INVESTIGATING THE USE OF AMMONIUM THIOSULPHATE (ATS) FOR SOFT RED WINTER WHEAT PRODUCTION IN KENTUCKY

Edwin Ritchey[1] and John Grove[2], Plant and Soil Sciences, University of Kentucky
[1] Extension Soils Specialist; [2] Professor and Director
University of Kentucky Research and Education Center (UKREC) – Princeton
PH: (270) 365-7541 Ext. 301; Email: Edwin.ritchey@uky.edu

OBJECTIVES

Evaluate the effectiveness of 12-0-0-26 (S) or ATS for a sulfur (S) amendment as part of the nitrogen source used to produce soft red winter wheat. To determine the effectiveness of this product, wheat yield and tissue sulfur content where compared among plots treated with ATS mixed with UAN, UAN alone, and UAN treated with urease and nitrification inhibitors (NBPT and DCD).

METHODS

This test was conducted in the 2015-2016 crop year in fields cropped to soft winter wheat following corn. Four fields were utilized to test the product's effectiveness, two producer fields and two fields located at the UKREC. Producer's fields were located in Christian County on a Pembroke silt loam and Logan County, also on a Pembroke silt loam. A Crider silt loam was present at the UKREC-Kevil location and the UKREC-Watson soil was a Sadler silt loam (Table 1).

Table 1. Soil types, N-rates, and application times for individual locations.

Location	Soil type	N-rate 1 (lb/A)[1]	N-rate 2 (lb/A)[2]	S-rate (lb/A)
Christian	Pembroke	40*[3]	0	10
Logan	Pembroke	45	55*	10
UKREC – Kevil	Crider	40*	55	10
UKREC - Watson	Sadler	40*	55	10

[1] N-rate1 = greenup application (Feekes 2-3)
[2] N-rate2 = second application (Feekes 5-6)
[3] * indicates treatment application

Table 2. Soil nutrient and soil organic matter status for the 0-4 and 0-12 inch depths.

Location	Depth (in)	Sulfur (lb/A)[1]	Total N (%)[2]	SOM (%)[3]
Christian	0-4	21	0.10	2.0
Christian	0-12	29	0.07	1.3
Logan	0-4	24	0.12	2.3
Logan	0-12	16	0.08	1.5
UKREC – Kevil	0-4	20	0.11	2.2
UKREC – Kevil	0-12	14	0.08	1.5
UKREC - Watson	0-4	19	0.11	2.1
UKREC - Watson	0-12	32	0.06	1.2

[1] Total Sulfur determined by Mehlich III extraction
[2] Total N determined by LECO combustion
[3] Soil organic matter determined by LECO combustion

Producers were selected that were interested in S fertility for wheat production. One producer had a neighboring producer that routinely applied S fertilizer. Wheat at all locations was planted at appropriate times for western Kentucky using standard practices. Fields were soil sampled prior to treatment application to determine initial sulfur fertility status at each location (Table 2).

Wheat tissue samples were collected at flag leaf stage to determine tissue sulfur content. Once tissue samples were collected, they were oven dried and ground prior to analysis.

Since ATS is a known weak urease and nitrification inhibitor, N treatments were developed so that the influence of S fertility and N conservation could be separated. Nitrogen was applied using an ATV-drawn plot sprayer with a 20-foot boom. Sulfur was added to the wheat plots at 10 lb S/A as ATS mixed with liquid UAN (30%). Nitrogen was typically split applied at a rate of 40 lb N/A with added ATS. At UKREC, both sites received 40 lb N/A at greenup (Feekes 2-3) and 55 lb N/A at approximately Feekes 5-6. The on-farm tests varied with regards to their N program. The Christian County location received 40 lb N/A (10 lb S/A) at greenup, but failed to receive a second N application at Feekes 5. The Christian County location received 45 lb N/A applied at greenup and the ATS treatment (and comparison treatments) were applied at Feekes 5 at a rate of 55 lb N/A and 10 lb S/A at this location (Table 1).

Plot width was 40 feet for all locations except UKREC-Kevil which was 6 feet in width. Plot length was 100 feet in length for UKREC-Kevil, 200 feet for UKREC-Watson, 300 feet for Logan County, and 500 feet for Christian County. All plots except UKREC-Kevil were end trimmed prior to harvest. Plot lengths were collected for each location following harvest and plot size adjusted accordingly. Yields were determined in the middle of the plots to avoid potential border effects that could influence yield. Plots were harvested at UKREC-Kevil and UKREC-Watson using a plot combine and individual plot weights were determined with an internal weigh system in the combine. Plots at Christian and Logan counties were harvested with the producers' combines and wheat yields were determined using weigh wagons for individual plots. Data was analyzed using the PROC GLM procedure in SAS version 9.4 (SAS Institute, 2015).

RESULTS

Fields differed between locations as regards profile S distribution (Table 2). In Logan County and UKREC-Kevil, S was more prominent at the 0-4 inch sample depth compared to the 0-12 inch sample depth. This indicated less S was present at the deeper depths for these locations. The Christian County and UKREC-Watson locations indicated that more S was present in the 0-12 inch depth sample. Total N was similar at all locations within the same depth increment. Soil organic matter also showed similar characteristics within depth increments and ranged from, 2.0 to 2.3% in the 0-4 inch depth and 1.2 to 1.5% in the 0-12 inch depth.

Wheat yields varied between sites ($P<0.001$) but not within sites ($P = 0.889$) (Table 3). No statistical yield differences were present among the treatments within a given location. The Pembroke and Crider soils present in Christian, Logan, and UKREC-Kevil represent prime wheat soils common to western Kentucky wheat production areas. The UKREC-Watson location had a more marginal soil due to the fragipan present and resulted the lowest yields of the four locations. This soil has a fragipan located at approximately 30 inches below the surface, which can lead to a wetter soil in the spring, favoring denitrification losses. All three treatments behaved in a similar fashion within a location. The Christian county location received only 40 lb N/A at the greenup application with no additional N, but still had impressive yields for all three treatments. The Logan County and UKREC-Kevil locations had the highest yields for the

experiment but no treatment differences were observed (Table 3). Yield data does not suggest any benefit to added S at any of the four locations tested (Table 3).

Tissue S content varied between locations (P<0.001), but not for individual treatments within a given location (P=0.803) (Table 3). The lowest tissue S values were at the Christian County location that received only 40 lb N/A. Although 10 lb S/A was added at this location, there is clearly a direct relationship between N and S fertility as they are both essential components of protein. Although not directly tested in this experiment, the results suggest that decreased N rates lowered the amount of S uptake in the tissue at this location. Grain protein was not tested, but at the present time there is no pricing premium based on grain protein content for soft red winter wheat. The UKREC-Watson location had the next highest tissue S content, followed by the Logan and UKREC-Kevil locations. There was no increase in tissue S content with the sulfur application.

Tissue N content also varied between locations (P<0.001) but not within locations (P=0.625) (Table 3). The Christian County location received the lowest amount of applied N of the four locations, but did not have the lowest tissue N content. UKREC-Watson resulted in the lowest tissue N content of the study. As with tissue S content, the Logan County and UKREC-Kevil locations had the highest tissue N content. The N/S ratios followed the same trend as the tissue N results (Table 3).

Table 3. Wheat grain yield and tissue analyses for individual locations and treatments.

Location	Treatment	Yield (bu/A)[1,2]	Tissue S (%)[3]	Tissue N (%)[3]	N/S Ratio
Christian	UAN	88.9 b	0.23 a	3.35 b	14.8 b
Christian	UAN + ATS	93.8 b	0.23 a	3.46 b	15.1 b
Christian	UAN + Inhibitor	93.3 b	0.23 a	3.44 b	15.2 b
Logan	UAN	102.6 c	0.28 c	3.88 c	14.0 c
Logan	UAN + ATS	104.1 c	0.28 c	3.81 c	13.5 c
Logan	UAN + Inhibitor	107.0 c	0.27 c	3.86 c	14.1 c
UKREC – Kevil	UAN	100.6 c	0.28 c	3.78 c	13.5 c
UKREC – Kevil	UAN + ATS	100.3 c	0.27 c	3.74 c	13.8 c
UKREC – Kevil	UAN + Inhibitor	99.2 c	0.28 c	3.74 c	13.5 c
UKREC - Watson	UAN	69.9 a	0.26 b	3.35 a	12.9 a
UKREC - Watson	UAN + ATS	68.1 a	0.26 b	3.17 a	12.4 a
UKREC - Watson	UAN + Inhibitor	73.6 a	0.26 b	3.15 a	12.1 a

[1] Yield was adjusted to standard harvest moisture (13.5%)

[2] Values followed by the same letter are not significantly different at the 10% level of confidence.

[3] Tissue samples were collected at flag leaf prior to anthesis

SUMMARY

Although locations differed for wheat yield and tissue nutrient contents, no treatment was statistically better than another within a given location. This study showed no benefit to added S, and no statistically significant benefit to urease plus nitrification inhibition, over the use of untreated UAN fertilizer. Based on these findings, the economics of fertilizer source should be considered in developing a fertilizer management program. All three fertilizer products are acceptable for soft red winter wheat production in western Kentucky under the conditions present during the 2015-2016 growing season. Further evaluation is merited, under different growing conditions, to fully understand if a benefit would be received from either of these products.