ALTERNATIVE NITROGEN STRATEGY FOR GROWING COTTON IN THE MID-SOUTH

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Abstract

Nitrogen management for all crops remains at the forefront of most research programs across the Mid-south and receives much of the emphasis when discussing fertilizer use efficiency. As fertilizer continues to remain a significant input cost and nitrogen an ever-increasing environmental concern, research will continue. Nitrogen (N) and phosphorus (P) receive their fair share of publicity due to their potential for leaving the application area whether that is a producer field or urban lawn. Various means are available to reduce nutrient losses from agricultural fields with the most productive means through nutrient uptake by growing plants of commercial interest. This has been best described by the Global "4R" Nutrient Stewardship Framework that helps define fertilizer Best Management Practices (BMP's). Fertilizer BMP's can be described simply as the application of the **R**ight source (or product) at the **R**ight rate, **R**ight time, and **R**ight place (Right Product@Right Rate, Right Time, Right Place™ is trademark registered by the fertilizer industry). Producers have various opportunities to make fertilizer applications whether it be fall application of P and potassium (K) followed by incorporation all the way through pre-tassel N application in corn or foliar applications of micro-nutrients. The objectives of stakeholders and site-specific soil, climate, crop, management system and logistics all have a significant impact on fertilizer management and should always be considered when selecting fertilizer BMP's. Getting nutrients to plants as close to the time they are needed leads to the most efficient use of nutrients whether coming from organic or inorganic sources. The plants themselves do not distinguish between nutrient sources. However, some crops such as rice preferentially take up certain forms while others through a symbiotic relationship with bacteria get N from the atmosphere. Many products are being brought to the market place with claims of increased nutrient use efficiency, reduced nutrient loss, nutrient stabilizers, or various other mechanisms to reduce nutrient loss or enhanced nutrient uptake. Not always are the mechanisms of activity evident from the literature provided by the marketer. In recent years products have been marketed to reduce ammonia volatilization, nitrification, denitrification or even some combinations that involve more than one mechanism. This research project was designed to evaluate some of these materials compared to traditional N sources, urea (46% N) and urea-ammonium nitrate (UAN) solution (32% N) under dryland (rain-fed) and irrigated conditions and on different soil types.

The materials evaluated in current study included ESN® (Agrium Advanced Technolgies, Inc) Environmental Smart Nitrogen that is a urea granule within a micro-thin polymer coating. The coating allows water within the soil to move into the granule and dissolve the urea inside. The urea solution then moves out through the coating into the soil where it becomes available to the growing crop. A second material evaluated has been Agrotain® (N-*(n-Butyl*) thiophosphoric triamide (NBPT) from Koch Agronomic Services. This product has been billed as the world's leading urease inhibitor and is meant to reduce ammonia volatilization when coated on urea granules. Other companies have similar materials but generally the same active ingredient. The other product that was included in the study was NutriSphere-N® (Specialty Fertilizer Products, Leawood, KS). The enhancer is said to operate by "killing the spectrum of soil bacteria and manages N fertilizer at the molecular level." This product is also spray-coated onto granular urea or mixed with UAN solution to enhance nutrient uptake. These three products were compared to urea and UAN solution applied at 90, 120, and 150 lb N/acre. The products were mixed with the appropriate N source just prior to application. All fertilizer sources were applied as a split application, except ESN which was applied 100% at planting. For the split applications, 60 lb N/acre was applied just after emergence with the remaining N applied as a sidedress application (to establish rates) at the pin-head square growth stage (PHS). All cultural practices were maintained uniformly through the season. The non-irrigated study was located at the Tribbett Satellite Farm (TSF) on a Dundee-Forestdale silty clay loam with some Dowling soil intermingled. The experimental design was a factorial arrangement of treatment in a randomized complete block (RCB) design with five replications and grown as a continuous cotton system. The study was initiated in 2010 and continued through 2012. The irrigated site was established in 2011 at the Delta Research and Extension Center (DREC) on a Dubbs silt loam. Since this irrigated study is rotated with corn, the study location varies from year to year and was located on a Newellton silty clay in 2012. Treatments were arranged in an RCB design with four replications. All granular

treatments at each location were hand-applied pre-weighed samples applied after emergence. Each plot was harvested with a commercial spindle picker adapted for individual plot harvest. Grab-samples were taken at the time of harvest and ginned through a 10-saw micro-gin to determine the lint percent and subsequent lint yields. All data was then analyzed with the Statistical Analysis System (SAS Institute, Cary, NC) utilizing Analysis of Variance with mean separation by Waller-Duncan K-ration t-test and Fisher's Protected Least Significant Difference.

Previous research has shown a significant decrease in lint percent with increasing N rates so only lint yields will be included in the discussion. First, for the TSF location in 2010 (Agrotain not included in 2010), lint yields ranged from 1159 to 1274 lb lint/acre across all treatments with no significant difference between any of the treatments. There was no significant interaction between N sources and N rates so main effects were calculated. There was no significant difference between sources and no response to increasing N rates. The 2010 rainfall at this location was at least 20 inches below normal which would limit total lint even through yields averaged almost 1200 lb lint/acre. The 2011 growing season was also dry with above average temperatures and below average rainfall for the second consecutive year. With reduced soil moisture coming into 2011 followed by drought conditions, lint yields were only about 50% of the preceding year. Lint yields ranged from 523 to 663 lb lint/acre. As in 2010, there was no significant difference between treatments. Variability was again high in 2011 but no significant interaction between N source and rate. Two of the lower treatment yields occurred at the lowest N rate. There was no significant interaction and thus main effects showed no difference in N rate or N source again in 2011. Total rainfall in 2012 continued to remain below normal but temperatures favored more normal production in 2012. Lint yield sin 2012 ranged from 1295 to 1423 lb lint/acre. As in previous years, there was no response to increasing N rates. Lint yields were 1383, 1378, and 1351 for the 90, 120, and 150 lb N/acre rates, respectively. This data would indicate that 90 lb N/acre is sufficient to produce optimum yields where irrigation is not an option. With respect to the N management systems, averaged across N rates, there was no difference between sources. The range in yields across the sources was less than 50 lb lint/acre.

An irrigated study at the DREC was initiated in 2011 following corn in rotation. Yields from this study ranged from 1137 to 1365 lb lint/acre. Even though this study was irrigated, the variation in the field was much greater than in the rain-fed study at the TSF location. Lint yield, averaged across all treatments (1255 lb lint/acre), was twice that in the rain-fed study in 2011. Statistical analysis showed no significant response to any of the of N source by N rate combinations. Even though it was not significant, there was a 6% lint yield reduction when going from 120 to 150 lb N/acre. The DREC was more variable and ended up with a higher coefficient of variation and larger LSD. The site was shifted to a Newellton silty clay in 2012 and the study had an average lint yield of 1545 lb/acre compared to the 1255 lb/acre in 2011 (23.1% higher yield). Yields ranged from 1435 to 1623 lb lint/acre with an LSD of 145 lb lint/acre (no statistical significance). When averaged across the other factors, there was no difference between any of the main effects

To date (five site years), research with the different N sources (and amendments) have not shown a significant yield increase as of yet. However, this research will be continued in future years. Average rainfall at both research sites was much below normal and conditions that lead to potential volatilization losses or nitrification/ denitrification losses have not been present. The potential for these products still remains as long as their cost is not prohibitive. The data collected does suggest lower N requirement for both locations. The ESN, a relatively new concept for the South, allows for a single application and reduced trips across the field and has not reduced lint yields. However, this system adds costs to the fertilizer. At high N prices the relative cost is less than if N prices are low. This products does allow for a more timely release of N and is being further evaluated on other crops.