INFLUENCE OF POST-EMERGENCE APPLICATION TIMING ON RHIZOME JOHNSONGRASS CONTROL IN CORN WITH NICOSULFURON AND PRIMISULFURON

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Summary. The influence of application timing on nicosulfuron and primisulfuron activity in rhizome johnsongrass, *Sorghum halepense*, was examined in a naturally infested corn field in north-eastern Kansas, USA. Herbicide treatments included single applications at 0.5, 0.75, and 1.0X rates (1.0X = 35 and 40 g/ha for nicosulfuron and primisulfuron, respectively) and split applications at 0.5 plus 0.5X and 0.75 plus 0.25X rates. Split applications provided more rhizome johnsongrass control than single applications 8 weeks after first application. Corn yield was not affected by herbicide application timing and was 70% less in untreated plots than in treated plots. The results of this study in addition to published results in previous studies suggest that an application of either nicosulfuron or primisulfuron 4 to 6 weeks after planting can allow a grower an option of determining if a second application is necessary. Growers not able to inspect treated fields or reluctant to make two applications for johnsongrass control should make a single application at a labeled rate 6 to 8 weeks after planting.

INTRODUCTION

Johnsongrass was declared by Holm *et al.* (6) as the sixth most serious weed in the world. Hafliger and Scholz (5) reported that johnsongrass was widely distributed in America (North, Central, and South), Africa, Europe, Asia, Australia, New Zealand, Philippines, Indonesia, and the Pacific islands. Johnsongrass infestations in corn reduce both grain quality and quantity and, if severe enough, prevent grain production (1).

Bendixen (2) reported that fall plowing and herbicide applications provided effective (greater than 90%) johnsongrass control in corn in a 3 year rotation with winter wheat and soybean. Fall plowing and herbicide applications provided less than 50% control in monocultured corn. Recently, the sulfonylurea herbicides nicosulfuron and primisulfuron were registered for post-emergence control of rhizome johnsongrass (plants emerged from perennating tissues) in corn. Camacho *et al.* (4) reported that although these herbicides display soil activity, neither herbicide prevented regrowth from johnsongrass rhizomes within treated soils. Field studies (4, 7) revealed more consistent control of rhizome johnsongrass with split applications of nicosulfuron and primisulfuron at a 0.5X rate (17.5 and 20 g ai/ha, respectively) 2 weeks apart compared to single applications at a 1.0X rate at the early date. An additional study was deemed necessary to compare split applications of both herbicides at either 0.5 plus 0.5X or 0.75 plus 0.25X rates with single applications at 0.5, 0.75, and 1.0X rates.

METHODS

A corn field naturally infested with rhizome johnsongrass in north-eastern Kansas (dryland) was selected. Soil texture was a Grundy silty clay loam (22% sand, 50% silt, and 28% clay) with 2.2% organic matter and pH 5.9. Plots consisted of four corn rows spaced 0.76 m wide and 7.5 m long. Jacques 8210 hybrid was planted 23 April 1991 and the field immediately treated with alachlor and atrazine at labeled rates to control annual weeds (including seedling johnsongrass) and permethrin at a labeled rate to control cutworms, *Agrotis spp.*

Treatments consisted of nicosulfuron and primisulfuron applied as single applications at 0.5, 0.75, and 1.0X rates (1.0X = 35 and 40 g/ha, respectively) on 28 May or as split applications at 0.5 plus 0.5X or 0.75 plus 0.25X rates with the second application made on 11 June. All treatments contained a nonionic surfactant (X-77, Valent USA Corp.) at a concentration of 0.25% (v/v). Herbicides were applied with a CO_2-pressurized plot sprayer equipped with flat-fan nozzles calibrated to deliver 187 L/ha at 276 kPa. Untreated plots served as checks.

Corn injury and johnsongrass control were visually rated at 4 and 8 weeks after treatment (WAT), respectively, on a scale of 0 to 100, where 0 indicated neither stand nor growth reduction and 100 indicated plant death. Corn yields were determined by hand harvesting ears from 4.5 m of each of the two middle rows of each plot, shelling the corn, and correcting kernel weights for moisture content.

Treatments were assigned in a split-plot arrangement with herbicides as main plots and application timings as subplots. A randomized complete block design with four replications was used. Analysis of corn injury and johnsongrass control ratings did not include those for check plots to avoid the use of zeros and therefore creating unequal variances. Treatment means were separated by Fisher's protected l.s.d. test at P=0.05.

RESULTS AND DISCUSSION

Interactions between herbicides and application timing were not significant for corn injury, rhizome johnsongrass control, or corn yield. Therefore, only herbicide and application timing main effects are presented (Table 1).

Both nicosulfuron and primisulfuron injured corn slightly which was evident at 4 but not 8 WAT. Injury was lowest with single applications. Nicosulfuron provided greater rhizome johnsongrass control averaged across application timing than primisulfuron. Greater control of rhizome johnsongrass with nicosulfuron compared to primisulfuron was also observed in earlier studies in north-eastern Kansas under dryland conditions (4). Camacho *et al.* (3) reported greater foliar absorption of radiolabeled nicosulfuron compared to primisulfuron in rhizome johnsongrass cultured in the greenhouse which explains the greater activity of nicosulfuron.

Rhizome johnsongrass control with split applications averaged across herbicides was excellent (greater than 95%). Control with split applications (combined rate = 1.0X) was significantly greater than with single applications made at the earlier date at 0.5 or 0.75X rates and tended to be greater than a single application at the 1.0X rate. We attribute most of the increase in efficacy of split applications to the effect that the second application has on plants previously treated but not completely killed (and producing new shoots) and some of the increase in efficacy to control of plants that emerged after the earlier application date. Without the second application, most of the late emerging plants would survive the first application because soil activity with both nicosulfuron and primisulfuron is minimal (4).

Corn yield was not significantly affected by herbicide averaged across application timing. Also, no significant differences in corn yield occurred between herbicide applications applied as single or split applications. Corn yield in untreated plots was 70% less than the average yield for the treated plots. This indicates that rhizome johnsongrass is a very competitive weed.

A grower applying nicosulfuron or primisulfuron at 0.5 to 0.75X rates at an early date (4 to 6 weeks after corn planting) may choose not to make the second application 2 weeks later (or substitute row cultivation for the herbicide application) if treated plants are satisfactorily controlled and few if any late-emerging plants are present. The grower however must determine if treated plants are recovering and if plants are emerging since the herbicide was applied. A grower who is reluctant to perform a second operation (herbicide application or row cultivation) should consider a single application at the full labeled rate when essentially all rhizome johnsongrass plants have emerged and most plants have more than five leaves present (7). A previous study (4) revealed that single applications at a 1.0X rate 6 to 8 weeks after planting provided equivalent johnsongrass control as split applications in corn grown under dryland conditions in north-eastern Kansas.

Table 1. Effect of nicosulfuron and primisulfuron and application timing on rhizome johnsongrass control and corn injury and yield in north-eastern Kansas in 1991

Herbicide	Application timing[b]	Corn injury[c] (%)	Johnsongrass injury[c] (%)	Corn yield (kg/ha)
			Herbicide main effect[a]	
Nicosulfuron	--	11	1.33 (97)	4720
Primisulfuron	--	16	1.21 (92)	4050
l.s.d. = 0.05		NS	0.11	NS
			Application timing main effect	
--	½ x early	8	1.13 (88)	4930
--	¾ x early	10	1.23 (93)	5290
--	1 x early	13	1.25 (95)	4930
--	½ x + ½ x	20	1.35 (97)	4670
--	¾ x + ¼ x	18	1.39 (98)	5000
--	None	--	--	1510
l.s.d. = 0.05		6	0.15	710

[a] Herbicide by application timing interaction was not significant at P=0.05 for all parameters.

[b] Full rates (1x) for nicosulfuron and primisulfuron were 35 and 40 g/ha, respectively.

[c] Visual ratings for corn injury and johnsongrass control were taken at 4 and 8 weeks, respectively, after the first application was made. Johnsongrass control ratings were arcsine-transformed for statistical analysis; values in parentheses are nontransformed values.

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