MANGANESE FERTILIZER ANTAGONISM OF GLYPHOSATE EFFICACY. Mark L. Bernards, Kurt D. Thelen, and Donald Penner, Graduate Research Assistant, Assistant Professor, and Professor, Department of Crop and Soil Sciences, Michigan State University, East Lansing, MI 48824. (23)

Michigan soybean producers have observed an antagonism of glyphosate efficacy when it is tank-mixed with foliar manganese (Mn) fertilizers. The objectives of this study were to 1) document the basis for the observed antagonism of glyphosate activity when applied with Mn micronutrient solutions, and 2) develop recommendations for growers to effectively use foliar applied Mn with glyphosate in their soybean production systems.

Glyphosate was applied at 0.28 kg a.e. ha^{-1} to velvetleaf (*Abutilon theophrasti*) and giant foxtail (*Setaria faberi*) in greenhouse bioassays and at 0.84 kg a.e. ha^{-1} in field trials. Manganese was applied at 9.35 L ha^{-1} (liquid formulations) or 7.84 kg ha^{-1} (powder formulations) in both field and greenhouse studies. Three Mn formulations, Mn with ethylaminoacetate (Mn-EAA), Mn with lignin sulfonate (Mn-LS), and manganese sulfate monohydrate ($MnSO_4$), antagonized glyphosate efficacy in the greenhouse and the field (25-80% reduction). Manganese-ethylenediaminetetraacetate (Mn-EDTA) did not antagonize glyphosate efficacy. The adjuvants diammonium sulfate (AMS) and citric acid each reduced some of the antagonism in tank-mixtures with Mn-EAA, Mn-LS, and $MnSO_4$. However, the extent to which the antagonism was ameliorated depended upon the specific combination of Mn and adjuvant, and for most combinations a slight antagonism persisted when compared to glyphosate and AMS. Varying the rate of Mn fertilizer (2.34, 4.68, and 9.35 L ha^{-1} or 1.95, 3.9 and 7.8 kg ha^{-1}) tank mixed with glyphosate did not vary the antagonism of velvetleaf control caused by Mn-LS or $MnSO_4$. However, control with the 2.34 L h^{-1} Mn-EAA treatment was significantly greater than the two higher rates (38 % vs. 22% and 18% respectively, $p=0.05$).

To test if the antagonism is the result of reduced glyphosate absorption, the adaxial surface of the second leaf of velvetleaf was treated with two 1-µL drops of formulated glyphosate spiked with 127 Bq of ^{14}C-labeled glyphosate. Leaves were excised and rinsed at 4, 24, and 48 h. For the glyphosate check (averages of +/- AMS treatments) 19% of the applied glyphosate was absorbed by 4 h, 49% by 24 h, and 53% at 48 h. Absorption of the Mn-EDTA tank mixes paralleled those of the glyphosate check. Mn-EAA solutions were absorbed very rapidly, 42% within 4 h, with little absorption occurring thereafter. Absorption from the Mn-LS and $MnSO_4$ solutions was significantly lower than the glyphosate check at both 24 and 48 h ($p=0.05$). Adding AMS improved the absorption of glyphosate, Mn-LS, and $MnSO_4$ solutions. With one exception, the absorption data reflect the efficacy data: in the glyphosate, Mn-LS, and $MnSO_4$ solutions efficacy and absorption were both enhanced by adding AMS to the spray solution; glyphosate efficacy and absorption in solutions with Mn-EDTA were similar with and without AMS; the exception – glyphosate in Mn-EAA solutions was absorbed at rates equal to the glyphosate check, but weed control efficacy was significantly less.

Not all Mn fertilizers antagonize glyphosate efficacy. Part of the Mn fertilizer antagonism is caused by reduced glyphosate absorption, but there are likely additional interferences not yet identified. For some Mn fertilizers this antagonism my be ameliorated (but not eliminated) by the use of AMS or a similar adjuvant in the tank mix solution.