz/a
	Reviton	1	fl oz/a
	MSO	1	% v/v
8	AMS	8.5	lb/100 gal
	Roundup Powermax3	30	fl oz/a
	Voraxor	1.4	fl oz/a
	MSO	1	% v/v
9	AMS	3	lb/a
	Rapidicil	5	fl oz/a
	Roundup Powermax3	32	fl oz/a
	COC	1	% v/v
10	Gramoxone SL 3.0	2	pt/a
	Metribuzin 75DF	5.33	oz/a
	COC	1	% v/v
11	AMS	3	lb/a
	Select Max	6	fl oz/a
	NIS	0.25	% v/v
12	AMS	3	lb/a
	Liberty 280 SL	32	fl oz/a
	Sharpen	1	fl oz/a

MSO	1	% v/v

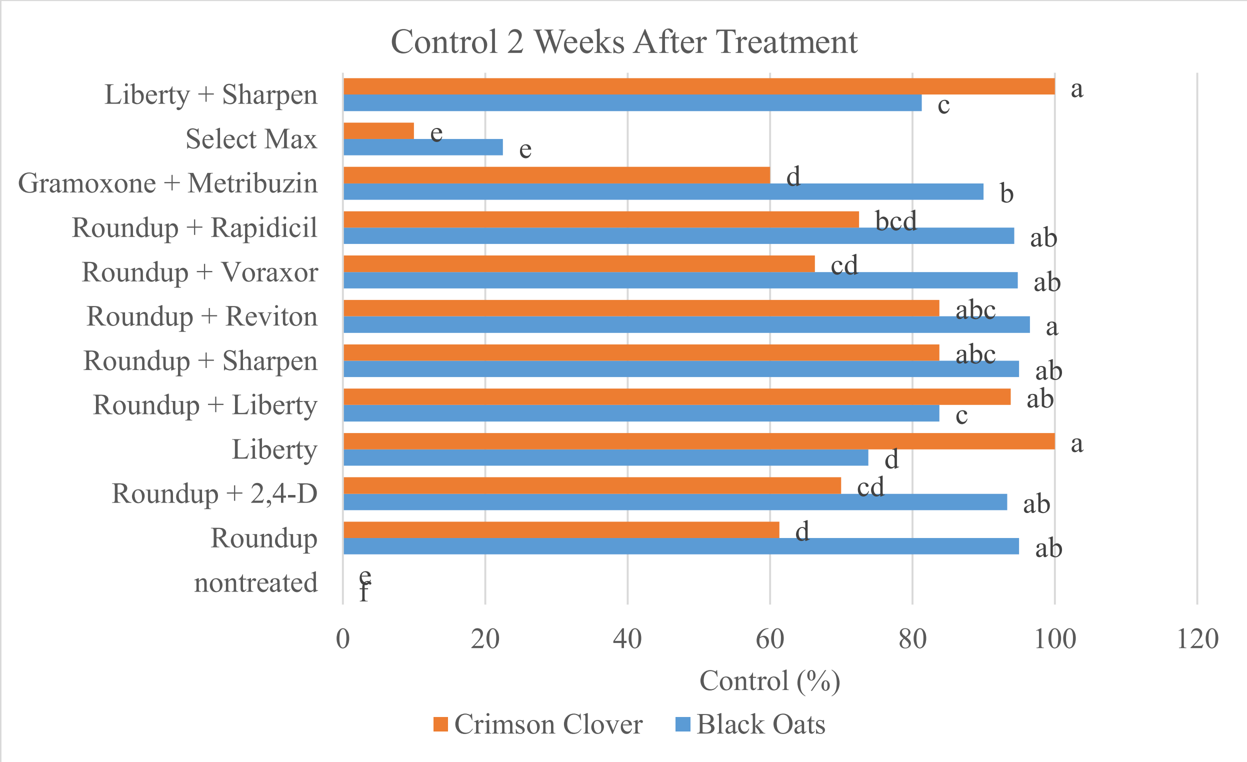


Figure 3. Control of crimson clover and black oats 2 weeks after treatment with various preplant burndown herbicides. Bars sharing a letter are not significantly different according to Fisher's Protected $LSD_{(0.05)}$ withing weed species.

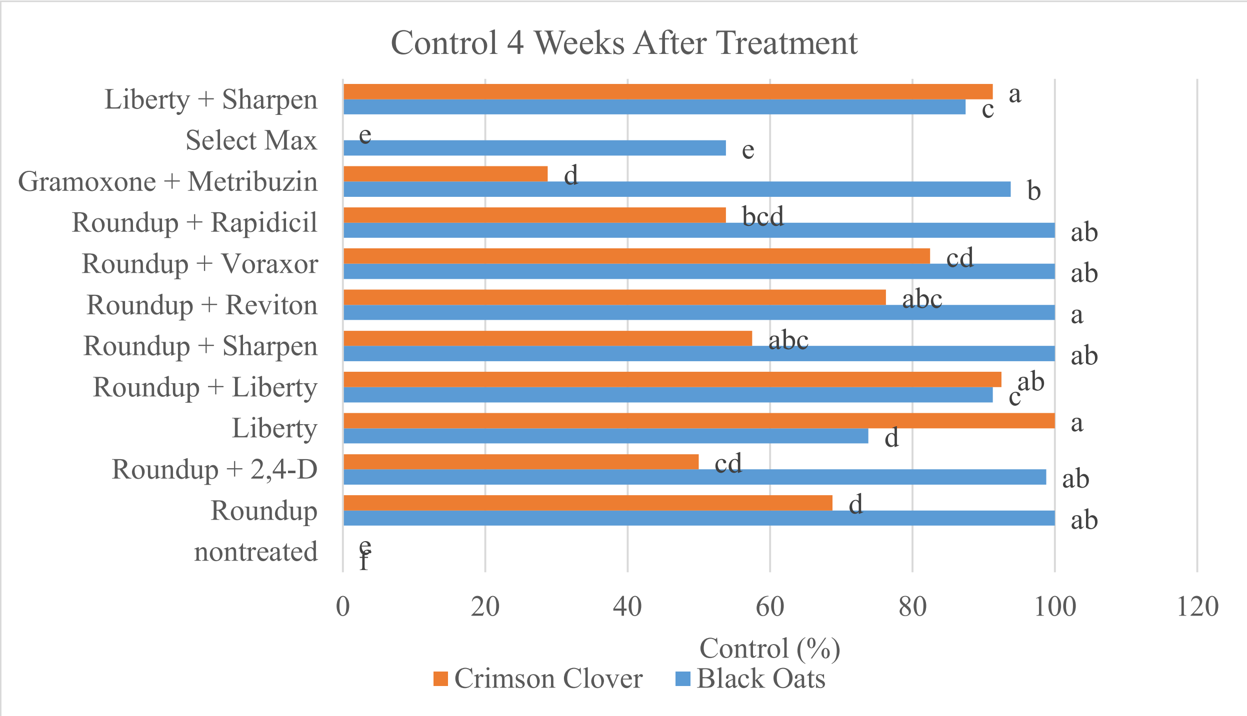


Figure 4. Control of crimson clover and black oats 4 weeks after treatment with various preplant burndown herbicides. Bars sharing a letter are not significantly different according to Fisher's Protected $LSD_{(0.05)}$ withing weed species.

Results: Liberty containing treatments were the top performing group for crimson clover control (Figures 2 and 4), resulted in 90 to 100% control 4 weeks after treatment (Figure 4). All other treatments resulted in less than 80% control of crimson clover 4 weeks after treatment.

Black oats was best controlled with glyphosate containing treatments both 2 and 4 weeks after treatment (Figures 3 and 4). Glyphosate containing treatments resulted in 100% control 4 weeks after treatment (Figure 4).

Table 3. Treatments evaluated in Experiment 3.

Trt No.	Treatment Name	Form Conc	Form Unit	Form Type	Rate	Rate Unit
1	Untreated Check					
2	2,4-D LV4	3.8	LBAE/GAL	SL	0.5	lb ae/a
3	Aatrex 4L	4	LBA/GAL	SL	1	lb ai/a
	COC	100	%	SL	1	% v/v
4	Stinger	3	LBAE/GAL	SL	0.25	lb ae/a
5	Clarity	4	LBAE/GAL	SL	0.5	lb ae/a
	NIS	100	%	SL	0.25	% v/v
6	Roundup Powermax3	4.8	LBAE/GAL	SL	0.75	lb ae/a
7	Roundup Powermax3	4.8	LBAE/GAL	SL	1.5	lb ae/a
8	Roundup Powermax3	4.8	LBAE/GAL	SL	0.75	lb ae/a
	Clarity	4	LBAE/GAL	SL	0.5	lb ae/a
	NIS	100	%	SL	0.25	% v/v
9	Callisto	4	LBA/GAL	SL	0.166	lb ai/a
	Aatrex 4L	4	LBA/GAL	SL	1	lb ai/a
	COC	100	%	SL	1	% v/v
10	Gramoxone 3SL	3	LBA/GAL	SL	0.75	lb ai/a
	COC	100	%	SL	1	% v/v
11	Gramoxone 3SL	3	LBA/GAL	SL	0.75	lb ai/a
	Aatrex 4L	4	LBA/GAL	SL	1	lb ai/a
	COC	100	%	SL	1	% v/v
12	Gramoxone 3SL	3	LBA/GAL	SL	0.75	lb ai/a
	2,4-D LV4	3.8	LBAE/GAL	SL	0.5	lb ae/a
	COC	100	%	SL	1	% v/v

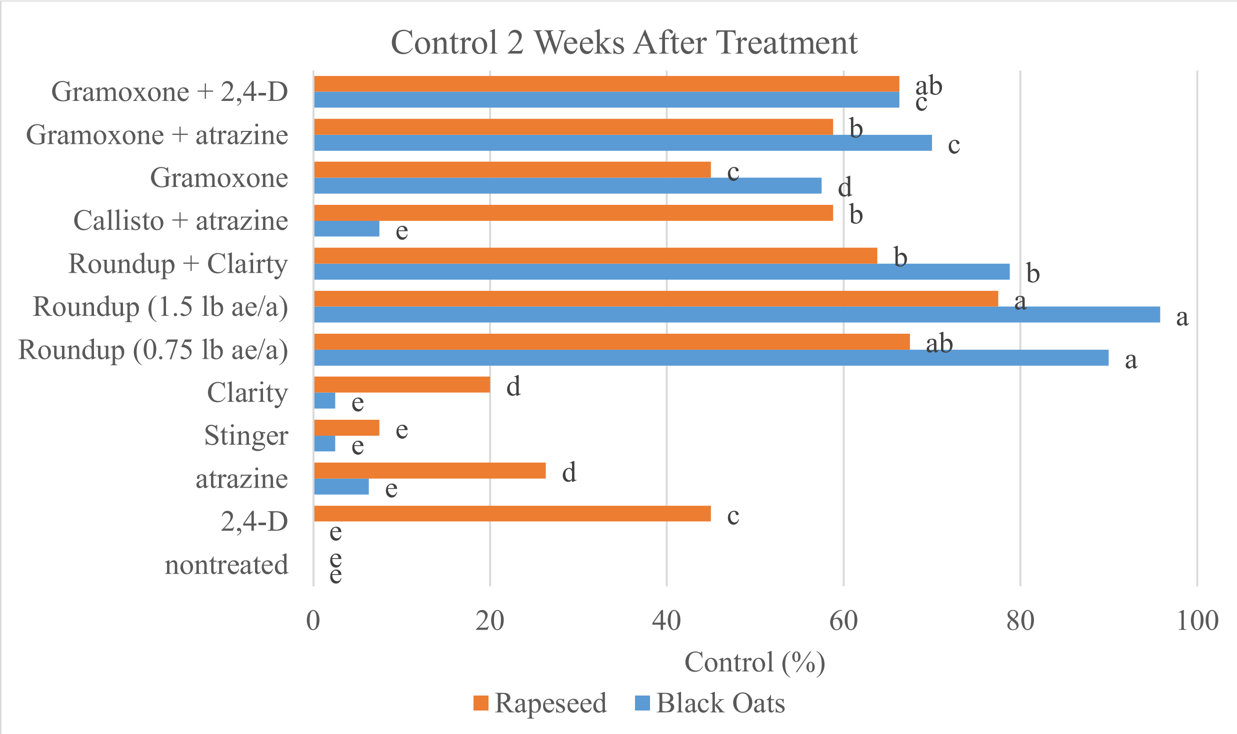


Figure 5. Control of rapeseed and black oats 2 weeks after treatment with various preplant burndown herbicides. Bars sharing a letter are not significantly different according to Fisher's Protected LSD$_{(0.05)}$ withing weed species.

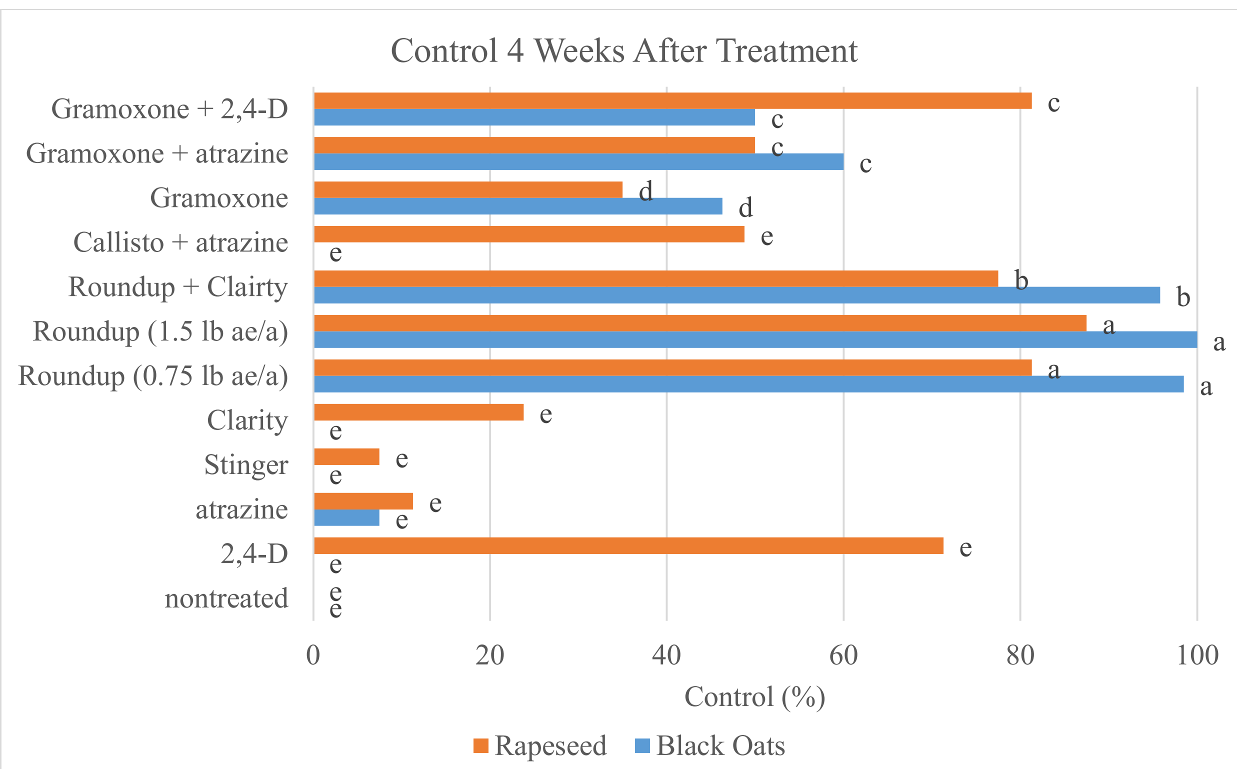


Figure 6. Control of rapeseed and black oats 4 weeks after treatment with various preplant burndown herbicides. Bars sharing a letter are not significantly different according to Fisher's Protected $LSD_{(0.05)}$ withing weed species.

Results: Black oats was best controlled with glyphosate containing treatments both 2 and 4 weeks after treatment (Figures 5 and 6). Glyphosate containing treatments resulted in 90% control or more 4 weeks after treatment (Figure 6).

Rapeseed was best controlled with glyphosate containing treatments both 2 and 4 weeks after treatment (Figures 5 and 6). Gramoxone + 2,4-D also resulted in notable (about 82%) control 4 weeks after treatment (Figure 6). All other treatments resulted in less than commercially acceptable control. Rapeseed is notoriously difficult to control, especially when it is treated at the flowering stage, as was the case in these studies.

Experiment 4: Two-pass herbicide programs in corn comparison.

Table 4. Treatments evaluated in Experiment 4.

Trt No.	Treatment Name	Form Conc	Form Unit	Form Type	Rate	Rate Unit	Appl Timing
1	nontreated						
2	Bicep II Magnum	5.5	LBA/GAL	SC	1.8	qt/a	PRE
	Halex GT	4.39	LBA/GAL	EC	3.6	pt/a	V4
	NIS	100	%	SL	0.25	% v/v	V4
	AMS	100	%	SG	3	lb/a	V4
3	Bicep II Magnum	5.5	LBA/GAL	SC	1.8	qt/a	PRE
	Maverick	2.04	LBA/GAL	SC	14	fl oz/a	V4
	Roundup Pmax3	5.88	LBA/GAL	SL	1	lb ai/a	V4
	NIS	100	%	SL	0.25	% v/v	V4
	AMS	100	%	SG	3	lb/a	V4
4	Harness Extra	5.6	LBA/GAL	SC	2	qt/a	PRE
	Kyro	3.07	LBA/GAL	ZC	45	fl oz/a	V4
	Roundup Pmax3	5.88	LBA/GAL	SL	1	lb ai/a	V4
	NIS	100	%	SL	0.25	% v/v	V4
	AMS	100	%	SG	3	lb/a	V4
5	Harness Extra	5.6	LBA/GAL	SC	2	qt/a	PRE
	Maverick	2.04	LBA/GAL	SC	14	fl oz/a	V4
	Roundup Pmax3	5.88	LBA/GAL	SL	1	lb ai/a	V4
	NIS	100	%	SL	0.25	% v/v	V4
	AMS	100	%	SG	3	lb/a	V4
6	Verdict	5.57	LBA/GAL	EC	12	fl oz/a	PRE
	Armezon Pro	5.35	LBA/GAL	EC	14	fl oz/a	V4
	Roundup Pmax3	5.88	LBA/GAL	SL	1	lb ai/a	V4
	NIS	100	%	SL	0.25	% v/v	V4
	AMS	100	%	SG	3	lb/a	V4
7	Verdict	5.57	LBA/GAL	EC	12	fl oz/a	PRE
	Maverick	2.04	LBA/GAL	SC	14	fl oz/a	V4

	Roundup Pmax3	5.88	LBA/GAL	SL	1	lb ai/a	V4
	NIS	100	%	SL	0.25	% v/v	V4
	AMS	100	%	SG	3	lb/a	V4
8	Resicore XL	3.26	LBA/GAL	ZC	1.4	qt/a	PRE
	Resicore XL	3.26	LBA/GAL	ZC	1.4	qt/a	V4
	Roundup Pmax3	5.88	LBA/GAL	SL	1	lb ai/a	V4
	NIS	100	%	SL	0.25	% v/v	V4
	AMS	100	%	SG	3	lb/a	V4
9	Acuron	3.44	LBA/GAL	SC	1.5	qt/a	PRE
	Acuron	3.44	LBA/GAL	SC	1.5	qt/a	V4
	Roundup Pmax3	5.88	LBA/GAL	SL	1	lb ai/a	V4
	NIS	100	%	SL	0.25	% v/v	V4
	AMS	100	%	SG	3	lb/a	V4
10	Maverick	2.04	LBA/GAL	SC	18	fl oz/a	PRE
	Maverick	2.04	LBA/GAL	SC	14	fl oz/a	V4
	Roundup Pmax3	5.88	LBA/GAL	SL	1	lb ai/a	V4
	NIS	100	%	SL	0.25	% v/v	V4
	AMS	100	%	SG	3	lb/a	V4

Results:

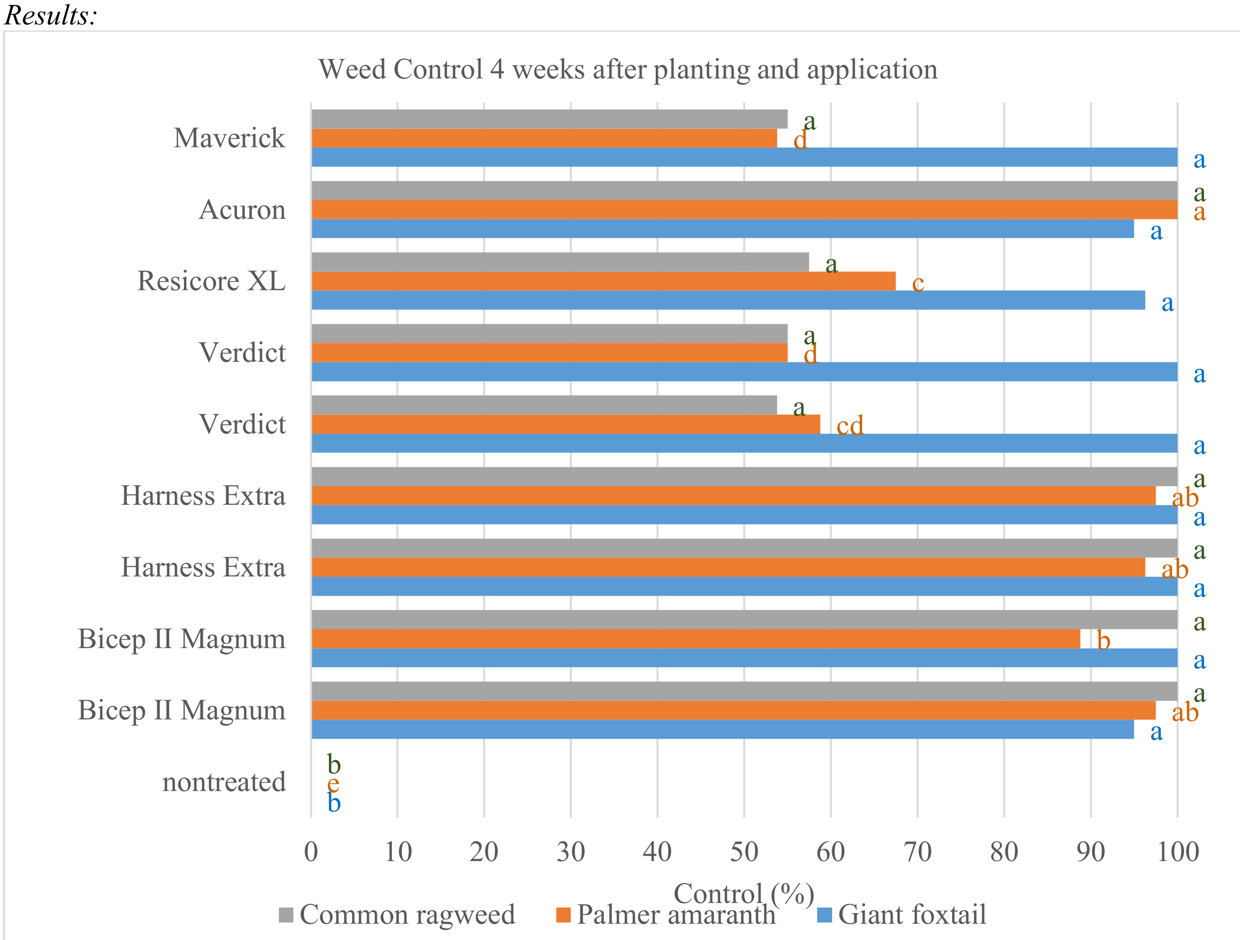


Figure 7. Control of common ragweed, Palmer amaranth, and giant foxtail 4 weeks after treatment with various preemergence herbicides. Bars sharing a letter are not significantly different according to Fisher's Protected $LSD_{(0.05)}$ withing weed species.

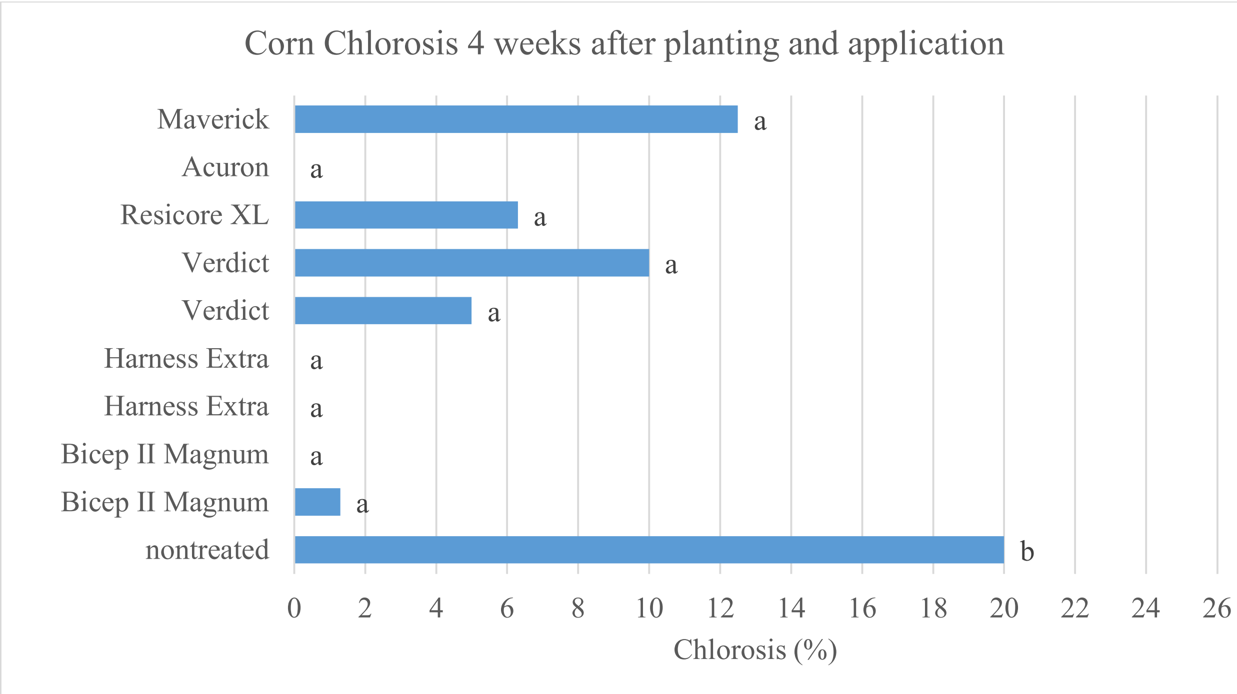


Figure 8. Chlorosis (yellowing) of corn 4 weeks after treatment with various preemergence herbicides. Chlorosis was due to weed competition, not due to herbicide injury. Bars sharing a letter are not significantly different according to Fisher's Protected $LSD_{(0.05)}$ withing weed species.

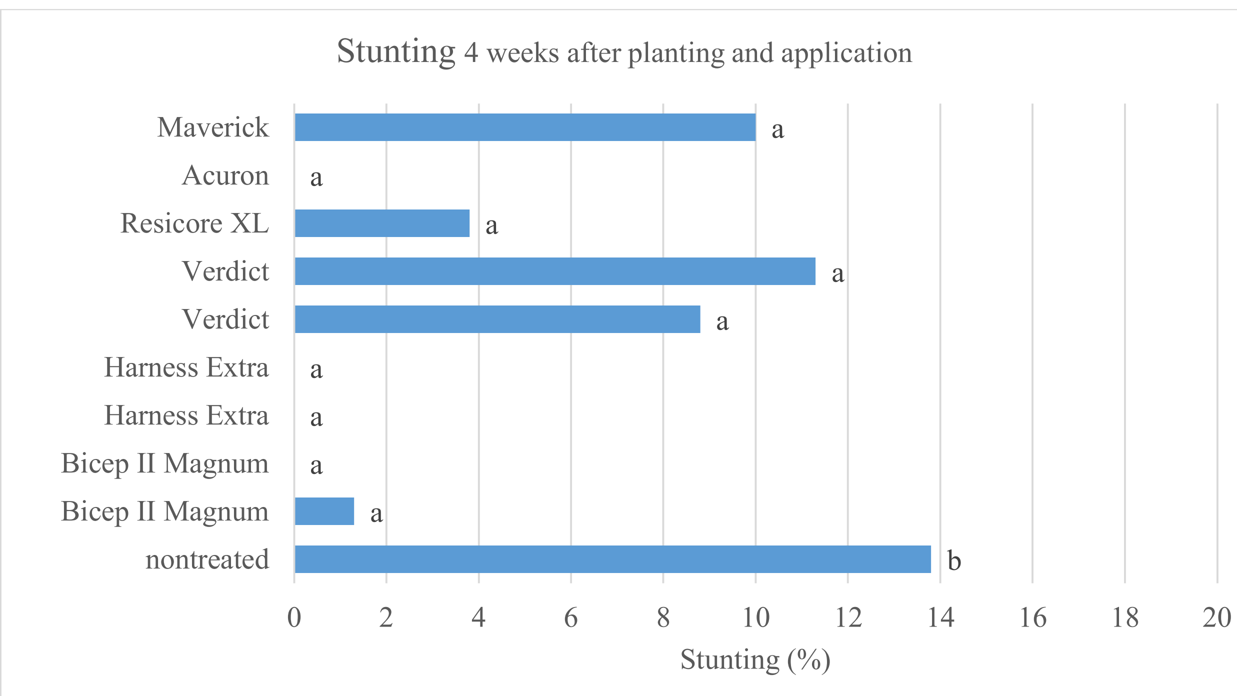


Figure 9. Stunting (height reduction) of corn 4 weeks after treatment with various preemergence herbicides. Stunting was due to weed competition, not due to herbicide injury. Bars sharing a letter are not significantly different according to Fisher's Protected $LSD_{(0.05)}$ withing weed species.

Results: Preemergence weed control was best with Harness Extra, Bicep II Magnum, and Acuron compared to other treatments evaluated (Maverick, Resicore XL, and Verdict) (Figure 7). Accordingly corn was chlorotic and stunted where weeds were not well controlled (Figures 8 and 9).

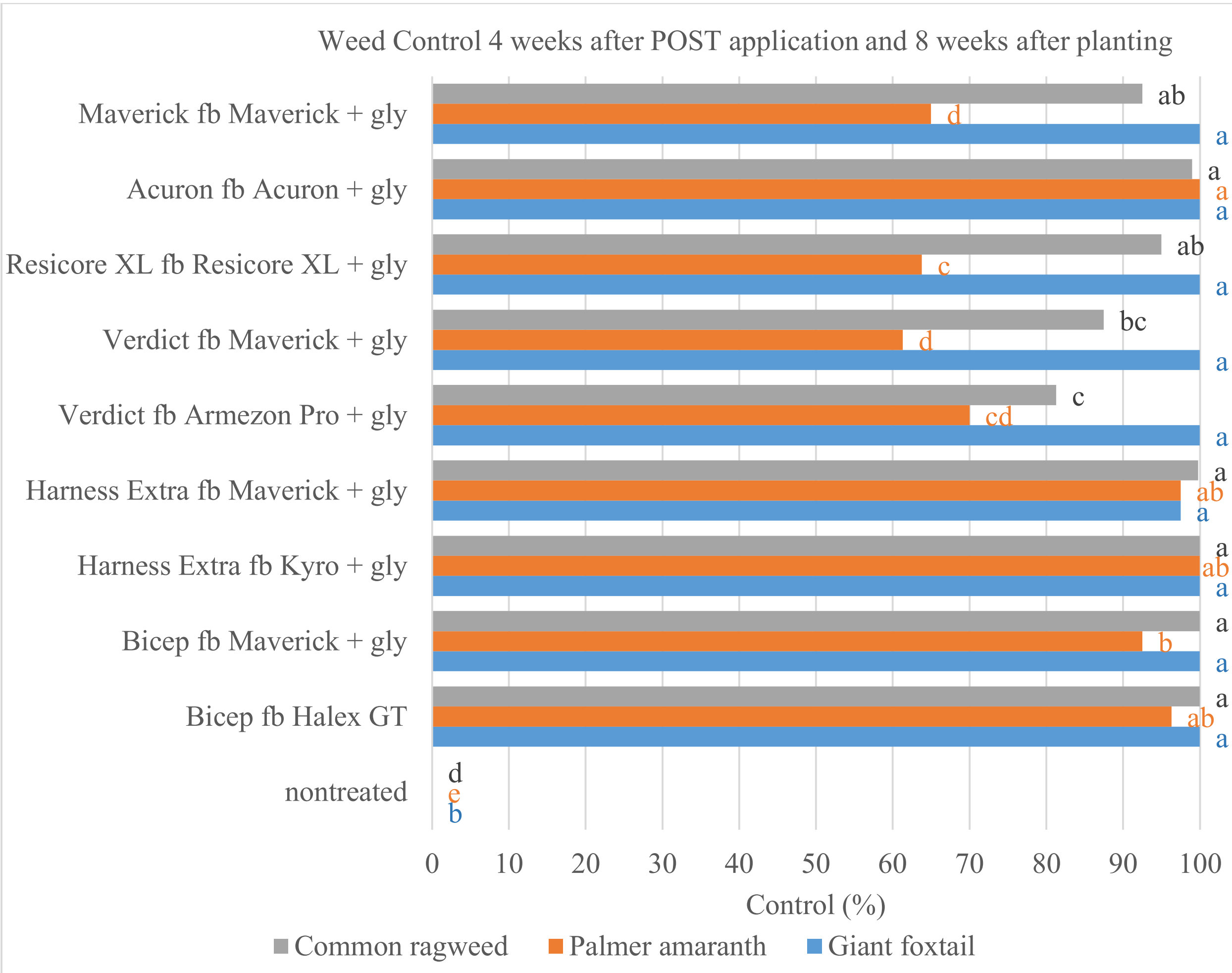


Figure 10. Control of common ragweed, Palmer amaranth, and giant foxtail 4 weeks after treatment postemergence herbicide application. Preemergence herbicides were applied at corn planting and were followed by (fb) postemergence herbicides approximately 4 weeks later. Bars sharing a letter are not significantly different according to Fisher's Protected $LSD_{(0.05)}$ withing weed species.

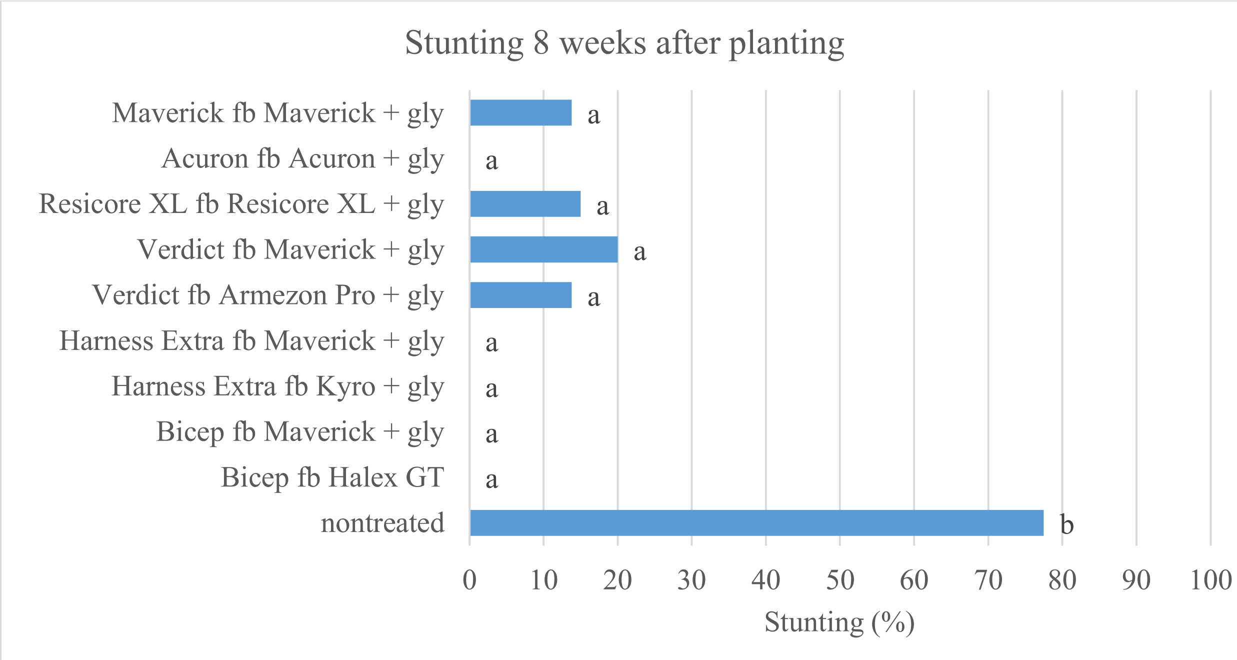


Figure 11. Corn stunting (height reduction) 4 weeks after treatment postemergence herbicide application. Preemergence herbicides were applied at corn planting and were followed by (fb) postemergence herbicides approximately 4 weeks later. Bars sharing a letter are not significantly different according to Fisher's Protected $LSD_{(0.05)}$ withing weed species.

Results: Weed control was best with Harness Extra, Bicep II Magnum, and Acuron starting treatments compared to other treatments evaluated (Maverick, Resicore XL, and Verdict) (Figure 10). Some c stunting was observed, although no treatments were significantly different from each other (Figures 11).

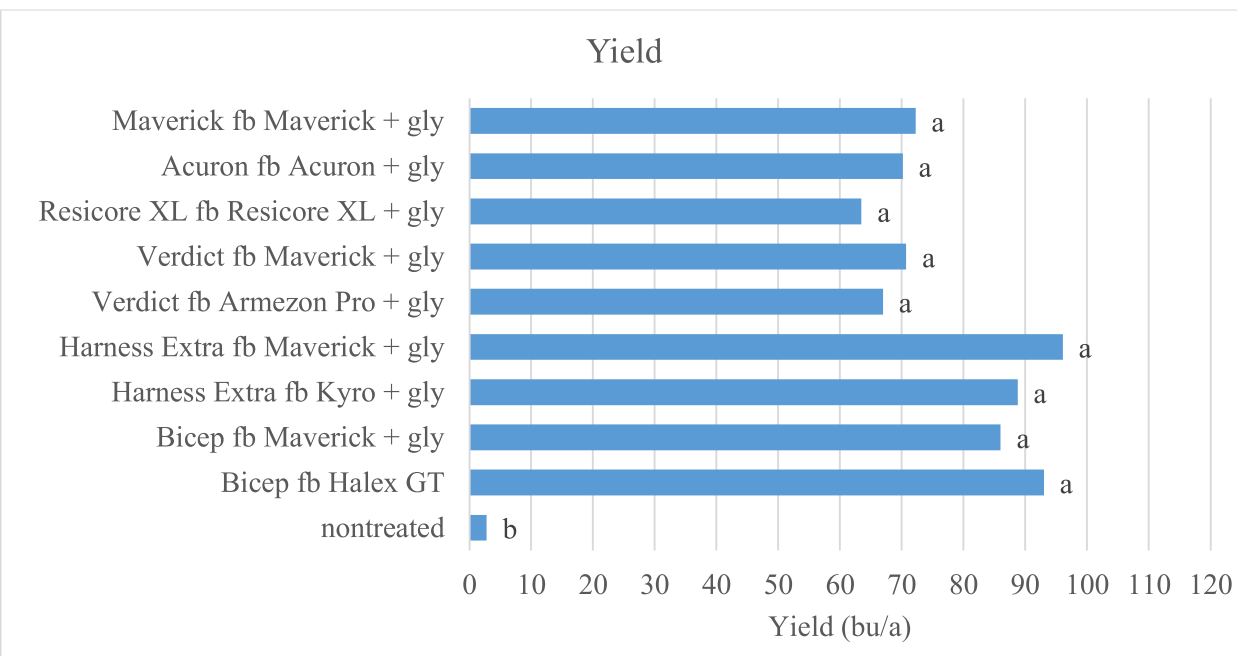


Figure 12. Corn yield in experiment 4.

Results: Corn yield was low due to drought conditions at the trial location during tasseling to grain fill. While differences were noted earlier in the season for weed control and corn injury, differences in yield were not detected (Figure 12). Expected differences in yield were likely masked by the drought.

Objective 2: Capitalizing on cereal rye cost share and winter protection for hairy vetch before corn.

Background:

This objective determined if cereal rye + hairy vetch, with cereal rye terminated in mid-March, is superior to hairy vetch alone before corn. The addition of cereal rye allows for a larger cost-share payment in most areas of Virginia and may provide additional winter protection to the hairy vetch. However, there is additional costs and management when including cereal rye. The hypothesis is that the addition of cereal rye to hairy vetch will not improve outcomes (N-fixation, biomass, weed suppression) relative to hairy vetch alone, when cereal rye is terminated in mid-March.

Procedures:

This experiment wase a 4 by 3 factorial design with 4 cover crops and 3 cereal rye termination programs. Cover crops included (1) early maturing hairy vetch variety, (2) late maturing hairy vetch variety, (3) cereal rye + early maturing hairy vetch, and (4) cereal rye + late maturing hairy vetch. Cereal rye termination programs included (1) nontreated check, (2) 8 fl oz/a of Clethodim 2EC/Volunteer (or equivalent amount of clethodim) in 50/50 water/28% N (about 30 lbs of N per acre), and (3) 8 fl oz/a of Clethodim 2EC/Volunteer (or equivalent amount of clethodim) in water with surfactant according to label.

Cover crops were planted at Kentland Farm near Blacksburg, VA and at the Southern Piedmont Agricultural Research and Extension Center in Blackstone Virginia in Oct. 2023. Cereal rye termination programs were applied on or shortly after March 15th, 2023. Corn was planted on or about April 15th and glyphosate + 2,4-D was applied at that time. A postemergent herbicide (Halex GT at 3.6 pt/a) was applied 4 weeks after corn planting.

Data collection included: hairy vetch biomass on or about Dec. 1st, Mar. 15th, and April 15th. April 15th (corn planting timing) data were subjected to N quantification. Data on weed suppression was collected 2 and 4 weeks after corn planting (i.e. May 1st and 15th). Corn yield was also collected.

Results:

Biomass data in December and March indicated a location by cover crop interaction. In general, hairy vetch monocultures had more biomass compared to when grown with cereal rye (Figures 13 and 14).

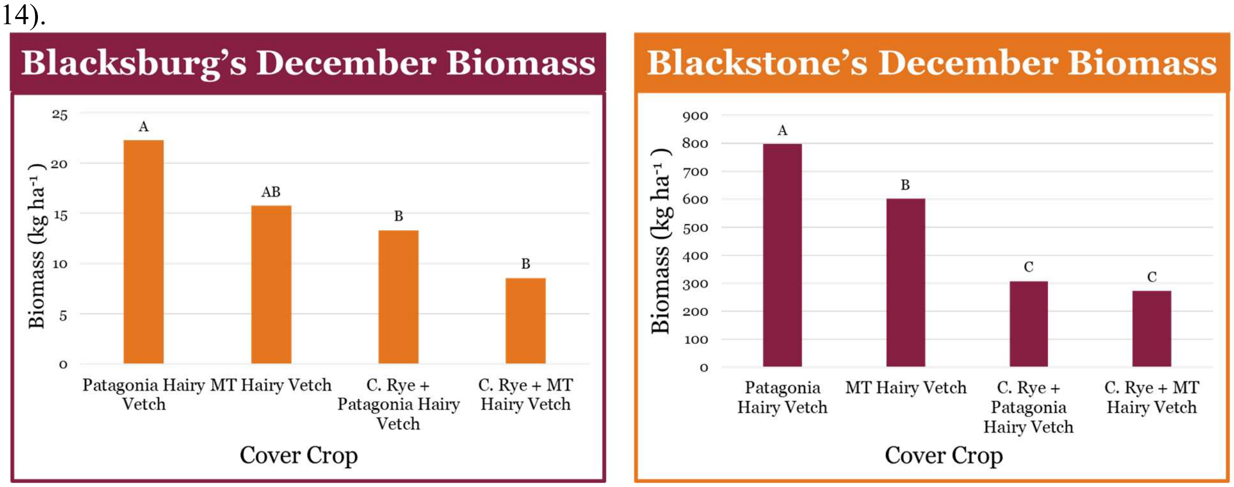
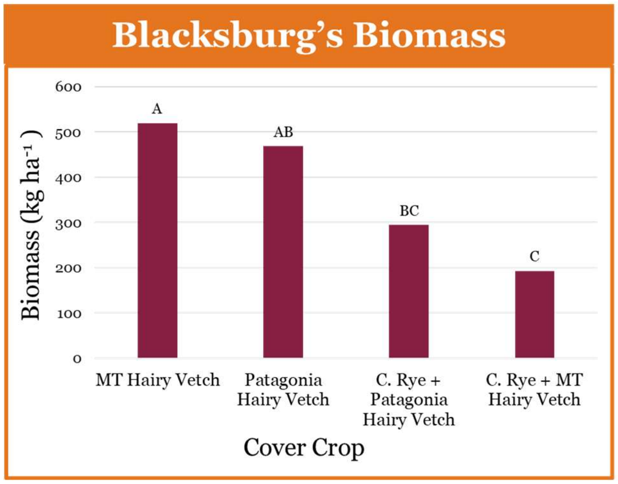


Figure 13. Cover crop biomass accumulation in December.



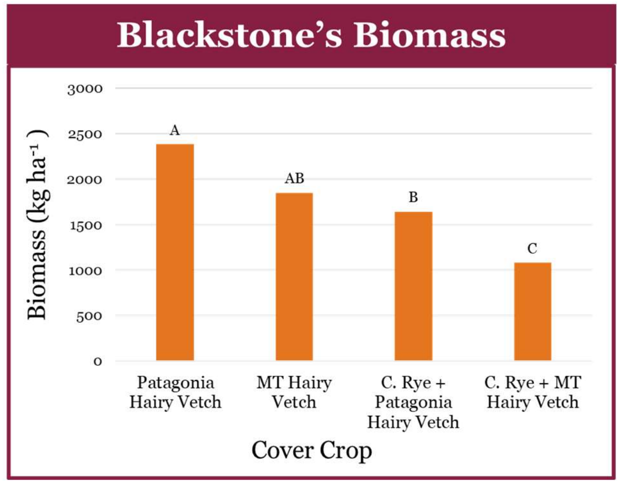
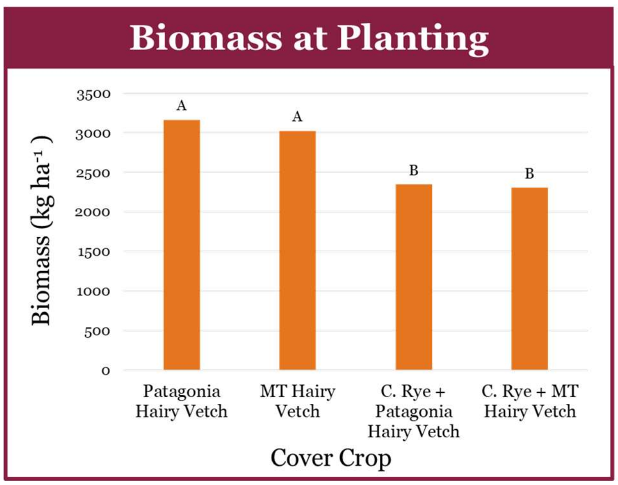


Figure 14. Cover crop biomass accumulation in March.

At planting, biomass data had location and cover crop as main effects without an interaction. Hairy vetch monocultures resulted in greater biomass (3,023 to 3,162 kg ha^{-1}) compared to cereal rye (2,303 to 2,347 kg ha^{-1}) (Figure 15).



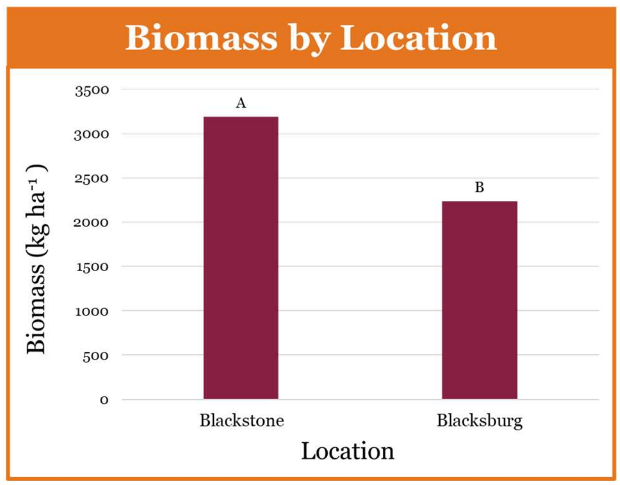


Figure 15. Cover crop biomass accumulation at planting in April.

Location and cover crop were significant main effects without an interaction for N content of hairy vetch. Across locations, Patagonia and MT hairy vetch as well as Patagonia hairy vetch with cereal rye were in the top statistical grouping and had 106 to 127 kg N ha^{-1} (Figure 15). MT hairy vetch with cereal rye resulted in 89 kg N ha^{-1} and was not different than Patagonia hairy vetch with cereal rye.

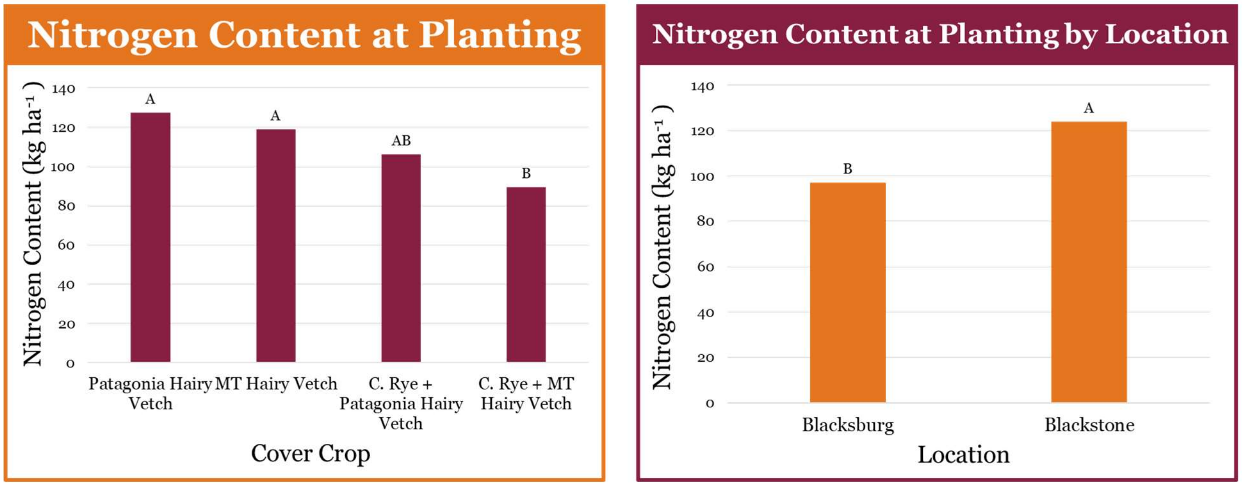


Figure 16. Nitrogen content of hairy vetch cover crop residues at corn planting in April.

While differences were detected between locations in weed density, no differences were detected due to cover crop for Palmer amaranth (*Amaranthus palmeri* L.), common ragweed (*Ambrosia artemisiifolia* L.), morningglory (*Ipomoea sp.*) (Blacksburg only), large crabgrass (*Digitaria sanguinalis* L.) (Blackstone only), other weeds, and total weeds.

Corn yield was greater at Blacksburg (9,467 kg ha^{-1}) than Blackstone (4,538 kg ha^{-1}). Overall, while cereal rye did not positively influence hairy vetch, N content of cover crops was >89 kg ha^{-1} and weed suppression was similar across cover crops.

Conclusion:

Farmers can benefit from increased cost share associated with cereal rye while not negatively influencing N fertilizer savings or weed suppression using this system.

Objective 3: Determining reduced herbicide inputs with hairy vetch before corn.

Background:

This objective was to evaluate the probability of success for 1, 2, or 3 pass corn herbicide programs in hairy vetch compared to cereal rye + hairy vetch and no cover crop. The hypothesis was that cereal rye will have the greatest probability for successful herbicide programs with fewer passes, followed by hairy vetch alone, followed by no cover.

Procedures:

This experiment was a 4 by 3 factorial design with 3 cover crops and 5 herbicide programs. Cover crops will include hairy vetch, cereal rye + hairy vetch, and a no cover crop. Herbicide programs included: (1) 1-pass Acuron + glyphosate 2 weeks prior to planting, (2) 1-pass Acuron + glyphosate at planting, (3) 2-pass Bicep II Magnum + glyphosate 2 weeks prior to planting followed by Halex GT when weeds are 4 inches or corn is 12 inches (whichever is earlier), (4) 2-pass Bicep II Magnum + glyphosate at planting followed by Halex GT when weeds are 4 inches or corn is 12 inches (whichever is earlier), and (5) 3-pass Glyphosate + 2,4-D 2 weeks prior to planting, Bicep II Magnum at planting, Halex GT when weeds are 4 inches or corn is 12 inches (whichever is earlier).

Cover crops were planted at Kentland Farm near Blacksburg, VA and at the Southern Piedmont Agricultural Research and Extension Center in Blackstone Virginia in Oct. 2023. On or about April 1st, 2 weeks prior to corn planting herbicide applications were made. Corn planting and at planting herbicide applications occurred on or about April 15th. On or about May 15th, herbicide applications were made as determined by weed height or corn size. On or about May 15th, weed density and number of weeds over 4 inches in height were quantified. On or about June 15th, the postemergent over-the-top herbicide applications were made and weed density and number of weeds >4 inches in height was quantified. Lastly, on or about Sept. 15th, corn harvest/yield data, weed density and number of weeds > 4 inches in height were quantified.

Results:

Results are being analyzed at the time this report is due. Observationally, cover crops increased weed control compared to no cover crops. A one-pass herbicide program did not result in commercially acceptable weed control.

Objective 4: Evaluate black oats as a cover crop for weed suppression in corn.

Background:

This objective compared black oats and cereal rye for cover crop characteristics (C:N and lignin content) as well as evaluated weed suppression in corn. The hypothesis is that there are not differences between these grass species for the stated purposes.

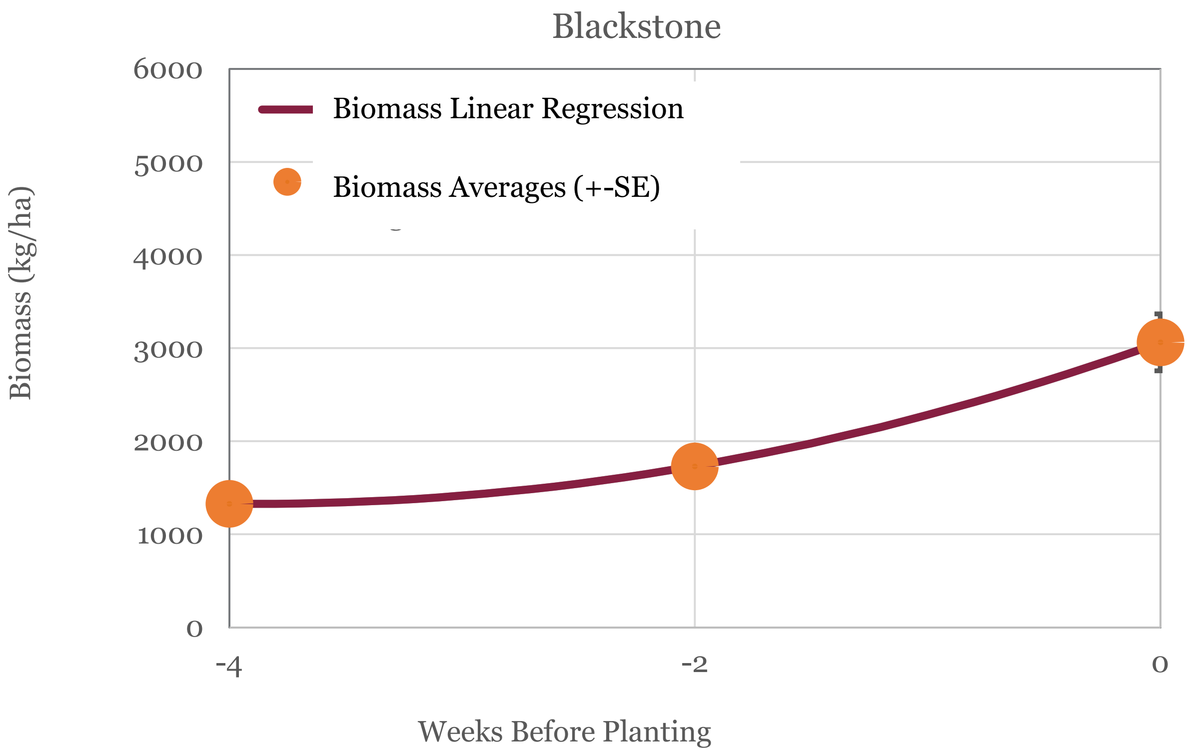
Procedures:

This experiment evaluated 4 cover crop treatments: (1) black oats, (2) cereal rye, (3) black oats + hairy vetch, and (4) cereal rye + hairy vetch. Cover crops were planted at Kentland Farm near Blacksburg, VA and at the Southern Piedmont Agricultural Research and Extension Center in Blackstone Virginia in Oct. 2023. Cover crops were terminated on or about April 15th and corn planted on or about May 1st. 4 weeks after planting a postemergent herbicide were applied.

Data collection included ground cover on Dec. 1, April 1, April 15, and May 1. Cover crop biomass, C:N ratio, and lignin content on April 1, April 15, and May 1. Weed suppression in corn was evaluated 2 and 4 weeks after planting. Weed density, biomass and number of plants above 4 inches in height was quantified 4 weeks after planting.

Results:

Biomass accumulation increased with time and varied by location. In Blackstone, no differences were detected between cereal rye and black oats. However, cereal rye accumulated greater biomass than black oats in Blacksburg at planting (Figure 17).


Blackstone
Biomass Linear Regression
Biomass Averages (+-SE)
Biomass (kg/ha)
6000
5000
4000
3000
2000
1000
0
-4
-2
0
Weeks Before Planting

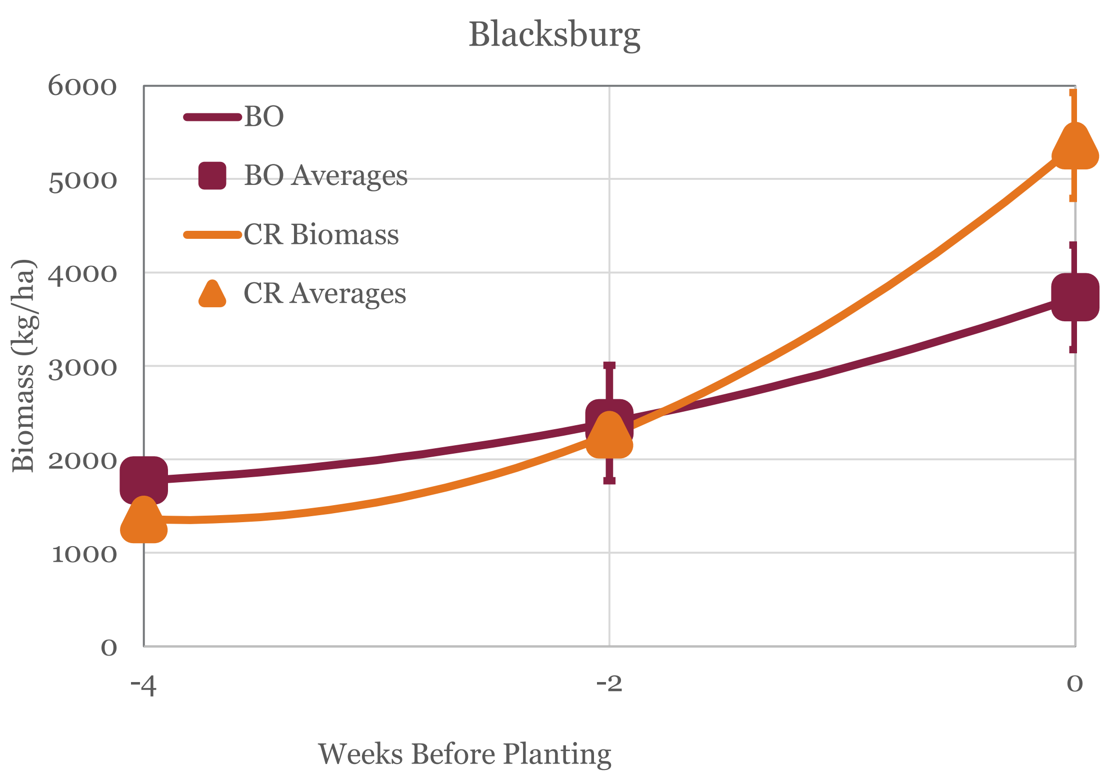

Blacksburg
BO
BO Averages
CR Biomass
CR Averages
Biomass (kg/ha)
6000
5000
4000
3000
2000
1000
0
-4
-2
0
Weeks Before Planting

Figure 17. Cover crop biomass accumulation, which varied by location. In Blackstone, not differences were detected between cereal rye (CR) and black oats (BO), so data were pooled and presented. In Blacksburg, differences were detected between the two species. Means are points surrounded by standard error and polynomial regression lines are presented.

Lignin content was similar across locations. Lignin increased for cereal rye but decreased for black oats resulting in a significant difference at planting (Figure 18).

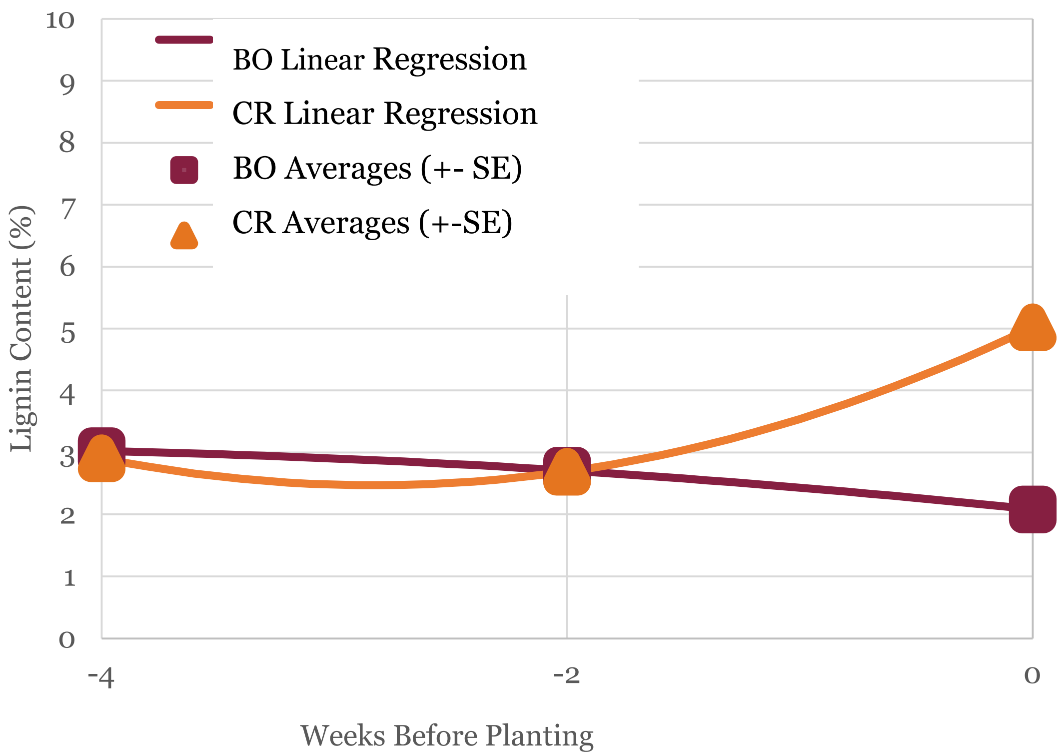


Figure 18. Lignin content of cereal rye (CR) and black oats (BO). Means are points surrounded by standard error and polynomial regression lines are presented.

For C:N ratio, there were no differences across species or location. Over time, C:N ratio increased over time (Figure 3).

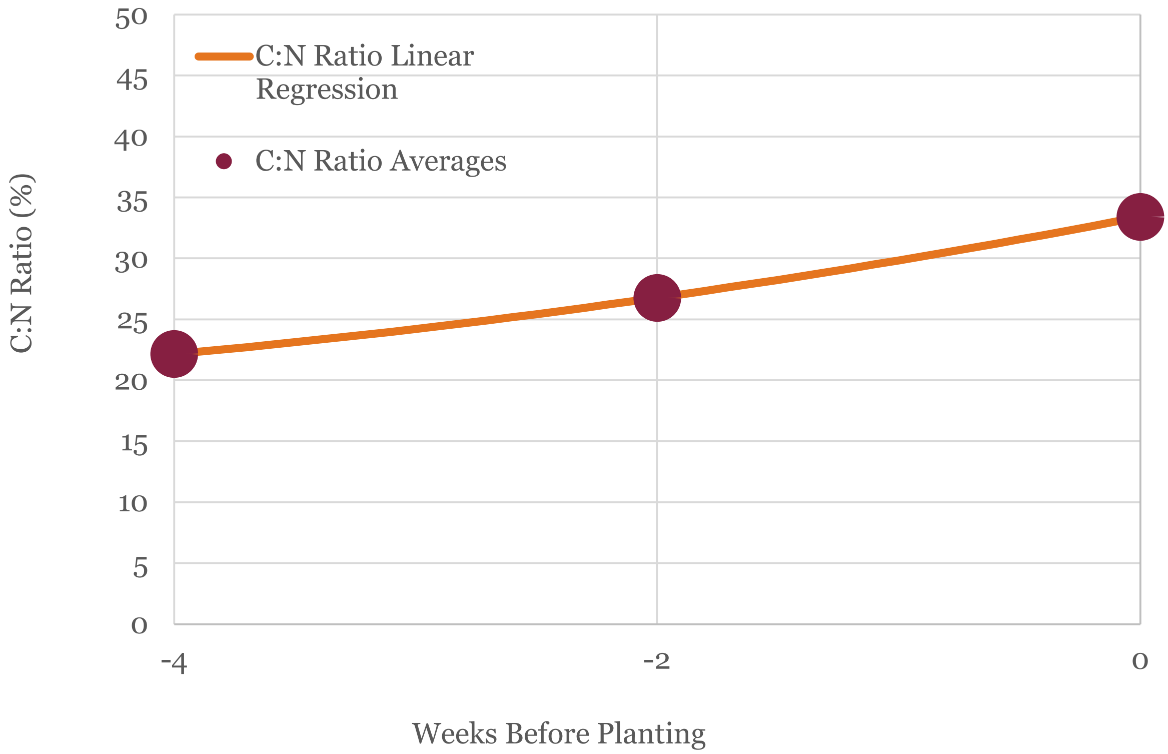


Figure 19. Carbon to nitrogen (C:N) ratio of cereal rye (CR) and black oats (BO). Means are points surrounded by standard error and polynomial regression lines are presented.

Weed species varied by location but weed densities at each location were statistically not different (Table 5). There were no differences in weeds over 10 cm (data not shown).

Table 5. Average Weeds (M^2)			
Weed Species		**Blacksburg**	**Blackstone**
Johnsongrass	*Sorghum halepense*	156	None present
Palmer amaranth	*Amaranthus palmeri*	220	124
Yellow nutsedge	*Cyperus esculentus*	59	None present
Common ragweed	*Ambrosia artemisiifolia*	None present	11
Large crabgrass	*Digitaria sanguinalis*	None present	121
Average Total Weeds		381	257

Conclusion:

Black oats provided similar amounts of biomass and weed suppression when compared to cereal rye. Differences between the species were present at planting when black oats had a lower C:N ratio an less lignin content than cereal rye, but these differences were not present when measured 2 and 4 weeks prior to planting. These data shows that black oats would be a suitable substitute for cereal rye.

Objective 5. Disseminate findings and best practices through Extension.
Research findings of this and previously funded work were disseminated to audiences throughout Virginia as relevant through Dr. Flessner's extension program. In 2024, this included 17 presentations reaching an audience of >900. Extension presentations per year, updating the Virginia Cooperative Extension Pest Management Guide for Field Crops and the Mid-Atlantic Field Crop Weed Management Guide, and numerous direct communications.

Personnel/Facilities:

Michael L. Flessner, Associate Professor and Extension Weed Science Specialist
Phone: 540-315-2954
Email: flessner@vt.edu
Virginia Tech, School of Plant and Environmental Sciences
675 Old Glade Rd., Blacksburg, VA 24061

Submitted by:

Signature: Michael Flessner
Printed Name: Michael Flessner
Title: Associate Professor and Extension Weed Science Specialist
Virginia Tech (Virginia Polytechnic Institute and State University)