WATER CONDITIONER EFFECTIVENESS IN GLYPHOSATE-MICRONUTRIENT TANK-MIXTURES. Mark L. Bernards, Kurt D. Thelen, and Donald Penner, Research Associate, Associate Professor, Professor, Department of Crop and Soil Sciences, Michigan State University, East Lansing, MI 48824.

Application of micronutrient foliar fertilizers in tank-mixtures with glyphosate can increase efficiency in glyphosate-resistant soybean production. However, the prescience of the hard-water cations Ca^{2+} and Fe^{3+}, and the fertilizer Mn^{2+}, in the spray solution have antagonized glyphosate efficacy. In solution, glyphosate is a weak acid and readily forms complexes with cations. When glyphosate complexes with di- and trivalent metal cations, glyphosate absorption into and/or translocation within the plant is reduced. The objectives of this study were to 1) quantify the antagonism caused by cations commonly found in hard-water sources and foliar micronutrient fertilizers, and 2) determine if commercially available water-conditioners were able to eliminate the antagonism.

Velvetleaf and common lambsquarters were grown in 0.9 L pots in the greenhouse. Treatments were applied to 14-cm velvetleaf and 10-cm common lambsquarters using a single tip track sprayer. Treatment solutions were prepared in distilled water. Plants were evaluated visually for control 7, 14, and 21 d after treatment, and were measured for shoot height and weight. All experiments were conducted twice. Data was evaluated against the assumptions of analysis of variance, and then analyzed using the proc mixed procedure of SAS.

Nine salts (aluminum sulfate, calcium carbonate, calcium nitrate, calcium sulfate, copper sulfate, ferric chloride, magnesium sulfate, manganese sulfate, and zinc sulfate) were applied at four different concentrations with a 41% a.i. commercial formulation of isopropylamine-glyphosate (0.45 kg a.e./ha) to determine the cation concentration at which glyphosate efficacy was reduced approximately 50%. The spray volume was 190 L/ha.

Ten water conditioners – AccuQuest (0.5%), ammonium sulfate (1% and 2%), AX0405 (1%), Alliance (0.75%), Choice (0.5%), Class Act Next Generation (2.5%), NTANK (1%), ReQuest (0.5%), Superb (1%), and Surfate (1.0%) – were used in glyphosate tank-mixtures with ferric chloride (160 mg Fe^{3+}/L), manganese sulfate (800 mg Mn^{2+}/L), or zinc sulfate (540 mg Zn^{2+}/L). The glyphosate rate was 0.28 kg/ha, and the spray volume was 90 L/ha.

Velvetleaf was more sensitive than common lambsquarters to the presence of metal cations in glyphosate tank-mixtures. At the rate of 0.4 kg glyphosate/ha, velvetleaf control was reduced approximately 50% at the following cation concentrations: Al^{3+} (200 mg/L), Ca^{2+} (200 mg/L, from nitrate salt), Fe^{3+} (270 mg/L), Ca^{2+} (400 mg/L, from sulfate salt), Mn^{2+} (500 mg/L), Zn^{2+} (540 mg/L), Mg^{2+} (600 mg/L), Cu^{2+} (1600 mg/L). Only Al^{3+} (320 mg/L), Fe^{3+} (400 mg/L), and Ca^{2+} (1600 mg/L, from nitrate salt) reduced control of common lambsquarters 50%. Calcium carbonate did not interact significantly with glyphosate due to poor solubility. The antagonism caused by calcium sulfate decreased as the Ca^{2+} concentration increased above 400 mg/L. This phenomenon may be related to the solubility of calcium sulfate. Glyphosate-metal precipitates formed in the spray solution when Fe^{3+} levels exceeded 70 mg/L, and Al^{3+} levels exceeded 200 mg/L.

The water conditioners evaluated were grouped into three categories. NTANK, AMS, and Class Act Next Generation were the most effective at reducing the antagonism caused by Fe, Mn, and Zn. However, slight but significant reductions in control remained evident for certain water conditioner-cation combinations. Fe, Mn, and Zn in the spray solution caused large reductions in control by tank-mixtures with the least effective water conditioners, AccuQuest, ReQuest, and Choice. Weed control obtained from tank-mixtures with the moderately effective water conditioners, AX0405, Alliance, Surfate and Superb, were intermediate the other two categories.

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