Kansas Agricultural Experiment Station Research Reports

Volume 10
Issue 3 *Kansas Field Research*

Article 13

2024

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Igor G. R. Lima
Kansas State University

Alec C. Adam
Kansas State University

Wade T. Burris
Kansas State University

See next page for additional authors

Recommended Citation

Lima, Igor G. R.; Adam, Alec C.; Burris, Wade T.; Raila, Salina; and Lancaster, Sarah (2024) "Herbicides and Cereal Rye for Palmer Amaranth Management in Corn and Soybean," *Kansas Agricultural Experiment Station Research Reports*: Vol. 10: Iss. 3. https://doi.org/10.4148/2378-5977.8599

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Authors

Igor G. R. Lima, Alec C. Adam, Wade T. Burris, Salina Raila, and Sarah Lancaster

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Summary

Palmer amaranth control is a substantial problem for corn and soybean producers in the United States. Farmers are increasingly interested in cover crops a tool to manage this troublesome weed. Studies were conducted at Rossville, Kansas, in 2023, to assess the most effective combination of herbicides and cereal rye cover crop termination time to control Palmer amaranth in corn and soybean. Treatments that included atrazine + an HPPD-inhibiting herbicide + a VLCFA-inhibiting herbicide plus glyphosate provided the greatest weed control in corn. For soybeans, the combination with the greatest weed control was a PPO-inhibiting herbicide + a VLCFA-inhibiting herbicide + an ALS-inhibiting herbicide plus glyphosate.

Introduction

Palmer amaranth poses a significant threat to corn and soybean production across the United States due to its aggressive growth, prolific seed production, and herbicide resistance. Many studies show that to manage this glyphosate-resistant weed, it is necessary to include an effective pre-emergent (PRE) herbicide with residual activity in the herbicide program (Culpepper et al., 2008; Whitaker et al., 2008; Whitaker et al., 2011; Powell, 2014; Bell et al., 2016; Norsworthy et al., 2016). Control of Palmer amaranth with atrazine and acetochlor (Group 5 and 15) has been 78% and 95%, respectively, at 10-12 weeks after planting (Grichar, WJ, Besler BA, Palrang DT et al., 2005). Flumioxazin (Group 14) has been one of the most effective PRE herbicides used to control Palmer amaranth, with observed control of up to 100%, 99%, and 98%, for 20, 40, and 60 days after application (Whitaker et al., 2011).

Planting winter cover crops can help control Palmer amaranth and reduce the reliance on herbicides to deal with resistant biotypes. Preliminary studies have shown that cover crops can play a significant role in mitigating resistance and improving overall weed control. Bellinder and Warholic (1988) reported effective weed control and equal yields when using a cereal rye cover crop and herbicides in corn production systems. Studies with soybeans show that herbicide and cereal rye have greater weed control due to weed suppression, and cover crops provide other benefits through improvements in soil quality. This study focused on the combined use of herbicides and cereal rye cover crops for weed management strategies.

Experimental Procedures

This study was conducted in Rossville, Kansas, and included the establishment of cereal rye cover in the fall of the year 2022. Corn and soybean were established when cereal rye was approximately 40 inches tall, on April 27, 2023. The herbicides (Tables 1 and 2) were applied at various times, starting at planting, and continuing until V5 corn or 28 days after soybean planting. Cereal rye control, crop injury, and weed control were assessed visually at the time of the first herbicide application, after crop emergence, and continuing until 85 days after planting. Assessments ranged from 100% representing complete control to 0% representing weed populations and growth similar to that observed in the untreated control.

Results and Discussion

When evaluated before the complete termination of cereal rye, 26 DAP in corn and 42 DAP in soybean, the average control for all treatments was 99% and 97%, respectively (data not shown). On the other hand, after cereal rye was completely terminated, 55 DAP, control was more variable, ranging from 33% to 98% in corn (Figure 1) and 15% to 86% in soybean (Figure 3). Treatments that included atrazine + an HPPD-inhibiting herbicide + a VLCFA-inhibiting herbicide plus glyphosate had the greatest weed control in corn (Figures 1 and 2). For soybeans, the combination with the greatest weed control was a PPO-inhibiting herbicide + a VLCFA-inhibiting herbicide + an ALS-inhibiting herbicide plus glyphosate (Figures 3 and 4).

In corn and soybean, the average control across all herbicide treatments was 80% and 67%, respectively, at the 85-day evaluation. In corn, treatments with one application resulted in an average of 70% control as opposed to 85% for treatments with two applications. In soybeans, weed control by treatments that included one application was similar to treatments that included two applications. The combined results of these studies indicate that the use of herbicide combinations with different modes of action, along with cover cropping, provides a solid foundation for Palmer amaranth control throughout the growing season.

Table 1. A description of all the treatments applied to corn

Treatment	Active ingredients (Group)	Herbicide trade name	Spray time (DAP)
c01	Glyphosate (9)	Roundup PowerMax	At planting
c02	Atrazine (5) + Bicyclopyrone (27) + Mesotrione (27) + S-Metolachlor (15) + Glyphosate (9)	Acuron + Roundup PowerMax	At planting
c03	Atrazine (5) + Bicyclopyrone (27) + Mesotrione (27) + S-Metolachlor (15)	Acuron + Roundup PowerMax	V3 (26 DAP)
c04	Atrazine (5)	Aatrex + Gramoxone	At planting
	Atrazine (5) + Bicyclopyrone (27) + Mesotrione (27) + S-Metolachlor (15)	Aatrex + Acuron	V3 (26 DAP)
c05	Atrazine (5) + Bicyclopyrone (27) + Mesotrione (27) + S-Metolachlor (15)	Acuron	At planting
	Atrazine (5) + S-Metolachlor (15) + Glyphosate (9) + Mesotrione (27)	Aatrex + Halex	V4 (35 DAP)
c06	Atrazine (5) + Bicyclopyrone (27) + Mesotrione (27) + S-Metolachlor (15) + Glyphosate (9)	Acuron + Roundup PowerMax	At planting
	Atrazine (5) + S-Metolachlor (15) + Glyphosate (9) + Mesotrione (27)	Aatrex + Halex	V3 (26 DAP)
c07	Atrazine (5) + Bicyclopyrone (27) + Mesotrione (27) + S-Metolachlor (15)	Acuron + Gramoxone	At planting
	Atrazine (5) + S-Metolachlor (15) + Glyphosate (9) + Mesotrione (27)	Aatrex + Halex	V3 (26 DAP)
c08	Saflufenacil (14) + Dimethenamid-P (15)	Verdict	At planting
	Dicamba (4) + Diflufenzopyr (19) + Glyphosate (9)	Status + Roundup PowerMax	V3 (26 DAP)
c09	Atrazine (5) + Bicyclopyrone (27) + Mesotrione (27) + S-Metolachlor (15)	Aatrex + Storen + Gramoxone	At planting
	Atrazine (5) + S-Metolachlor (15) + Glyphosate (9) + Mesotrione (27)	Aatrex + Halex	V3 (26 DAP)
c10	Atrazine (5) + Bicyclopyrone (27) + Mesotrione (27) + S-Metolachlor (15) + Glyphosate (9)	Storen + Roundup PowerMax	At planting
	Atrazine (5) + S-Metolachlor (15) + Glyphosate (9) + Mesotrione (27)	Aatrex + Halex	V3 (26 DAP)

Table 2. A description of all the treatments applied to the soybean

Treatment	Active ingredients (Group)	Herbicide trade name	Spray time (DAP)
s01	S-Metolachlor (15) + Metribuzin (5) + Cloransulam-Methyl (2)	Tendovo	At planting
	S-Metolachlor (15) + 2,4-D (4) + Glyphosate (9)	Roundup PowerMax + Enlist One + Dual Magnum	V6 (11 DAP)
s02	S-Metolachlor (15) + Metribuzin (5) + Cloransulam-Methyl (2) + Glyphosate (9)	Tendovo + Roundup PowerMax	At planting
	S-Metolachlor (15) + 2,4-D (4) + Glyphosate (9)	Roundup PowerMax + Enlist One + Dual Magnum	V6 (11 DAP)
s03	S-Metolachlor (15) + Fomesafen (14) + Metribuzin (5)	Prefix + Tricor 4F	At planting
	S-Metolachlor (15) + 2,4-D (4) + Glyphosate (9)	Roundup PowerMax + Enlist One + Dual Magnum	V6 (1 1 DAP)
s04	S-Metolachlor (15) + Fomesafen (14) + Metribuzin (5)	Tricor 4F + Prefix	At planting
	S-Metolachlor (15) + 2,4-D (4) + Glyphosate (9)	Roundup PowerMax + Enlist One + Dual Magnum	V6 (11 DAP)
s05	2,4-D (4) + S-Metolachlor (15) + Fomesafen (14) + Glyphosate (9)	Roundup PowerMax + Enlist One + Dual Magnum + Prefix	V2 (5 DAP)
s06	Glyphosate (9) + Fomesafen (14) + Glufosinate (10) + S-Metolachlor (15)	Flexstar GT + Liberty 280 + Dual Magnum	V6 (11 DAP)
s07	Glyphosate (9) + Fomesafen (14) + Glufosinate (10) + S-Metolachlor (15)	Flexstar GT + Liberty 280 + Dual Magnum	V2 (5 DAP)
s08	Glyphosate (9)	Roundup PowerMax	V2 (5 DAP)
s09	Imazethapyr (14) + Pyroxasulfone (15) + Saflufenacil (2) + Glyphosate (9)	Zidua Pro + Roundup PowerMAx	At planting
	Pyroxasulfone (15) + 2,4-D (4) + Glyphosate (9)	Zidua + Enlist One + Roundup PowerMax	V6 (11 DAP)
s10	S-Metolachlor (15) + Metribuzin (5) + Sulfentrazone (14) + Glyphosate (9)	Roundup PowerMax + Boundary + Broadaxe	At planting
	S-Metolachlor (15) + 2,4-D (4) + Glyphosate (9)	Roundup PowerMax + Dual Magnum + Enlist One	V6 (11 DAP)

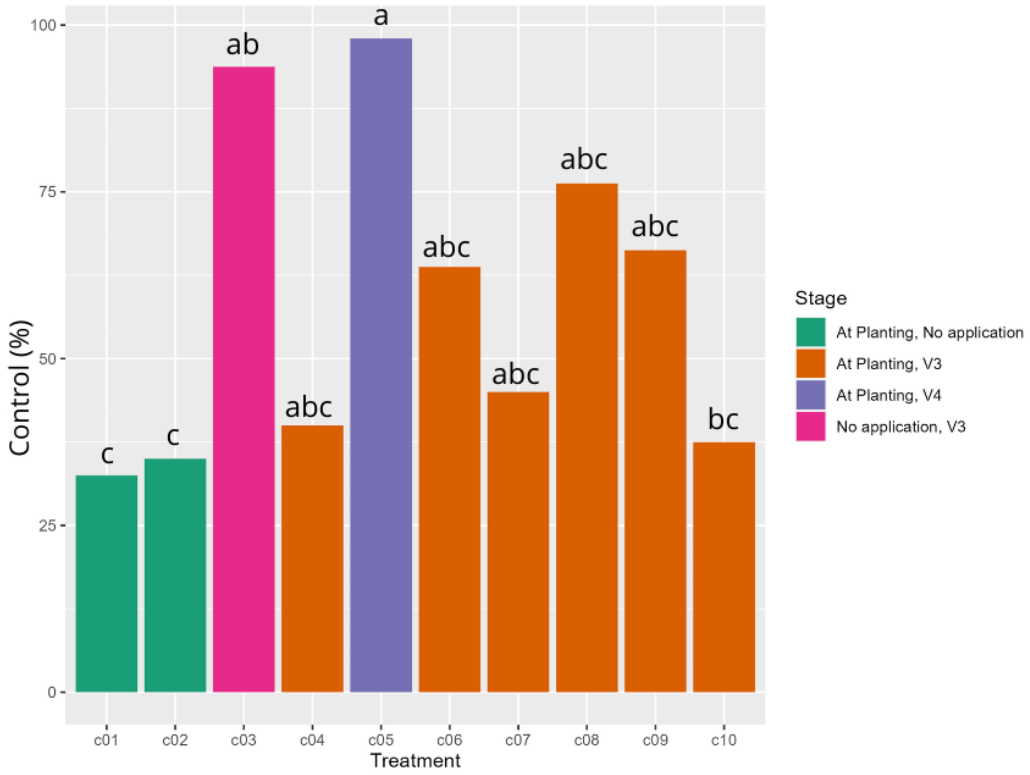

Figure 1. Palmer amaranth control 55 days after planting the corn, cereal rye had already been completely terminated. Similar letters indicate means are similar according to Tukey's HSD (0.05).

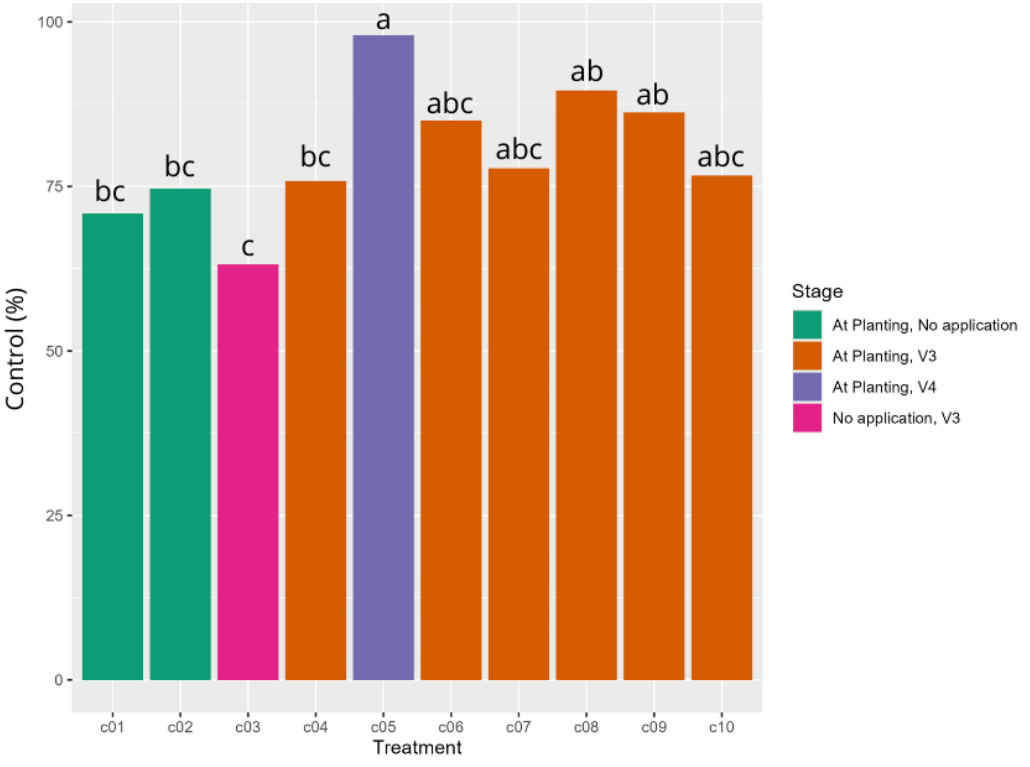

Figure 2. Palmer amaranth control 85 days after planting corn. Similar letters indicate means are similar according to Tukey's HSD (0.05).

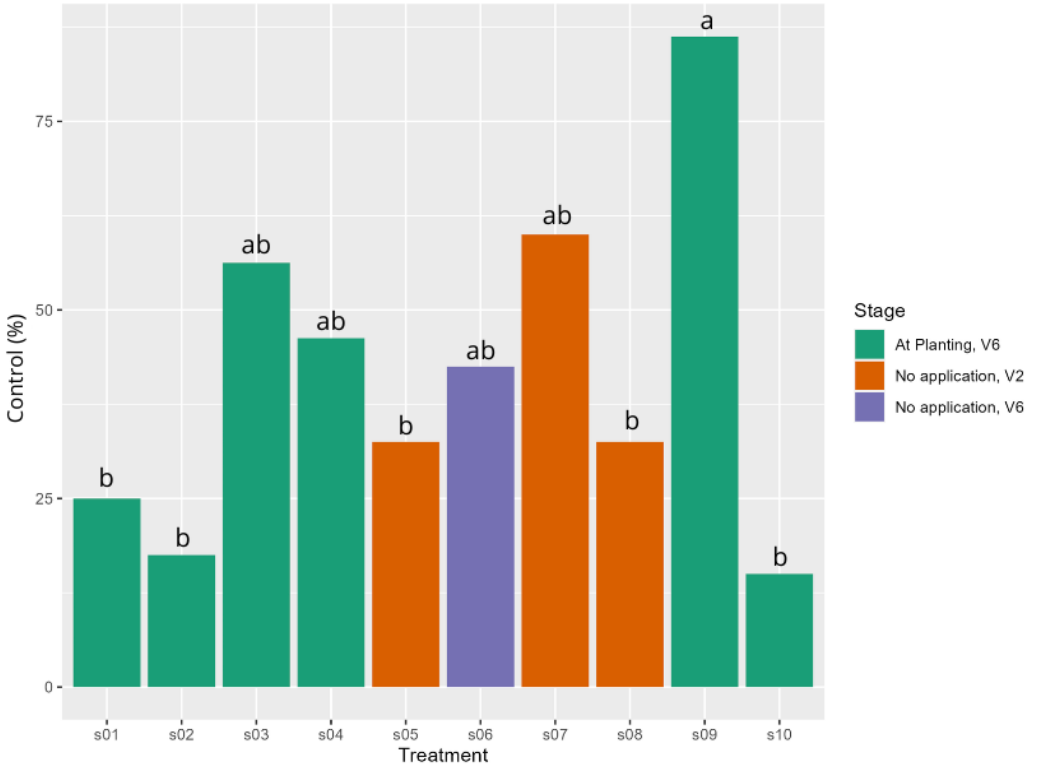

Figure 3. Palmer amaranth control 55 days after planting the soybean, cereal rye had already been completely terminated. Similar letters indicate means are similar according to Tukey's HSD (0.05).

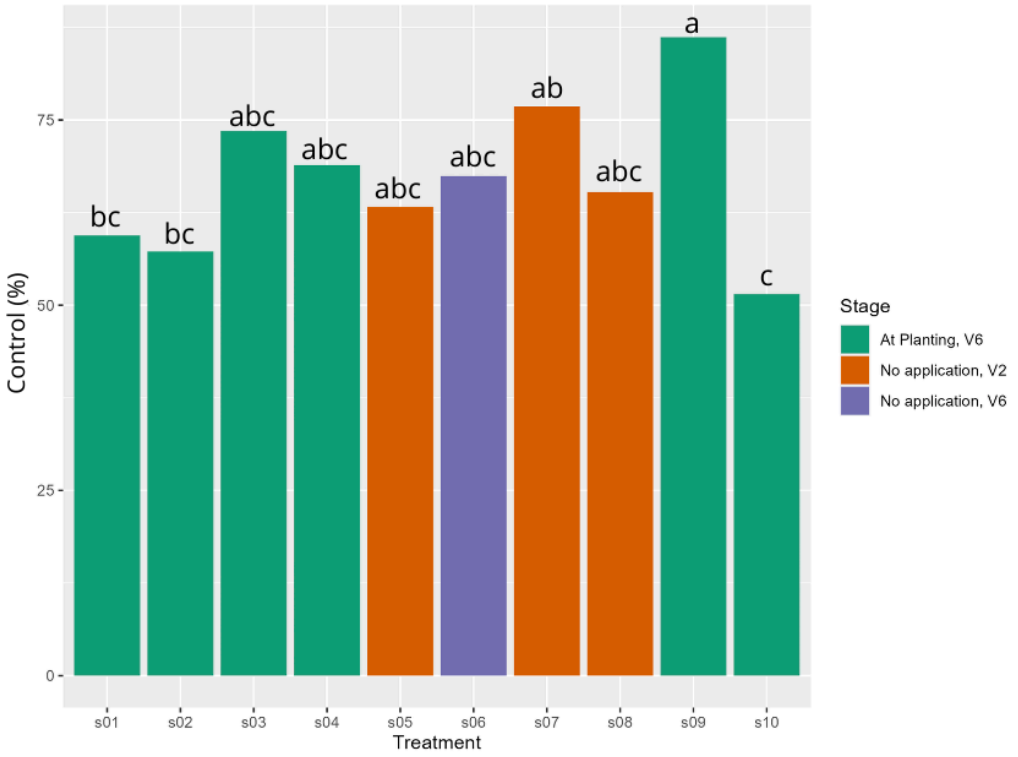

Figure 4. Palmer amaranth control 85 days after planting soybean. Similar letters indicate means are similar according to Tukey's HSD (0.05).