AGRONOMY JOURNAL PAPER HIGHLIGHTS BENEFITS OF AMMONIUM SULFATE

A review article in the May/June 2016 issue of *Agronomy Journal* highlights the advantages of ammonium sulfate (AS) over new granular nitrogen/phosphorus (N/P) fertilizer products formulated with elemental sulfur (ES) or a combination of ES and AS.

Agronomists and soil scientists have long known that ES is not plant available unless it is oxidized into the sulfate-S form. The *Agronomy Journal* paper describes the conversion of ES to the plant-available sulfate-S form, which is performed by microbes in the soil. The authors reviewed the published results of greenhouse experiments and agronomic field trials pitting granular ES-enriched commercial fertilizers against traditional AS.

Dose of Reality

Lead author Dr. S.H. (Norman) Chien, retired Principal Scientist-Soil Chemistry of the International Fertilizer Development Center in Muscle Shoals, Alabama, says the reality of how the granular ES-enriched fertilizers behave in the soil can differ widely from the assumptions people have of them.

"Some of these products claim that their ES will become available in time to meet plant needs in the season it's applied, or that a combination of AS and ES will provide season-long available sulfur for the crop," Chien says. "But peer-reviewed science has demonstrated that the oxidation of granular ES in a soil may be nil or inadequate during the plant growth to maturity. That would be far too late for the crop to utilize any of the sulfur from the granular ES in the season immediately following application."

To meet their sulfur needs, Chien says, plants must have sulfate-S. That means they must either wait until soil microbes convert ES into sulfate—a process that can take weeks or months, depending on rate of ES oxidation, or sulfur must be applied in the sulfate form.

The Locality Effect

Some fertilizer manufacturers micronize ES—grinding it extremely fine—to increase its surface area. The strategy is that greater surface area will encourage faster conversion to the sulfate form.

That theory would only work well if the sulfur was spread widely through the soil, Chien explains in the paper.

However, notes Chien, the micronized sulfur is typically granulated with clay or nitrogen/phosphorus fertilizers to make it easier to handle. As a result, the micronized particles remain clustered in the soil as the granules break down.

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Furthermore, because ES is hydrophobic (water-repellent), the tiny sulfur particles tend to form aggregates that reduce the surface area of ES particles in moist soil, reversing the benefits of fine grinding.

Chien points out that the clustering—which he calls "the locality effect"—decreases contact between the ES particles and the soil, in turn limiting the colonization of S-oxidizing bacteria on the surface of the ES particles.

For the MAP or DAP granulated with ES plus AS, a high concentration of dissolved MAP or DAP can lower the pH of nearby soil if nitrification of ammonium from MAP or DAP occurs, Chien adds, further inhibiting the action of S-oxidizing bacteria due to acidity. For AS, nitrification of ammonium from AS has no effect on S status since S is already in the sulfate form.

Greenhouse/Field Studies

Chien and his co-authors reviewed the results of numerous greenhouse and field studies performed in different countries. They determined that granular N and P fertilizers enriched with ES often do not perform well—in terms of both crop yield and S uptake—compared to AS and other traditional forms of sulfate-S like gypsum.

The *Agronomy Journal* paper details a recent greenhouse study in Brazil that compared sulfur availability in treated soil in two successive corn crops. Each "crop" was grown for six weeks, and had been fertilized with either granular AS or a MAP-15S granular product containing 7.5% ES and 7.5% AS-S.

The dry-matter yield and sulfur uptake by both crops was higher in the plants treated with AS than those treated with MAP-15S. Further, a regression plot charting sulfur uptake by both crops demonstrated that there was not a significant oxidation of ES in the MAP-15S to sulfate-S during the corn's growth.

Similar results were observed in wheat grown to maturity in another experiment comparing AS to granular MAP-15 S.

"In all, the *Agronomy Journal* paper reveals that providing ES to crops delivers little benefit the year it is applied," Chien concludes. "Further peer-reviewed research is needed to identify the crop, soil and fertilizer application method and climate conditions under which ES-enriched N/P products work best. Until those details become evident, it is important that farmers and crop advisors recognize the shortcomings of these enriched products that rely on ES to provide vital sulfur to crops, especially where the sulfur need is significant and immediate."

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