Impact of micronutrient packages on soybean yields in Missouri

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Objectives and Relevance to the Missouri Fertilizer and Lime Industry:

The main objective of this research is to determine the effect of various micronutrient packages offered by the fertilizer industry on soybean yield and seed quality.
The specific objectives are to:

1) quantify the impact of pre-formulated micronutrient packages on yield and seed quality of glyphosate as well as glufosinate resistant soybean cultivars.
2) measure micronutrient uptake by the soybean plants and develop nutrient response curves.
3) determine effects of applications on soil micronutrient status.

The use of micronutrients is increasing as the costs of fungicides and pesticides have many growers and producers focused on balanced plant nutrition to optimize plant health (Brown, 2008). Pre-formulated micronutrient packages are advertised to improve yields and nutritional content of Missouri's crops. Increased yields and grain quality would translate into greater returns for Missouri producers and increased fertilizer sales. Statistics on micronutrient use and yield improvement in Missouri are scant. However, ever-higher crop yields and, with the advent of cellulosic biofuel production, increases in whole plant removal will result in more micronutrients leaving farmers' fields. This increase in micronutrients leaving the field and the potential reduction in soil supply power (associated with reductions in soil organic matter caused by the removal of not only grain yield but also crop residues) emphasize the importance to critically examine the role of micronutrient fertilization in Missouri.

Dozens of micronutrient formulations are available for the Ag market in general and soybean producers in particular (SoyScience, Pro Bean Mix, Bean Mix, and Crop Mix among others). However, evaluation of product performance by independent researchers is largely lacking, complicating the decision making process for farmers. For producers like Kip Cullers, micronutrient packages are likely a necessary management practice to meet the demands of ever-more productive soybeans. Although most producers do not aspire to achieve world record yields, applications of micronutrients may increase their yields and economic bottom line. Because glyphosate interacts with Mn both in tank mixtures and in the plant (Bernards et al., 2005), products that aim to combat GIMD may be particularly promising. However, because these products are relatively new to the Missouri market, their effect on the "average" soybean grower's yield is uncertain.

2011 ACCOMPLISHMENTS:

- This year was the first year of the project that evaluates micronutrient packages on soybean yield, micronutrient uptake and soil micronutrient status.

- The following treatments were applied to MorSoy RT3930N RoundUp Ready and MorSoy LL3939N LibertyLink soybean planted in 8-row, 15" row spacing, 20' long plots that were replicated four times.

  1) United Suppliers' Sovereign (foliar; liquid; EDTA chelate)
  2) Agrium's Bean Mix (soil; granular; non-chelated oxides and sulphates)
  3) Tetra Micronutrients' Pro Bean Mix (foliar; liquid; citric acid and EDTA chelates)
  4) Helena's HM609 (foliar or soil; liquid; Lignosulphonate sequestered)
  5) AgExplore's SoyScience (foliar; liquid; non-chelated sulphates)
  6) Stoller's X-tra Power (liquid; foliar or soil; MEA chelate)
  7) Tetra Micronutrient's ManGro (foliar Mn; specifically for GIMD)
  8) untreated control

- To assess the effect of herbicide interactions with the micronutrient applications the following herbicide x soybean treatments were imposed.

  1) RR soybean with glyphosate applications
  2) RR soybean without glyphosate applications
  3) LL soybean with glufosinate applications
  4) LL soybean without glufosinate applications

2011 PRELIMINARY RESULTS:

NOTE: Results are from one field season and are considered preliminary

- Despite adverse growing conditions that included wet, cool weather at planting and throughout much of May, severe hail damage in July, and extreme drought, soybean yields in this experiment were above average for the Bradford Research and Extension Center (Fig. 1, 2, 3, 4).

- Tetra Mangro ($P<0.05$) and Stoller X-tra Power ($P<0.10$) improved soybean yield relative to no micronutrient treatment when glyphosate was applied to MorSoy RR soybean as part of a typical weed management program (Fig. 1).

- When glyphosate was not applied to Morsoy RR soybean, both Tetra Micro ProBean and Stoller X-tra Power improved soybean yield ($P<0.05$). Other micronutrient treatments yielded similarly to the no micronutrient control.

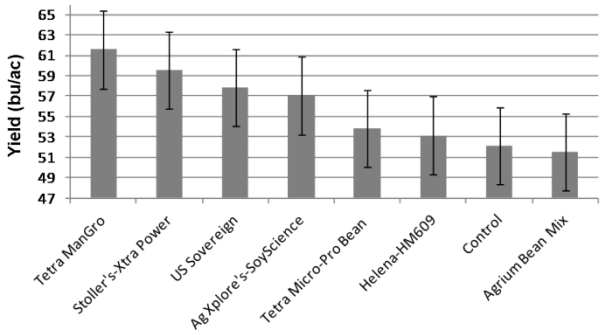

Figure 1. Yield response of RR soybean to micronutrient packages when soybean is treated with glyphosate.

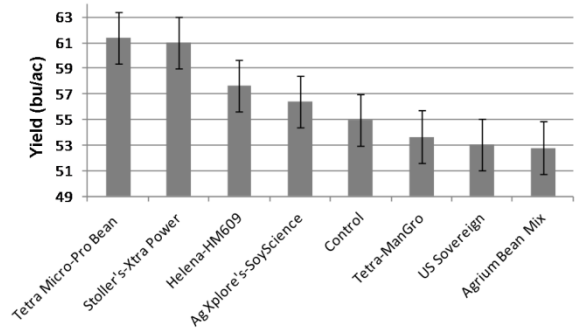

Figure 2. Yield response of RR soybean to micronutrient packages when soybean is not treated with glyphosate.

- When glufosinate was applied to MorSoy LL soybean as part of a typical weed management program, no micronutrient packages improved yield relative to the no micronutrient control (Fig. 3).

- Tetra ManGro (P<0.10) improved MorSoy LL soybean yield when glufosinate was not applied (Fig. 4).

- The interactions between soybean variety, whether or not they were sprayed, and the micronutrient packages were significant (P<0.01) suggesting that there is a genotype x micronutrient response as well as micronutrient x herbicide response.

- This experiment will be repeated in 2012 and results from 2012 could provide further evidence of these interactions.

- Seed and plant samples are currently being processed for evaluation of seed quality and plant tissue micronutrient concentrations.

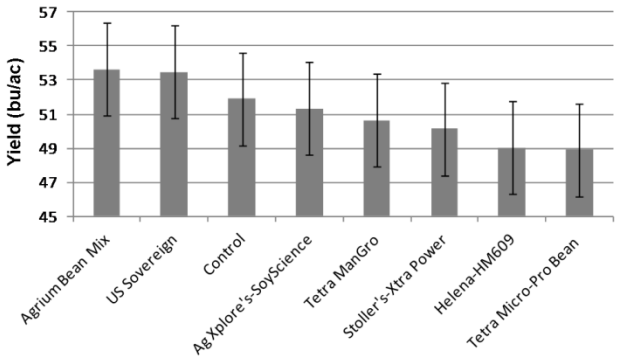

Figure 3. Yield response of LL soybean to micronutrient packages when soybean is treated with glufosinate.

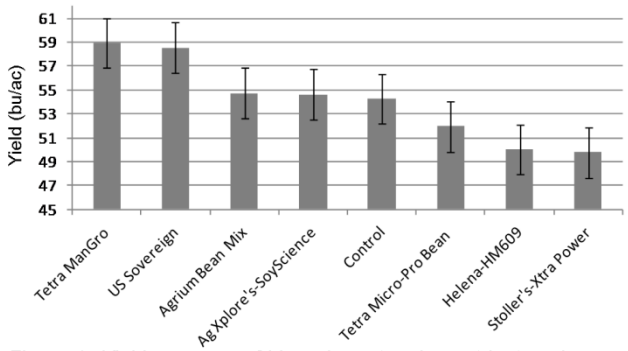

Figure 4. Yield response of LL soybean to micronutrient packages when soybean is not treated with glufosinate.

OBJECTIVES FOR YEAR 2:

In year two we will repeat the experiment as originally proposed. We will soil sample the plots from the 2011 experiment to determine any carryover micronutrient effects from soybean residue and roots. Further, we will plant the same or similar soybean varieties in a similar experimental design and sample plants five times from emergence to early reproductive stage. We will finish tissue nutrient and seed quality analyses from the 2011 season and continue with sampling protocol of harvest yield at the end of the season. We intend to present preliminary results of this research at the 2012 ASA-CSSA-SSSA annual meeting in October 2012.

BUDGET FOR YEAR 2:

Category	**Year 2**
Personnel	
Graduate Student	$18,000
Undergraduate help	$3,200
Field cost (fertilizers, herbicide, bags, etc.)	$2,000
Tissue and seed analyses	$4,300
Travel	$1,200
Total	**$28,700**