Foliar Micronutrients for Greater Corn Yield

Crop Physiology

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Question: ***Can timed foliar micronutrient applications improve corn yield?***

Objective: ***Quantify uptake and yield responses to foliar nutrition when used in intensive corn production systems.***

Introduction:

- Under high-yield growing conditions, adequate nutrient availability often limits corn (*Zea mays L.*) growth and productivity.
- Hybrid selection and increased planting densities create a high-yield potential in today's modern corn production systems.
- Greater planting populations tend to decrease individual plant root volume, and may limit the ability to accumulate nutrients.
- Hybrids respond differently to stresses and to levels of crop management.
- Boron (B) and zinc (Zn) are the most limiting micronutrients for crop growth, as most U.S. soils are deficient in B and Zn.
- Chelated micronutrients, using amino acid source technologies, allow plants to translocate micronutrients that are typically immobile.

Nutrient Uptake Response:

- **Foliar Zn, applied in-season, had no effect on grain yield in 2014, however, it did significantly increase Zn accumulation by 13% averaged across all three planting densities.**
- **B applications had no impact on final grain yield or B accumulation, which is likely due to the loss of additional B during pollen shed before the R2 + 7 days plant sampling date.**

Table 1. Effect of nutrient applications on final grain yield and whole plant B and Zn content at R2 + 7 days growth stage averaged across all three populations for corn grown at Champaign, IL during 2014. Grain yield and plant nutrient accumulation are presented at 0% moisture concentration.

Treatment	Yield	Zn Content	B Content
	Mg ha^{-1}	g Zn ha^{-1}	g B ha^{-1}
Control	12.48	304	60
B at V16	12.49	324	57
Zn at R2	12.62	344	51
LSD (α=0.10)	NS	30	NS

Background:

- Micronutrients exhibit uptake patterns that contain short periods of rapid uptake.
- B plays a key role in flowering, pollen development, and the pollination process.
- Peak accumulation of B occurs immediately prior to pollination and is subsequently remobilized from leaf tissues to developing reproductive organs (ear and tassel) during the initiation of reproductive growth.
- B also helps with the viability of the pollen as the pollen grains germinate and grow down the silk of the corn.

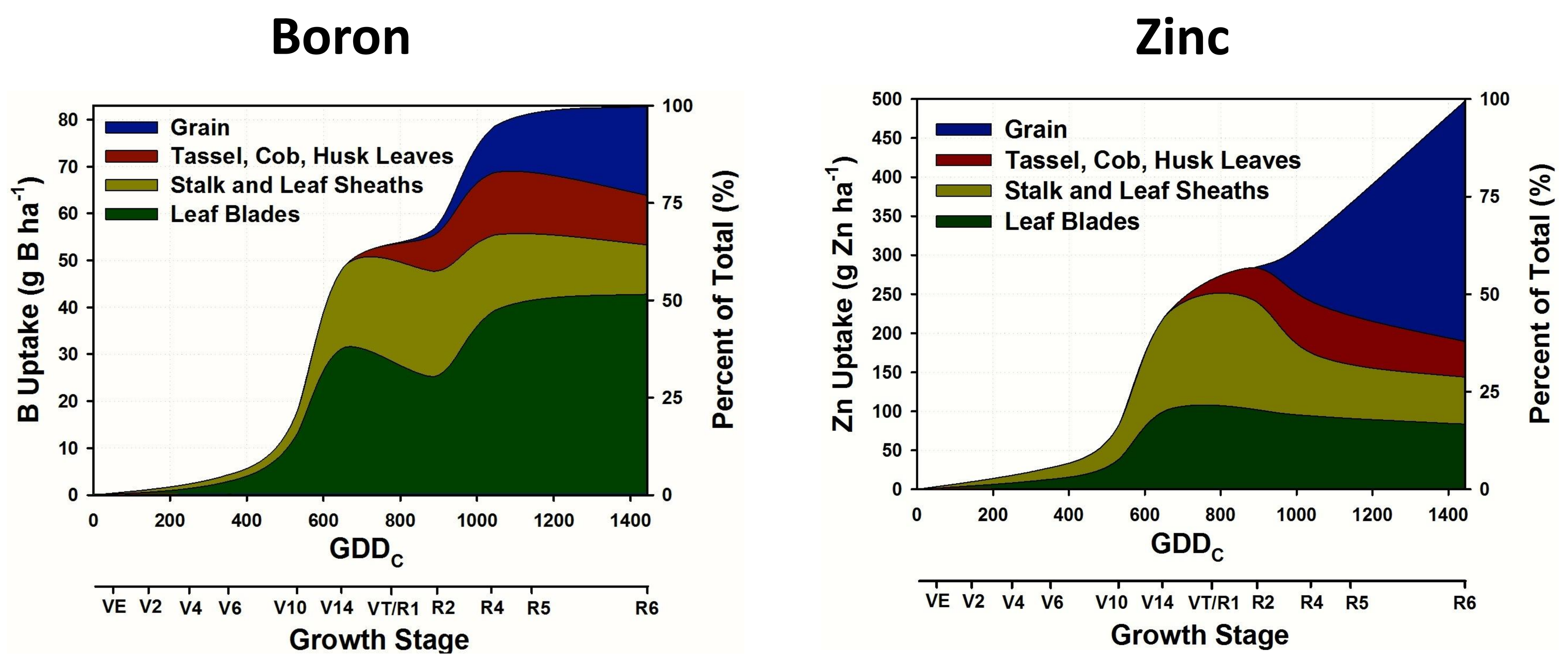

Figure 1 and 2. The total corn B and Zn uptake and partitioning across four plant stover fractions: leaf, stalk, reproductive, and grain tissues (Bender et al., Agron. J. 105:161-170 (2013).

- Zn is essential for regulating growth hormones, activating enzymes for protein synthesis, aiding in starch, chlorophyll and seed formation, and assisting in healthy root development.
- After VT/R1, Zn uptake continues at a constant rate during grain-fill as Zn binds to phytic acid forming phytates as the seed's principal phosphate reserve.

Yield Response from Foliar B and Zn:

- **There was a significant difference in yield between hybrids and also between different planting densities in 2015, with DKC 64-87 yielding higher than DKC63-33 and increased populations yielding higher than decreased populations.**
- **However, yield response associated with treatment effects were similar for both hybrids, therefore only data for one hybrid is shown.**
- **In no instance did foliar micronutrient applications significantly effect grain yield, although there was a tendency for mid-season B applications to increase yield, especially at the highest planting density.**

Table 2. Effect of population and nutrient applications on grain yield for hybrid DKC64-87 grown at Champaign, IL during 2015. Grain yield is presented at 0% moisture concentration

	Plant Population (plants ha^{-1})		
Treatment	79,000	93,800	108,600
	Mg ha^{-1}		
Control	13.12	13.51	13.76
B at V6	12.88	13.47	14.09
B at VT/R1	13.53	13.29	14.26
Zn at V6	13.17	13.37	13.83
Zn at VT/R1	12.80	13.85	13.54
LSD (α=0.10)	NS	NS	NS

Research Approach:

- A two-year field experiment was conducted at Champaign, Illinois on a Drummer-Flanagan silty loam soil.
- Plots had a target final stand of approx. 79,000, 93,800, and 108,600 plants ha^{-1} (32,000, 38,000, 44,000 plants ac^{-1}).
- Foliar applications included 148 g ha^{-1} of chelated B and 302 g ha^{-1} of chelated Zn and were made using a backpack sprayer.

2014

- DKC63-33 GENSS was planted on 8 May 2014 with 202 kg nitrogen ha^{-1}.
- Foliar applications of B and Zn at VT and R2 growth stages, respectively.
- 6 plants plot^{-1} were sampled at the R2 + 7 days growth stage for determination of maximum dry weight and total B and Zn accumulation.

2015

- Two hybrids (DKC63-33 GENSS and DKC64-87 GENSS) were planted on 24 April 2015 with 269 kg nitrogen ha^{-1}.
- Foliar applications of B and Zn at both the V6 and VT growth stages.
- A subsurface drip irrigation system was used to reduce plant stress and create a high yield potential environment by maintaining adequate water availability throughout the growing season.

Conclusions:

1. Can foliar applied micronutrients be used as in-season supplemental nutrition?

✓ **Yes, late-season foliar Zn applications increased Zn accumulation, ensuring adequate Zn availability during grain-filling.**

2. Does the use of foliar B and Zn increase corn yield in conjunction with higher populations?

× **No, although foliar micronutrients tended to increase grain yield at higher populations, the increase was not significant.**

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