Weed Technology 2013 27:341–346

Response of Sweet Corn to Pyroxasulfone in High-Organic-Matter Soils

Dennis C. Odero and Alan L. Wright*

Field experiments were conducted in 2011 and 2012 in Belle Glade, FL to evaluate the response of sweet corn and weed control to pyroxasulfone on high-organic-matter soils in the Everglades Agricultural Area (EAA) of southern Florida with the use of dose-response curves. Pyroxasulfone was applied PRE at 31.25, 62.5, 125, 250, 500, and 1,000 g ai ha^{-1} on soil with 80% organic matter. Dose-response curves based on a three-parameter log-logistic model were used to determine pyroxasulfone rate required to provide 90% control (ED_{90}) of spiny amaranth, common lambsquarters, and common purslane in sweet corn. The ED_{90} values for spiny amaranth, common lambsquarters, and common purslane control were 209, 215, and 194 g ha^{-1} of pyroxasulfone, respectively, at 21 d after treatment (DAT). At 42 DAT, the ED_{90} values for spiny amaranth, common lambsquarters, and common purslane control were 217, 271, and 234 g ha^{-1} of pyroxasulfone, respectively. Sweet corn yield increased with increasing rates of pyroxasulfone. An estimated 214 g ha^{-1} of pyroxasulfone was required to maintain sweet corn yield at 90% level of the weed-free yield. In addition, pyroxasulfone did not result in sweet corn injury. These results indicate that pyroxasulfone can provide effective weed control in sweet corn on high-organic-matter soils of the EAA.

Nomenclature: Pyroxasulfone; common lambsquarters, *Chenopodium album* L. CHEAL; common purslane, *Portulaca oleracea* L. POROL; spiny amaranth, *Amaranthus spinosus* L. AMASP; sweet corn, *Zea mays* L.

Key words: High-organic-matter soil, preemergence herbicide, weed control.

Se realizaron experimentos de campo en 2011 y 2012 en Belle Glade, FL para evaluar la respuesta del maíz dulce y el control de malezas a pyroxasulfone en suelos con alta contenido de materia orgánica en el Área Agrícola de Everglades (EAA) en el sur de Florida, usando curvas de respuesta a dosis. Se aplicó pyroxasulfone PRE a 31.25, 62.5, 125, 250, 500 y 1,000 g ai ha^{-1} en suelo con 80% materia orgánica. Se usaron curvas de respuesta a dosis basadas en un modelo log-logístico de tres parámetros para determinar la dosis requerida de pyroxasulfone para obtener 90% de control (ED_{90}) de *Amaranthus spinosus*, *Chenopodium album*, y *Portulaca oleracea* en maíz dulce. Los valores de ED_{90} para el control de *A. spinosus*, *C. album*, y *P. oleracea* fueron 209, 215 y 194 g ha^{-1} de pyroxasulfone, respectivamente. El rendimiento del maíz dulce incrementó con dosis crecientes de pyroxasulfone. Se requirió un estimado de 214 g ha^{-1} de pyroxasulfone para mantener el rendimiento del maíz dulce a un nivel de 90% del rendimiento con cero malezas. Adicionalmente, pyroxasulfone no causó daño al maíz dulce. Estos resultados indican que pyroxasulfone puede brindar control efectivo de malezas en maíz dulce en suelos con alto contenido de materia orgánica en el EAA.

Sweet corn is an important crop grown in rotation with sugarcane (*Saccharum* spp. hybrids) in the Everglades Agricultural Area (EAA) of southern Florida for the fresh market. The EAA is dominated by organic or muck soils (Histosols) underlain by limestone rock (Snyder 1994). These soils formed under flooded conditions that precluded decomposition of organic matter, allowing those materials to form organic soils with up to 85% organic matter (Wright and Hanlon 2009). Weed control is one of the main costs of production associated with sweet corn in the EAA. Despite extensive use of herbicides in sweet corn, weed persistence and resulting yield reduction from weed interference is still common in the EAA. Weed control is generally more difficult on these organic soils than mineral soils. Organic soils have high cation exchange capacity, large soil microbial populations, and relatively high soil moisture and temperature (Schueneman and Sanchez 1994) often associated with herbicide adsorption and metabolism by soil microorganisms (Shea 1989). These factors combine to promote rapid weed growth while binding or degrading soil-applied herbicides, thus significantly reducing their efficacy (Schueneman and Sanchez 1994).

Atrazine and *S*-metolachlor have been the foundation for PRE weed control programs for sweet corn in the EAA. These herbicides have been shown to provide control of many annual broadleaf and grass weeds in sweet corn (Boydston et al. 2008; Malik et al. 2008; O'Connell et al. 1998; Williams et al. 2010). Mesotrione is also labeled for PRE use in sweet corn in the EAA to provide control of problematic weeds like common lambsquarters and common purslane (Anonymous 2012a). O'Sullivan et al. (2002) reported tolerance of several sweet corn cultivars to PRE-applied mesotrione. Approximately 71, 42, and 14% of sweet corn hectarage for the fresh market is treated with atrazine, *S*-metolachlor, and mesotrione, respectively, in the United States (NASS 2012). However, sweet corn growers in the EAA have observed reduced efficacy of these herbicides on organic soils. As a result, tillage between row middles is used to supplement chemical weed control. Therefore, highly efficacious novel herbicides with residual activity on high-organic-matter soils of the EAA are needed to minimize the negative effect of weeds on sweet corn production in the area.

Pyroxasulfone is a low-use-rate herbicide developed by Kumiai Chemical Industry Co. Ltd. and BASF Corporation to provide residual broad-spectrum weed control in corn,

---

DOI: 10.1614/WT-D-12-00133.1

* Assistant Professor and Associate Professor, University of Florida Everglades Research and Education Center, Belle Glade, FL 33430. Corresponding author's E-mail: dcodero@ufl.edu.

wheat (*Triticum aestivum* L.), soybean (*Glycine max* L. Merr.), and sunflower (*Helianthus annuus* L.) (Anonymous 2012b; Geier et al. 2006; Olson et al. 2011; Porpiglia et al. 2005, 2006). Pyroxasulfone is a root and shoot growth inhibitor that controls germinating seedlings of susceptible weed species. The mode of action of pyroxasulfone is the inhibition of the very-long-chain fatty acid synthesis (Tanetani et al. 2009). Several studies have shown that PRE application of pyroxasulfone provides excellent control of many broadleaf and grass weeds (Geier et al. 2006; Gregory et al. 2005; King et al. 2007; King and Garcia 2008; Knezevic et al. 2009; Nurse et al. 2011; Olson et al. 2011). Pyroxasulfone has also been shown to provide better weed control compared to *S*-metolachlor, making it a potential alternative for sweet corn growers in the EAA. King and Garcia (2008) reported that pyroxasulfone provided 85 to 100% control of kochia [*Kochia scoparia* (L.) Schrad.] and velvetleaf (*Abutilon theophrasti* Medik.) 4 mo after planting compared to 48 to 73% control by *S*-metolachlor in field corn. Steele et al. (2005) reported that pyroxasulfone provided up to 90% control of Texas panicum (*Panicum texanum* Buckl.) compared to 78% control by *S*-metolachlor in field corn 9 wk after treatment. Previous studies on the efficacy of PRE-applied pyroxasulfone have been on soils with organic-matter content between 1 to 9% (King and Garcia 2008; Knezevic et al. 2009; Nurse et al. 2011; Steele et al. 2005). Knezevic et al. (2009) reported that the dose of pyroxasulfone needed for control of several weed species in field corn increased with increasing organic matter. In their study, pyroxasulfone at 200 to 300 g ai ha^{-1} provided excellent control of most grasses and certain broadleaf weeds for at least the first 4 wk of the growing season on soils with up to 3% organic matter in Nebraska. Pyroxasulfone is currently being considered as a potential PRE herbicide for selective weed control in sweet corn in the EAA. However, it is unclear if pyroxasulfone will have the same efficacy observed in previous studies in the high-organic-matter soils of the EAA. Therefore, the objective of this study was to evaluate the efficacy of PRE-applied pyroxasulfone and the response of sweet corn in high-organic-matter soils of the EAA with the use of dose-response curves.

Materials and Methods

Field experiments were conducted at the University of Florida Everglades Research and Education Center in Belle Glade, FL in 2011 and 2012. The soil was a Dania Muck (Euic, hyperthermic, shallow Lithic Haplosaprists) with pH of 7.3 and 80% organic matter. Experimental fields were prepared by chisel plowing followed by disking with a harrow prior to planting both years. Sweet corn 'Garrison' was planted on October 13, 2011 and February 1, 2012 at a seeding rate of 79,000 seeds ha^{-1}. 'Garrison' was chosen because it is one of the major sweet corn varieties cultivated in the EAA. Fertilizer was applied at 120 kg P_2O_5 ha^{-1}, 9 kg Mn ha^{-1}, 9 kg Zn ha^{-1}, and 1 kg B ha^{-1} at planting. A large amount of P was applied because the organic soils of the EAA are naturally P deficient (Alt 1987). Water was applied by subsurface irrigation from field ditches by maintaining a water table 61 cm below the soil surface (Snyder et al. 1978). Predominant weed species in both years were spiny amaranth, common lambsquarters, and common purslane.

The experiment was arranged in a randomized complete block design with four replications of treatments both years. Treatments consisted of six rates of pyroxasulfone (Zidua®, BASF Corporation, Research Triangle Park, NC 27709) applied PRE at 31.25, 62.5, 125, 250, 500, and 1,000 g ai ha^{-1}. Season-long weed-free and weedy controls were included. The weed-free control was maintained by hand hoeing throughout the season. Experimental plots consisted of four sweet corn rows 7.6 m long and spaced 76 cm apart. Herbicide treatments were applied with the use of a CO_2-pressurized sprayer calibrated to deliver 180 L ha^{-1} of total volume at pressure of 276 kPa with the use of Teejet® XR8002VS nozzle tips (Spraying Systems Co., Wheaton, IL 60187). Experimental plots were overhead irrigated to supply 12.5 mm of water to incorporate the herbicide immediately following treatment application.

A visual estimation of sweet corn injury was made with the use of a scale of 0 to 100%, with 0 being no injury and 100 being complete plant death at 21 and 42 d after treatment (DAT). Weed control was assessed by counting a randomly selected area 3 m long between the middle two rows of each plot at 21 and 42 DAT. Weed control for each species was calculated as a percentage of the number of each species in each plot divided by the number of each species in the weedy (untreated control) plots. The middle two rows in each plot were harvested by hand at sweet corn maturity and marketable yield recorded on January 4, 2012 and May 1, 2012. Sweet corn ears were considered marketable if 90% of kernels were full and yellow, and ears were least 5 cm in diameter.

Analysis of variance was performed on sweet corn injury and weed control data using the lme function in R at 5% level of significance to assess the effect of pyroxasulfone treatment (Pinheiro and Bates 2000). Year was considered a random variable and the treatment main effects were tested for error associated with the appropriate treatment-by-year interaction (McIntosh 1983). Data were pooled by year when the treatment-by-year interaction was not significant. Nonlinear regression analysis was then performed on weed control data with the use of the drc package (Ritz and Streibig 2005) of the open-source language R (R version 2.15.0, R Development Core Team 2012). A three-parameter log-logistic equation (Equation 1) similar to that proposed by Seefeldt et al. (1995) was fit to weed control data for each weed species, but with the lower limit constrained to 0, so that the equation takes the form

$$Y = d/1 + \exp[b(\log x - \log e)], \qquad [1]$$

where Y is the response (% weed control), x is the pyroxasulfone rate in g ha^{-1}, b is the slope of the inflection point, d is the upper limit of the curve, and e is the inflection point of the fitted line (equivalent to the dose required to cause 50% response [ED_{50}]). Equation 1 is biologically relevant because no weed control will be observed when a herbicide is not applied (Kniss and Lyon 2011). The fitted curve was used to estimate ED_{90} values (effective dose required to provide 90% control) for each weed species. The

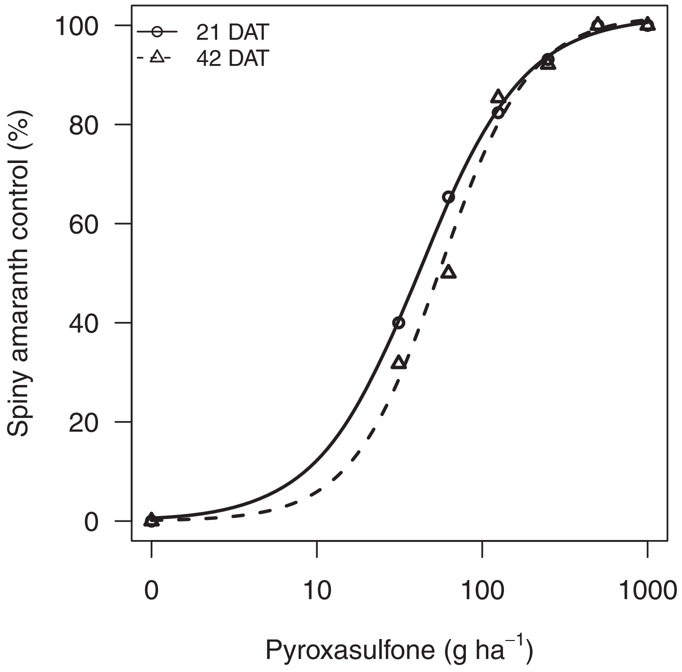

Figure 1. Spiny amaranth control at 21 and 42 d after treatment (DAT) in response to pyroxasulfone applied PRE on high-organic-matter soil. Parameter estimates and standard errors of the fitted curve, as described in Equation 1, are listed in Table 1. Control expressed as a percentage of an average 10 and 12 spiny amaranth plants m^{-2} at 21 and 42 DAT evaluation dates, respectively, in the untreated control.

Table 1. Parameter estimates (standard error in parentheses) and pyroxasulfone rates (g ha^{-1}) that provide 90% weed control (ED$_{90}$) in sweet corn on high-organic-matter soil with the use of a log-logistic model.[a]

Weed species	DAT[b]	Parameter estimates (± SE)			ED$_{90}$
		b	*d*	*e*	
					g ha^{-1}
Spiny amaranth	21	−1.4 (0.3)	101.9 (4.7)	42.3 (5.1)	208.5 (82.1)
	42	−1.6 (0.3)	102.1 (4.1)	56.0 (5.7)	217.2 (60.9)
Common lambsquarters	21	−1.6 (0.2)	102.7 (3.2)	52.1 (4.3)	214.5 (49.4)
	42	−1.7 (0.2)	102.0 (3.4)	74.8 (6.0)	270.6 (55.9)
Common purslane	21	−1.6 (0.2)	101.5 (3.2)	49.0 (4.0)	194.2 (45.4)
	42	−1.7 (0.2)	100.1 (3.2)	66.7 (5.3)	234.2 (49.8)

[a] Log-logistic: $Y = d/1 + \exp[b(\log x - \log e)]$, where Y is the response (% weed control), x is the pyroxasulfone rate in g ha^{-1}, b is the slope of the inflection point, d is the upper limit of the curve, and e is the inflection point of the fitted line (equivalent to the dose required to cause 50% response [ED$_{50}$]).

[b] DAT = d after treatment.

ED$_{90}$ and ED$_{50}$ values at 21 and 42 DAT were compared with the use of likelihood tests.

Sweet corn relative yield for individual plots were calculated as a percentage of the corresponding weed-free yield. Relative yield was subjected to ANOVA and data combined when there was no treatment-by-year interaction as previously described. The relationship between sweet corn relative yield and pyroxasulfone rate was plotted with the use of a hyperbolic model (Cousens 1985):

$$Y = \frac{Id}{1 + Id/A} \qquad [2]$$

where Y is sweet corn relative yield (% of season-long weed free), d is the pyroxasulfone rate in g ha^{-1}, I is the slope, and A is the asymptote of the fitted hyperbolic line. Equation 2 was also fit to data with the use of the drc package of R.

Results and Discussion

Spiny Amaranth Control. There was no treatment-by-year interaction for spiny amaranth control in sweet corn on high-organic-matter soils with PRE pyroxasulfone at 21 ($P = 0.999$) and 42 ($P = 0.987$) DAT evaluation dates; therefore, data were combined over years for analysis at each evaluation date. Spiny amaranth control was modeled as a function of pyroxasulfone rate with the use of the three-parameter log-logistic model (Equation 1). A lack-of-fit test at the 95% level was not significant ($P = 0.928$) for the curves (Figure 1), indicating that the regression model was appropriate (Ritz and Streibig 2005). Parameter estimates for the fitted curves are provided in Table 1. Spiny amaranth control at 21 and 42 DAT increased as pyroxasulfone rate increased (Figure 1). Control of spiny amaranth was greater at 21 compared to 42 DAT. The ED$_{90}$ values were estimated to be 209 and 217 g ha^{-1} at 21 and 42 DAT, respectively. A higher rate of pyroxasulfone was estimated to provide 90% control of spiny amaranth at 42 compared to 21 DAT even though the ED$_{90}$ values were not significantly different at the two evaluation dates ($P = 0.931$). The estimated ED$_{50}$ value (Table 1) was significantly lower at 21 compared to 42 DAT ($P = 0.045$), indicating that a higher rate of pyroxasulfone was required to provide 50% control of spiny amaranth at 42 DAT. There are several studies that have reported control of *Amaranthus* species in sweet and field corn with lower pyroxasulfone rates. Nurse et al. (2011) reported 90% control of redroot pigweed (*Amaranthus retroflexus* L.) in sweet corn with pyroxasulfone at 93 g ha^{-1} on soils with up to 9.2% organic matter. Steele et al. (2005) reported more than 96% control of Palmer amaranth (*Amaranthus palmeri* S. Wats.) in field corn with pyroxasulfone at 125 g ha^{-1} on soils with 1% organic matter. Knezevic et al. (2009) reported that 152 and 198 g ha^{-1} of pyroxasulfone provided 90% control of tall waterhemp (*Amaranthus tuberculatus* Moq.) in field corn at 28 and 45 DAT, respectively, on soils with up to 3.1% organic matter. The rates of pyroxasulfone reported to provide at least 90% control of *Amaranthus* species in previous studies are lower than our estimated rates of 208 and 217 g ha^{-1} at 21 and 42 DAT, respectively, on 80%-organic-matter soil. In contrast, Geier et al. (2006) reported that control of Palmer amaranth in field corn on 2.7%-organic-matter soil resulted from higher pyroxasulfone rates of 250 to 332 g ha^{-1}, which provided 95 to 99% control. In this study, the higher rate of pyroxasulfone was required when above-normal rainfall enhanced Palmer amaranth growth late in the season.

Common Lambsquarters Control. No treatment-by-year interaction effects for common lambsquarters control with pyroxasulfone in sweet corn in high-organic-matter soils was observed at 21 ($P = 0.952$) and 42 ($P = 0.909$) DAT

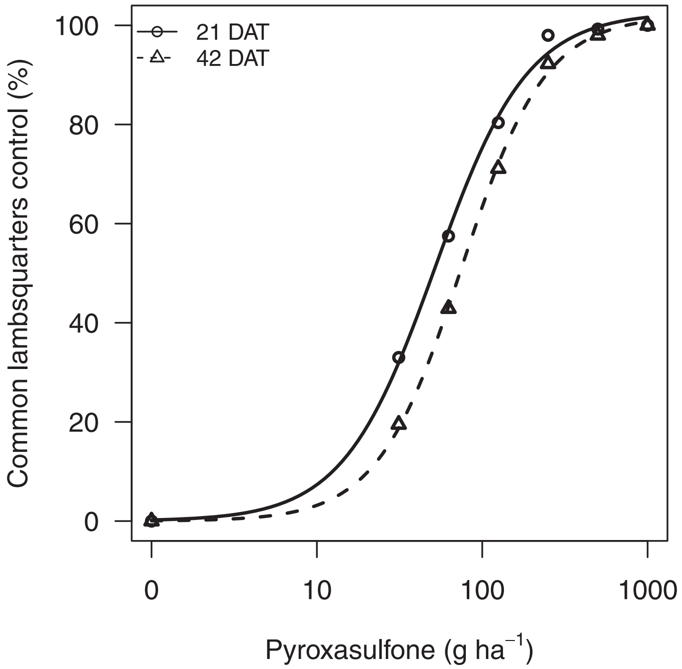

Figure 2. Common lambsquarters control at 21 and 42 d after treatment (DAT) in response to pyroxasulfone applied PRE on high-organic-matter soil. Parameter estimates and standard errors of the fitted curve, as described in Equation 1, are listed in Table 1. Control expressed as a percentage of an average 40 and 41 common lambsquarters plants m^{-2} at 21 and 42 DAT evaluation dates, respectively, in the untreated control.

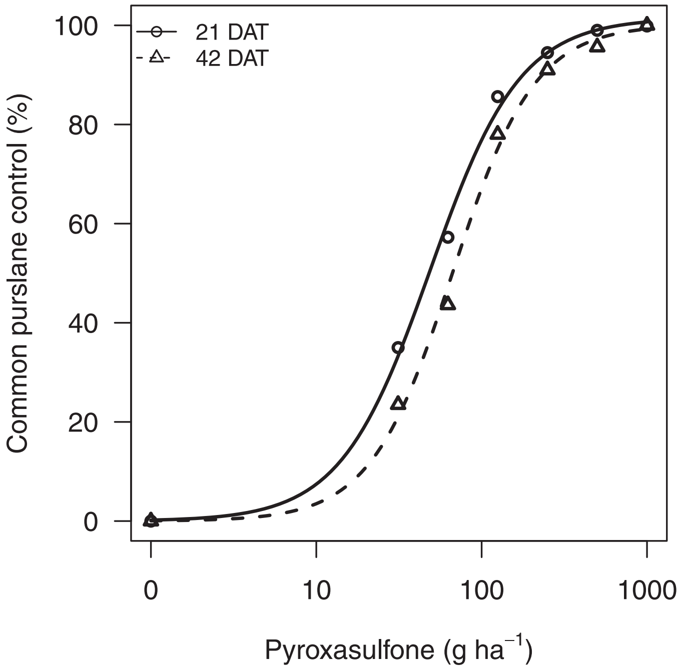

Figure 3. Common purslane control at 21 and 42 d after treatment (DAT) in response to pyroxasulfone applied PRE on high-organic-matter soil. Parameter estimates and standard errors of the fitted curve, as described in Equation 1, are listed in Table 1. Control expressed as a percentage of an average 69 and 73 common purslane plants m^{-2} at 21 and 42 DAT evaluation dates, respectively in the untreated control.

evaluation dates; therefore, data were combined over years for analysis at each evaluation date. Common lambsquarters control was modeled as a function of pyroxasulfone rate with the use of the three-parameter log-logistic model (Equation 1). A lack-of-fit test at the 95% level was not significant ($P = 0.990$) for the curves (Figure 2), indicating that the regression model was appropriate (Ritz and Streibig 2005). Parameter estimates for the fitted curves are provided in Table 1. As pyroxasulfone rate increased, common lambsquarters control at 21 and 42 DAT increased (Figure 2). However, control was greater at 21 compared to 42 DAT. The ED_{90} values were estimated to be 215 and 271 g ha^{-1} at 21 and 42 DAT, respectively. The ED_{90} values were not significantly different at 21 and 42 DAT ($P = 0.401$) although a higher rate of pyroxasulfone was required to provide 90% control of common lambsquarters at 42 DAT. At 21 DAT, the estimated ED_{50} value (Table 1) was significantly lower than at 42 DAT ($P < 0.001$), indicating that higher rate of pyroxasulfone was required to provide 50% control of common lambsquarters at 42 DAT. In contrast, Nurse et al. (2011) estimated that pyroxasulfone rate of 499 g ha^{-1} was required to provide 90% control of common lambsquarters in sweet corn in soils with up to 9.2% organic matter. In addition, Nurse et al. (2011) reported <80% control of common lambsquarters at pyroxasulfone doses below 250 g ha^{-1}.

Common Purslane Control. There was no treatment-by-year interaction for common purslane control in sweet corn on high-organic-matter soils with PRE-applied pyroxasulfone at 21 ($P = 0.522$) and 42 ($P = 0.982$) DAT evaluation dates; thus data were combined over years for analysis at each evaluation date. Common purslane control was modeled as a function of pyroxasulfone rate with the use of the three-parameter log-logistic model (Equation 1). A lack-of-fit test at the 95% level was not significant ($P = 0.911$) for the curves (Figure 3), indicating that the regression model was appropriate (Ritz and Streibig, 2005). Parameter estimates for fitted curves are provided in Table 1. Similar to spiny amaranth and common lambsquarters control, common purslane control at 21 and 42 DAT increased as pyroxasulfone rate increased (Figure 3). At 21 DAT, control of common purslane was greater than 42 DAT. The ED_{90} values were estimated to be 194 and 234 g ha^{-1} at 21 and 42 DAT, respectively. A higher-rate pyroxasulfone was required to provide 90% control of common purslane at 42 DAT, although the ED_{90} values were not significantly different at 21 and 42 DAT ($P = 0.512$) evaluation dates. The estimated ED_{50} value (Table 1) was significantly lower at 21 compared to 42 DAT ($P = 0.002$), indicating that higher rate of pyroxasulfone was required to provide 50% control of common purslane at 42 DAT.

Sweet corn Tolerance to Pyroxasulfone and Yield. Pyroxasulfone did not result in any visible injury on sweet corn at any of the rates used in the study. Similarly, previous studies reported no injury on field corn following application of pyroxasulfone. King and Garcia (2008) reported no injury on field corn from pyroxasulfone applied at 116 to 250 g ha^{-1}. Steele et al. (2005) reported no significant field-corn injury at

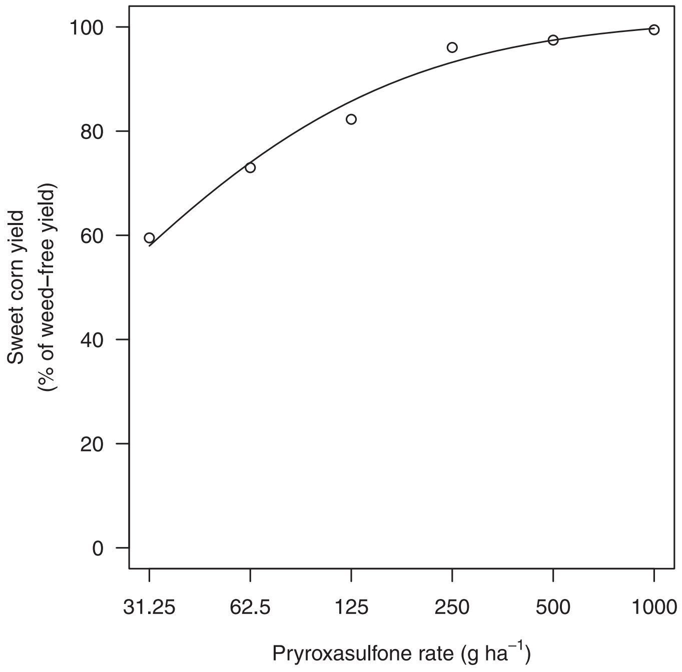

Figure 4. Sweet corn relative yield (% weed-free yield) in response to pyroxasulfone applied PRE on high-organic-matter soil. Parameter estimates and standard errors (in parentheses) of the fitted curve, as described in Equation 2, are $I = 4.3$ (0.4) and $A = 102.1$ (2.0).

pyroxasulfone applied at 125 to 500 g ha^{-1}. Geier et al. (2006) reported no significant field-corn injury at pyroxasulfone applied at 125 to 332 g ha^{-1}. Knezevic et al. (2009) reported no visible injury to field corn at pyroxasulfone applied at 25 to 700 g ha^{-1}. All these previous studies were on field corn grown on finely textured soils. It has been recommended that lower rates of pyroxasulfone are required on coarse-textured or lower-organic-matter soils to avoid crop injury (Anonymous 2012b). The organic soils of the EAA are very finely textured, probably explaining our observed results. In contrast, Nurse et al. (2011) reported sweet corn injury exceeding 10% when pyroxasulfone was applied at 250 g ha^{-1} or greater in a coarse-textured soil with 82% sand.

The average sweet corn weed-free yield for the study was 15,140 kg ha^{-1}. There was no treatment-by-year interaction ($P = 0.513$) for relative sweet corn yield on high-organic-matter soils with PRE pyroxasulfone; thus data were pooled over years for analysis. Sweet corn relative yield control was modeled as a function of pyroxasulfone rate with the use of the hyperbolic model (Equation 2). A lack-of-fit test at the 95% level was not significant ($P = 0.604$) for the curve (Figure 4), indicating that the regression model was appropriate (Ritz and Streibig 2005). Similar to weed control, sweet corn relative yield increased as pyroxasulfone rate increased. Approximately 214 g ha^{-1} of pyroxasulfone was required to maintain the yield at 90% of the weed-free control. This rate was within the range of rates estimated to provide 90% control of spiny amaranth, common lambsquarters, and common purslane.

These results show that PRE pyroxasulfone provided effective control of spiny amaranth, common lambsquarters, and common purslane, which are the most problematic weeds in sweet corn on high-organic-matter soils of the EAA. The effective rate of pyroxasulfone that was required to provide 90% control varied from 194 to 215 g ha^{-1} and 217 to 271 g ha^{-1} at 21 and 42 DAT, respectively, depending on the weed species. These rates are within the labeled use rate of 149 to 238 g ha^{-1} for coarse-textured soils, with the exception of common lambsquarters control, which required the highest rate of 271 g ha^{-1} at 42 DAT. This implies that higher rates of pyroxasulfone may be required in fields with heavy infestation of common lambsquarters. Our study shows that pyroxasulfone can provide excellent control of problematic weeds in high-organic-matter soils of the EAA at the labeled use rate.

Acknowledgments

The authors wish to thank Nikol Havranek, Yigang Luo, and Galo Cabrera, and the staff at the Everglades Research and Education Center for their assistance with establishing, maintaining, and harvesting experimental plots.

Literature Cited

Alt, D. 1987. Influence of P- and K-fertilization on yield of different vegetable species. J. Plant Nutr. 10:1429–1435.

Anonymous. 2012a. Callisto® herbicide. Syngenta Crop Protection, LLC. http://www.syngenta.com/global/corporate/en/products-and-innovation/product-brands/crop-protection/herbicides/Pages/callisto.aspx. Accessed September 1, 2012.

Anonymous. 2012b. Zidua Herbicide Worldwide Technical Brochure, Report No. GL-7001A. Florham Park, NJ: BASF The Chemical Company.

Boydston, R. A., H. P. Collins, and A. K. Alva. 2008. Control of volunteer potato (*Solanum tuberosum*) in sweet corn with mesotrione is unaffected by atrazine and tillage. Weed Technol. 22:654–659.

Cousens, R. 1985. A simple model relating yield loss to weed density. Ann. Appl. Biol. 107:239–252.

Geier, P. W., P. W. Stahlman, and J. C. Frihauf. 2006. KIH-485 and *S*-metolachlor efficacy comparisons in conventional and no-tillage corn. Weed Technol. 20:622–626.

Gregory, L. S., P. J. Porpiglia, and J. M. Chandler. 2005. Efficacy of KIH-485 on Texas panicum (*Panicum texanum*) and selected broadleaf weeds in corn. Weed Technol. 19:866–869.

King, S. R. and J. O. Garcia. 2008. Annual broadleaf control with KIH-485 in glyphosate-resistant furrow irrigated corn. Weed Technol. 22:420–424.

King, S. R., R. L. Ritter, E. S. Hagood, Jr., and H. Menbere. 2007. Control of acetolactate synthesis-resistant shattercane (*Sorghum bicolor*) in field corn with KIH-485. Weed Technol. 21:578–582.

Knezevic, S. Z., A. Datta, J. Scott, and P. J. Porpiglia. 2009. Dose-response curves of KIH-485 for preemergence weed control in corn. Weed Technol. 23:34–39.

Kniss, A. R. and D. J. Lyon. 2011. Winter wheat response to preplant applications of aminocyclopyrachlor. Weed Technol. 25:51–57.

Malik, M. S., J. K. Norsworthy, A. S. Culpepper, M. B. Riley, and W. Bridges, Jr. 2008. Use of wild radish (*Raphanus raphanistrum*) and rye cover crops for weed suppression in sweet corn. Weed Sci. 56:588–595.

McIntosh, M. S. 1983. Analysis of combined experiments. Agron. J. 75:153–155.

[NASS] National Agricultural Statistics Service. 2012. Agricultural Chemical Use Database. http://www.pestmanagement.info/nass/app_statcs3_crop.cfm. Accessed September 1, 2012.

Nurse, R. E., P. H. Sikkema, and D. E. Robinson. 2011. Weed control and sweet maize (*Zea mays* L.) yield as affected by pyroxasulfone dose. Crop Prot. 30:789–793.

Olson, B.L.S., R. K. Zollinger, C. R. Thompson, D. E. Peterson, B. Jenks, M. Moechnig, and P. W. Stahlman. 2011. Pyroxasulfone with and without sulfentrazone in sunflower (*Helianthus annuus*). Weed Technol. 25:217–221.

O'Connell, P. J., C. T. Harms, and J. R. F. Allen. 1998. Metolachlor, *S*-metolachlor and their role within sustainable weed-management. Crop Prot. 17:207–212.

O'Sullivan, J., J. Zandstra, and P. Sikkema. 2002. Sweet corn (*Zea mays*) cultivar sensitivity to mesotrione. Weed Technol. 16:421–425.

Pinheiro, J. C. and D. M. Bates. 2000. Mixed-Effects Models in S and S-PLUS. New York: Springer-Verlag. 530 p.

Porpiglia, P. J., M. Nakatani, and R. Ueno. 2005. KIH-485: a new broad spectrum herbicide. Weed Sci. Soc. Am. Abstr. 45:314.

Porpiglia, P. J., O. Watanabe, M. Kurts, Y. Yamaji, and H. Honda. 2006. KIH-485 potential in southern row crops. South. Weed Sci. Soc. Abstr. 59:43.

R Development Core Team. 2012. R: A Language and Environment for Statistical Computing. Vienna, Austria: R Foundation for Statistical Computing. http://www.R-project.org/. Accessed March 20, 2012.

Ritz, C. and J. C. Streibig. 2005. Bioassay analysis using R. J. Statist. Software 12:1–22.

Schueneman, T. J. and C. A. Sanchez. 1994. Vegetable production in the EAA. Pages 238–277 *in* A. B. Bottcher and F. T. Izuno, eds. Everglades Agricultural Area (EAA): Water, Soil, Crop, and Environmental Management. Gainesville: University Press of Florida.

Seefeldt, S. S., J. E. Jensen, and E. P. Feurst. 1995. Log-logistic analysis of herbicide dose-response relationships. Weed Technol. 9:218–227.

Shea, P. J. 1989. Role of humified organic matter in herbicide adsorption. Weed Technol. 3:190–197.

Snyder, G. H. 1994. Soils of the EAA. Pages 27–41 *in* A. B. Bottcher and F. T. Izuno, eds. Everglades Agricultural Area (EAA): Water, Soil, Crop, and Environmental Management. Gainesville: University Press of Florida.

Snyder, G. H., H. W. Burdine, J. R. Crockett, G. J. Gascho, D. S. Harrison, G. Kidder, J. W. Milshoe, D. L. Myhre, F. M. Pate, and S. F. Shih. 1978. Water table management for organic soil conservation and crop production in the Florida Everglades. Univ. Fla. Bull. 801:13–14.

Steele, G. L., P. J. Porpiglia, and J. M. Chandler. 2005. Efficacy of KIH-485 on Texas panicum (*Panicum texanum*) and selected broadleaf weeds in corn. Weed Technol. 19:866–869.

Tanetani, Y., K. Kaku, K. Kawai, T. Fujioka, and T. Shimizu. 2009. Action mechanism of a novel herbicide, pyroxasulfone. Pestic. Biochem. Physiol. 95:47–55.

Williams, M. M., C. M. Boerboom, and T. L. Rabaey. 2010. Significance of atrazine in sweet corn weed management systems. Weed Technol. 24:139–142.

Wright, A. L. and E. A. Hanlon. 2009. Soil structure in Everglades Agricultural Area. Histosols: effects of carbon sequestration and subsidence. SL 301, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences. Gainesville: University of Florida.

Received September 7, 2012, and approved December 4, 2012.