DETERMINING GLYPHOSATE SUSCEPTIBILITY IN TEXAS POPULATIONS OF COMMON WATERHEMP

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Abstract

Variability in the level of common waterhemp (*Amaranthus rudis*) control by labeled rates of glyphosate has been observed in the Coastal Bend of Texas. The objective of this research was to screen five populations of common waterhemp seed to determine the levels of susceptibility to glyphosate. The collected seeds were germinated in flats containing potting media and sprayed when plants were less than 6 in. with 0.5, 1, 2, and 4X rates of glyphosate (1X = 22 oz/A). Twelve DAT the survivors were counted and compared against the original population to determine the percentage of survivors. A Chi-Square analysis of the data was performed at $P = 0.05$ to evaluate the possible zygosity of the populations. Two of the lines were determined to have w^+w X w^+w^+ parents, an additional two lines were determined to have w^+w X w^+w, and one had inconclusive parentage. The novel *w* allele is believed to impart the variable levels of glyphosate control. F_2 seed from each of the populations exhibited dormancy. The dormancy issues must be overcome prior to creation of dose response curves and determination of I_{50} values for each parental line, as well as confirmed glyphosate-resistant and susceptible biotypes.

Introduction

Common waterhemp is an annual weed species that frequently infests fields across the cotton producing region. Like other pigweeds, it is dioecious and has an aggressive growth habit that allows it to not only compete for resources during the growing season, but also to interfere with crop harvest at the end of the growing season. The current Roundup PowerMAX® label provides for common waterhemp control at 22 oz/A when weeds are less than 6 in. or 32 oz/A when the weeds are less than 12 in. However, variable glyphosate control of common waterhemp has been observed in the Coastal Bend region of Texas. Therefore, the objective of this research was to obtain seed from plants surviving multiple in-season glyphosate applications and screen them to determine the glyphosate susceptibility level of each weed population.

Materials and Methods

Five (5) individual plants were identified that had survived three applications of glyphosate: 30 oz/A on 3-29-08, 22 oz/A on 4-25-08, and 22 oz/A on 5-15-08. The plants were allowed to mature and seed was harvested on 7-2-08. The seed dried under ambient conditions prior to planting on 8-25-08. The seed were broadcast in flats containing Sun Gro® SB300 universal potting media and adequate moisture was maintained to facilitate germination. Fourteen DAP plant counts were taken, and the flats were sprayed with glyphosate at 11, 22 (1X), 44, and 88 oz/A of Roundup PowerMAX® in a standard greenhouse sprayer equipped to deliver 10 GPA with TurboTee® 110015 spray tips at 28 PSI. Twelve DAT the number of surviving plants was counted and the percentage of survivors was determined. A Chi-Square analysis of the surviving progeny was performed at $P = 0.05$ to evaluate the possible zygosity of each line.

Results and Discussion

Susceptibility Levels

The number of germinated plants in each flat ranged from a low of 5 to a high of 37. At 11 oz/A of glyphosate, the rate of survivors ranged from 60 to 88%. As the glyphosate rate increased to 88 oz/A, the percentage of survivors dropped (Table 1). However, both the 6A and 6C lines maintained survival rates above 60%. There was a significant drop in the survival rate between the 1X and 2X rates in the 1A and 1B populations (Figure 1).

Table 1. Percentage of common waterhemp survivors following glyphosate application.

Rate	*Parental Plant*	*Initial Count*	*12 DAT Survivors*	*% Survivors*
0.5X	1a	34	24	71
	1b	25	22	88
	6a	18	15	83.3
	6b	5	3	60
	6c	25	21	84
1X	1a	34	24	71
	1b	21	13	62
	6a	28	23	82
	6b	10	3	30
	6c	37	27	73
2X	1a	35	16	46
	1b	14	5	36
	6a	22	13	59
	6b	10	2	20
	6c	33	22	66
4X	1a	24	11	46
	1b	23	8	35
	6a	27	18	67
	6b	8	0	0
	6c	25	16	64

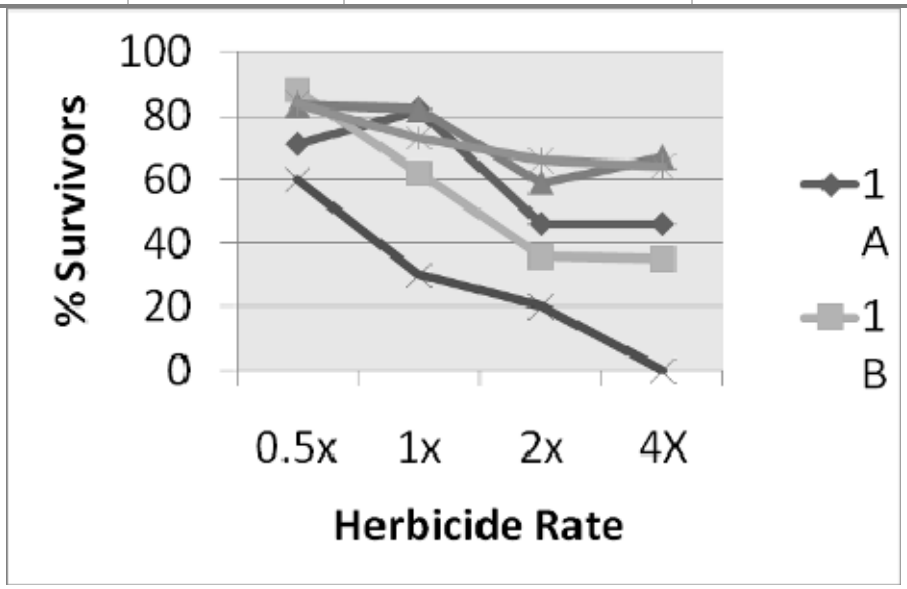

Figure 1. Rate of common waterhemp survivors following glyphosate application.

Chi-Square Analysis

The w^+ allele designates the wild-type, while the *w* allele represents a novel allele likely imparting differential glyphosate susceptibility. The lines designated as 1A and 1B failed to reject the hypothesis that their parentage was w^+w X w^+w^+. The lines designated as 6A and 6C failed to reject the hypothesis that their parentage was w^+w X w^+w. Based on the low population levels, the zygosity of line 6B was unable to be evaluated. Therefore, all of the surviving 1A and 1B progeny are heterozygous at this loci or w^+w. In the 6A and 6C populations, one-third of the survivors are homozygous for the novel allele or *ww*, while the remaining two-thirds are heterozygous or w^+w.

Analysis of F_2 Generation

The F_2 seed failed to germinate and will need to be cold-treated to release dormancy prior to dose response curve analyses using nine rates of glyphosate from 0 to 12X. Subsequent analyses will also include a confirmed glyphosate-resistant and glyphosate-susceptible biotype as positive and negative controls.

Summary

Based on survival rates exceeding 60% when glyphosate was applied at 88 oz/A, further testing of common waterhemp seed is warranted. Preliminary evidence suggests that a novel allele may impart differential glyphosate susceptibility in four of the five heterozygous lines tested.

Acknowledgements

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