



Cover Crop Management and Herbicide Program Selection Impact on Weed Suppression and Soybean Yields

Trial Objective

- To suppress troublesome weeds, farmers may need to consider all possible tools available to them. While herbicides have a long history of effective weed suppression, cover crops have the potential to add value by competing with weeds.
- The objective of this study was to evaluate the combination of cover crops with pre- and post-emergence herbicides in suppressing weed populations and the potential impact on soybean yield.

Experiment/Trial Design

Location	Soil Type	Previous Crop	Tillage Type	Year	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Gothenburg, NE	Hord silt loam	Corn	No-till	2022 & 2023	70	160,000

- The trial design was a randomized complete block with four replications and three treatment factors (Table 1):

Table 1. List of experimental factors and herbicide application dates.

Experimental Factor	Date of herbicide application		
	2022	2023	
Cover Crop Termination* Timing WBP = Weeks before planting soybean WAP = Weeks after planting soybean	5 WBP	April 22	April 22
	3 WBP	May 6	May 8
	1 WBP	May 21	May 22
	1 WAP	June 4	June 6
Pre-emergence (PRE) herbicide application	Yes	June 4	May 31
	No		
Post-emergence (POST) herbicide application	Yes	June 21	June 27
	No		

*Cover crops were terminated with an application of Roundup PowerMax® herbicide at 32 fl oz/acre and a spray volume of 15 gallons per acre.

Cover Crop Management and Herbicide Program Selection Impact on Weed Suppression and Soybean Yields

- Field operations, seeding rates for cover crops and soybean, fertilizer nutrients and application rates, and the amount of irrigation water applied are listed in Table 2:

Table 2. List of field operations, precipitation, irrigation, seeding, and fertilizer rates by year.

Field Operation	Products/Rates	2022	2023
Cover crop planting	Winter Wheat (approximately 100 lb seed/acre)	November 12, 2021	November 17, 2022
Soybean planting*	MG 2.5 product with XtendFlex® Technology at 160,000 seeds/acre	May 31	N/A
	MG 2.7 product with XtendFlex® Technology at 160,000 seeds/acre	N/A	May 24
Precipitation	Growing season total (inches)	6.48	12.63
Irrigation	Irrigation water applied (inches)	9.0	6.0
Base fertilizer nutrient application	Nitrogen	29.3 lb/acre	Dribbled on soil surface April 12 Furrow applied at soybean planting May 24
	Phosphorus	60.0 lb/acre	
	Sulfur	25.0 lb/acre	
	Zinc	0.25 lb/acre	

*30 inch row spacing.

- The pre-emergence (PRE) and post-emergence (POST) herbicide programs used in this study are presented in Table 3:

Table 3. List of herbicide products, application timing and rates in 2022 and 2023.

Year	Application Timing	Products	Rate (fl oz/acre)
2022	Pre-emergence (PRE)	Roundup PowerMAX® herbicide	32.0
		Fierce® MTZ Herbicide	16.0
	Post-emergence (POST)	Roundup PowerMAX® herbicide	32.0
		Warrant® herbicide	48.0
		XtendiMax® Herbicide with VaporGrip® Technology	22.0
Sentris™ Buffering Technology	8.0		
2023	Pre-emergence (PRE)	Roundup PowerMAX® herbicide	32.0
		Zidua® SC herbicide	3.0
		XtendiMax® Herbicide with VaporGrip® Technology	22.0
		Sentris™ Buffering Technology	8.0
	Post-emergence (POST)	Roundup PowerMAX® herbicide	32.0
		Warrant® herbicide	48.0
		XtendiMax® Herbicide with VaporGrip® Technology	22.0
		Sentris™ Buffering Technology	8.0

All herbicide tank mixes were applied at a spray volume of 15 gallons per acre. OnTarget® adjuvant at 0.5% v/v was included in the POST applications in both years, and in the PRE application in 2023.



Cover Crop Management and Herbicide Program Selection Impact on Weed Suppression and Soybean Yields

- Weed suppression for the pre-emergence (PRE) herbicide treatments (Figure 2) was evaluated at 17 days after treatment (DAT) on 6/21/2022 and at 25 DAT on 6/25/2023.
- The post-emergence (POST) herbicide treatments were evaluated for weed suppression on 7/8/2022 (17 DAT) and at 21 DAT on 7/18/2023 (Figure 3).
- After weed suppression evaluations, weeds were removed by hand to facilitate soybean harvest.
- The study was machine harvested with a plot combine. The moisture content, test weight, and total weight of the grain was collected using the combine.
- Statistical analysis for Fisher's Least Significant Difference (LSD) was performed.

Understanding the Results

- The most prevalent weeds during the growing season were Palmer amaranth (*Amaranthus palmeri*) and kochia (*Bassia scoparia*). Volunteer corn pressure was high.
- Pre-emergence (PRE) herbicides provided good control of volunteer corn. However, control of volunteer corn due to the cover crop was minimal (data not presented).
- Cover crops terminated at 5 WBP had minimal plant growth and were essentially equal to not having a cover crop present at all.

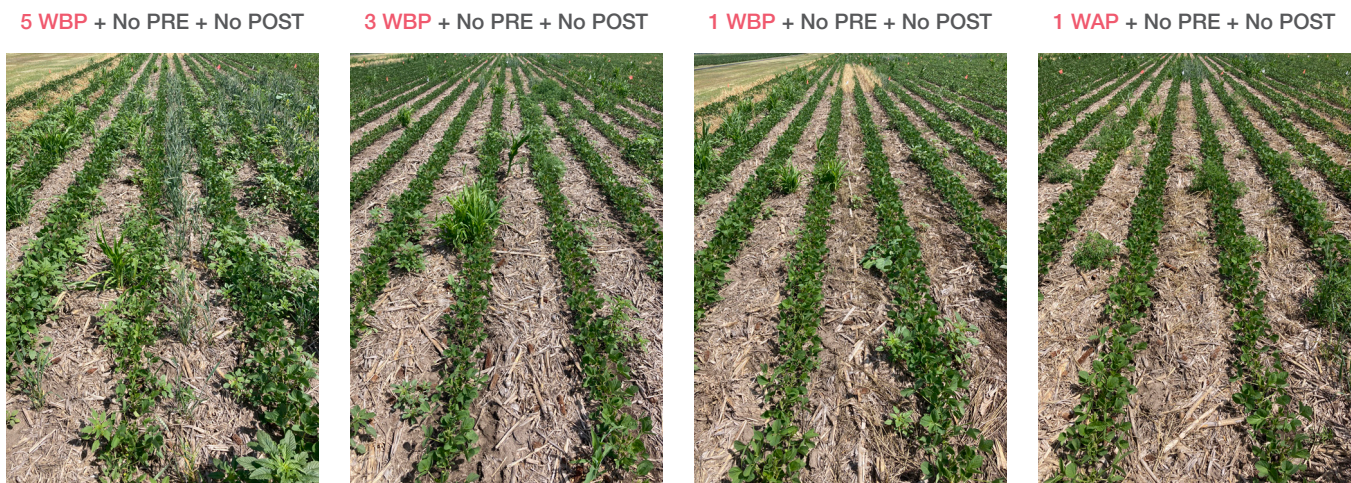


Figure 1. Effect of cover crop termination timing without PRE and POST herbicides on weed suppression. Pictures were taken on 6/26/2023 at the Bayer Water Utilization Learning Center, Gothenburg, NE by Alex Rosa.

Cover Crop Management and Herbicide Program Selection Impact on Weed Suppression and Soybean Yields

Table 4. Effect of pre-emergence herbicide (PRE) application and cover crop termination timings on percent weed suppression in 2023.

Cover Crop Termination Timing	Pre-emergence (PRE) Herbicide		Average of Cover Crop Termination*
	Yes PRE	No PRE	
	Weed Suppression (%)		
5 WBP	92 bc	50 f	71
3 WBP	89 cd	62 e	76
1 WBP	94 ab	86 d	90
1 WAP	96 a	93 ab	95
Average of pre-emergence (PRE) herbicide*	93	73	-

*No statistical comparison. Abbreviations: WBP, weeks before planting; WAP, weeks after planting. Weed suppression ratings taken on 6/25/2023. Numbers followed by letters indicate statistical difference at $\alpha = 0.1$.

- Cover crops terminated one week after planting soybean (1 WAP) resulted in 95% weed suppression compared to 90%, 76%, and 71% for the 1 WBP, 3 WBP, and 5 WBP treatments, respectively (Table 4 and Figure 1).
- Averaged across cover crop termination timings, pre-emergence herbicide application (Yes PRE) provided 93% weed suppression compared to 73% without a pre-emergence herbicide (No PRE) treatment (Table 4 and Figure 2).
- Cover crop termination at 1 WAP combined with pre-emergence herbicide (Yes PRE) application had slightly improved weed suppression (96%) compared to the 1 WAP + No PRE (93%) and 1 WBP + Yes PRE (94%) treatments. Weed suppression resulting from the combination of 1 WAP + with PRE herbicide was statistically higher than all other treatment combinations (Table 4). Cover crops terminated at 5 WBP without pre-emergence (No PRE) herbicide resulted in the least amount of weed suppression (Table 4).



Cover Crop Management and Herbicide Program Selection Impact on Weed Suppression and Soybean Yields

5 WBP + **No PRE** + No POST



5 WBP + **Yes PRE** + No POST



Figure 2. Effect of PRE emergence herbicides on weed suppression. Pictures were taken on 6/26/2023 at the Bayer Water Utilization Learning Center, Gothenburg, NE by Alex Rosa.

Table 5. Effect of post-emergence herbicide (POST) application and cover crop termination timings on percent weed suppression in 2023.

Cover Crop Termination Timing	Post-emergence Herbicide (POST)		Average of Cover Crop Termination*
	Yes POST	No POST	
	Weed Suppression (%)		
5 WBP	90 b	45 e	68
3 WBP	89 b	57 d	73
1 WBP	92 b	77 c	85
1 WAP	95 a	81 c	88
Average of POST emergence herbicide*	92	65	-

*No statistical comparison. Abbreviations: WBP, weeks before planting; WAP, weeks after planting. Weed suppression ratings taken 7/18/2023. Numbers followed by letters indicate statistical difference at $\alpha = 0.1$.



Cover Crop Management and Herbicide Program Selection Impact on Weed Suppression and Soybean Yields

- Averaged across cover crop termination timings, the post-emergence herbicide application (Yes POST) provided 92% weed suppression compared to 65% without a POST treatment applied (No POST, Table 5 and Figure 3).
- Terminating the cover crop one week after planting soybeans (1 WAP) resulted in 88% weed suppression compared to 85%, 73%, and 68% for the 1 WBP, 3 WBP, and 5 WBP treatments, respectively (Table 5).
- Cover crop termination at 1 WAP combined with post-emergence herbicide (Yes POST) application resulted in the highest weed suppression (95%) among all treatments. Cover crops terminated 5 WBP without post-emergence herbicide (No POST) had 45% weed suppression, the lowest among all treatments (Table 5).

5 WBP + No PRE + No POST



5 WBP + No PRE + Yes POST



Figure 3. Effect of POST herbicides in weed suppression. Pictures were taken on 7/18/2023 at the Bayer Water Utilization Learning Center, Gothenburg, NE by Alex Rosa.

Table 6. The effect of a pre-emergence herbicide (PRE) application with or without a post-emergence herbicide (POST) application on percent weed suppression. Results are combined from 2022 and 2023 data.

Pre-emergence Herbicide (PRE)	Post-emergence Herbicide (POST)		Average of PRE herbicide*
	Yes POST	No POST	
	Weed Suppression (%)		
Yes PRE	94 a	83 c	89
No PRE	89 b	45 d	67
Average of POST herbicide*	92	64	-

*No statistical comparison. Abbreviations: WBP, weeks before planting; WAP, weeks after planting. Weed suppression ratings were taken on 7/8/2022 and 7/18/2023. Numbers followed by letters indicate statistical difference at $\alpha = 0.1$.



Cover Crop Management and Herbicide Program Selection Impact on Weed Suppression and Soybean Yields

- The post-emergence herbicide application treatment (Yes POST) resulted in 89% weed suppression; however, it was significantly increased to 94% when the Yes POST treatment was combined with the pre-emergence (Yes PRE) herbicide treatment (Table 6).
- The POST and PRE herbicide treatments alone are not a fair comparison because of the timing of the weed suppression ratings between the two years of the study. Weed suppression was evaluated at 32 and 48 days after PRE herbicide application in 2022 and 2023, respectively. Weed suppression ratings for the POST herbicide treatments were taken at 17 and 21 days after POST application in 2022 and 2023, respectively (Table 6).

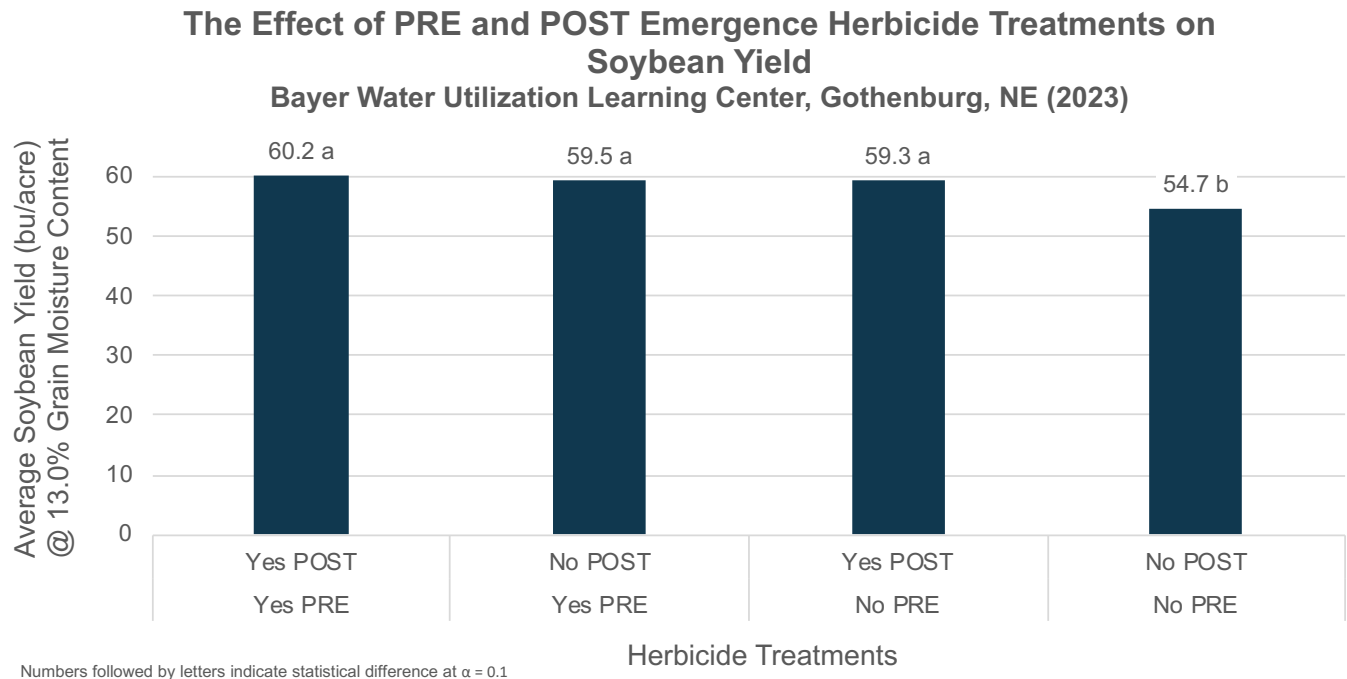


Figure 4. Soybean seed yield according to PRE and POST emergence herbicide treatments.

- The PRE and POST emergence herbicide alone, and in combination, had significantly ($\alpha = 0.1$) higher yields compared to no herbicide application (Figure 4).



Cover Crop Management and Herbicide Program Selection Impact on Weed Suppression and Soybean Yields

Key Learnings

- Cover crops did not influence soybean yields (data not presented); however, they had key participation in suppressing weeds in this study.
- Post-emergence herbicides were successful in suppressing weeds and achieving higher soybean yields, especially when combined with pre-emergence herbicides.
- The treatment combining pre-emergence and post-emergence herbicides enhanced weed suppression compared to the use of either treatment alone.
- Cover crop termination within 1 week before or after soybean planting increased percent weed suppression compared to termination taking place at 3 or 5 weeks before planting.
- Cover crops function as a weed management tool and are a valuable resource when suppressing herbicide-resistant weeds.

Legal Statements

The information discussed in this report is from a single site, replicated demonstration. This informational piece is designed to report the results of this demonstration and is not intended to infer any confirmed trends. Please use this information accordingly. **ALWAYS READ AND FOLLOW PESTICIDE LABEL DIRECTIONS. Performance may vary**, from location to location and from year to year, as local growing, soil and environmental conditions may vary. Growers should evaluate data from multiple locations and years whenever possible and should consider the impacts of these conditions on their growing environment.

The recommendations in this material are based upon trial observations and feedback received from a limited number of growers and growing environments. These recommendations should be considered as one reference point and should not be substituted for the professional opinion of agronomists, entomologists or other relevant experts evaluating specific conditions.

No dicamba may be used in-crop with seed with Roundup Ready® Xtend Technology, unless and until approved or specifically permitted, and no dicamba formulations are currently registered for such use in the 2024 season. Please follow <https://www.roundupreadyxtend.com/pages/xtendimax-updates.aspx> for status updates.

Based on Court ruling and EPA Existing Stocks Order* on XtendiMax® Herbicide registration, Bayer has stopped its sale and distribution of XtendiMax® Herbicide. Visit our XtendiMax herbicide updates page to learn the latest www.roundupreadyxtend.com/xtendimaxupdates. *Low-volatility dicamba products subject to the ruling include XtendiMax® herbicide with VaporGrip® Technology, Engenia® herbicide and Tavium® Plus VaporGrip® Technology herbicide.

XtendiMax® herbicide with VaporGrip® Technology has been classified as a restricted use pesticide and must be used with VaporGrip® Xtra Agent (or an equivalent volatility reduction adjuvant). For approved tank-mix products (including VRAs and DRAs), nozzles and other important label information visit XtendiMaxApplicationRequirements.com. Applicators must check XtendiMaxApplicationRequirements.com no more than 7 days before application of this product for additional labeling, including state restrictions. Where applicable, users must comply with additional requirements found on this website.

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