TANK-MIXING MICRONUTRIENT FERTILIZERS WITH GLYPHOSATE – POTENTIAL PROBLEM OR EFFICIENT SOLUTION

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Summary: Many agribusinesses are currently promoting the application of micronutrient foliar fertilizers in tank-mixtures with glyphosate for increased efficiency in glyphosate-resistant soybean production. This practice is inconsistent with data which shows decreased glyphosate efficacy in the presence of the hard-water cations Ca^{2+} and Fe^{3+}, and the fertilizer Mn^{2+}, in the spray solution. In solution, glyphosate is a weak acid and readily forms complexes with cations. When those complexes include di- and trivalent metal cations, glyphosate absorption into and/or translocation within the plant is often reduced. Adjuvants have shown effectiveness in reducing the hard-water antagonism by 1) sequestering or precipitating the offending metal cation, and 2) by including monovalent cations, such as NH_4^+ or isopropylamine, that will compete with di- and trivalent cations for binding sites on glyphosate, but will not reduce glyphosate absorption. Our objectives in this study were to 1) compare the antagonistic value of micronutrients and cations that are used in foliar fertilizer formulations or which may be present in water sources, and 2) determine if the water-conditioners ammonium sulfate (AMS) and NTANK were able to eliminate the antagonism.

Velvetleaf (*Abutilon theophrasti*) and common lambsquarters (*Chenopodium album*) were grown in 0.9 L pots in the greenhouse. 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 commercial formulation of isopropylamine-glyphosate (0.4 kg a.e./ha) to determine the cation concentration at which glyphosate efficacy was reduced approximately 50%. Treatments were applied to 14-cm velvetleaf and 10-cm common lambsquarters using a single-tip track sprayer at 190 L/ha. In the water-conditioner study, ammonium sulfate (AMS) was added to tank-mixtures at 1 and 2% (w/w), and NTANK was added at 0.5 and 1% (v/v). Each cation was used at the concentration that reduced glyphosate efficacy about 50%, the glyphosate rate was 0.25 kg/ha, and the spray volume was 90 L/ha. Plants were visually evaluated for control 7, 14, and 21 d after treatment, and were measured for shoot height and weight.

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 ppm), Ca^{2+} (200 ppm – nitrate salt), Fe^{3+} (270 ppm), Ca^{2+} (400 ppm – sulfate salt), Mn^{2+} (500 ppm), Zn^{2+} (540 ppm), Mg^{2+} (600 ppm), Cu^{2+} (1600 ppm). Only Al^{3+} (320 ppm), Fe^{3+} (400 ppm), and Ca^{2+} (1600 ppm – nitrate salt) reduced control of common lambsquarters 50%. Calcium carbonate did not interact significantly with glyphosate because of poor solubility. Precipitation occurred with Fe^{3+} levels greater than 100 ppm, and Al^{3+} levels greater than 200 ppm. Adding AMS and NTANK, or increasing the rate of glyphosate, increased the weed control obtained in glyphosate and metal cation tank-mixtures. However, slight but significant reductions in control persisted for most cation-adjuvant combinations.

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