MEASUREMENT OF GLYPHOSATE RESISTANCE IN WATERHEMP. David A. Smith and Steven G. Hallett, Graduate Research Assistant and Associate Professor of Weed Science, Department of Botany and Plant Pathology, Purdue University, West Lafayette, IN 47907.

Waterhemp, *Amaranthus tuberculatus* Sauer., has become a key weed in the Midwestern US in the last 10-15 years. One of the reasons for the ascendance of waterhemp has been the development of biotypes of the weed resistant to s-triazine, diphenylether, ALS-inhibitor, and protox-inhibitor chemistries, and recently growers have expressed concern that biotypes of the weed have developed resistance to glyphosate. We received samples of seed from putative glyphosate resistant populations in Illinois, Missouri, and Iowa in order to test the levels of tolerance of waterhemp from different parts of the Midwest. Investigating glyphosate resistance in waterhemp presents a significant challenge, since the plant exhibits extreme genetic variability, and is dioecious. To overcome these difficulties, we chose to follow a screening process followed by glyphosate rate testing on clonally-propagated populations from selected plants. Seed from these putative resistant populations were sown in large flats, grown to the 4-6 leaf stage and then challenged with glyphosate (foliar spray, 0.63 kg ae ha^{-1} at 186 L ha^{-1}). In the case of the Illinois and Missouri populations approximately 10% of the plants survived. All the plants from the Iowa population were killed, and therefore not used further in this experiment. Of the surviving plants, selected individuals were transferred to individual pots and propagated. As a control, we used a population of waterhemp from Fowler, IN which was not pre-screened prior to the selection of parent clonal populations. Shoot apices were cut just below axillary buds, dipped in rooting hormone, planted into fresh potting soil and maintained in a humid environment under a plastic cover for 7 d. In this way 54 clones of each selected parent was generated. Clones were challenged with glyphosate at 1/8X, 1/4X, 1/2X, 1X, 2X, 4X, 8X, and 16X rates (X = 0.63 kg ae ha^{-1}). In order to control for the effect of changing formulation concentrations, we used a fixed concentration of the formulation blank of GlyphomaxPlus® mixed with various concentrations of the technical grade isopropylamine salt of glyphosate. Clonal populations of waterhemp from different parents had different responses to glyphosate. Although GR50 values were similar for all clones, GR90 values were considerably different. Clone 1 (Altamont, IL) and Clone 10 (Altamont, IL) had GR90 values 7.2 and 9.1 times greater than that of the susceptible control (Fowler, IN). The lethal dose to kill 50% or 90% was greater than 10.08 kg ae ha^{-1} for clone 1. Several clones had LD50 and LD90 values which were much higher than for clone 16 (susceptible control). These findings confirm that different populations of waterhemp in the Midwest respond very differently to glyphosate. Some individual waterhemp plants survived applications of glyphosate more than 16 times greater than the recommended rate for waterhemp control in the region. Plant survival at 1-4 times the recommended rate was common. Current glyphosate use rates are frequently delivering sub-optimal control of waterhemp, which may result in waterhemp escapes where glyphosate is used as the predominant weed management strategy. We hypothesize that this practice has caused selection for resistance to glyphosate in Midwestern waterhemp, and we predict that glyphosate resistance in waterhemp will continue to develop if management regimes do not change to reduce this selection pressure.

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