Forage Team Newsletter | March 2016 | Vol. IV, Issue I *Edited by Carole Knight*

UGA Extension Forage Team

Northwest District

Norman Edwards
nedwards@uga.edu
706-638-2548

Steve Morgan
smorgan@uga.edu
706-628-4824

Wes Smith
swsmith@uga.edu
706-647-8989

Northeast District

Lucy Ray
lray@uga.edu
706-342-2214

Adam Speir
aspeir@uga.edu
707-795-2281

Southwest District

Jeremy Kichler
jkichler@uga.edu
229-616-7455

Brock Ward
bward1@uga.edu
229-732-2311

Southeast District

Carole Knight
clh@uga.edu
912-871-6130

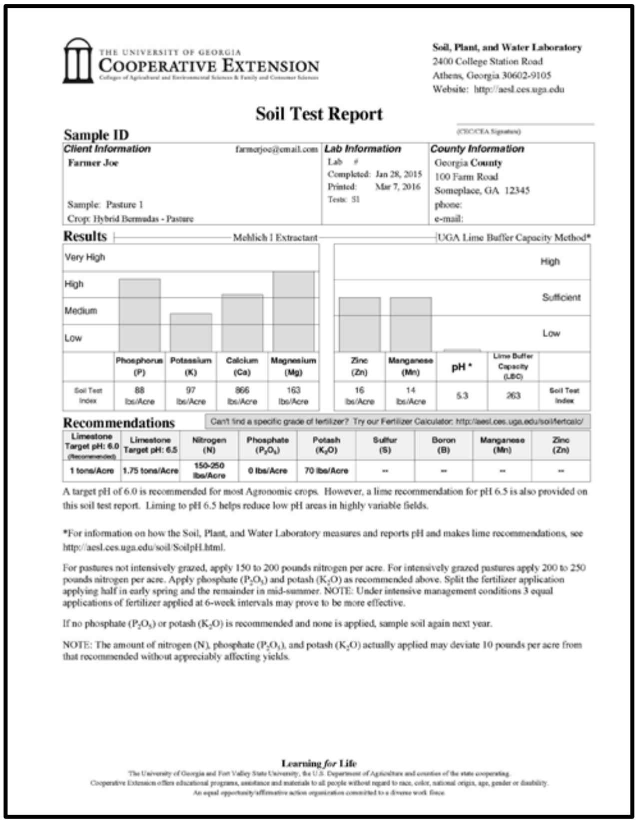
Ray Hicks
rhicks@uga.edu
912-564-2064

Will Lovett
welovett@uga.edu
912-387-5560

Sam Ingram
singram@uga.edu
912-754-8040

Interpreting a Soil Analysis

By Steve Morgan
Harris County CEC



THE UNIVERSITY OF GEORGIA COOPERATIVE EXTENSION

Soil, Plant, and Water Laboratory
2400 College Station Road
Athens, Georgia 30602-9105
Website: http://aesl.ces.uga.edu

Soil Test Report

(CEC/CEA Signature)

Sample ID

Client Information	Lab Information	County Information
Farmer Joe, farmerjoe@email.com Sample: Pasture 1 Crop: Hybrid Bermudas - Pasture	Lab # Completed: Jan 28, 2015 Printed: Mar 7, 2016 Tests: S1	Georgia County 100 Farm Road Someplace, GA 12345 phone: e-mail:

Results — Mehlich I Extractant — UGA Lime Buffer Capacity Method*

	Phosphorus (P)	Potassium (K)	Calcium (Ca)	Magnesium (Mg)	Zinc (Zn)	Manganese (Mn)	pH *	Lime Buffer Capacity (LBC)	
Soil Test Index	88 lbs/Acre	97 lbs/Acre	866 lbs/Acre	163 lbs/Acre	16 lbs/Acre	14 lbs/Acre	5.3	263	Soil Test Index

Recommendations Can't find a specific grade of fertilizer? Try our Fertilizer Calculator: http://aesl.ces.uga.edu/soil/fertcalc/

Limestone Target pH: 6.0 (Recommended)	Limestone Target pH: 6.5	Nitrogen (N)	Phosphate (P_2O_5)	Potash (K_2O)	Sulfur (S)	Boron (B)	Manganese (Mn)	Zinc (Zn)
1 tons/Acre	1.75 tons/Acre	150-250 lbs/Acre	0 lbs/Acre	70 lbs/Acre	--	--	--	--

A target pH of 6.0 is recommended for most Agronomic crops. However, a lime recommendation for pH 6.5 is also provided on this soil test report. Liming to pH 6.5 helps reduce low pH areas in highly variable fields.

*For information on how the Soil, Plant, and Water Laboratory measures and reports pH and makes lime recommendations, see http://aesl.ces.uga.edu/soil/SoilpH.html.

For pastures not intensively grazed, apply 150 to 200 pounds nitrogen per acre. For intensively grazed pastures apply 200 to 250 pounds nitrogen per acre. Apply phosphate (P_2O_5) and potash (K_2O) as recommended above. Split the fertilizer application applying half in early spring and the remainder in mid-summer. NOTE: Under intensive management conditions 3 equal applications of fertilizer applied at 6-week intervals may prove to be more effective.

If no phosphate (P_2O_5) or potash (K_2O) is recommended and none is applied, sample soil again next year.

NOTE: The amount of nitrogen (N), phosphate (P_2O_5), and potash (K_2O) actually applied may deviate 10 pounds per acre from that recommended without appreciably affecting yields.

Learning *for* Life

Many farmers are busy now soil sampling in preparation for the upcoming growing season. How soil test data are reported varies from laboratory to laboratory. However, they all report key measures of soil fertility, including pH, phosphorous, and potassium. These results are used to develop fertilizer recommendations. Correctly interrupting these results is critical in order to maximize growth potential of forage.

On the soil test report there are the characters "N", "P", and "K." N stands for nitrogen, P stands for phosphorus, and K stands for potassium. To ensure good yield and quality, nutrient balance has to be maintained. Recommendations are given for each crop listed in order to maximize crop production of that crop. Soil tests allow you to know the starting point, and this is a very valuable piece of information. In some cases, organic materials such as manures and plant residues can supply some or all the nutrients required by plants. However, plants cannot differentiate between nutrients from organic, inorganic, liquid or granular sources. Nutrients are absorbed by plant roots as ions and all ions of a given element are identical regardless of the source.

Growers can guess how much fertilizer should be applied to their crop but soil testing provides a more accurate, prescriptive, and cost-effective fertilizer application rate. In most cases, the recommended amounts are on the basis of N, P_2O_5, and K_2O (units reported on fertilizer tags) in pounds per acre.

Nutrient concentrations vary with soil depth. Soil test recommendations for forage crops are based on research studies where soils were consistently sampled to a 4 to 6 inch depth. Failure to obtain a sample from this same depth may result in under- or over-fertilizing.

pH
Soil pH is a measure of the acidity and alkalinity in soils. pH levels range from 0 to 14, where 7 being neutral, below 7 is acidic, and above 7 is alkaline. The optimal pH range for most plants is between 5.5 and 7.0. Because pH levels control many chemical processes that take place in the soil – specifically, plant nutrient availability – it is vital to maintain proper levels for your plants to reach their full yield potential.

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UGA extension

Soil Analysis (cont.)

Correcting soil acidity by the use of lime is the foundation of a good soil fertility program. Lime does more than just correct soil acidity. It also:

- Supplies essential plant nutrients like calcium and, if dolomitic lime is used, magnesium
- Makes other essential nutrients more available to the plants
- Prevents elements such as manganese and aluminum from being toxic to plant growth

Liming materials contain calcium and/or magnesium carbonate. When these elements are dissolved, the carbonate ion will neutralize soil acidity. Not all materials containing calcium and magnesium are capable of neutralizing soil acidity. For instance, gypsum contains calcium, but does not reduce soil acidity.

The subsoil for most Georgia soils is acidic and is difficult to correct. Lime does not readily move down through a soil. Experiments have shown that downward movement of lime occurs only when the surface soil has been limed regularly over a long period of time or is near neutral (pH 7.0) or greater. Subsoil acidity can be detrimental to crops and can significantly affect crop growth by limiting root development into the subsoil. Root development in acid subsoils (pH $\leq$ 5.5) is limited because of the presence of toxic levels of aluminum and, in some cases, manganese toxicity. In order to minimize this problem, the surface soil should be kept at the proper pH by the addition of lime based on a soil test recommendation.

Nitrogen

Nitrogen is the nutrient needed in greatest quantities for most non-legume crops and is the nutrient that most frequently limits crop production. A satisfactory routine soil test has not been developed that will accurately predict the amount of available nitrogen in Georgia soils. Therefore, soil tests do not measure nitrogen because N does not persist long in soil. Soil reports provide a N recommendation based on the known requirements of the crop(s) specified on the sample information form. N applications must be timely to maximize profit and yield and minimize potential environmental impact. Therefore, the total suggested N rate may not and often should not be applied all at once. Nitrogen is often put out in several applications.

Potassium

All too often, the importance of potassium is overlooked in forage production systems. Potassium is second only to nitrogen in plant tissue concentration. Potassium is important for a plant's ability to withstand extreme cold and hot temperatures, drought and pests.

Potassium has a role in the plant physiology and chemistry with movement of water, nutrients, and carbohydrates within the plant. Potassium will stimulate early growth, increase protein production, improve water use efficiency, and improve resistance to diseases and insects. Plants with insufficient K result in more drought stress and have a more difficult time in absorbing water and N from the soil, which can increase drought stress. Potassium availability is highest under warm, moist conditions in soils that are well aerated with a neutral or slightly acidic pH.

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Upcoming Events

NW Georgia Mini-Hay School
Mar. 22, 2016 |Calhoun, GA @ the Gordon County Ag Service Center

Georgia Forages Conference @ the Georgia Cattleman's Association's Annual Convention
Mar. 30, 2016 | Perry, GA @ the Georgia National Fairgrounds

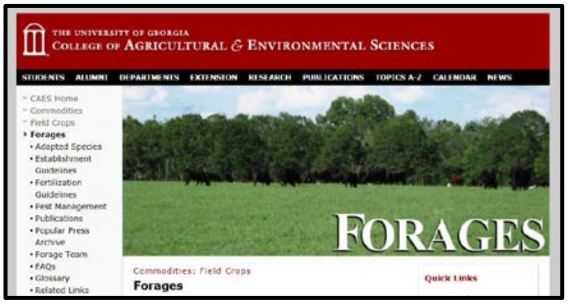
Alfalfa Establishment and Management Workshops
May 10: Franklin Co. (RSVP: Call Amanda@ 706-384-2843)
May 11: Floyd/Gordon Co. (RSVP: Joan@ 706-629-8685)
May 12: Carroll Co. (RSVP: Richard or Paula@ 770-836-8546)
June 2: Hall Co. (RSVP: Becky@ 770-535-8293)
June 9: Putnam Co. (RSVP: Call Lori Lee@ 706-485-4151)

Grassfed Exchange Conference - 2016
April 27-29, 2016 | Perry, GA @ the Georgia National Fairgrounds

Georgia Grazing School - 2016
Sept. 20-21, 2016 | Location TBD

Looking for more forage information?

Be sure to visit **GeorgiaForages.com**!



Soil Analysis (cont.)

The amount of potassium needed is dependent upon the level of management. For instance, there is a high demand for potassium in a hayed bermudagrass field compared to one that is grazed. This is due to the amount of potassium removed in the hay. For each ton of bermudagrass hay, the equivalent of about 50 pounds of potassium fertilizer is removed from the field.

Phosphorus
Plants require much smaller quantities of phosphorus than either nitrogen or potassium. Generally, plants contain much less phosphorus than either nitrogen or potassium. Therefore, unless the entire plant is removed such as hay or silage production, the amount of phosphorus lost through crop removal is comparatively small. Phosphorus is unlike some of the other plant nutrients, in that it is less mobile and tends to remain near the soil's surface. The principal ways that phosphorus is removed from the soil is through water and wind erosion and crop removal.

Based on the soil sample results, fertilizers can be applied to the soil and taken up by the roots or applied to the plant as a liquid for uptake by the leaves and stems (foliar application). Each method has advantages and disadvantages. Soil application is usually less expensive and is better suited for large application rates of the major nutrients and for pre-plant application. Foliar applications are better suited for low application rates of minor nutrients (e.g., boron, molybdenum, etc.) For the most part, soil applications by broadcasting are the most economical and efficient.

If you follow soil test recommendations, and apply the correct amount of lime and other soil nutrients, then you are one step closer to having a much healthier and successful growing season.

Think about Hay Storage

By Jeremy Kichler
Colquitt County CEC

Hay is a big expense for cattle operations and keeping the expense down requires hay to be stored efficiently and cost effectively. A lot of hay harvested in Georgia is stored outside in large round bales. When hay is stored outside it is exposed to rain and it deteriorates before it can be fed in the winter months. Some producers store forage in hay barns which significantly cuts down on waste and increases profits. Before the rush of hay making season is upon us, let’s discuss some tips on storing hay both outside and also under the barn.

Hay that is stored outside will go through times when it will get wet and then dry out and will develop a fibrous, weathered layer. When the forage goes through the wetting and drying process, nutrients are leached out and cause the fiber component of the forage to represent a larger proportion of the dry weight. Below Table 1 shows the changes in digestibility and crude protein of a grass and a grass-legume mixed forage when is weathered and not weathered. This experiment shows that weathering causes TDN to decrease while the crude protein increases in both the grass and grass legume mix. Carbohydrates often leach out, but protein does not. So, weathering decreases digestibility and, by difference, the protein is a greater proportion (i.e., the percentage increases).

Table 1. Digestibility and crude protein of weathered and unweathered grass and grass-legume hay.*

Hay Type	*Portion*	*Digestibility*	*Crude Protein*
		------- % of dry weight ------	
Grass	unweathered	58.8	13.5
	weathered	42.5	16.4
Grass – legume mix	unweathered	56.5	14.2
	weathered	34.2	16.9

* Adapted from Lechtenberg et al., 1979. Purdue Univ. Agric. Exp. Stn. West Lafayette, IN.

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Table 2 shows the typical ranges of storage losses for various hay storage methods that include pole barns, hoop structures, and outside storage. This experiment also evaluates how baling the hay with twine or net wrap affects storage. When the hay is stored under a pole barn or hoop structure then dry matter losses ranged from 2 to 5%. Dry matter losses from outside storage ranged from 20 to 60%.

Table 2: Typical ranges in storage losses for various hay storage methods.

	Twine	*Net wrap*
	% of dry weight	
Pole barn	2-5%	2-5%
Hoop structure	2-5%	2-5%
Tarp	5-10%	5-8%
Stack pad,		
covered stack	5-10%	5-8%
uncovered stack	15-40%	10-30%
Plastic wrap	5-10%	N/A
Outside on ground,		
well-drained	20-40%	15-40%
poor drainage/shaded	30-60%	30-45%

Table 3 shows the value of hay lost based off the percent of forage lost and how much per dry matter ton the hay is valued. For example, if hay is valued at $100 per ton on a dry matter basis and we experience 30 percent loss, then there is a $30 per ton loss forage. That is a lot considering the investment in fertilizer, lime, pesticides, etc. that is required in hay production.

Table 3: Value of hay lost.

	Value of Hay ($/dry ton)			
% Loss	$75	$100	$125	$150
10	$8	$10	$13	$15
20	$15	$20	$25	$30
30	$23	$30	$38	$45
40	$30	$40	$50	$60
50	$38	$50	$63	$75
60	$45	$60	$75	$90

If hay must be stored outside, it should be stored in a sunny location. Hay should never be stored under trees where air circulation is questionable. Bale rows should run north and south instead of east to west. Hay growers should place the flat ends of round bales together and the rounded sides should not touch. Hay rows should be at least 3 feet apart to help with air circulation.

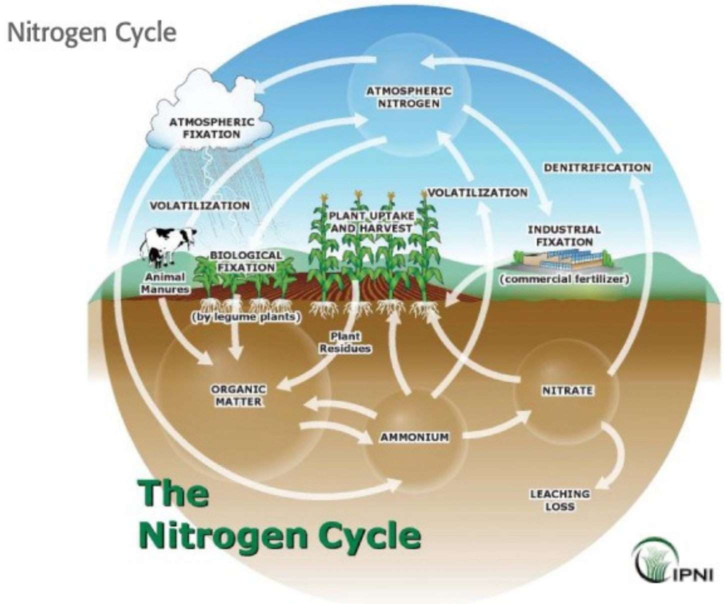
Having well-formed, tight bales can help hay growers reduce storage loses. A minimum of 10 pounds of hay per cubic foot is recommended for outside hay storage. A denser bale will resist water infiltration which will cut down on weathering. In order to make a denser bale, hay growers need to be more aware of baling at safe moisture levels because a denser bale can reduce the amount of moisture and heat that can escape.

Soil contact of hay bales is an issue with outside storage. Research data shows that around 50% or more outside storage losses occur due to hay having contact with soil. Hay growers reduce storage losses by placing their crop on a rock pad, concrete or wooden pallets but if this is not possible then look for well drained areas. Growers can place bales on a slope that will allow water to drain away from the hay. Bales should be placed up and down the slope to minimize water flowing around the hay.

Let's now discuss some points to consider for storing hay under the barn. If a hay producer has an open sided barn then it should be oriented with the long axis east and west to minimize the exposure to sun light. If one side of the hay barn is open, then face it away from the prevailing wind which would generally be on the south side. This would minimize rain exposure of the hay being stored. Buildings for hay storage need to be open at the peak of the roof to allow moisture to escape as the hay dries. If the gables are closed then condensation and rust will occur inside the roof. More hay can be stored in a barn if you stack the bales on the flat end rather on the round side. Also consider the addition of side walls so the facility can be used for both equipment storage and hay.

Utilizing the Nitrogen Cycle

By Adam Speir
Madison County CEC



All nutrients (including water) move through the environment in what are referred to as "cycles". These cycles are very dynamic and also interact with one another, making nutrient cycling a complicated concept to explain (especially in a newsletter!). And nitrogen can be one of the most complicated, yet important, cycles to understand.

While nitrogen is an abundant element in our atmosphere (almost 80% of the air we breathe), it is often the limiting factor in our pastures' productivity. Nitrogen is a critical macronutrient for plants that is required in high amounts, and a critical component of living systems, but almost all of the nitrogen in pasture ecosystems is bound up in organic matter, with very little nitrogen being "plant available". In order to become plant available, nitrogen must undergo many different chemical changes as part of what is known as the nitrogen cycle. We'll discuss some of the aspects of the nitrogen cycle and how forage producers can manage it to their benefit.

As mentioned, nitrogen can take many forms, both organic and inorganic. The two primary forms of inorganic nitrogen are ammonium (NH_4^+) and nitrate (NO_3^-). The processes that result in all the different forms of nitrogen - the different stages of the nitrogen cycle – include (but are not limited to) nitrogen fixation, mineralization, leaching, and volatilization.

Nitrogen Fixation - In its "elemental" state of dinitrogen (N_2) gas, where it is found in abundance in the atmosphere, it is not useful for most organisms. This is one of the reasons nitrogen is most often the limiting factor in forage production. In order for nitrogen to be introduced into the cycle as proteins, amino acids, and other biological forms, it must first be "fixed" or chemically changed, from a gaseous form into ammonia (NH_3) and ammonium (NH_4^+). While nitrogen fixation can take place through processes like lightning strikes, or industrial processes, much of the work is carried out biologically. Legumes are one means by which nitrogen is "fixed". However, it's not the legumes directly doing the work. Rhizobia bacteria found in the soil form a symbiotic relationship with the plant in nodules found on the legume's root systems. While there are other free-living bacteria and organisms that are able to biologically fix nitrogen in the environment, the symbiotic relationship found in legume root nodules provides a majority of this work. This complex and energy demanding process is the first step in changing nitrogen into a plant available form.

Legumes perform best with adequate nutrition and soil pH, so conducting proper soil testing and following your Extension Agent's recommendations will be important to maximize the benefit of incorporating legumes into your operation. Also, because nitrogen fixation is such an energy-demanding process, legumes will utilize existing nitrogen in the soil from fertilizers or manures if it is available, reducing their nitrogen fixing potential.

The importance of nitrogen fixation in the pasture environment cannot be overlooked. Well-managed legumes such as alfalfa can provide more than 200 lbs of N per acre per year that can be available to plants that same growing season. Studies have shown that 20-40% of nitrogen fixed by legumes can be available to plants that same year. While legumes are actively growing, the nitrogen fixed in the root nodules is primarily available only to the legumes. The nitrogen can only be made available to nearby grasses after plant material such as root hairs, nodules, and above ground material dies and decomposes. Research has also shown that pastures with 20-45% legumes can provide sufficient nitrogen to sustain the nitrogen needs of the other forage plants in that pasture.

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Nitrogen Cycle (cont.)

Mineralization - The mineralization process is one other primary way that nitrogen is made plant available. While animal manure, urine, plant material, roots, and other organic material make up a large portion of nitrogen in a pasture ecosystem (close to 98%), this organic nitrogen is not available to plants in its current form. Through the process of mineralization, soil organisms decompose manure, plant residues, dead animals, and other microorganisms, transforming those nitrogen-containing compounds into forms that are available for use by plants. First, it results in the formation of ammonia. Then, two other types of bacteria quickly work together to convert ammonia (NH_3) into nitrite (NO_2^-) and then nitrate (NO_3^-) before it is used by plants. The decomposition and mineralization of nitrogen in these forms provides a significant amount of nitrogen to plants and other organisms in the pasture ecosystem.

Ensuring soils maintain healthy amounts of soil organic matter (SOM) is a critical component of having nitrogen available through mineralization. As mentioned, microorganisms convert organic sources of nitrogen into inorganic forms for plant use. If soils do not have sufficient levels of organic material, these microorganisms cannot have enough material to survive. Likewise, soils with low SOM will therefore have a low population and diversity of soil organisms to do the job of cycling nitrogen.

To promote healthy levels of SOM, minimize tillage practices, reduce soil compaction (see the Winter 2015 forage team newsletter related to this), maintain a diversity of plants such as grasses, legumes, and forbs, and use grazing management techniques that promote growth of plant roots (rotational grazing, rational grazing, etc.). Not only is SOM critical to bolstering nitrogen mineralization as part of the nitrogen cycle, but soils high in organic matter also have higher moisture retention that will aid in drought stress management.

Volatilization & Leaching – While activities like fixation and mineralization help add plant available nitrogen to the pasture system, volatilization and leaching are two processes that lead to nitrogen losses. For forage and livestock producers, this can mean significant nitrogen losses, depending on conditions and practices.

Volatilization is the transformation of ammonium (NH_4^+)-based nitrogen into ammonia gas. Volatilization is a concern with all ammonium-based fertilizers as well as animal manures, but ammonia losses can be managed to some extent by proper placing and timing. Losses through volatilization are greatest at higher soil temperatures and conditions that favor evaporation. These losses are also higher when utilizing urea-based fertilizers as compared to other nitrogen-based fertilizers. To reduce volatilization from urea-based fertilizers, producers could utilize new products on the market that are added to urea fertilizers to prevent these losses. Products such as Agrotain® have been shown to reduce nitrogen losses by shielding nitrogen from the urease enzyme that converts urea into ammonia. Surface applying animal manures will increase nitrogen losses through volatilization as opposed to incorporating manures or fertilizers into the soil. However, this loss can be minimized if timed to account for more ideal weather conditions (lower temperatures, low winds, or forecasted rainfall), but this could result in other issues such as reduced mineralization as a result of lower temperatures, or leaching and/or nutrient runoff due to high rainfall.

Although nitrate is a plant-available form of nitrogen, it is not held very tightly by soil particles or organic matter. Nitrate is highly mobile in the soil and especially in ground and surface water. Because of these issues, leaching can be a concern in pasture systems. This is true especially on sandy soils or during times of heavy rainfall. In pasture systems, cattle urine can also be a leading cause of nitrogen leaching. Forage producers can reduce leaching risks by keeping actively growing plants on the soil throughout the year and maintain a deep and vigorous root system to uptake those nutrients by maintaining adequate soil pH and reducing overgrazing. Also, avoiding nutrient applications on wet soils or prior to heavy rainfall events will prevent leaching and runoff of nitrates to surface and groundwater before plants can utilize the nitrogen.

While the nitrogen cycle is complicated, using sound agronomic principles and good common sense can help keep nitrogen available to plants without requiring large additions of nitrogen fertilizers. Incorporating legumes into your management can pay large dividends in nitrogen availability as well as improve animal production through improved forage quality. Maintaining healthy soil organic matter levels and rotating livestock to distribute animal manure will improve the ability of soil organisms to convert organic nitrogen into inorganic, usable nitrogen. Finally, using sound judgement when applying fertilizers and manures can reduce nitrogen losses from volatilization and leaching. These pasture management practices can help maintain productive grasses and productive livestock, all while reducing environmental risks from nitrogen losses.