

Starter/Foliar Fertilizers Improve Corn/Soybean Yields

Experiments conducted in four Kansas locations in 2010 and 2011.

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Summary: Corn and soybean production under high yield environments may benefit from the combined use of starter and foliar fertilization, including macro and micronutrients. Experiments were conducted in 2010 and 2011 at four locations for corn and soybean under irrigation. Changes in soybean leaf concentration due to micronutrient starter fertilizers were observed for boron (B) and manganese (Mn). Average soybean yield was slightly higher when micronutrients were included in the starter fertilizer. Corn plant concentration (V6) was increased for copper (Cu) and zinc (Zn). Early growth was significantly increased over the control with starter fertilizer, however no additional biomass increase was observed with the addition of micronutrients.



The use of alternative fertilizer application strategies can help to achieve maximum yields and enhance nutrient use efficiency (NUE), particularly under environments with high yield potential. Often a combination of broadcast and band fertilizer applications can provide optimum nutrient uptake in low fertility/low soil test conditions. However, under current reduced tillage systems with high yield potential, alternative fertilizer application methods and sources should be considered.

With the increase in corn and soybean yields due to important genetic improvements, demand for nutrients has also increased. It is likely that the increased use of reduced tillage systems and some soil conditions, such as high soil pH found in large areas of the Great Plains, may decrease

the plant-availability of some macro and micronutrients. This may be corrected through some combination of starter and foliar fertilizer application or fertilizer rate adjustment of both macro and micronutrients.

Previous work showed that direct application of phosphorus (P) and

“Foliar N application showed average corn yield increases”

potassium (K) to soybeans can have a significant impact on soybean yield, with average increases as high as 34 bu/A. However, further studies are needed to investigate starter and foliar application with

other nutrients to maximize yields in soybeans. On the other hand, fluid fertilizer placed in a band near the seed at planting of corn has frequently shown positive effects on yield. Furthermore, this approach can be especially valuable under conditions of reduced tillage. In addition, foliar fertilization could, in some cases, increase nutrient supply at early growth stages when the root system is not well developed. Thus, foliar application of nutrients to corn and soybeans, in addition to starter fertilizer, can help to overcome possible limitations in crop nutrient uptake and increase NUE and yields.

Some soil conditions such as high soil pH and low organic matter may contribute to decreasing the supply of micronutrients to crops. Increased nutrient demands from

Table 1. Average soil test values for study locations in 2010 and 2011. Loc. 1 and 2 are in 2010

Crop	Location	pH	P (ppm)	K (ppm)	OM(%)	Soil texture
Soybean	Loc 1	7.1	34	252	1.6	Fine sandy loam
	Loc 2	7.0	11	482	2.8	Silt loam
	Loc 3	6.4	17	96	0.9	Fine sandy loam
	Loc 4	6.5	7	455	2.2	Silt loam
Corn	Loc 1	7.4	114	389	1.8	Silt loam
	Loc 2	6.7	11	462	2.9	Silt loam
	Loc 3	6.4	13	244	1.8	Silt loam
	Loc 4	6.3	10	563	2.4	Silt loam

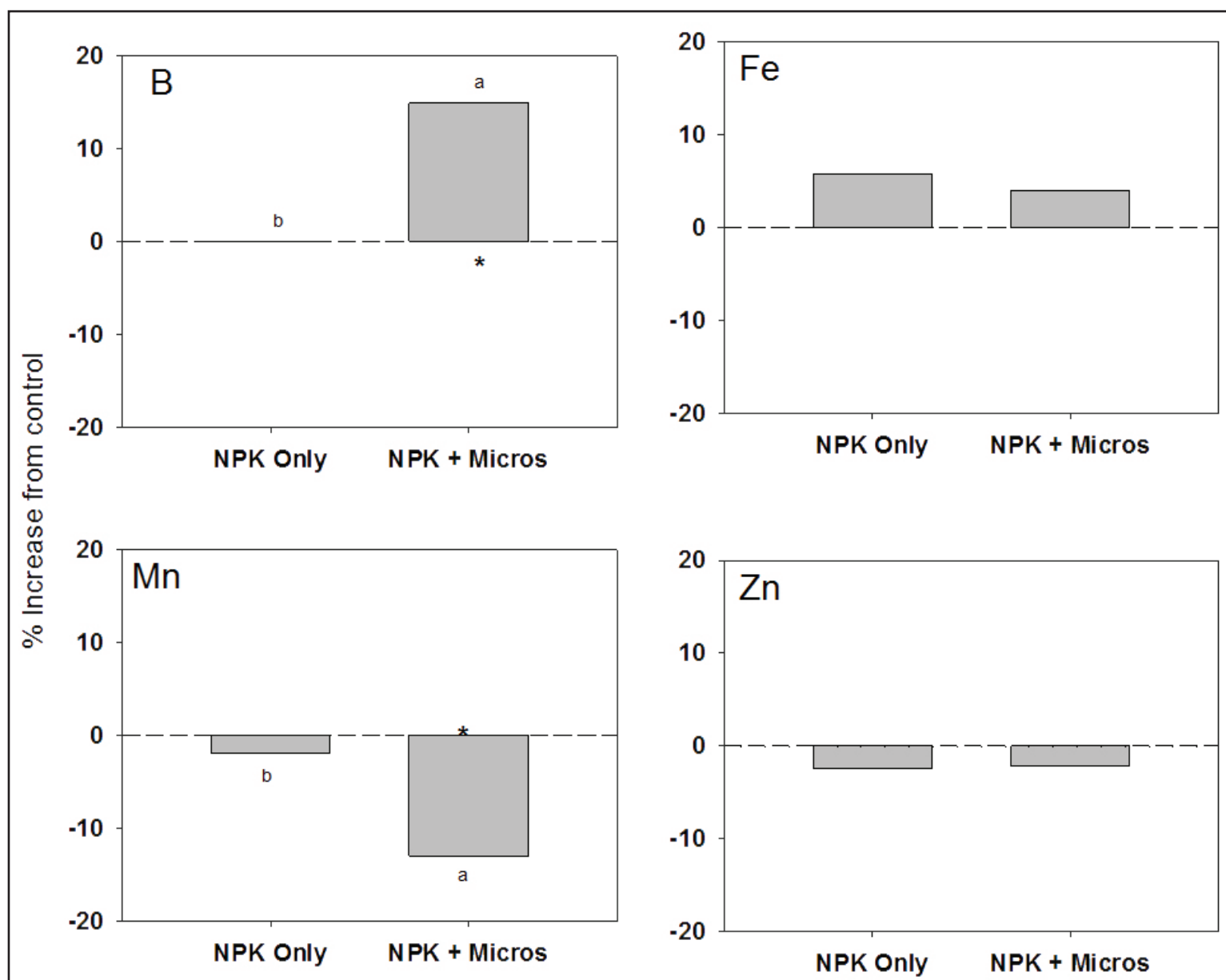


Figure 1. Effect of starter fertilizer application on leaf nutrient concentration in soybean compared to the control. Asterisk (*) indicate statistically significant difference from zero at $p \leq 0.05$. Letters indicate statistically significant difference between treatments at $p \leq 0.05$



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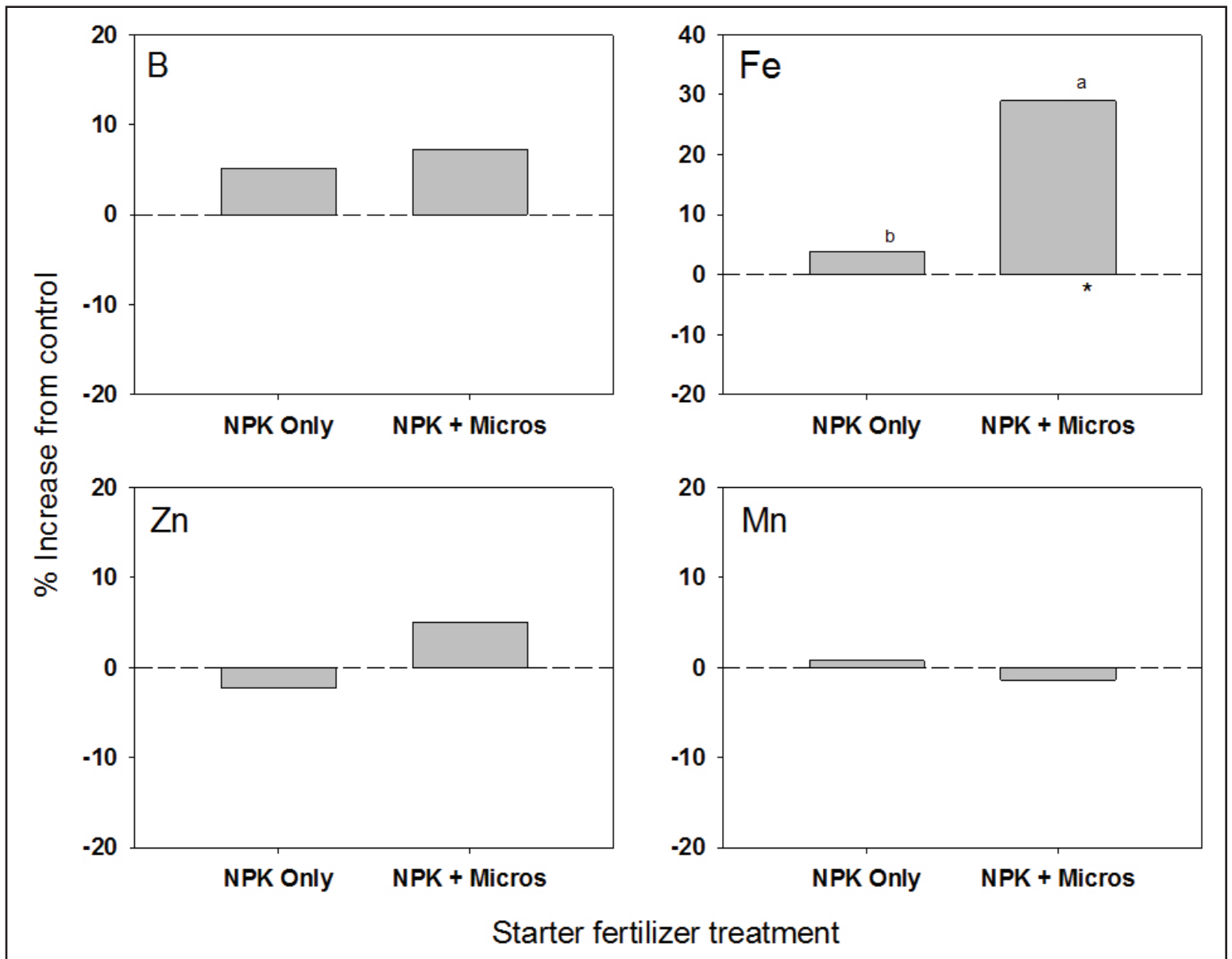


Figure 2. Effect of starter fertilizer application on tissue nutrient concentration in corn compared to the control. Asterisk (*) indicate statistically significant difference from zero at $p \leq 0.05$. Letters indicate statistically significant difference between treatments at $p \leq 0.05$

more intensive cropping practices, as well as high-yielding-potential crops, may also require additional micronutrients for optimum yield. Supplementary foliar application of nitrogen (N), P, and K and micronutrients can help to enhance crop yields under these conditions. Consequently, there is an increasing interest from producers about the potential benefits of foliar application of nutrients as a complement to their fertilization programs to maximize yields.

Overall goal

The overall objective of this study was to evaluate crop response to starter fluid fertilizers in combination

with foliar application of macro - and micronutrients to maximize corn and soybean yields.

Specific objectives included:

- Assessment of corn and soybean grain yield and early growth response to starter application of fluid fertilizers
- Compare responses with and without additional foliar fertilizers
- Evaluate plant nutrient analysis as a diagnostic tool to explain responses to foliar and starter macro, and micro-nutrient applications.

Methodology

Target. Studies were subject

to high-yield potential, irrigated conditions.

Plots. Field studies consisted of small-plot field research of four to six rows wide by 35 to 50 feet in length.

Treatments. Macronutrient treatments included NPK. The micronutrient mix (micros) included iron (Fe), Mn, Zn, B, and Cu. Three starter treatments (none, NPK only, and NPK + micros) were combined with three foliar treatments (none, NPK only, and NPK + micros) for a total of nine treatment combinations. Fertilizer used for starter application was a 4-10-10 formulation. Zinc, Cu

and Mn were chelated with EDTA. Iron was chelated with HEDTA, and B was derived from boric acid.

Application. Starter fluid fertilizer and foliar fertilizers were applied in various combinations in a factorial arrangement. Starter fluid fertilizers were applied near the seed using a dribble band placement. The procedure for fluid fertilizer application simulated procedures commonly used by producers. Foliar fertilizer was diluted into water and applied with a hand-held CO₂-powered sprayer. NPK was foliar applied using a 10-10-10 fertilizer formulation.

Timing. Foliar fertilizer application was made before the plant begins the rapid increase in nutrient and dry weight accumulation. For corn, foliar application was around the 6- to 8-leaf grown stage and for soybeans around the 5 to 7 trifoliate.

What happened

Soil test. Average soil test levels are presented in Table 1.

Plant analysis. Soybean leaf analysis showed a significant increase in B concentration with the addition of micronutrients in the starter fertilizer. Concentrations of Cu, Fe, and Zn were similar to the control. Manganese concentration was decreased with the addition of Mn in the starter fertilizer (Figure 1). A decrease in Mn concentration in soybeans with the use of a chelated (EDTA) source has been observed in previous studies. Plant nutrient analysis in corn showed an increase in Cu and Zn concentration with the addition of micronutrients into the starter, however other nutrients showed no clear difference (Figure 2).

Yield. Average soybean yield across sites was slightly higher when micronutrients were added to the starter fertilizer (Figure 3). This suggests that a lower Mn tissue concentration may not be necessarily indicative of yield response in this case.

Early growth. Early growth in corn was significantly increased with starter fertilizers compared to the control (Figure 4). The addition of micronutrients in the starter fertilizer did not contribute to additional growth, thus it is likely that the effect in early growth is contributed by N and P.

Foliar application of N (derived from methylene urea and triazone) in corn showed average yield increases at all locations in addition to preplant N application (Figure 5). This suggests a possible additional benefit of foliar applications. Additional studies should evaluate different rates and application timing.

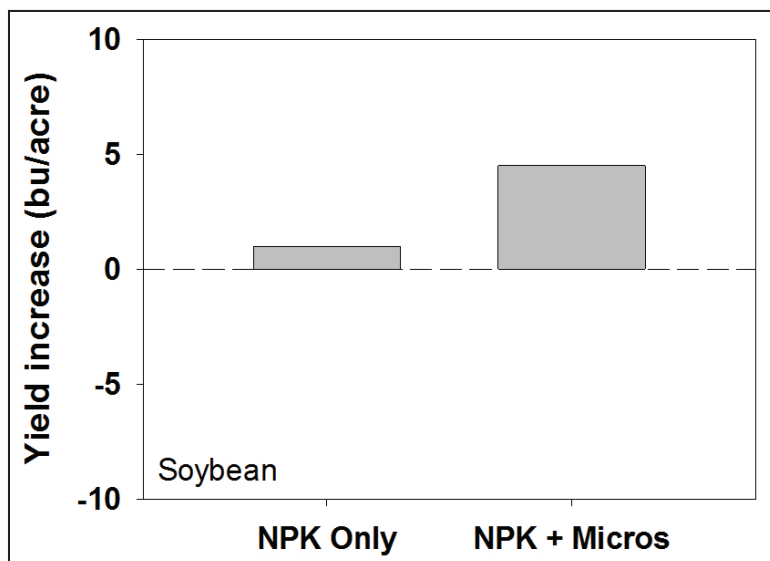


Figure 3. Effect of starter fertilizers with and without micronutrient application on soybean yield increase compared to the control.

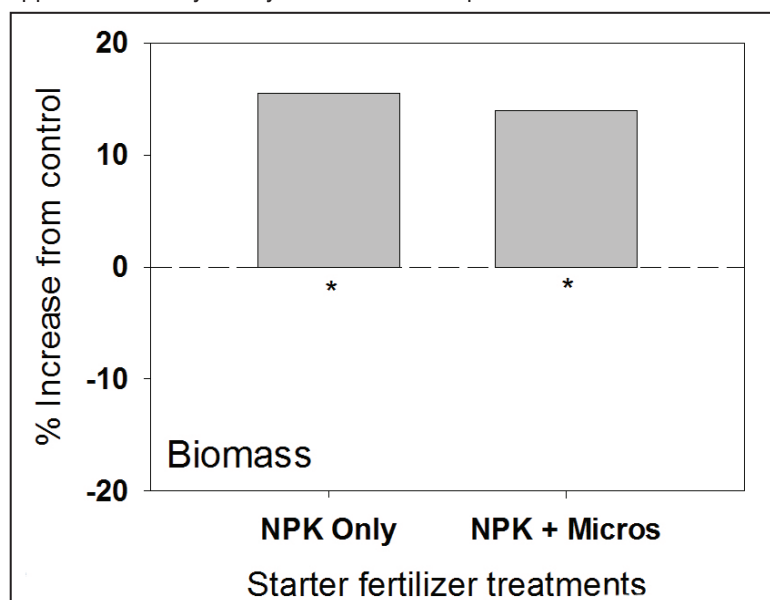


Figure 4. Increase in corn early growth biomass (V6) as affected by starter fertilizer treatments compared to the control. Asterisk (*) indicates statistically significant difference from zero at $P \leq 0.05$.

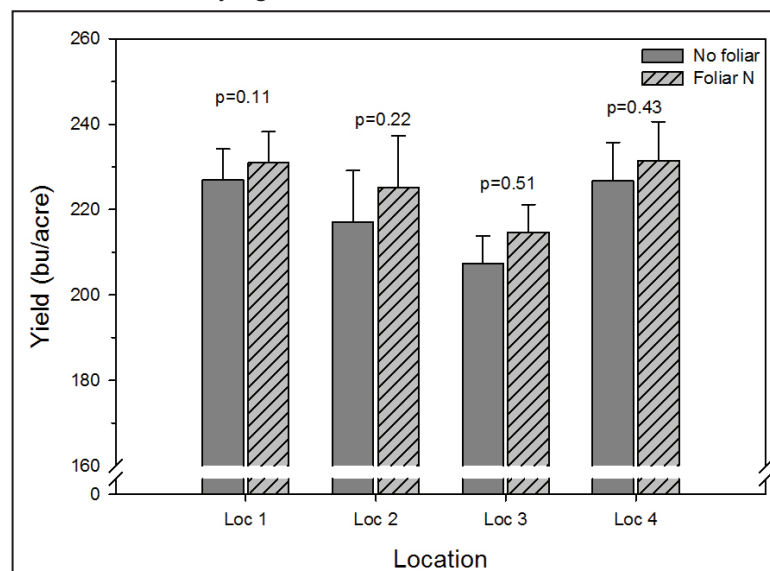


Figure 5. Foliar nitrogen fertilizer application to corn at 4 locations during 2010 and 2011. Probable values for mean comparisons are included for each site. Pre-plant N rates were: Loc 1: 180 lbs; Loc 2: 200 lbs; loc 3: 150 lbs; loc 4: 200 lbs N/acre.

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