STAY AHEAD OF CORN'S SULFUR DEMAND IN COOL SPRING CONDITIONS

Sulfur Boosts Yields in 10 Out of 20 Fields in Purdue Trial

The five no-S treatments are evident (see arrows) in this aerial image from Shelby County, Indiana, in the 2019 growing season. The other treatments, 10 and 20 pounds of S per acre in the sidedress application, are not distinguishable for the most part. Grain yield increased by five bushels per acre with sidedress S, showing no difference between rates of 10 and 20 pounds of S per acre. It is suspected that extremely dry weather during grain-filling likely tempered the yield response to applied S.

Photo credit: R.L. Nielsen, Purdue University

In a sulfur study, 10 out of 20 fields across Indiana responded to sulfur sidedress fertilization in corn trials conducted from 2017-2019. Dr. Jim Camberato, professor and extension specialist at Purdue University – who conducted the study with Dr. Bob Nielsen, Purdue agronomy professor and graduate student Diana Salguero – says the yield responses ranged from 4 to 24 bushels per acre. Some areas in the most responsive fields added approximately 40 bushels per acre.

In the Indiana corn study cited above, areas of 15 to 40 acres were sidedressed with a constant rate of nitrogen (N) plus varying rates of sulfur (S) with commercial-type applicators.

Camberato says the results of the trials indicate that more fields than expected may respond to applied S. "There is still a lot of uncertainty about the extent of S deficiency in Indiana and which soils and management systems will most likely require routine S fertilization," he says. "We hope to continue this type of research for several more years."

Camberato also notes that the dynamics of S in the soil appear to make long-time benchmarks less reliable predictors of the need for an application of S.

"We did not expect some of the fields to be S deficient because they had organic matter levels up to 3.5 percent and mineralization of organic S might be expected to supply sufficient S to avoid deficiency," he explains. "Other soils were lower in organic matter and some were loam or sandier in texture, and those soils were considered more likely to be S deficient. Soil test levels were generally below 10 ppm sulfate-S, which some would consider deficient, but soil testing is not considered a good method for prediction of soil deficiency."

The Right Source and Right Time

Camberato points out that organic S in the soil may not be mineralized by microbes into the plant-available sulfate form early enough in the spring.

- The microbial process of converting organic S into sulfate-S can take several weeks even in warm soils and can be significantly slower, or completely stalled, when soils are cool.
- Similar biological factors also influence the oxidation of powdered elemental S, with oxidation delayed even further in the case of granular elemental S fertilizers due to the reduced surface area.

Camberato further states that fall or winter applications of sulfate-S are not a good option in Indiana either, because the sulfate-S could leach below the root zone before the crop needs it. For these reasons, he recommends spring-applied sulfate-S.

The challenge for corn growers is to ensure that S is accessible to corn in a readily available form at or before the crop's V-4 to V-5 stage. This is vital to maintaining maximum yield potential, says Dr. Daniel Kaiser, associate professor in the Department of Soil, Water and Climate at the University of Minnesota.

"It doesn't take a whole lot of sulfur to get really substantial yield responses, but it's a question of having it available early in the growing season," Kaiser says.

According to Camberato, many sources of S — whether bound in soil organic matter or present as elemental S — are not accessible to the crop and will not even start oxidizing while temperatures are low.

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Kaiser concurs, stating, “I know our soils will oxidize elemental sulfur, but it takes time and from the end of planting to mid-May, we’re too cold. That’s where a readily available source like ammonium sulfate is really helpful.”

Delays in mineralizing organic matter, Kaiser adds, are a particular challenge in conservation tillage or no-till fields because residue keeps the soil cool and ties up S – as well as N – as microbes break down biomass on the surface.

“In 2019, we were seeing a lot of symptoms of deficiency, though in early- to mid-June they started to green up,” Kaiser states. “We didn’t see that (the deficiency symptoms) where we had applied sulfate.”

By the time S reserves are oxidized into sulfate-S or growing roots reach buried sulfate later in the spring, untreated crops may green up, but the damage may already be done — either as lost yield or delayed maturity. This can result in higher grain moisture levels at harvest.

“If we can’t get sulfur out there until V-5, we’ll see the crop looking a little deficient, but we haven’t seen a yield penalty,” Kaiser notes. “We can still get the yield back, but it will cost us in maturity.”

The Right Place

Dr. Glen Harris, extension agronomist at the University of Georgia, notes that available S in coarse-textured coastal soils can leach down to buried layers of heavier subsoil, out of reach of the roots of corn seedlings.

“It seems like if we’re going to see a deficiency, it’s early on,” Harris says. “When the crop hits some subsoil clay, it snaps out of it. That can be seven or eight inches deep, or three feet deep.”

Waiting for the crop to find subsoil S may delay its access to the nutrient until it is too late to meet the crucial period of demand in the early vegetative stages. This is also true if one waits for a sidedress application, notes Harris, who favors preplant or starter applications of S.

Granular ammonium sulfate, which delivers S in the plant-available sulfate-S form along with ammonium-N, is highly flexible when it comes to placement, adds Mercedes Gearhart, senior agronomist with AdvanSix. Growers can broadcast it on the surface of most soils without the need for incorporation, or apply it as a sidedress during the growing season, thanks to its resistance to volatilization. Ammonium sulfate also makes an excellent starter fertilizer in proximity to the root, where it may have the additional benefit of increasing the availability of phosphorus and micronutrients.

The Right Rate

Sidedressing helps keep S levels balanced with N. The two nutrients work together in plants to help create vital proteins and chlorophyll, so S deficiencies can lead to the under-utilization of N and inadequate crop growth. As a result, targeting higher yields by increasing N rates also requires adjusting S rates.

“If you only put on 10 pounds of sulfur and fertilize for 300 bushels of corn, you’re asking for a sulfur deficiency,” Harris points out. “For 150-bushel corn, our recommendation is 180 pounds of nitrogen. For 300-bushel corn, it’s 360 pounds. If you only put 10 pounds of sulfur on, you’re asking for sulfur problems for sure.”

Harris recommends that Georgia growers aiming for bin-busting yields should add sulfate-S to their N sidedress applications, increasing their S application rates to a total of 20 pounds of sulfate-S per acre. Kaiser notes that the high levels of soil organic matter in Minnesota can allow growers there to apply lower rates of S.

Research continues as soil scientists and agronomists address complex questions surrounding S fertilization, including the dynamics of S in the soil, more accurately predicting which soils would benefit from applied S, and ensuring S is available when the crop needs it.

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