Characterization of Three Horseweed (*Conyza canadensis*) Populations with Different ALS Mutations

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Introduction

Glyphosate-resistant horseweed has been identified in a number of counties in Indiana. Postemergence cloransulam is commonly recommended for control of glyphosate-resistant horseweed. However, ALS-resistant horseweed populations have been identified in 30 counties in Indiana. Three mutations in the ALS enzyme have been identified in Indiana horseweed populations (Zheng et al. 2007). Understanding how populations with various ALS mutations respond to cloransulam will improve our understanding of the impact of these mutations on tolerance to cloransulam.

Objective

To quantify the level of ALS resistance conferred by each of the ALS target-site mutations.

Materials and Methods

Horseweed seed samples (composite of up to 40 plants) were collected from four soybean fields in Indiana. Three populations were ALS-resistant and one was susceptible to ALS inhibitors. The location of the target site resistance for each of the three resistant populations was previously reported by Zheng et al. (2007). Frequency of resistance was determined by spraying 100 seedlings for each of the three ALS-resistant populations and 21 plants from the susceptible population with 8.8 g ai/ha of cloransulam. Additionally, a dose response experiment was conducted with ten rates of cloransulam (0, 4.4, 8.8, 17.7, 35.3, 70.6, 141.2, 282.5, 564.9, or 1129.8 g ai/ha) applied to approximately 4 cm diameter horseweed rosettes. Data were subjected to dose response analysis (drc) in R.

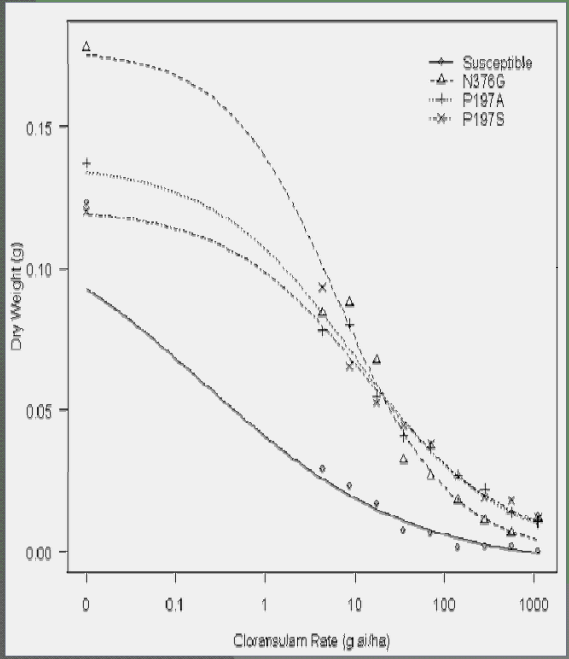

Figure 1. Response of dry weights for four different horseweed populations to cloransulam.

Results and Discussion

The resistant population with a proline to serine mutation at position 197 had the highest level of resistance (70-fold higher than the susceptible) and 98% of the plants within the population were resistant (Table 1). The population with a proline to alanine mutation at position 197 showed the second highest level of resistance (52-fold), but only 85% of the plants within the population were resistant, suggesting that the population probably had either a reduced fitness or was still segregating. The population with a asparagine to glycine mutation at position 376 had a lower level of resistance (33-fold) despite having a 98% of the plants within the population being resistant. The data suggests that the mutation at position 376 confers a lower level of resistance than either of the two mutations found at position 197 (Figure 1). Future work will be done to address the response of a homogenous population with each of known mutations to cloransulam.

Table 1. Characteristics of three known cloransulam-resistant horseweed populations.

Population	Frequency of Resistance[a]	GR_{50} (SE)	GR_{90} (SE)	R:S Ratio
	%	g ai/ha		
Susceptible	0	0.2 (0.3)	69.8 (132)	1
N376G	98	6.6 (1.2)	159.7 (90)	33
P197A	85	10.3 (4.5)	590.7 (1018)	52
P197S	98	13.9 (10.0)	737.1 (2001)	70

[a] The percentage of resistant plants observed when screened with 8.8 g ai/ha of cloransulam. Plants were observed at 28 DAT.

Figure 2. Response of four horseweed populations to 70.6 g ai/ha of cloransulam.

Literature Cited

Zheng, D., P. J. Tranel, V. M. Davis, G. R. Kruger, and W. G. Johnson. 2007. Target-site resistance to ALS inhibitors in horseweed. Proc. N. Cent. Weed Sci. Soc., St. Louis, MO. 62:34.