AGRONOMIC Spotlight
Technology Development by MONSANTO ®

Corn Starter Fertilizer with Sulfur or Zinc

Higher corn yields mean more minor nutrients are removed from the soil; thus, minor nutrient deficiencies may occur. Starter fertilizer is one way to help ensure nutrient availability to the crop early in the season. While sulfur (S) and zinc (Zn) are needed in smaller quantities than nitrogen (N), phosphorus (P), and potassium (K), it is important to acknowledge their contribution to corn development. Including S or Zn with starter fertilizer is being examined as a way to improve yield potential.

Role of Sulfur and Zinc

Sulfur. Sulfur plays a major role in the formation of proteins needed for crop growth.

Zinc. Because Zn is required by corn in very small amounts, it is termed a micronutrient. Zinc is an important component of multiple enzymes that drive metabolic reactions in all crops.

Sulfur and Zinc Deficiency Symptoms

Sulfur. Sulfur deficiency appears as a general yellowing of young leaves. Sulfur deficiency is sometimes confused with nitrogen deficiency. Because S is not as easily translocated within the plant, younger leaves show the visual symptoms first (Figure 1).

Sulfur deficiency may occur in the following situations:

- Sandy soils or soils with low organic matter
- Cool soil temperatures, when mineralization is slowed.

Zinc. Plants fail to develop normally when Zn is deficient. A Zn deficient corn plant exhibits interveinal chlorosis on the upper leaves. The veins, midrib, and leaf margin remain green. As the deficiency intensifies, bands (or "stripes") develop on either side of the midrib and the leaves may turn almost white (Figure 2). Additionally, a Zn deficient corn plant may be stunted, *i.e.* shortened internodes on the stalk (Figure 3).

Zinc deficiency may occur in the following siutations[1]:

- Soil pH above 7.4; Zn availability may be reduced in soils with high soil pH values.
- Cool/wet soils, when mineralization is slowed
- Sandy soils or soils with low organic matter
- Topsoil removed, or eroded soils

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Figure 1. Corn showing sulfur deficiency symptoms. Photo courtesy: University of Minnesota Extension and Department of Soil, Water and Climate, *Nutrient Deficiency Symptoms in Corn,* http://blog.lib.umn.edu/efans/cropnews/

Figure 2. A young corn plant showing typical zinc deficiency symptoms. Note the broad white stripes on both sides of the leaf midrib. Photo courtesy: University of Minnesota Extension, *Zinc for Crop Production.* www.extension.umn.edu

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- High phosphorus (P) levels; a P-induced Zn deficiency is a concern and may occur if very high rates of phosphate fertilizer (more than 100 lb P_2O_5/acre) are used and the soil test for Zn is in the low and very low range.

Tissue testing can confirm deficiencies of S and Zn. There is currently no accurate soil test for S. A soil test can help confirm a Zn deficiency; however, micronutrient soil tests are not as reliable as tests for soil acidity (pH) or for P and K[2]. As a result, plant analysis is also very important in diagnosing S and Zn deficiencies.

Management of Sulfur and Zinc

Sulfur Study. Michigan State University partnered with the Corn Marketing Board of Michigan to study the effects of starter fertilizer with S on corn production. Six study locations were evaluated in 2005 and 2006, and data indicated there was no significant response to the addition of S in the starter fertilizer[3]. The yield responses observed in the study were attributed to N or P, or a combination of N and P, rather than S alone. As atmospheric sulfate deposition continues to decrease, a corn yield response to S is more likely to occur[3]. The likelihood of response should increase in cool, wet springs where mineralization is minimized and early crop growth is slowed[3].

Zinc Study. A soil test can be used to determine Zn levels. A 200 bu/acre corn crop requires approximately 0.4 lbs/acre of Zn[4]. The addition of Zn in small quantities can produce significant increases in crop production, where soil test Zn levels are low[1]. For example, a University of Nebraska study found that when applied in a band near the seed at planting, a rate of 0.1 lb. Zn/acre nearly doubled the yield of irrigated corn. This is an extremely rare occurrence, and it should be noted that the Zn soil test was low. University of Nebraska recommends Zn be included in starter when the Zn soil value is marginally adequate[5].

Sources of S and Zn. If the decision to apply S in starter fertilizer is made, soluble S sources (*e.g.* ammonium sulfate, ammonium thiosulfate) should be selected rather than elemental S, which may not be available to the growing crop in a timely fashion. Zinc sulfate is one of the more common sources of Zn. It can be applied in a band application with dry starter fertilizer at planting.

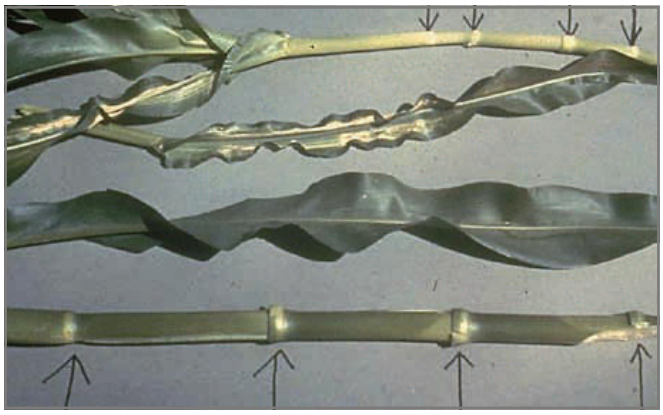

Figure 3. A normal plant (*bottom*) is shown in contrast to the zinc-deficient plant, which has shortened internodes.
Photo courtesy: University of Minnesota Extension, *Zinc for Crop Production.* www.extension.umn.edu

In summary, we often think of N-P-K when discussing corn fertility. Minor nutrients can be just as important to yield potential, even though they are not required in large quantities. Research does not seem to show a consistent yield response to either S or Zn, when used in corn starter fertilizer simply as an extra input. However, certain soil and environmental conditions exist that may warrant a closer look at adding S or Zn to starter fertilizer for a positive yield response.

References. *[1]Rehm, G. and M. Schmitt. 1997. Zinc for crop production. University of Minnesota Extension publication FO-00720-GO.*
[2]Tri-State fertilizer recommendations for corn, soybeans, wheat & alfalfa. Michigan State University, The Ohio State University, and Purdue University. Extension Bulletin E-2567 (New), July 1995.
[3]Sulfur and nitrogen starter fertilizer in Michigan corn. Michigan State University Field Crop Advisory Team Alert. May 3, 2007. Online at http://ipmnews.msu.edu
[4]Mengel, D.B. Role of Micronutrients in Efficient Crop Production. Purdue University AY-239.
[5]Hergert, G.W. and C.S. Wortmann. Using starter fertilizers for corn, grain sorghum, and soybeans. University of Nebraska. NebGuide G361. Revised June 2006.