

2020 Annual Conference Workshop



Tall Fescue Management – What are the Choices?

Tall fescue (*Schedonorus arundinaceus*) provides reliable forage during spring and fall seasons, but how forage is managed to get the most effective production from forage-fed livestock may not always be most obvious. This workshop explored perspectives on how to manage tall fescue pastures for production, soil health improvement, ecosystem health, and economic outcomes. This session occurred on Tuesday 7 January 2020 in Greenville, South Carolina as part of the Annual Conference of the America Forage and Grassland Council. The following speakers engaged an attentive audience of ~150 attendees:

- Dr. Matt Poore, Department Extension Leader, Department of Animal Science, North Carolina State University, Raleigh NC, matt_poore@ncsu.edu
- Mr. Mike Jones, Farmer/Ecologist, Beaver Creek Farm, Surry County NC, bcangus@surry.net
- Dr. Alan Franzluebbbers, Research Ecologist, USDA – Agricultural Research Service, Raleigh NC, alan.franzluebbbers@usda.gov
- Dr. Greg Halich, Associate Extension Professor, Department of Agricultural Economics, University of Kentucky, Lexington KY, greg.halich@uky.edu

Opportunities for improvement in tall fescue management – Matt Poore

Tall Fescue dominates pastures in a region called the fescue belt, which includes all or part of the mid-west, mid-south and mid-Atlantic. Tall fescue is quick to make a strong sward, it persists well, has good nutritive value, and is tolerant of relatively modest or even poor management. The ability of tall fescue to survive continuous overgrazing is partly due to its association with the endophytic fungus, *Epichloë coenophiala*, which unfortunately has contributed to many pastures receiving very low management. Fescue toxicosis associated with KY-31 is a well-documented problem with a variety of symptoms related to either vasoconstriction or depressed release of the hormone prolactin.

Strategies to improve management and reduce fescue toxicosis include diversifying the forage system with other species, reducing grazing pressure in summer, shift tall fescue grazing to stockpiled forage in winter when toxins may be lowest, use rotational grazing and avoid close grazing, and renovate pastures with novel endophyte varieties. Other management approaches that partially mitigate fescue toxicosis include nutritional support, genetic selection of animals, and strategies to minimize toxins in the plant. Plant-based approaches include avoiding grazing swards during toxic periods of late spring and fall, suppression of seed heads to avoid consumption of seed with the most toxic levels of ergot alkaloids in the plant,



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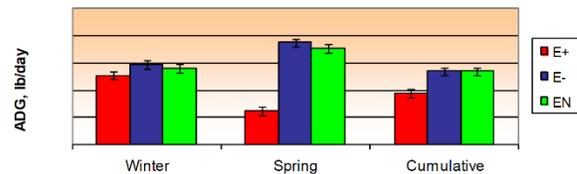
March 10, Middleburg, VA
March 12, Mt. Ulla, NC
March 16, Athens, GA
March 18, Springhill, TN
March 19, Lexington, KY
March 24, Harrison, AR
March 25, Mt. Vernon, MO



aggressive and adaptive pasture management, planting novel endophyte varieties, adding legumes to the sward to dilute toxins, and diversify forage systems with nutritious annuals and native warm-season grasses. Animal-based approaches including selection of animals with slick hair coat and/or heat tolerance with genetic markers, progesterone supplementation, and supplying feed remedies. However, no single practice has overwhelming impact on overcoming toxicosis.

Tall fescue is the premier species for stockpiling for winter grazing, and adoption could improve the efficiency of most farms in the fescue belt. We initiated in 1999 a long-term study of Jesup tall fescue with no endophyte (E-), with wild endophyte (E+), and with novel endophyte without toxins (EN). Average daily gain of heifers grazing the different forage stands was no different in the winter period, but only became different in spring when the endophyte became fully expressed in the lush spring growth (Drewnoski et al., 2009). This lack of difference in cattle performance during winter was associated with the lowest ergot alkaloid content of forage from approximately late December to early March (Drewnoski et al., 2007).

Growth performance of heifers consuming fescue with varying endophyte status



Protein supplementation during the winter stockpile period was evaluated for 3 years in Butner NC. After two months of grazing, heifers were synchronized and AI bred followed by a clean-up bull. Poured tubs were Southern States Maxi Cattle 24%. Forage was allocated every 2 days (65-75% utilization). Protein supplementation improved heifer performance (ADG, average daily gain), but didn't affect grazing days on pasture.

Protein Tubs or Extra Forage Allocation For Developing Heifers Grazing Stockpiled Fescue

Item	Normal Mineral	Normal Tub	Extra Mineral	Extra Tub
Supplement Intake, lb/d ^a dm (as is)	0.29	0.77 (0.99)	0.20	0.81 (1.10)
Forage Intake, lb/d ^b	10.42	10.53	12.41	11.94
ADG, lb/d ^{ab}	0.62	0.95	0.95	1.12
Forage Utilization, % ^b	75	74	66	65
Grazing Days/ac ^b	247	222	220	227

^a P < 0.05 Main Effect for Tub
^b P < 0.05 Main Effect for Allocation
 NC STATE UNIVERSITY College of Agriculture & Life Sciences
 Lyons et al., 2016

Over three years, winter grazing demonstrations were conducted on 22 farms (Freeman et al., 2019).

Farmers were provided a "Amazing Grazing Kit" composed of temporary fence supplies including tread in posts, corner posts, reels, polywire and a fence fault finder, and they were supported during strip-grazing by a team of local advisors. Producers involved in the project learned how to use temporary fence, saved \$28/cow, and 93% adopted the technology for use elsewhere on their farms. Novel endophyte technology has been available for 20 yrs. KY-31 has a role in many grazing systems in the fescue belt, but converting part of the pasture to novel endophyte will benefit animal performance and welfare, and will improve economic outcomes.

More information on grazing by the author can be found in Progressive Forage:

- how different tall fescue varieties make for an effective base forage in the southeastern US – <https://www.progressiveforage.com/forage-types/grasses-and-grazing/an-ideal-base-forage-for-the-eastern-u-s>
- seedhead management of tall fescue – <https://www.progressiveforage.com/forage-types/grasses-and-grazing/unrealized-revenue-makes-fescue-seedhead-management-critical>
- nutrient recycling in grazing systems – <https://www.progressiveforage.com/forage-types/grasses-and-grazing/making-the-most-of-nutrient-recycling-in-grazing-systems>

- the power of temporary fencing for strip grazing – <https://www.progressiveforage.com/forage-types/grasses-and-grazing/temporary-fencing-long-term-results>
- using annuals as alternative forages in your grazing system – <https://www.progressiveforage.com/forage-types/grasses-and-grazing/why-grow-annuals-as-part-of-your-forage-system>

Grazing management choices on the Beaver Creek Farm – Mike Jones

My wife, Jean, and I farm and manage 215 acres of pasture and wildlife habitat in the steep hills of Surry County, North Carolina. Two miles of streams flow through our property – Fisher River, Beaver Creek, and 5 small unnamed streams. We have 9 hills with elevation of 950 to 1160 feet. On 100 acres of pasture, 15 paddocks are divided into 1.5 to 20-acre parcels. Tall fescue is the primary forage and much of it contains the wild endophyte known to cause animal health disorders, and some renovated pastures contain the novel or friendly endophyte. Grazing of different forages and rotational stocking help overcome the fescue toxicosis problem. Our story of managing tall fescue has been an evolution and we’ve gained from interactions with NC State University, University of Georgia, NC Wildlife resources Commission, NC Forest Service, USDA-Natural Resources Conservation Service, American Forage and Grassland Council, National Grazing Lands Coalition, and others. These conversations and demonstrations have taught us different techniques in grazing that help us make very good beef without grain.

One of our cows (#6 to the right) has been with us for 16 years. She has seen many changes. “Weeds” are looked at in a different way. She grazes with the herd in a rotational pattern, receiving fresh pasture regularly throughout the year. She’s accustomed to single-strand polywire to keep in bounds. She might receive hay that is unrolled onto pasture in the winter. She grazes tall fescue much of the year, but also native warm-season grasses during spring and summer. She knows that grass lies below the occasional snowfall in winter. She has water from drinking stations and is treated occasionally with lush annual pastures that are rapidly consumed to support her offspring. Over winter, we utilize ryegrass (*Lolium multiflorum*), crimson clover (*Trifolium incarnatum*), and brassicas (*Brassica* spp.).



We’ve made choices that help our cattle thrive on our property without feeding grain. Chemical fertilizer is used very little, using grazing practices and unrolling of purchased hay to add some nutrients to the soil. We’ve worked with a soil ecologist to confirm that nitrogen fertilizer may not always be needed, as we’re building up soil health with a biologically active surface soil fed by forage growth and deposition of carbon from growing roots, as well as the return of dung and urine distributed onto the pastures from the grazing cattle. Sunlight, rain, and grazing help build



the soil and unrolling hay helps add organic nutrients and feeds the soil biota too. Our pastures provide enough habitat for rodents that are the natural prey for coyotes, so there is no predation on calves. We do move cows close to home prior to calving in spring so that we can keep a good look out for them and they receive stockpiled pasture during this time. In the fall of 2010, we tried fall stockpiling of pasture for the first time. We fed hay in different areas to distribute nutrients. We liked it a lot, and so in 2011, we sold our hay equipment and used the funds to install more pipeline and drinkers to graze more year-round.

We enrolled in the USDA-NRCS Environmental Quality Incentives Program (EQIP) to fence out streams, develop a rotational grazing system, and stockpile Virginia wildrye (*Elymus virginicus*) for summer grazing. We're currently working with the NC Wildlife Resources Commission to convert a section of hardwoods forest into a silvopasture with native grasses and pollinators. We've changed from unrolling hay in the winter to feeding hay in strategic areas around the farm to distribute organic nutrients and avoid pugging land too much. We've planted native warm-season pastures of eastern gamagrass (*Tripsacum dactyloides*) to get better forage quality and seasonal distribution, as well as to remove cattle from the toxic fescue during the summer. Big bluestem (*Andropogon gerardii*) and indiagrass (*Sorghastrum nutans*) are also a part of our pastures and help to keep our pastures fuzzy for the wildlife during the winter.



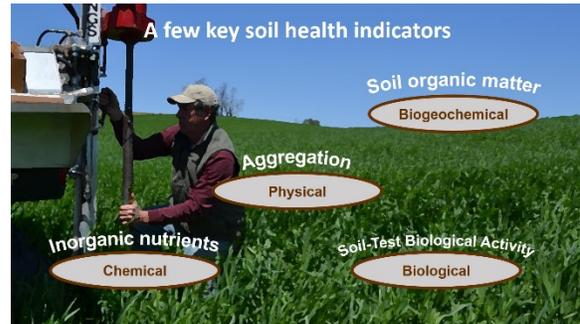
We've been quick to change and try something new, because we think it will help be better land managers for our livestock and for the wildlife. We have diversified our forage base with tall fescue, native warm-season grasses, and annual forages. We restrict livestock access to pasture with permanent and temporary fencing. We've unrolled hay and move around hay feeding stations to distribute imported organic nutrients from hay. We keep records. We test soil and forages. We like to share our experiences and benefit from the dialogue! We're proud members of the North Carolina Forage and Grassland Council and the North Carolina Cattlemen's Association. We participate in the reGenerative Grazing Group on Facebook.

Measuring soil health to make nitrogen management decisions – Alan Franzluebbbers

Current N fertilization recommendations for fall-stockpiled tall fescue in many states of the southeastern and Mid-Atlantic regions of the US suggest 50 to 100 lb N/acre be applied in early September after clipping summer growth. This strategy seems reasonable based on agronomic principles, but does not adequately account for a potential pool of organic nitrogen that could be present in soil and that would deem fall fertilizer nitrogen to be ineffective and a waste of time, money, and valuable resource, as well as a low-level, persistent threat to the environment. The issue is that soil testing for nitrogen has simply not been widely practiced, partly because of the focus on readily available inorganic forms, such as nitrate and ammonium, which are transient in soil. This presentation addresses the role of surface-soil organic nitrogen as a major contributing factor to plant-available nitrogen in forage production systems. In general, organic nitrogen must be transformed from an organic state to an inorganic state through the biologically mediated process of mineralization to be

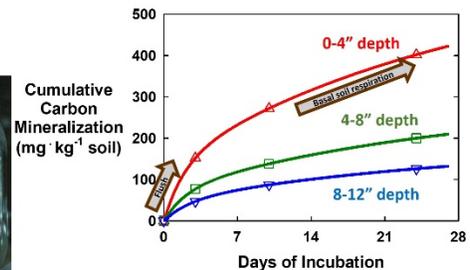
taken up by plants. Soil microorganisms are responsible for nitrogen mineralization. Although nitrogen mineralization can be measured from a soil sample in the laboratory, it is time consuming and highly dependent on methodology. An alternative is to measure soil-test biological activity during a short period of time to mimic the process. This presentation described the role that soil-test biological activity has on predicting nitrogen availability in fall-stockpiled tall fescue pastures. Knowing the level of soil nitrogen mineralization in a pasture could lead to more cost-effective nitrogen management decisions.

Soil health is defined as the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans. Healthy soil is at the forefront of all sustainable agricultural systems. Soil is vitally important to global issues facing society now and in the coming decades – food security, climate change, clean water and its availability, and recycling and nutrient utilization. Soil organic carbon powers many important ecosystem services provided by soil – water and nutrient cycling, climate regulation, and food, feed, fiber, and fuel production. Conservation management systems are capable of restoring soil organic carbon for the benefit of society. This includes conservation tillage, well-managed pastures, cover cropping, and use of animal manures. Soil health can be measured from a variety of soil chemical, physical, and biological properties. However, I suggest that we could focus on four key items (depicted in figure to the right). Soil-test biological activity is a vitally important indicator of nutrient cycling, since soil microorganisms are largely responsible for soil nitrogen transformations that keep it sequestered in organic matter and make it available for plant uptake.



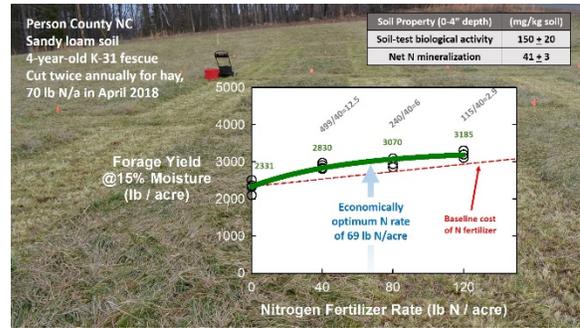
Soil-test biological activity is a simply determined measure of carbon mineralization during a short incubation period. The flush of carbon dioxide emitted following the rewetting of dried soil at standard temperature and moisture relates to the extent of resident soil microbial activity. With numerous samples analyzed across a broad swath of North Carolina and surrounding states, we now have a good calibration of how much nitrogen can be mineralized per unit of soil-test biological activity. By testing soil for biological activity, we are now able to inform land owners and managers how much nitrogen can be potentially supplied by native organic matter. Different land use history and recent management will change how much soil biological activity is present. If the amount of mineralizable organic nitrogen is not the same on each field of the same soil type or of all soils within a state or region, then should we expect nitrogen fertilizer recommendations to be the same across a state or region?

What is soil-test biological activity?

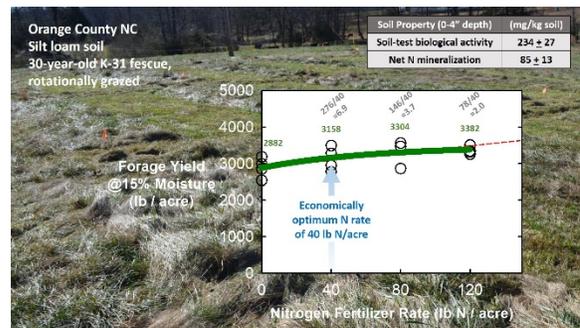


We tried to answer this question of whether nitrogen availability might be different on different farms with unique management through a series of trials on farms in North Carolina and the surrounding region. Our experimental setup was to conduct a nitrogen rate trial (4 rates and 4 replications of each) on a field of stockpiled tall fescue with collaborating farmers. We did this on 40 fields in the fall of 2018 and had data to support this effort from 55 other field trials conducted in the fall of 2015 and 2016. Three case studies will be reported here and additional results will be available in peer-reviewed scientific papers.

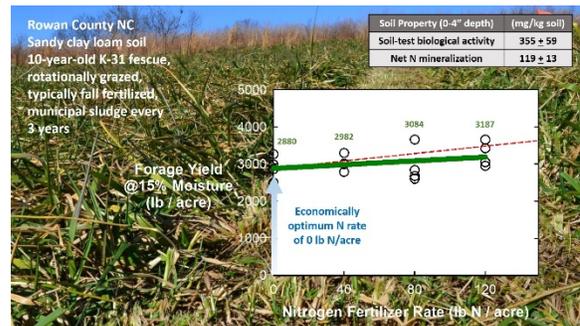
In the first case, a 4-year-old hayed K-31 tall fescue stand in Person County NC was routinely cut for hay, but was allowed to be fall stockpiled for this study, starting in September 2018. Soil-test biological activity and associated nitrogen mineralization were relatively low. Application of urea with urease inhibitor in early September led to increasingly greater forage yield, as nitrogen fertilizer rate increased. An economically optimum nitrogen fertilizer rate determined specifically for this field and soil condition was 69 lb N/acre. This level of nitrogen fertilizer represented the maximum distance between the yield curve (solid, green line) and the baseline cost of nitrogen fertilizer (dashed, red line). If nitrogen were applied more than this 69 lb N/acre, then the incremental cost of nitrogen fertilizer would have been greater than the gain in forage value.



The second case study was from a 30-year-old K-31 tall fescue field that was routinely rotationally grazed in Orange County NC. On this field, the same experimental setup occurred with 4 nitrogen rates repeated 4 times. Soil-test biological activity and nitrogen mineralization were greater than in the first case. Forage yield increased with increasing nitrogen fertilizer application, but the magnitude of increase was lower. The most economical nitrogen fertilizer rate was achieved with 40 lb N/acre.



The third case study was from a 10-year-old stand of K-31 tall fescue that was rotationally grazed and had municipal sludge applied every 3 years in Rowan County NC. Soil-test biological activity and nitrogen mineralization were even greater than in previous cases. Due to the greater biological activity and ability to mineralize nitrogen from soil organic matter, sufficient nitrogen was available to the fall stockpiled forage such that yield changed only slightly with increasing level of nitrogen fertilizer. The small increase in forage with nitrogen fertilizer was not sufficient to cover the cost of the nitrogen fertilizer, so the economically optimum nitrogen rate was 0 lb N/acre in this case.



Economically optimum nitrogen rate was determined at a cost-to-value threshold of 5 lb forage/lb nitrogen, equivalent to \$160/ton of forage and \$0.40/lb of nitrogen. If nitrogen cost were greater or hay cost lower, then economically optimum nitrogen rates would have been lower for these cases. From 36 completed trials conducted in 2018, 24 of the fields had sufficient nitrogen mineralized from soil organic matter and no need for additional nitrogen fertilizer. That meant that only 1 out of 3 fields responded significantly to supplemental nitrogen. Only 14 out of 55 trials conducted in 2015 and 2016 had need for supplemental nitrogen fertilizer to optimize yield. The level of soil-test biological activity was able to generally discern which of those fields were responsive and which ones were not responsive to

supplemental nitrogen fertilizer. Therefore, this simple, rapid, and reliable indicator of soil biological health has strong relevance in predicting (a) the supply of mineralizable organic nitrogen in soil and (b) the need for supplemental nitrogen fertilizer. The routine and typical recommendation of 50 to 100 lb N/acre applied at the beginning of the fall stockpile period in early September has to be seriously questioned. You wouldn't know the level of soil-test biological activity unless you had your soil tested. Some soil-testing labs are offering soil biological testing, so inquire with them to get your test results if saving this expensive fertilizer might be of interest to you. More information on managing nitrogen on your farm with soil-test biological activity can be found in Progressive Forage at - <https://www.progressiveforage.com/forage-production/management/use-the-nitrogen-on-your-farm-then-fertilize-if-needed> and <https://www.progressiveforage.com/forage-types/grasses-and-grazing/managing-stockpiled-fescue-are-all-the-questions-answered>.

Bottom-line decisions for fall stockpiling – Greg Halich

Discussions and debate on whether we should stockpile tall fescue pastures for winter grazing almost always center on nitrogen management: should we apply nitrogen and if so, how much. Studies have been extremely varied in terms of tall fescue forage response to nitrogen applications. Part of this variation can be explained by different climatic conditions of the studies (e.g. wet vs. dry years), but a main contention of this workshop was that a large part of this variation may have been due to previous studies not controlling for nitrogen that is naturally released through mineralization in the soil. Previous studies that showed large benefits to applying nitrogen were likely situations with low organic matter and soil biological activity that led to little nitrogen mineralization. Previous studies that showed low benefits to applying nitrogen were likely situations where soil organic matter and biological activity were high.

In the analysis of stockpile conditions, there are common assumptions that need to be addressed adequately to make good choices. Some of these include determination of utilization rate, nutrient value of hay, and machinery and/or labor costs. Unrealistically high rates of forage utilization are often used, and there is no definitive research on what is appropriate. Nitrogen fertilization could thicken swards and lead to greater utilization with good management. It is estimated that 60 to 80% forage utilization could be a reasonable target, and to achieve this target one would have additional labor costs.

Nutrient value of hay can be calculated from the quantity of nutrients and the unit values of each relevant nutrient. General guidelines for nutrient content can be used (as shown in the table to the right), but the only way to really know for sure would be to have it tested. In the table at right, the % effective as fertilizer column accounts for nutrients in hay that could be effectively returned as fertilizer. In a dry-lot, these percentages would be low due to waste trampling into the ground. However, if the hay were fed by unrolling or by bale-grazing, these percentages could be high. The upper limit is probably 75% to 85%. The nitrogen value of the hay is typically not given value as we assume sufficient

Fertilizer Value Estimation for Hay Feeding					
	Price (\$/unit)	lbs per Ton Hay	Lbs / Day	% Effective as Fertilizer	Nutrient Value/Day
Nitrogen	\$0.45	35	0.74	0%	\$0.00
P ₂ O ₅	\$0.35	12	0.25	75%	\$0.07
K ₂ O	\$0.35	53	1.13	75%	\$0.30
Total					\$0.36
<i>Notes: 1300 lb cow, 2.5% dry matter intake, 15% waste rate</i>					

nitrogen fertilization to overcome deficits (i.e. cattle are eating the additional stockpiled forage and most of that is being returned to pasture). With the example in the table, it is assumed that 75% of the P and K in the hay is effectively recycled as fertilizer. Thus if the cost of the hay itself were \$1.75 per cow per day, and the value of additional nutrients were \$0.36 per cow per day, the effective cost of the hay would be reduced to \$1.39 per cow day (\$1.75 - \$0.36).

An analysis of labor and machinery costs for grazing and hay feeding is shown in the table to the right. Labor cost for grazing can be reduced with less frequent moves, but one would have to account for lower utilization of the stockpile as move frequency decreases, and vice versa. The labor and machinery cost per day for each cow for both grazing and hay feeding would change based on herd size and the particular management style of the farm. You can estimate your own labor and machinery costs as well as fertilizer value of your hay at the following site:

<https://agecon.ca.uky.edu/files/grazinghaycostcalc.xlsx>.

Labor and Machinery Cost Estimation: Grazing and Hay Feeding				
		Hours per Move	Hours per Week	Cost per Day per Cow
Grazing:				
Days between moves	2.0			
Hours per move		0.75	2.6	\$0.19
Other Time - hours per week			1.0	\$0.07
Total				\$0.26
Feeding Hay:				
Tractor Time – hours/week			2.0	\$0.29
Other Time – hours / week			1.0	\$0.07
Total				\$0.36
<i>30 Cows, \$15/hr variable tractor cost, \$15/hr labor rate</i>				

A decision of whether to fertilizer stockpiled tall fescue with nitrogen should be based on economics. Analyses of the fall stockpile studies conducted in the fall of 2018 by Alan Franzluebbers suggest that nitrogen application on stockpiled tall fescue was economic only when the marginal return on forage biomass production was greater than 13 lb forage / lb nitrogen. This analysis was based on \$0.45/lb N, \$80/ton of hay, 75% utilization of the stockpiled forage, and fertilizer and labor-machinery costs shown in the table above.

The stockpiled trials in fall of 2018 conducted by Alan Franzluebbers had low marginal yield responses at all soil-test biological activity levels, and even at very low levels. This was in contrast to other published studies that have shown marginal return values greater than 20 lb forage / lb nitrogen. It is possible that real-world, grazed long-term tall fescue pastures simply have a large store of active soil organic matter that feeds a healthy soil biological community. Many previous studies were conducted on research stations with forage recently established on land that may have been exhausted due to historical cropping or other land uses. More research is needed to understand why there were such large discrepancies among studies.

Marginal Response Rates (lb DM / Unit N)				
N Rate (lb/acre)	Very Low SBTA	Low SBTA	Fescue-Clover Kallenbach 2001-2004	Fescue Kallenbach 2001-2004
10	12	4	22	38
20	12	4	21	35
30	11	4	20	33
40	11	4	18	30
50	10	4	17	28
60	10	3	16	25
70	9	3	14	22
80	9	3	13	20
90	8	3	12	17
100	8	3	10	15

The opportunity to make more effective utilization of on-farm nutrient resources exists when combining knowledge of soil-test biological activity as a predictor of soil nitrogen availability with bale grazing to more evenly distribute purchased nutrients in hay onto pasture lands. I have been using bale grazing on my own farm for 8 years and found it to be a very effective means to supply plant nutrients from wasted feed and manure and urine depositions on the strip-grazed winter pastures. More information on bale grazing approaches can be found in the following two articles in Progressive Forage – <https://www.progressiveforage.com/forage-types/grasses-and-grazing/winter-bale-grazing> and <https://www.progressiveforage.com/forage-production/management/fertilizer-value-of-hay-feeding>.



More economic analyses by the author can be found in Progressive Forage:

- how often should one move cattle – <https://www.progressiveforage.com/forage-production/management/how-often-should-you-move-your-cattle>
- grazing myths that reduce profitability – <https://www.progressiveforage.com/forage-production/management/grazing-myths-that-reduce-profitability>
- can cattle be finished on pastures – <https://www.progressiveforage.com/forage-types/grasses-and-grazing/can-cattle-be-finished-on-pasture-2>
- calculating the real costs of hay production – <https://www.progressiveforage.com/forage-types/alfalfa/calculating-depreciation-and-interest-in-hay-production>
- determining when grazing may not be profitable, in a series of three articles
 - 1 <https://www.progressiveforage.com/forage-types/grasses-and-grazing/picking-apples-off-the-grazing-tree-when-grazing-isn-t-profitable>
 - 2 <https://www.progressiveforage.com/forage-types/grasses-and-grazing/picking-apples-off-the-grazing-tree-part-ii>
 - 3 <https://www.progressiveforage.com/forage-production/management/picking-apples-off-the-grazing-tree-part-iii-the-stocking-rate-hay-feeding-trade-off>.