

Is There a Better Nitrogen Fertilizer?

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Our most effective nitrogen (N) fertilizer, ammonium nitrate, has become hard to find in most areas. Farmers are increasingly turning to urea and urea-based formulations to meet their N fertilizer needs. Unfortunately, there is a substantial risk of N loss when urea is used for forage production. This gives rise to one of the most frequent questions I receive: “Is there a better nitrogen fertilizer?”

Ammonium nitrate fertilizer provides N in a form that the plant can readily use (Figure 1). When it is applied, it splits into its chemical halves: ammonium and nitrate. No major intermediate steps are necessary. The roots quickly take up the nitrate. The ammonium latches onto the soil particles, is taken up by the roots, or ultimately is converted by soil bacteria into nitrate and absorbed up by the roots. As a result of this simplicity, there is little risk that any of it will escape as a gas.

Urea, on the other hand, has to be broken down to form ammonium. Because of the chemistry involved, a substantial amount of N from urea is often lost to the atmosphere as ammonia gas. These losses can be extremely large. Research at the University of Georgia has recorded ammonia losses as high as 48 percent of the applied N. A review of other research shows that N losses are typically around 20 percent of the total N applied as urea.

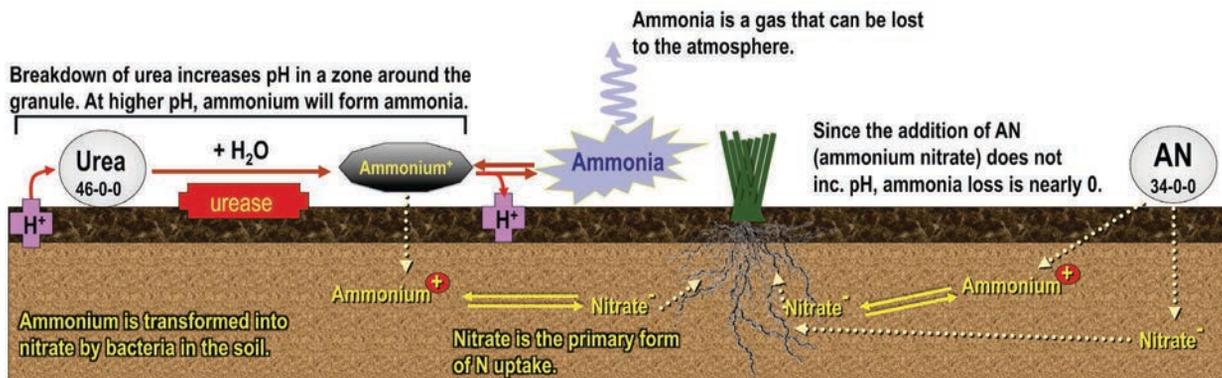
Fertilizer Additives

Recently, several products that are added to urea-based fertilizers to curb these N losses have been introduced to the market. Some act by controlling the breakdown of urea to ammonium (specifically, the rate of urease activity). Others create a barrier, such as a polymer coating, that slowly allows the urea encapsulated inside to be moistened and to seep out.

Over the past eight years, our Georgia Forages research program at UGA has been testing these products for bermudagrass hay production. In the earliest trials, we compared three of these products in a multi-year study at two locations in Georgia. The three products were: 1) Agrotain®, which is a urease inhibitor; 2) Nutrisphere-N®, which also is designed to control the urease; and 3) ESN® Smart Nitrogen, which is a polymer-coated urea product. Our study was conducted on bermudagrass hayfields, which were harvested four times each year.

We measured ammonia volatilization loss in the field studies using an acid-trap. As expected, we saw very high levels of loss (an average of 17 percent of applied N) in areas where urea was applied (Figure 2). The majority of this volatilization was prevented by the Agrotain® and ESN® Smart Nitrogen. Nutrisphere-N® did not effectively reduce ammonia loss in our study.

Figure 1. Overview of the availability of the N from ammonium nitrate and urea fertilizer.



Ammonia Volatilization Trap Data

2008-2009 (avg. over two locations)

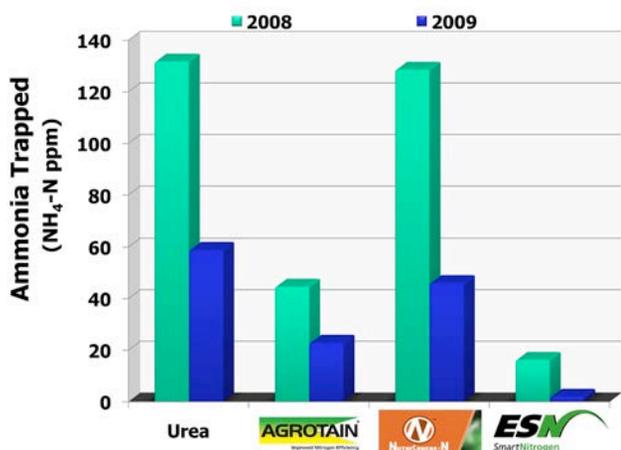


Figure 2. Ammonia trapped from N volatilization loss after a July N application in 2008 and 2009 (average of two locations).

The control of ammonia loss resulted in yields in the Agrotain®-treated urea plots being just as good as the yields from ammonium nitrate-fertilized bermudagrass, and there was more than 10 percent greater yields from where regular urea was used. In contrast, the forage yields were not different between areas treated with conventional urea or Nutrisphere-N®-treated urea. A larger review of studies evaluating Nutrisphere-N® in other crops has also shown little to no effect on yields or ammonia volatilization and is not recommended.

In our initial studies, the ESN® Smart Nitrogen produced lower yields even though it reduced ammonia volatilization. We found that this was because it was releasing N too slowly for our fast-growing bermudagrass. In more recent experiments, we studied blends of ESN® with regular urea to speed up the rate of N availability. We found when 50 or 75 percent of the blend was ESN® with the remainder being urea, yields were as good as or better than that of ammonium nitrate, with the same forage quality and lower incidence of high nitrates. Moreover, we found that applying these blends just twice per year was as effective, or more effective, than applying ammonium nitrate or urea four times per season.

The costs associated with using Agrotain®-treated urea or blends of 50-75 percent ESN® with urea has shown both systems to be economical. In either strategy, the cost of urea fertilizer is increased by \$0.05-0.08 per lb of N, but this makes urea function like ammonium nitrate. Meanwhile, ammonium nitrate sells for \$0.10-0.25 more per lb of N (if it can be purchased locally). The agronomic and economic value of using Agrotain® or ESN® cause it to be a recommended fertilizer additive.

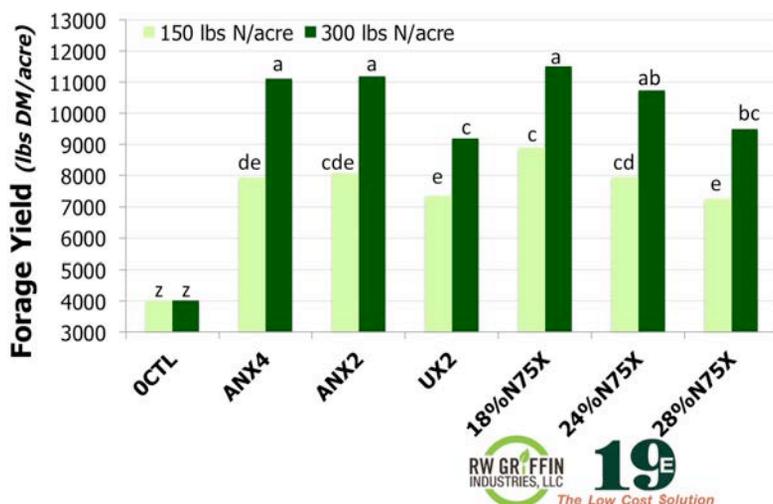


Figure 3. Bermudagrass forage yield in response to ammonium nitrate applied 4 or 2 times, urea applied 2 times, or 18%, 24%, or 28% N 19E fertilizer products compared to the 0 N control plots.

Other N Alternatives

Our Georgia Forages research program has also been evaluating a number of alternative N fertilizers, now entering our third season, in two locations. One of these alternative products, 19E fertilizer from R.W. Griffin Industries, LLC, is a by-product of a manufacturing process in Attapulgus, Georgia. Our first two years' results in both locations with the 18-0-0-3 19E blend have shown it to be quite promising. Whether fertilizing with 150 or 300 lbs N/acre per season (split applied), the 18 percent 19E product is equal in every way to ammonium nitrate and is superior to urea. Figure 3 presents the results from the 2014 production season averaged across the two sites. Other work in corn and cotton has shown similar successes. Furthermore, the 19E product line costs substantially less than ammonium nitrate and urea. More conclusions can be drawn after our third year of research, but we are confident enough in this product at this point to mention it as a viable alternative to conventional N fertilizer.

Our work with these fertilizer additives and locally-produced alternatives continues. Our results are promising, and the current cost-structure is quite beneficial. There are many other alternative products on the market that are NOT currently recommended, usually because little or no research has been conducted on them. We stand ready to evaluate other products.

For more information on our research, visit our website at www.georgiaforages.com. If you have additional forage management questions, visit or contact your local University of Georgia Cooperative Extension office by dialing 1-800-ASK-UGA1.