Dr. R. J. Goos

# ATS: The Multi-Use Sulfur Fertilizer

## Researcher cites data that demonstrate the muli-benefits of this valuable sulfur source.

***Summary:*** *Ammonium thiosulfate is a widely used fluid source of nitrogen and sulfur. It oxidizes rapidly. When mixed with other fluid fertilizers and applied to the soil in concentrated fertilizer bands, ammonium thiosulfate can enhance micronutrient availability, slow soil urease, slow nitrification, and improve the availability of P fertilizers. Ammonium thiosulfate is used for its convenience and other beneficial interactions.*

Ammonium thiosulfate (ATS 12-0-0-26S) is a standard product of the U.S. fluid fertilizer industry. Over the past 30 years, sales of ATS have steadily increased owing to its natural advantages:

- compatibility with most fluid NPK sources
- more rapid oxidation than el emental sources
- higher analysis than other fluid sulfur (S) sources.

Primary justification for use of ATS is the adding of S to fluid fertilizers. However, research over the past 20 years has also revealed that ATS, particularly when banded, may have other indirect benefits.

### Micronutrients more available

Because ATS is both a reducing and acidifying agent, it can improve the availability of iron and manganese in the soil. As a reducing agent, it donates electrons to other substances. As an acidifying agent, it works through oxidation by soil microbes. When the ATS is fully oxidized, nitric and sulfuric acids are produced in the soil.

The ability of ATS to improve iron availability has been clearly shown in research. Figure 1 shows that banding a ferrous sulfate-APP suspension with ATS in an alkaline soil was effective in increasing Fe uptake by sorghum. The study further revealed that when ATS was banded in direct contact with the sorghum seed, germination and seedling damage resulted. Normal plant growth occurred when the ATS was placed two inches to the side and two inches below the seed.

Research also has shown ATS enhances Mn availability. ATS reacts rapidly and abiotically with Mn-oxides in the soil, producing $Mn^{2+}$. Agronomists or growers who work in regions of Mn deficiency, or where Mn fertilization helps reduce certain crop diseases, are encouraged to experiment with ATS.

### Soil urease slowed

ATS can slow soil urease when mixed with UAN and surface banded (dribbled). Urease is an enzyme that converts urea and water to ammonia and carbon dioxide. If surface-applied urea is hydrolyzed too quickly, part of the ammonia produced can leak back into the atmosphere and be lost.

ATS is not a strong inhibitor of urease when compared to specific urease inhibitors such as NBPT. However, mixing ATS with UAN and applying in a band can slow urea hydrolysis significantly. Research also has shown that the strength of ATS as a urease inhibitor can be enhanced with large fertilizer droplets and at lower water contents.

Figure 1 shows how adding 5 percent ATS by volume to UAN or UAN-APP mixtures slowed but did not prevent ammonia loss. Note also that the banded solutions performed much better than those broadcast. Where ATS was added and the fertilizer was banded, ammonia loss was reduced more than 60 percent! Other research, while also successful, has shown that loss reductions can vary widely among soil types.

Inattention to details has and can cause problems. For example, some commercial ATS products are alkaline, with a strong odor of free ammonia. Adding more than 5

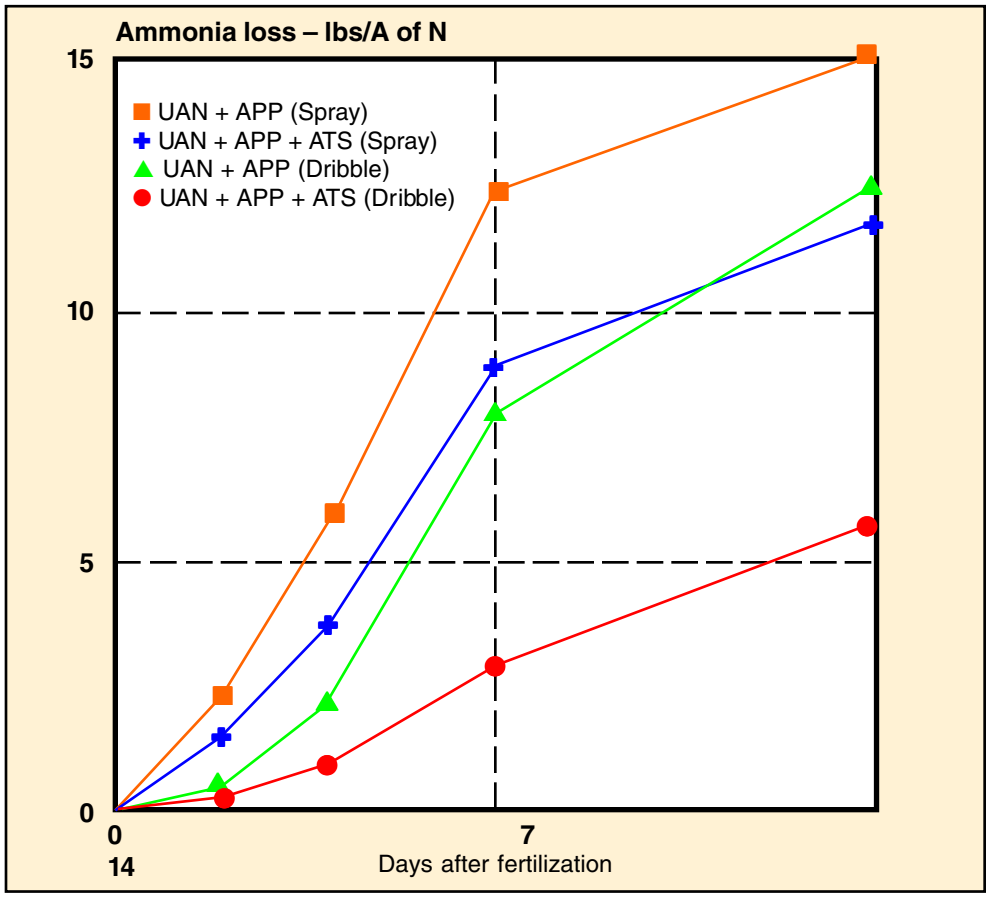


Figure 1. Effect of ammonia volatilization of placement and adding ATS to UAN-APP mixture on a Fargo-clay soil under field conditions, Fairlie and Goos.

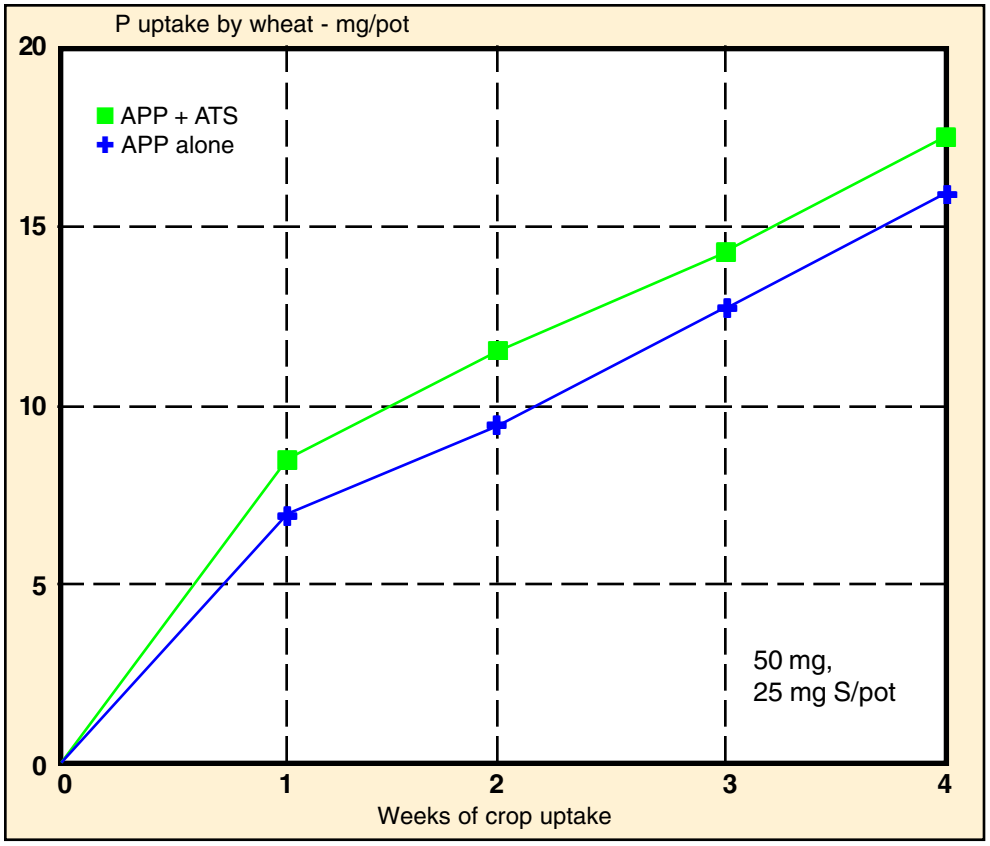


Figure 2. Effect of ATS on uptake of P from APP by wheat, Goos and Johnson.

percent by volume of alkaline ATS without an appropriate pH buffer (e.g., APP) can increase pH of the UAN and reduce the benefits of ATS in curbing ammonia loss. ATS also can interfere with some methods of determining residual urea in soils.

### Nitrification slowed

ATS can slow nitrification when banded with UAN. As with urease, effects of ATS do not equal those of specific nitrification inhibitors.

ATS, when added to UAN, increased the amount of residual ammonium in the soil four weeks after fertilizer application. Note the effect of the ATS was not as strong as for nitrapyrin. Thus, ATS should not be seen as a replacement for specific nitrification inhibitors. The UAN or UAN-ATS treatment was injected before planting spring wheat in North Dakota.

In some laboratory studies, use of thiosulfate has produced a temporary nitrite accumulation in the soil. But this has not been confirmed under field conditions.

### P more available

Recent research has shown that banding ATS with phosphorus can improve phosphate uptake by crops. Figure 4 shows a greater uptake of phosphate by wheat when fertilized with APP-ATS than with APP alone. The fertilizer was applied in an alkaline loam soil. In other trials, we observed that other acid-forming fluid S fertilizers (ammonium sulfate, ammonium bisulfite, and potassium thiosulfate) also enhanced P uptake. So, this effect is not specific for ATS.

In a study from Canada, barley or rapeseed showed a large response to phosphate when a MAP solution and ATS were banded either together or separately on an alkaline soil. However, the largest response occurred when they were banded together.

### Precautions

While the primary justification for ATS is its convenience as an S source for users of fluid fertilizers, a couple of precautions need mentioning.

One is its short-term phytotoxicity. For example, it should not be placed in direct contact with the seed of row crops.

The other is it should not be used for foliar fertilization.

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