SDSU Extension

iGrow Corn

BEST MANAGEMENT PRACTICES

Chapter: 27

Sulfur can Increase South Dakota Corn Yields

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Corn sulfur (S) deficiency symptoms include leaf yellowing and/or striping or interveinal chlorosis of new leaves (Fig. 27.1). Corn yield responses to S addition were more likely in sandy no-tillage fields where the surface 2 feet of soil contains < 40 lbs of SO_4-S/acre. Sulfur deficiency can be minimized by applying sulfur-containing fertilizers or manure. This chapter provides information needed to make informed decisions concerning sulfur fertilizer applications.

Figure 27.1 Corn sulfur deficiency symptoms. (Courtesy: SDSU Jim Gerwing)

A Growing Problem

Sulfur (S) is an essential nutrient for crop production that in the past was largely supplied through atmospheric deposition. However, improvements in air quality have reduced S depositions. For example, from 1972 to 1980, SO_2 emissions decreased in the United States from 32 million to 26 million tons, which was further reduced to 6.5 million tons in 2011 (Tisdale et al., 1985; Furiness et al., 1998; Jeschke and Diedrick, 2010; US-EPA, 2014). Decreasing sulfate depositions have been accompanied by increased applications of sulfur-containing fertilizers. In South Dakota from 2002 to 2010, the use of sulfur-containing fertilizers increased from 18,318 tons to 51,592 tons (USDA-NASS, 2012).

Sulfur in the Soil

Soil contains between 200 and 1000 lbs of S/acre, which can exist as inorganic SO_4^{-2}, gypsum ($CaSO_4$), reduced sulfide (S^{-2}), and organic-S. Plant requirements for S can be obtained from the mineralization of organic matter, the oxidation of sulfide, the solubilization of gypsum, and/or from atmospheric depositions. Sulfate (SO_4^{-2}) is an important form of S in the soil. This negatively charge anion can leach with percolating water. Sulfur mineralization converts organic-S to hydrogen sulfide (H_2S), which is then oxidized to sulfate. Processes that influence microbial activity, such as tillage, will impact sulfur mineralization.

Plant S Deficiencies

Due to relatively slow mobilization from older leaves to younger leaves, S deficiency generally includes

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yellowing as well as leaf striping of younger leaves (Fig. 27.1). Nitrogen (N) has similar symptoms in corn. However, yellowing is most observed in older leaves. Sulfur deficiency symptoms are most observed in low-organic-matter, no-till corn. Research conducted at 130 locations in South Dakota between 1990 and 2014 indicates that corn responds to S if: 1) the amount of sulfate in the surface 2 feet is < 40 lbs SO_4-S/acre, 2) no-tillage is used at the site; and 3) the soil texture is relatively course (Fig. 27.2). The S source used in these studies was ammonium sulfate and grain yields were adjusted to 15% grain moisture.

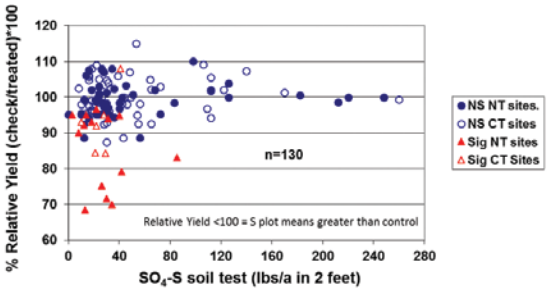

Figure 27.2 The influence of tillage (no-tillage and conventional-tillage) and SO_4-S amounts in the surface 2 feet on the relative yields in SD studies conducted between 1990 and 2014. Relative yield values < 100 indicate that sulfur fertilizer increased yield.

Causes of S deficiency may include reduced mineralization resulting from low organic matter contents, cool temperatures, the adoption of reduced-tillage systems where soil organic matter is sequestered, and/or the loss of sulfate with leaching water.

Collecting and Analyzing Soil Samples

Sulfate-S (SO_4^{-2}) is a negatively charged ion that is not strongly held in South Dakota's negatively charged soils. Because SO_4^{-2} can move with water percolating through the soil, samples collected from the surface 2 feet for N recommendations can be used for S recommendations. The soil samples should be kept cool and submitted to your soil testing laboratory as soon as possible. The samples can be analyzed for SO_4-S using Combs et al. (1998). Because the sulfate test is not always accurate, soil sulfate analysis should be used as a starting point for determining a sulfur recommendation. Consider the soil organic matter, soil texture, SO_4-S, and tillage practices when making a recommendation (Table 27.1).

There are a number of fertilizers that can be used to reduce S deficiencies including manure (Chapter 28). For example, ammonium thiosulfate (12-0-0-26) can be mixed with UAN or ammonium sulfate (21-0-0-24) can be mixed with urea (46-0-0). However, the S contained in Elemental S (0-0-0-90) is not readily available because it requires oxidation prior to plant uptake. Manure from animals that used distillers grains in their rations may contain relatively high concentrations of S.

Because both N and S are needed to produce plant proteins, the ratio between these nutrients can range from 8:1 to 10:1. Typically, if crop requirements for nitrogen are 100 lbs N/acre, then the sulfur requirements will be 7 to 13 lbs S/acre. Approximately 25 lbs of S are harvested in a 15-ton silage crop (Schulte and Kelling, 1992), and cereal grain crops have the highest S requirements while soybeans have the lowest.

Table 27.1 The sulfur recommendations for South Dakota. ***(Modified from Gerwing and Gelderman, 2005)***

		Soil Texture			
Sulfur Soil Test	*Relative S Soil Level*	*Coarse*		*Medium/Fine*	
		Tilled[A]	*Strip or no-till*	*Tilled*[A]	*Strip or no-till*
lbs/a (0-2ft)		---------- lbs S/a recommendation ----------			
0-9	Very Low	25	25	25	25
10-1-	Low	25	25	15	25
20-29	Medium	15	25	0	15
30-39	High	15	15	0	15
>=40	Very High	0	0	0	0

[A] conventional-tillage

[B] see ipni.net (International Plant Nutrition Institute) for placement guidelines, http://www.ipni.net/article/IPNI-3268.

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