

EVALUATION OF HERBICIDE RESIDUAL TIMINGS FOR CONTROL OF ITALIAN RYEGRASS IN KENTUCKY WINTER WHEAT

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INTRODUCTION (objective)

Italian ryegrass (annual ryegrass) continues to be problematic in Kentucky wheat acres and has shown rapid increases in infestations across the state. This weed species has proved to be the most problematic weed for Kentucky wheat growers with our previous research identifying multiple populations of glyphosate-resistant, pinoxaden (Axial XL), and pinoxaden plus fenoxaprop (Axial Bold) resistant annual ryegrass in Kentucky wheat fields.

In the absence of a post-emergence herbicide option many Kentucky wheat growers have utilized pyroxasulfone based residual herbicides for control of ryegrass. While these preemergence herbicides have proven to be effective for suppressing fall emerging ryegrass plants, we have witnessed more ryegrass emergence in the spring months when fall applied residuals have dissipated. The previous mild Kentucky winters have likely contributed to this trend of increased spring ryegrass emergence, but also has accelerated residual herbicide degradation. Research was initiated in 2023 to further examine how to maximize residual herbicide for both fall and spring emerging populations of Italian ryegrass in Kentucky wheat. The research objective was to investigate the use of residual herbicides and residual application timing for control of Italian ryegrass in wheat.

METHODS & MATERIALS

Two research trials were established in the fall of 2023, one at the UKREC in Princeton and a second on a grower field in Simpson County with a known Italian ryegrass infestation. The UKREC has an established field with a pinoxaden -sensitive ryegrass population, while the Simpson County field had a suspected pinoxaden-resistant ryegrass population. Herbicide treatment programs were implemented that include Fierce EZ and Anthem Flex applied as single fall application and multi-pass applications in the fall and early winter/early spring while staying within current label restrictions. For example, Anthem Flex was applied PRE only at the maximum rate of 3.5 fl oz/a and was compared to Anthem Flex applied Pre at 3 fl oz followed by a post application of 1.5 fl oz in either early winter (Dec) or early spring (Feb). The post applications were applied with and without 2oz Metribuzin 75DF to continue to evaluate the utility of postemergence metribuzin applications. Additionally, all residual treatments were split with and without an application of Axial Bold in the spring. A full list of treatments, planting dates, and application dates can be found in Tables 1 and 2 for the UKREC and Simpson locations, respectively.

Trials were laid out in a randomized complete block design with four replications. Individual plots measured 30 ft in length by 5 ft in width. All herbicide applications were applied using CO₂ pressurized backpack sprayers calibrated for 15 gallons per acre for all residual applications and 10 gallons per acre for the Axial Bold applications.

Visual ratings were collected in March 2024 prior to Axial Bold applications and again prior to wheat har-

vest at both locations. Additionally, ryegrass seed head panicle density per half meter square was collected prior to harvest. All data was analyzed in SAS using PROC GLIMMIX.

RESULTS & DISCUSSION

Italian ryegrass visual control ranged from 66 to 97% control on March 20, 2024 following residual applications at the UKREC location (Table 3). All treatments receiving Anthem Flex resulted in 95 to 97 % control regardless of timing of application or use of Metribuzin 75DF. Conversely, Fierce EZ resulted in reduced Italian ryegrass control when splitting the residual application as compared to the single fall application of Fierce EZ or any of the applications of Anthem Flex. Italian ryegrass control at Simpson County on March 18, 2024, ranged from 82 to 100% (Table 4). In contrast to the UREC site the Simpson County site did not have any statistical differences between residual herbicide packages.

Ryegrass control at the end of the growing season ranged from 38 to 100% control at the UKREC location on Jun 6, 2024 (Table 5). Treatments receiving applications of Anthem Flex resulted in the greatest control with 96 to 100% control. Anthem Flex treatments did not differ in control regardless of timing of application, the inclusion of Metribuzin 75DF, or the inclusion of an Axial Bold application in the herbicide program. Similar to the spring visual control, control at the end of the season was reduced with the split application of Fierce EZ as compared to the single fall application of Fierce EZ or the split Fierce EZ application with the inclusion of Metribuzin 75DF. Fierce treatments receiving a spring application of Axial Bold all resulted in 100% control of ryegrass, indicating the great utility of Axial Bold on a sensitive ryegrass population. The ryegrass seed head counts at UKREC had a similar trend to the end of the season visual control ratings with seed head counts ranging from 0 to 248 seed heads per m² (Table 6). The highest seed head counts occurred in the Fierce EZ split treatment without Metribuzin 75DF or a spring application of Axial Bold with 130 seed heads per m². Despite having a greater seed head count than all other herbicide treatments, the split Fierce EZ treatment did reduce seed head counts as compared to the untreated.

End of season visual ratings and seed head counts (data not shown) at the Simpson County site resulted in a lack of differences between treatments (Table 7). Despite the lack in statistical differences, numerical differences at Simpson County are similar to those found at the UKREC with the split applications of Fierce EZ resulting in lower control than the other treatments. The inclusion of Axial Bold as a spring application did not have an influence at the Simpson County location, in contrast to the UKREC location, pointing to a likely higher tolerance of the ryegrass population to pinoxaden and fenoxaprop.

CONCLUSION

At the Caldwell County (UKREC) location, statistical differences in treatment effectiveness were observed, while no significant differences were noted at the Simpson County site. The lack of differences at Simpson County is attributed to inconsistent ryegrass densities typical in on-farm research. Both total pre-emergent (PRE) and split applications of Anthem Flex did not differ in ryegrass control at either location. However, using Axial Bold after Anthem Flex led to complete ryegrass control at UKREC, while its application following all residuals in Simpson County did not enhance control. Split applications of Fierce EZ were less effective than a single 14 day pre plant (DPP) application of Fierce EZ at UKREC, necessitating the addition of metribuzin during the POST application to manage any emerged ryegrass. Although not statistically signifi-

cant, results from Fierce EZ in Simpson County displayed a similar trend to those observed at UKREC.

The differences in how Anthem Flex and Fierce EZ performed can be linked to the differences in total pyroxasulfone being applied between the two products. Anthem Flex allows for a season maximum cumulative rate of 4.5 fl oz/a or 0.13 lb pyroxasulfone while the Fierce EZ label has a maximum cumulative rate of 6 fl oz/a or 0.08 lb pyroxasulfone. The greater amounts of pyroxasulfone in Anthem Flex were observed in this research. Further research on the spilt rates of Fierce EZ is warranted to understand the correct balance of the reduced pyroxasulfone offered by this product.

Based on the first year results we would recommend the following for ryegrass control in wheat. Anthem Flex can be applied either all at planting or split between planting and post-emergence, with split applications potentially needing to occur in December or early February for maximum control. For split applications of Fierce EZ, the inclusion of metribuzin in the post-application applied in December would be necessary. The use of Axial Bold to clean up any escapes in the spring is still warranted for many populations in Kentucky. Further evaluation of the application rate for split Fierce EZ is required, although current label restrictions limit its potential use.

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TABLES

Table 1. Residual herbicide treatments applied at the University of Kentucky Research and Education Center (UKREC) and dates of herbicide applications. The UKREC trial was planted on November 6, 2023, with emergence occurring on November 15, 2023. All listed treatments were split with half receiving an Axial Bold application on March 20, 2024, and half receiving no spring post herbicide application.

Herbicide	Rate	Application Timing
Anthem Flex	3.5 fl oz/A	Preemergence – Nov 7, 2023
Anthem Flex fb	3 fl oz/A fb	Preemergence – Nov 7, 2023 fb
Anthem Flex	1.5 fl oz/A	Post – Feb 20, 2024
Anthem Flex fb	3 fl oz/A fb	Preemergence – Nov 7, 2023 fb
Anthem Flex + 75DF Metribuzin	1.5 fl oz/A + 2 oz/A	Post – Feb 20, 2024
Fierce EZ	6 fl oz/A	14 DPP – Oct 17, 2023
Fierce EZ fb	3 fl oz/A fb	14 DPP – Oct 17, 2023 fb
Fierce EZ	3 fl oz/A	Post – Feb 20, 2024
Fierce EZ fb	3 fl oz/A fb	14 DPP – Oct 17, 2023 fb
Fierce EZ + 75 DF metribuzin	3 fl oz/A + 2 oz/A	Post – Feb 20, 2024

Table 2. Residual herbicide treatments applied at Simpson County and dates of herbicide applications. The trial was planted on November 1, 2023. All listed treatments were split with half receiving an Axial Bold application on March 20, 2024, and half receiving no spring post herbicide application.

Herbicide	Rate	Application Timing
Anthem Flex	3.5 fl oz/A	Preemergence – Nov 2, 2023
Anthem Flex	3 fl oz/A	Preemergence – Nov 2, 2023
fb	fb	fb
Anthem Flex	1.5 fl oz/A	Post – Feb 20, 2024
Anthem Flex	3 fl oz/A	Preemergence – Nov 2, 2023
fb	fb	fb
Anthem Flex + 75DF Metribuzin	1.5 fl oz/A + 2 oz/A	Post – Feb 20, 2024
Fierce EZ	6 fl oz/A	14 DPP – Oct 3, 2023
Fierce EZ	3 fl oz/A	14 DPP – Oct 3, 2023
fb	fb	fb
Fierce EZ	3 fl oz/A	Post – Dec 6, 2023
Fierce EZ	3 fl oz/A	14 DPP – Oct 3, 2023
fb	fb	fb
Fierce EZ + 75 DF metribuzin	3 fl oz/A + 2 oz/A	Post – Dec 6, 2023

Table 3. Influence of residual herbicide timing and rates on visual ryegrass control at University of Kentucky Research and Education Center (UKREC) on March 20, 2024.

Herbicide	Rate	% Visual Ryegrass Control – March 20, 2024 ^a
Anthem Flex	3.5 fl oz/A	97 A
Anthem Flex	3 fl oz/A	
fb	fb	97 A
Anthem Flex	1.5 fl oz/A	
Anthem Flex	3 fl oz/A	
fb	fb	95 AB
Anthem Flex + 75DF Metribuzin	1.5 fl oz/A + 2 oz/A	
Fierce EZ	6 fl oz/A	90 AB
Fierce EZ	3 fl oz/A	
fb	fb	66 C
Fierce EZ	3 fl oz/A	
Fierce EZ	3 fl oz/A	
fb	fb	80 BC
Fierce EZ + 75 DF metribuzin	3 fl oz/A + 2 oz/A	

^a Means followed by the same letter are NOT statistically different. Tukey HSD $\alpha = 0.05$

Table 4. Influence of residual herbicide timing and rates on visual ryegrass control at Simpson County on March 18, 2024.

Herbicide	Rate	% Visual Ryegrass Control – March 18, 2024 ^a
Anthem Flex	3.5 fl oz/A	100 A
Anthem Flex fb	3 fl oz/A fb	99 A
Anthem Flex	1.5 fl oz/A	
Anthem Flex fb	3 fl oz/A fb	94 A
Anthem Flex + 75DF Metribuzin	1.5 fl oz/A + 2 oz/A	
Fierce EZ	6 fl oz/A	94 A
Fierce EZ fb	3 fl oz/A fb	84 A
Fierce EZ	3 fl oz/A	
Fierce EZ fb	3 fl oz/A fb	82 A
Fierce EZ + 75 DF metribuzin	3 fl oz/A + 2 oz/A	
^a Means followed by the same letter are NOT statistically different. Tukey HSD $\alpha = 0.05$		

Table 5. Influence of herbicide programs on visual ryegrass control at University of Kentucky Research and Education Center (UKREC) on June 6, 2024.

Herbicide	Rate	% Visual Ryegrass Control – June 6, 2024 ^a	
		No Axial Bold	Axial Bold
Anthem Flex	3.5 fl oz/A	96 A	100 A
Anthem Flex fb	3 fl oz/A fb	97 A	100 A
Anthem Flex	1.5 fl oz/A		
Anthem Flex fb	3 fl oz/A fb	98 A	100 A
Anthem Flex + 75DF Metribuzin	1.5 fl oz/A + 2 oz/A		
Fierce EZ	6 fl oz/A	76 A	100 A
Fierce EZ fb	3 fl oz/A fb	38 B	100 A
Fierce EZ	3 fl oz/A		
Fierce EZ fb	3 fl oz/A fb	75 A	100 A
Fierce EZ + 75 DF metribuzin	3 fl oz/A + 2 oz/A		

^a Means followed by the same letter are NOT statistically different. Tukey HSD $\alpha = 0.05$

Table 6. Influence of herbicide programs on ryegrass seed head density at University of Kentucky Research and Education Center (UKREC) on June 3, 2024.

Herbicide	Rate	Ryegrass Seed Heads per 0.5m ² –	
		June 3, 2024 ^a	
		No Axial Bold	Axial Bold
Anthem Flex	3.5 fl oz/A	4 C	0 C
Anthem Flex fb	3 fl oz/A fb	5 C	0 C
Anthem Flex	1.5 fl oz/A		
Anthem Flex fb	3 fl oz/A fb	2 C	0 C
Anthem Flex + 75DF Metribuzin	1.5 fl oz/A + 2 oz/A		
Fierce EZ	6 fl oz/A	43 C	0 C
Fierce EZ fb	3 fl oz/A fb	130 B	0 C
Fierce EZ	3 fl oz/A		
Fierce EZ fb	3 fl oz/A fb	39 C	0 C
Fierce EZ + 75 DF metribuzin	3 fl oz/A + 2 oz/A		
Untreated		248 A	
^a Means followed by the same letter are NOT statistically different. Tukey HSD $\alpha = 0.05$			

Table 7. Influence of herbicide programs on visual ryegrass control at Simpson County on May 29, 2024

		% Visual Ryegrass Control – May 29, 2024^a	
Herbicide	Rate	No Axial Bold	Axial Bold
Anthem Flex	3.5 fl oz/A	95 A	94 A
Anthem Flex fb	3 fl oz/A fb	87 A	94 A
Anthem Flex	1.5 fl oz/A		
Anthem Flex fb	3 fl oz/A fb	68 A	93 A
Anthem Flex + 75DF Metribuzin	1.5 fl oz/A + 2 oz/A		
Fierce EZ	6 fl oz/A	68 A	94 A
Fierce EZ fb	3 fl oz/A fb	75 A	72 A
Fierce EZ	3 fl oz/A		
Fierce EZ fb	3 fl oz/A fb	75 A	78 A
Fierce EZ + 75 DF metribuzin	3 fl oz/A + 2 oz/A		

^a Means followed by the same letter are NOT statistically different. Tukey HSD $\alpha = 0.05$