Forage News

MISSISSIPPI STATE UNIVERSITY EXTENSION SERVICE

Enhancing Nutrient Use Efficiency of Forage Crops

Volume 6, Issue 5

Rocky Lemus
Extension Forage Specialist

May 2013

Visit us at: **http://mississippiforages.com**

The increase in fertilizer and commodity prices has sparked a major concern among forage and livestock producers about efficiency on using nutrients such as nitrogen (N) and potassium (K) in hay and pasture production. At the same time, we are seeing an increase in new products that have been marketed with the purpose of trying to mitigate nutrient loses and replace fertilizer applications in forage systems. The major limitation with these products has been the lack of scientific data from applied studies in warm-season grasses. The testimonial information has been disseminated without providing the basis for the economic advantages of these products and in today's agricultural production, economic efficiency boils down to best management practices.

The ability of a forage system to minimize N leaching is enhanced by maximizing root depth and the nutrient use efficiency of the crop. To have a healthy pasture or a productive hay field, the selected forage species should be able to develop a strong root system to capitalize in several physiological functions such as water and mineral uptake and store of sugars and nutrient that will provide persistence of the plant. The opportunities to enhance nutrient uptake by promoting a good root system is essential and do so there is a need to reduce soil compaction and increase soil pH to 6.0 or above.

High yielding warm-season grasses in the southern USA depends on abundant plant-available nitrogen, especially in hay production systems. The forage program at Mississippi State University has conducted studies to determine how forage yield improvement efforts related to fertilizer applications and their efficiency. Grass nutrient use efficiency (NUE) is defined as the amount of forage dry matter produced per each unit of nutrient applied. The following summaries will provide an insight on management practices that that will impact forage production. The studies to be discussed were conducted on bermudgrass fields at Mississippi State University main campus in Starkville, MS. The soil was a Marietta soil.

Effect of soil pH and potassium applications in forage production – Bermudagrass plays a major role in forage production across the state and the same time over 70% of forage producers do no not soil test prior to nutrient applications, over 80% pasture and hay fields have a K deficiency and over 50% of hay fields has a pH that is less than optimum for forage production. This three year study was conducted using six hybrid bermudagrass species in which the initial soil pH was 5.5. The main objective was to simulate conditions in which most producers apply nitrogen (usually triple 13 or 17) without paying attention to soil pH or other nutrients that might be needed to balance the

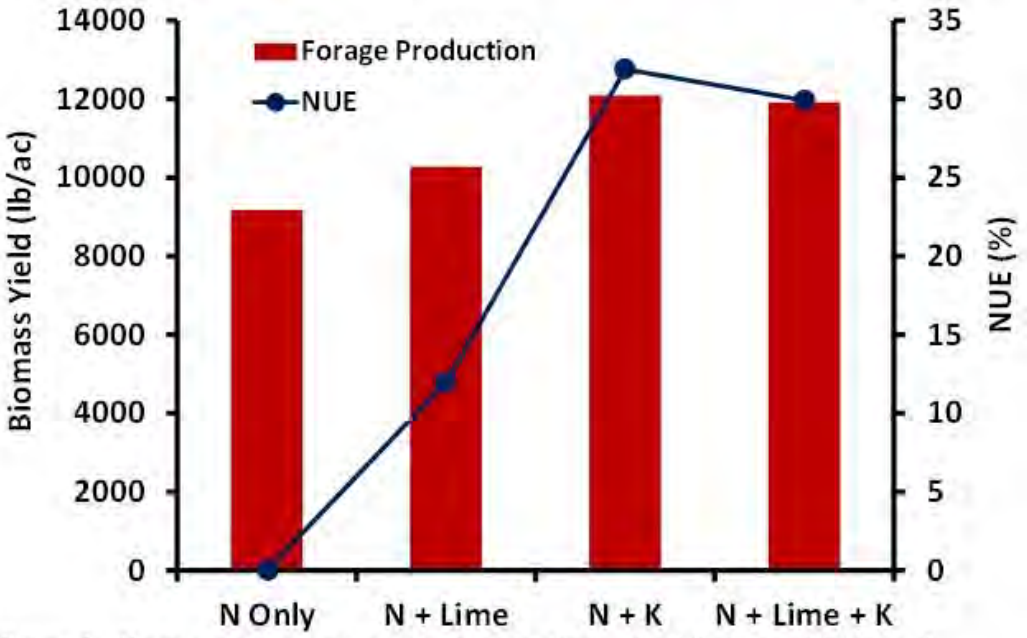

Figure 1. Three-year average seasonal production and nutrient use efficiency of bermudagrass impacted by nitrogen, lime and potash applications. N application was use for NUE comparison. Source: Lemus et al., 2013.

system. There were 4 treatments: N only, N+Lime, N+K, and N+Lime+K. All treatments received the same amount of nitrogen application, 200 lb N/ac/yr in split applications of 50 lb N/ac after each cut. Lime was applied at 2 ton/ac at green up and potash was applied at a rate of 120 lb K/ac in 50:50 split applications (green up and after first cut). Plots were harvested in a 28 to 35 days interval depending on environmental conditions. Data indicated that improving soil pH and providing potassium applications increase the forage production and nutrient efficiency compared to only nitrogen applications without proper soil testing (**Fig. 1**). Also, pH increase with lime applications ranged from 6.0 to 6.4 in year 2 and 3 of the study. Nitrogen application alone had higher yields in 2011 and 2012, but over 55% of the yields were weeds while deterioration in pH. The take home message for producers is that taking a soil a soil sample and knowing what nutrient need to be balanced will be provide better economic returns, improve NUE and the longevity of the stand than blanket nutrient applications.

Fertilizer enhancers in bermudagrass production – Fertilizer enhancers are products that might aid in increasing nitrogen efficiency by reducing N loss into the air and water. They usually include slow and controlled release fertilizers as well as stabilized nitrogen fertilizers. Nitrogen stabilizers extend the length of time nitrogen remains in the soil in a plant usable form. There are also urease inhibitors that inhibit the action of the urease enzyme, therefore, reducing volatilization or nitrogen loss into the air. Although, these products have been tested more extensively in the row crop industry, there has been little data in forage production. A two-year study was conducted at Mississippi State University in a 10-year old stand of Sumrall 007 hybrid bermudagrass. The treatments presented in this summary include urea treated with Agrotain Plus, Nutrisphere-N and ESN and applied at a 100, 75 and 50% rate. Data was also collected with 32% urea-ammonium nitrate solution (UAN). The 100% rate was 200 lb N/ac/yr applied in split-applications of 50 lb N/ac. The study also included a check (no N) and ammonium nitrate and urea-ammonium sulfate as check at the 100% application rate. The data collected over the two-year period showed very little or no yield advantage with the application of Agrotain Plus, Nutrisphere-N and ESN to forage bermudagrass under those split application to justify the economic expense (**Table 1**). Keep in mind no volatilization loses were collected. A study at University of Georgia indicated a slight increase in yields while reducing N volatilization with some fertilizer enhances, but the significance was not economically justified to add fertilizer enhancers. Other studies are underway to look at longer interval between N applications and if there might some benefits from these products under those management practices.

Table 1. Two-year average biomass production and NUE of bermudagrass fertilized with urea and treated with different fertilizer enhancers. Numbers in parenthesis represent percent NUE when compared to check.

N Rate (lb N/ac)	Urea only	Agrotain Plus	ESN	Nutrisphere-N
		lb/ac		
0	5875	–	–	–
100	7332 (25)	8779 (49)	7632 (30)	7359 (25)
150	8343 (42)	9501 (62)	7906 (35)	8206 (40)
200	10449 (78)	10309 (75)	10029 (71)	10022 (71)

Source: Lemus et al., 2013.

Bio-soil stimulants – Bio-soil stimulants are products that has become in the market in the last 3 years for forage production. They are products formulated to activate microbial activity and increase nutrient uptake of the plant. It not a new concept to nutrient management practices and soil health. The two-year study was conducted in a Sumrall 007 hybrid bermudagrass with the following products: C-Cat (CC), Hydra-Hume (HH) and Sumagrow (SG). Products were applied at a rate of ½ gal for CC and 1 gal/ac/ application for HH and SG, respectively. They were applied alone with UAN at a rate of 200 lb N/ac/yr in four split applications of 50 lb N/ac.

Table 2. Two-year biomass production of bermudagrass treated with different bio-soil stimulant and percent yield increase of treatments when compared to a control.

Bio-soil	N Source	Biomass Yield	Yield Increase
		lb/ac	%
Check	–	4759	–
	Urea	10524	121
	UAN	9899	108
C-Cat	–	6120	29
	Urea	10292	116
	UAN	9050	90
Hydra-Hume	–	5329	12
	Urea	11083	133
	UAN	8637	81
Sumagrow	–	5069	7
	Urea	9829	107
	UAN	9690	104

Source: Lemus et al., 2013.

Data indicated very little advantage of these products alone or with UAN. Higher yields in 2012 could be attributed to an extra harvest than in 2011. The cost of some products might economically prohibited when compared to yield responses (**Table 2**). There might the argument that products were not applied based on label recommendations during this study, but keep in mind that a typical acre of soil might contain billions of microbes and if a soil is low in organic matter and microbes, the amount of microbes in one gallon of product might not have enough microbes to provide nutrient cycling and uptake on a large scale forage system. The use of bio-soil stimulants might have a place of low input sustainable systems, but it has larger limitations where higher yields of forage production are needed for hay and intensive grazing management. Keep in mind that using these products alone might be conducive to soil nutrient mining and creating major soil nutrients imbalances that will be more costly to correct in the long term.

In summary, to realize the greatest return from the investment in fertilizer, this input must be fit to the crop being grown, local soil and climatic conditions, harvest management, and feed requirements for desired animal performance. Fertilizer for forages does not cost, it pays in many ways when adopting best management practices, but to receive that return in investment, soil sampling is still the only reliable way to develop a more comprehensive nutrient management plan. Follow the 4 R's of nutrient stewardship when it comes to forage production: right product (match fertilizer type to crop needs), right rate (match amount of fertilizer to crops needs), right time (match nutrients available when crops need them) and right place (keep nutrients where crops can use them). Producers interested on incorporating fertilizer enhancers and bio-soil stimulants into their forage production systems, should do it a very small scale and in different parts of the field to determine any possible responses before investing in large field scale production practices.

For future forage related events visit: http://forages.pss.msstate.edu/events.html