Honeywell Sulf-N® Ammonium Sulfate

RESEARCH BULLETIN

Soil Science Paper Highlights Strengths of Ammonium Sulfate

The July 2011 issue of *Soil Science* features a paper examining the performance of ammonium sulfate as a source of nitrogen and sulfur. The paper, "Comparison of Ammonium Sulfate with Other Nitrogen and Sulfur Fertilizers in Increasing Crop Production and Minimizing Environmental Impact: A Review," was authored by Sen H. Chien, former principal soil scientist for the International Fertilizer Development Center (IFDC); Mercedes Gearhart, agronomy manager for Honeywell; and Sven Villagarcia, professor emeritus at the National Agricultural University of La Molina (UNALM) in Lima, Peru. It is an extensive literature review covering decades of study of ammonium sulfate and other fertilizers.

Introduction

"It is very exciting to be able to collect so much great research into a single paper, subject it to peer-review, and have it published in such an esteemed journal as *Soil Science*," says Gearhart. "Ammonium sulfate is one of the oldest sources of ammonium-nitrogen, and as a result, scientists have built up a tremendous body of knowledge about its agronomic performance. The Soil Science paper helps agronomists understand ammonium sulfate in context with other sources of nitrogen and sulfur."

Nutrient Absorption

Sulfate is the only form of sulfur plants can absorb from the soil, giving ammonium sulfate an immediate advantage over other forms of the nutrient, such as elemental sulfur. As a nitrogen source, a three-year study by Chien et al. (2008) cited in the *Soil Science* paper demonstrated no significant yield differences in a wheat/corn rotation among ammonium sulfate (AMS), urea, urea ammonium nitrate (UAN), and ammonium nitrate under conditions non-conducive to nitrogen loss.

In fact, in the 2011 paper, Chien et al. found that, for increasing yield, ammonium sulfate may be more effective than urea in sandy, alkaline soils. The effect is likely to be at least in part because ammonium sulfate is a more acidic source of nitrogen, which reduces the toxicity of aqueous ammonia and nitrite to the plant, notes Gearhart.

The acidifying effect of ammonium sulfate on the rhizosphere has also been shown to improve uptake of phosphorus from indigenous calcium/phosphorus materials in neutral and alkaline soils; increase uptake of iron, zinc and manganese where alkalinity is a limiting factor in micronutrient uptake; and enhance the dissolution of applied phosphate rock.

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Though ammonium sulfate has been demonstrated in dozens of studies to maintain an acidic environment in the root zone after urea hydrolysis, a 2008 IFDC study demonstrated that the relative lime requirement (RLR) following ammonium sulfate applications in a variety of soils is significantly lower than the Association of Analytical Chemists' long-time recommendations – as much as 47% less in Sharkey clay soils. The study was also discussed in a 2010 paper by Chien et al. in *Better Crops*.

"Dr. Chien and his colleagues at IFDC explained the role of clay content and native pH buffering capacity in the soil that reduces the need for lime compared to the recommendations we've been hearing since the 1930s," says Gearhart. "That knowledge can change recommendations in the field and impact the economics of ammonium sulfate applications."

Environmental Fate

The 2011 *Soil Science* paper also reviewed studies comparing ammonium sulfate to other common nitrogen fertilizers under conditions conducive to nitrogen loss. "Nitrogen loss from volatilization, leaching and denitrification can represent significant economic and ecological costs," Gearhart points out.

A 1980 study cited in the paper notes that urea surface-applied to a soil with a pH of 6.7 experienced 36% loss of total nitrogen via ammonia volatilization, while ammonia losses from surface-applied ammonium sulfate and ammonium nitrate were less than 5%.

The nitrate in ammonium nitrate is prone to leaching, notes another study reviewed in the paper, while the ammonium in ammonium sulfate and urea must undergo nitrification before becoming nitrate. Moreover, the localized soil acidification caused by ammonium sulfate may explain its slow rate of nitrification – it may be associated with ammonium sulfate's higher resistance to leaching and denitrification losses compared to ammonium nitrate and urea, which is explored in the 2011 *Soil Science* review.

Ammonium sulfate applied in combination with urea appears to reduce ammonia volatilization – an effect several studies correlated with the rate of ammonium sulfate blended with the urea – and appears to enhance the nitrogen efficiency of urea when the two fertilizers are surface-applied together.

"Those findings could be especially exciting for farmers, who could tap into the benefit of lower potential for loss from ammonium sulfate while enjoying some of the cost benefits of urea," says Gearhart. "By bringing data like that to light – and presenting the knowledge of dozens of studies in a wide variety of crops, conditions and applications reviewed in a single, peer-reviewed document – the *Soil Science* paper will be a valuable resource to academics, advisors and farmers."

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References

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