ADDITION OF GLUTATHIONE *S*-TRANSFERASE INHIBITOR TO GLUFOSINATE: IS THIS AN OPTION FOR CONTROLLING GLUFOSINATE-RESISTANT PALMER AMARANTH?

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Abstract

Resistance to glufosinate in Palmer amaranth was first reported in 2021 in Arkansas, and alternative control options for these resistant populations is a high priority. Enhanced herbicide detoxification by glutathione *S*-transferase (GST) enzymes is one of the possible resistance mechanisms responsible for glufosinate resistance. Therefore, experiments were designed to 1) evaluate if the addition of a GST-inhibitor would overcome glufosinate resistance in Palmer amaranth; and 2) quantify the number of chloroplastic glutamine synthetase (*Gs2*) gene copies (enzyme inhibited by glufosinate) present in resistant plants. Seedlings of the resistant (20-59) and susceptible (SS) accessions were transplanted into a field located at the Milo J. Shult Agricultural Research & Extension, Fayetteville, AR. The treatments were glufosinate applied at 10 a.m., glufosinate at 10 p.m., and glufosinate + GST-inhibitor [NBD-Cl (4-chloro-7-nitrobenzofurazan)] at 10 p.m. The rates for glufosinate and NBD-Cl were 0.585 lb ai A^{-1} and 0.11 lb ai A^{-1}, respectively. A randomized complete block design with four replicates was used with a nontreated control for comparison. The total number of plants per accession in each plot was counted prior to and two weeks after application to calculate mortality (%). Concomitantly with the field experiment, a gene copy number assay was conducted with DNA extracted from nontreated plants from two different susceptible accessions and glufosinate survivors from accession 20-59 sprayed with glufosinate at 0.585 lb ai A^{-1}. *Gs2* copy number was calculated relative to two standard genes. Overall, mortality was 17% and 97% for 20-59 and SS, respectively. Mortality did not differ among treatments. Relative to two standard genes, gene copy number in the resistant accession significantly increased by 85- and 86-fold. In the two SS accessions, a 2-fold increase in copy number was found when calculated against the reference genes used. An increase in the chloroplastic glutamine synthetase gene copy number in the resistant plants enables production of enough enzyme to survive glufosinate, which explains why the addition of a GST-inhibitor had no impact on the control of glufosinate-resistant Palmer amaranth.