Effects of Fertility on Nutrient Content of Native Warm Season Grasses

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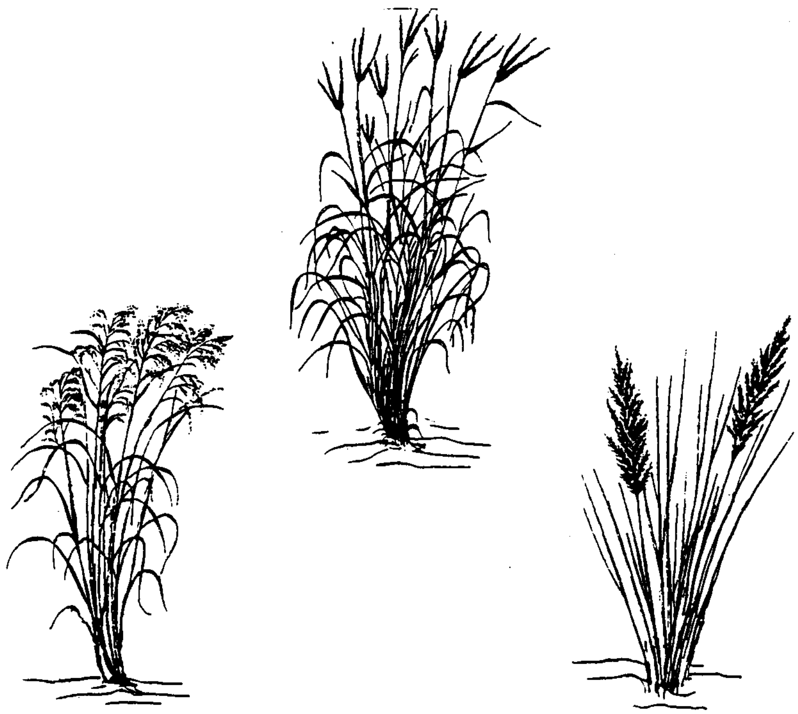
EFFECTS OF FERTILITY ON NUTRIENT

CONTENT OF NATIVE WARM SEASON GRASSES



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By

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APPROVAL PAGE

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CHAPTER I

INTRODUCTION

When the first settlers came to this land there were vast areas of native grasses that are generally categorized today as prairie grasses. The confines of the environs for these grasses, despite their names, were not limited to the geographic area known now as the Great Plains. Many of these same grasses were also indigenous to the eastern seaboard of North America as well. The grasses provided colonists with feed for domestic livestock and fiber for thatch roofs. The uses seemed to never exceed the abundant supplies of the native grasses (Barnes et al., 1995).

Along with the colonists came their agricultural methods, practices and their preferences for species that they were familiar with using in Europe. Tillage of the soil was a new challenge to these native grass sods. The species evolved over untold years by seeding themselves into existing sods and renewing themselves by the occasional wildfire that would set the successional clock back to zero. These events created large open areas that then would become the new meadows to support wildlife species which relied on these grasses for food and cover for nesting as well as shelter (Barnes et al., 1995).

As the cultural practices of the European settlers evolved and populations grew, whole ecosystems changed. One of the early casualties were the native grasses. The massive fields of native grasses were lost over time and replaced by other species much like the Native American tribes from this region. The presence of these grasses can still be seen in small bunches in low maintenance areas but have gone largely unrecognized.

Revered for their productivity and uses for wildlife species, the importance of these grasses has been once again realized by various groups of sportsman, farmers and government agencies. A concerted effort is being put forth by these groups to promote and re-introduce native grasses, especially native warm season grasses (NWSG), into the landscapes and habitats provided by cultivated fields. Numerous programs have offered livestock producers and wildlife enthusiasts cost share benefits to offset establishment expenses for several of these species as components of resource conservation plans.

The wildlife benefits have been well documented by agencies at the federal and state levels working with this issue. The bunching growth patterns of these plants make ideal habitat for quail providing food and cover for protection and nesting. But these grasses are also highly touted for their uses as livestock feed. Their growth periods and physiological habits make them an ideal component in a modern, forage-based ruminant animal production system.

Statement of the Problem

The problem of this study was to measure the effects of two synthetic fertilizer treatments upon the nutrient content of three native warm season grasses.

Research Goal

The goal of this study were to answer the following question:

H_0: Does the nutrient content of native warm season grasses vary with differing amounts of nutrients provided by synthetic sources?

Background and Significance

A demonstration plot containing three native warm season grasses was established at the Tayloe Unit of the Rappahannock River Valley Wildlife Refuge in late May of 1996. The plot contained plantings of big bluestem, indiangrass and switchgrass. The plot was established according to the standards and specifications of Virginia Polytechnic Institute and State University with assistance and oversight provided by the Virginia Department of Game and Inland Fisheries and the Virginia Cooperative Extension. The plant material has been maintained by research cooperator/producer Lloyd Mundie with no additional fertilizer and the plant material being harvested for hay. Samples from these cuttings have been taken and the nutrient analysis is listed below:

Analysis	SG-98	IG-98	BB-98	SG-97	IG-97	BB-97
Dry Matter %	35.65	34.66	38.45	90.98	91.38	89.91
Crude Protein %	4.52	6.54	6.22	6.21	7.58	8.50
Digest. Protein %	1.00	2.55	2.25	2.24	3.52	4.37
ADF %	34.76	40.45	43.43	42.34	42.42	42.53
TDN %	61.45	55.09	51.76	52.98	52.89	52.77
NE-L mcal/lb.	0.60	0.53	0.50	0.51	0.51	0.51

Analysis (con't)	SG-98	IG-98	BB-98	SG-97	IG-97	BB-97
NE-M mcal/lb.	0.61	0.51	0.46	0.48	0.48	0.48
NE-G mcal/lb.	0.35	0.26	0.21	0.23	0.23	0.23

Note: SG-98: swithcgrass harvested in '98 fresh sample; IG-98: indiangrass harvested in '98 fresh sample; BB-98: big bluestem harvested in '98 fresh sample; SG-97: switchgrass harvested in '97 hay sample; IG-97: indiangrass harvested in '97 hay sample; BB-97: big bluestem harvested in '97 hay sample.

While the examination of these results would indicate that these NWSG may provide sufficient nutrition for some classes of livestock, for others, such as lactating brood cows, these forages have not provided enough digestible nutrition to maintain suitable production of the cow herd as evidenced by the drastic reduction in body condition while on this feed. These grasses being considered and promoted by various programs and agencies have applications in many production scenarios and settings, be they livestock or wildlife oriented. The challenge is to re-discover the proper uses and apply new technology to this historical herbage so that it can be used effectively and efficiently to benefit the livestock producer by way of his/her livestock and wildlife.

Limitations

This study shall be limited in its scope to include only the three grasses produced in this given plot. Early season precipitation records indicate extremely low rainfall both prior to and during the testing period. While the impact of the low rainfall is difficult to determine, all plots were subjected to the same conditions.

Assumptions

Reviewing the literature, at least one source working with coastal bermuda grass indicates a response to fertility in nutrient density (Adams et al., 1967). Experience of the researcher has shown similar responses from common bermuda grass in areas with significant amounts of organic fertility added. While the plant growth habits are not the same for bermuda grasses and native warm season grasses, their carbon structures have similarities, the productive seasons are the same and a positive response is anticipated. Digestibility will vary depending on plant maturity, while there will be differences between species on a given day, plant development has been fairly consistent across species and will be assumed to be the same for the purposes of this study.

Procedures

Two fertilizer treatment tests included a dry fertilizer mixture of 5-10-10 at a rate of 400 lbs./acre and 40 lbs./acre of actual nitrogen from the source known as 30% liquid nitrogen. A control was used in each specie where no fertilizer was applied. Eight grab samples of plant material were randomly taken from standing forages prior to mechanical harvest. The samples were prepared and submitted to the Forage Testing Lab at Virginia Tech for analysis.

Definition of Terms

The following terms are defined to assist the reader:

ADF-acid detergent fiber, a means of determining fiber content of feed.

CP%- percent crude protein of a given feed sample.

DP%- percent digestible protein of a given feed sample.

Grab sample-a handful of plant material is gathered and cut at approximately 9 inches from the ground, the recommended harvesting height. The sample is then cut into one inch lengths and mixed with a sample being submitted of approximately 1 quart, fresh.

NE-G-net energy gain.

NE-L-net energy lactation.

NE-M- net energy maintenance.

NRC Requirements- National Research Council Requirements, the basis for determining the nutrient requirements for classes of livestock.

NWSG-native warm season grasses and in this case shall be limited to switchgrass, indiangrass and big bluestem.

TDN-total digestible nutrients within a given feed sample.

Overview of Chapters

Native warm season grasses have recently received the attention, and in some cases even the hype, of a new discovery. While most mention this to be more accurately a re-discovery, the majority of the presentations leave the would be producer feeling that this may be a valuable tool in meeting the nutrient needs of a herd of brood cows in a warm climate zone such as Eastern Virginia. But as the saying goes "what sounds too good to be true may not be true" may be more to the point. Establishment costs are high and the procedures quite exact and not easily implemented. The wildlife benefits are well documented, but the present recommendations for the use of these species leaves the feed value lacking and therefore limiting the uses of these grasses as livestock feed. More and more of the conservation programs offered by state and federal governments have NWSG components as requirements.

The intent of this study is to identify useful practices, add to the knowledge base and provide a working example of how these grasses may be used to fit into the larger scenario called production agriculture. The use of supplemental fertilizer is one production practice in contention at the outset of this study from within the proponents of NWSG. Some would contend supplemental fertilizer is not warranted. Others, while extolling the virtues of these species for wildlife habitat also contend the feed value is acceptable as well. The interrelationship, if any exists, between fertility and feed value for NWSG is explored within the review of literature and the field research of this study.

CHAPTER II

REVIEW OF LITERATURE

Native warm season grasses have fed animals for many centuries on this continent and others. Reviewing the literature finds this category of grasses referred to in several different contexts. One of the basic contexts that all these various warm season grasses have as a common link is how they regulate their photosynthetic process. Called C_4 grasses, this group of plants employs a specific process utilizing the ingredients of photosynthesis to produce food and then uses those compounds in such a way as to give the resulting plant material very unique characteristics (Mundie, 1999). The differences are not limited only to their photosynthetic and metabolic processes. The interstitial mechanisms allow the plant to use the inputs of photosynthesis more efficiently, are digested by foraging animals differently and even require unique management practices (Reid et al., 1988). These differences are foundational to the survival of the various species of this class of plants and make their applications useful in given situations (Nelson et al., 1995).

Plant Growth and Development

C_4 grasses have particular growth patterns. Their temperature requirements (30^{0}C to 40^{0}C, optimum) are such that the growing season for their peak dry matter accumulation to occur corresponds to our summer which is the time when our more traditional European cool season, C_3 grasses, tend to go dormant (Mundie, 1999). The C_4 grasses also have demonstrated their ability to produce tonnage more efficiently with given amounts of water, another desirable trait for the traditional dry summer months (Brown, 1978). In order to accomplish this enhanced production, producers must adhere to certain harvesting methods.

C_4 plants regenerate from the sheath of the stem. Cutting plants too short at harvest or allowing them to be grazed too short will result in less vigor and recuperation for subsequent cuttings. Grazing cattle with a set stocking rate or continuous grazing will reduce the population of the stand. History serves as the proof. Originally plentiful on the Great Plains and grazed by herds of buffalo, these plants were subjected to the pressures of grazing only periodically and during certain times of the year as herds migrated. Their grazing preferences placed selective pressure on the leaf areas of the plants. The animals ate what they wanted while they moved leaving the stems very long and ready to recuperate.

Modern man does not typically utilize the grazing methods of migratory herds. Fences restrict the movement of the grazing herds and management is required to simulate that grazing pattern. Modern equipment is designed for rapidly harvesting the entire plant for hay. Typically, cutting height may be closer to 3-4 inches rather than the 9 inches currently recommended.

Fertility

Warm season grasses not only utilize carbon and water more efficiently (Brown, 1978), they also use soil macro-nutrients, or fertility, more efficiently (Mundie, 1999). C_4 plants use relatively small amounts of N, P and K in accomplishing their production making tonnage potential very appealing and cost effective. But when the desire to produce raw tonnage is coupled with the need to produce quality feed for ruminant digestion, feed quality can become a concern and the limiting factor. In an attempt to determine the response of these grasses to fertilizer and the corresponding effect on protein content and overall feed quality, Reid et al. (1992) found no significant response in quality could be related to nitrogen fertilization. They also found that sheep used for the trial took a significant amount of time to adjust to the feed. This is contrary to work done by Perry et al. (1979) which found a positive response to nitrogen fertilization, except in a dry year, during a three year study.

Being noted for their efficient use of nutrients, this class of grasses may also have uses in areas with limited inherent fertility. In a Pennsylvania study of soils with low levels of naturally occurring P, warm season grasses out produced in tonnage their cool season C_3 contemporaries, during the second and subsequent years of the test, although the C_3 grasses out produced, by nutrient percentages, over the warm season C_4 grasses.

Nutritional Value

In considering the nutrient value of a given feedstuff, the ultimate test is in the performance of the target population while utilizing the feed. Removing bias, preference and error from live animal trials can be expensive and limiting to the applications attempted. Numerous factors can have a bearing on the results eventually expressed as performance. It is generally accepted that as a plant matures, the digestibility of the resulting plant material declines. Native warm season grasses are no exception to that rule. Griffen et al. (1983) found that not only do whole plant samples decline in the respective feed values as maturity increases, the percentage of plant component that is comprised of stem, increases by weight. As a fraction of stem increases, the fraction that is leaf decreases and so does the percentage crude protein and digestible protein as evidenced by chemical analysis. Similar results were found in live animal feeding trials; feed value decreased as plants matured (Vona et al., 1984).

Digestibility

Warm season grasses, while thought to be marginal feeds, may by virtue of their fiber structure possess the ability to resist ruminal degradation and enhance bacterial development due to the effects of slower rates of passage (Redfearn et al., 1995). In situ trials indicated that protein fractions resisted ruminal degradation resulting in those fractions being available for digestion in the lower gut, similar in effect, to by-pass protein. The slower rate of passage also has a direct impact on total feed intake and on dry matter digestibility and therefore digestible energy (Reid et al., 1988).

Utilizing the rumen to convert plant fiber into animal protein was the basis for the study of warm season grass digestion of Puoli et al. (1991). One of the unique capabilities of the rumen is to take the elemental nitrogen and fix it into bacterial protein for the animal to use for digestion and eventual nutrition. This nitrogen, being one of the building blocks of protein, can be fed as an ingredient to a feedstuff plant, or as a feed ingredient itself. The difference is one of timing and amount. Is the nitrogen fed to the plant and then to the animal or fed directly to the animal at recommended levels? In both instances, nitrogen applications had a positive effect on dry matter digestibility but has a negative effect on the ruminal turnover times of both sheep and cattle.

Summary

Although the long heritage of this group of grasses might indicate hope for broad geographic use and adaptation, the measuring stick by which we measure animal performance may have moved. It is no longer sufficient to have animals "survive" the winter, they must be able to produce a marketable product, or be making progress toward that end, every day of the year. Agricultural producers of the next millennium will not be able to accept production levels of every other year, which may prove to be the best these forages can produce. The literature is inconclusive as to what level of performance we might expect these grasses to achieve with the addition of nutrients. This study will hope to address this disparity.

CHAPTER III

METHODS AND PROCEDURES

This was an experimental study to determine the responses of three native warm season grasses; big bluestem, indiangrass, and switchgrass, to commercial supplemental fertilizer. Sub-sections contained within this chapter are population, research variables, instrument design, field and lab procedures, methods of data collection, statistical analysis and the summary.

Population

The population for this study was comprised of three native warm season grasses that have similar cultural practices, growth habits, photosynthetic processes and uses. The three grasses of the study were:

Big bluestem (Bothriochloa gerardi) is a native warm season grass which forms a coarse bunch sod, has a tall growth habit and is found in the eastern regions of the Great Plains states. It provides good pasture during late spring and summer and can be used for hay if cut before the plants head (Martin et al., 1975).

Indiangrass (Sorghastrum nutans) is a native warm season grass that has a tall, coarse growth habit, producing a quick ground cover after seeding. Indiangrass is frequently found in pastures and open woodlands in the eastern three-fourths of the United States and is very well suited to hay production (Martin et al., 1975).

Switchgrass (Panicum virgatum) is a native warm season grass that is a sod forming species grown primarily in the central and southern Great Plains. Its productive summer growth habit lends itself to grazing as well as hay production in times of surplus soil moisture (Martin et al., 1975).

Research Variables

The two variable treatments used in this study were fertilizer treatments containing: A) dry fertilizer mixture of 5-10-10 at a rate of 400 lbs./acre, B) 40 lbs./acre of actual nitrogen from a source known as 30% liquid nitrogen, and C) a control for each of the three species of grasses.

Field Procedures

Each of the NWSG species were planted in a plot, side by side, in a field approximately ten acres in size. The initial soil test values (Appendix A) were 6.5pH; 144 lb./A, VH for P; 180 lbs./A, H- for K; 912 lbs./A, M- for Ca; 192 lbs./A, H for Mg and 1.7% OM. The plots were divided into three sections, approximately the same size and treated in a side by side fashion providing a sampling area approximately 15 feet wide for each treatment of each specie.

The fertilizer treatments were applied to all plots on May 10, 1999, with appropriate equipment for the application. The equipment was calibrated according to the specifications of the manufacturer to assure accuracy of measure.

Lab Procedures

Laboratory testing of the soil sample and the resulting forage samples were conducted according to laboratory testing protocol by the respective labs for each at the Virginia Polytechnic Institute and State University. Tests conducted included: standard analysis for the soil and standard nutrient analysis, macro-mineral analysis, Acid Detergent

Fiber (ADF), calculations for energy and Total Digestible Nutrients (TDN) for the grasses.

Methods of Data Collection

Samples of the resulting forage were collected on June 10, 1999. Eight grab samples were randomly collected and combined for each treatment section of each specie of grass. The samples were cut at a height of nine inches (9"), while standing, prior to mechanical harvest. There were no visible seed heads in any of the plant material. Each sample was then prepared by cutting the total plant material collected, mixed and sent to the lab for testing.

Statistical Analysis

Standard statistical analysis was used to determine the significance, P>(.05), of each variable treatment compared to the control for the fields or values of crude protein, digestible protein, Acid Detergent Fiber (ADF), Total Digestible Nutrients (TDN) and Net Energy Levels.

Summary

While field procedures and some outcomes were dictated by the weather, other variables and inputs were provided by the cooperator. There are vagaries, however, with any field experiment and hence the level of significance, P>(.05), in order for the difference to be determined significant. Also, a significant difference of one measure, crude protein for example, may be offset by no significant difference for another measure.

CHAPTER IV

FINDINGS

The problem of this study was to measure the effects of two synthetic fertilizer treatments upon the nutrient content of three native warm season grasses. This chapter will examine the data that was collected during this trial. The findings reflect the nutrient analysis results and are shown, by specie, in tabular form.

Forage Analysis Results

The forage analysis data is presented first per specie to provide a concise point of reference for each specie in the test. Complete results from the Forage Testing Lab at Virginia Polytechnic Institute and State University are included in Appendix B. No statistical comparison is provided between treatments within each specie since that was not a consideration of the research goals.

Big Bluestem

The big bluestem stand was three years old and in a generally productive state. There was no evidence of pest infestations or weakness of stand. Visual appraisal of the plots showed no marked difference in growth. The results of the three treatments of big bluestem are designated by: **BBS-F**- big bluestem blended fertilizer treatment, **BBS-C**- big bluestem control and **BBS-N**- big bluestem nitrogen only treatment. See Table 1.

Table 1- Big Bluestem

	BBS-F	**BBS-C**	**BBS-N**
Dry Matter %	31.73	32.28	32.06
Crude Protein %	6.55	8.39	7.89
Digestible Protein %	2.56	4.27	3.80
Acid Detergent Fiber %	37.33	38.86	39.43
TDN (Estimated) %	59.70	57.99	57.35
NE-L mcal/lb	.58	.56	.56
NE-M mcal/lb	.59	.56	.55
NE-G mcal/lb	.33	.30	.29

All treatment samples show nutrient levels and density within the expected performance range for the given specie (Reid et al., 1988).

Indiangrass

The plot containing the indiangrass was generally pest free, with very little evidence of any weed infestation and no insect pressure noted. The stand was generally healthy and productive with a plant population sufficient for average production. There was no visual difference between treatment areas. The results of the three treatments of indiangrass are designated by: **IG-F**- indiangrass blended fertilizer treatment, **IG-C**- indiangrass control and **IG-N**-indiangrass nitrogen only treatment. See Table 2.

Table 2- Indiangrass

	IG-F	IG-C	IG-N
Dry Matter %	34.04	35.03	32.46
Crude Protein %	7.37	7.07	7.82
Digestible Protein %	3.32	3.04	3.74
Acid Detergent Fiber %	36.88	38.03	37.14
TDN (Estimated) %	60.20	58.92	59.91
NE-L mcal/lb	.59	.57	.58
NE-M mcal/lb	.59	.57	.59
NE-G mcal/lb	.33	.31	.33

All treatment samples show nutrient levels and density within the expected performance range for the given specie (Reid et al., 1988).

Switchgrass

The switchgrass plot was in very good condition with no evidence of weed or insect populations. The stand was dense with no visual difference between the treatment areas. The results of the three treatments of switchgrass are designated by: **SW-F-** switchgrass blended fertilizer treatment, **SW-C**-switchgrass control and **SW-N-** switchgrass nitrogen only treatment. See Table 3.

Table 3- Switchgrass

	SW-F	SW-C	SW-N
Dry Matter %	28.52	31.91	29.93
Crude Protein %	6.86	6.46	7.28
Digestible Protein %	2.85	2.48	3.24
Acid Detergent Fiber %	37.55	35.78	38.27
TDN (Estimated) %	59.45	61.43	58.65
NE-L mcal/lb	.58	.60	.57
NE-M mcal/lb	.58	.61	.57
NE-G mcal/lb	.32	.35	.31

All treatment samples show nutrient levels and density within the expected performance range for the given specie (Reid et al., 1988).

Protein Evaluation

In considering the data from the forage tests, the results reflect a mixed response in the levels of protein attained. While the big bluestem actually showed the higher level being present in the control (8.39% vs. 6.55% and 7.89%), the other two species showed a slight but not significant ($P>.05$) difference in the representative samples between treatments and the control. See Table 4.

Table 4- Protein Evaluation

	BBS-F	BBS-C	BBS-N
Crude Protein %	6.55	8.39	7.89
Digestible Protein %	2.56	4.27	3.80
	IG-F	**IG-C**	**IG-N**
Crude Protein %	7.37	7.07	7.82
Digestible Protein %	3.32	3.04	3.74
	SW-F	**SW-C**	**SW-N**
Crude Protein %	6.86	6.46	7.28
Digestible Protein %	2.85	2.48	3.24

Means and t-test values

CP %	mean	6.93		7.31		7.66
	t-test		.556		.520	
DP %	mean	2.91		3.26		3.59
	t-test		.614		.590	

The mean values for the treatments show that there was actually very little difference between treatments and the control. Considering the data within this category, the values for protein content that resulted from the different fertilizer treatments provided a level of response that fails to meet the level of significance, P>(.05), for a two-tailed t-test. The critical value of 2.776 was not attained.

Total Digestible Nutrient Evaluation

The total digestible nutrient content is an estimated value that is based on many of the parameters of the feed. It is generally accepted as an easily used and understandable reference for producers to use in order to judge the general feed value of a feedstuff. In the category, the differences between the fertilizer treatments and the control was mixed. In one specie, the big bluestem, the highest value was resultant from the blended fertilizer treatment (59.70% vs. 57.99% and 57.35%). In the switchgrass plot, the highest value corresponded with the control (61.43% vs. 59.45% and 58.65%). In the indiangrass plot, the highest sample value resulted from the blended fertilizer treatment (60.20%), while the nitrogen fertilized sample rated second highest (59.91%) which was the treatment that rated lowest or third with the big bluestem and switchgrass plots, respectively. See Table 5.

Table 5- Total Digestible Nutrient Evaluation

	BBS-F	**BBS-C**	**BBS-N**
TDN (Estimated) %	59.70	57.99	57.35
	IG-F	**IG-C**	**IG-N**
TDN (Estimated) %	60.20	58.92	59.91
	SW-F	**SW-C**	**SW-N**
TDN (Estimated) %	59.45	61.43	58.65
mean	59.78	59.45	58.64
t-test		.310	.640

The numerical difference between the values discussed are inconsistent, by their own merit, with the indicators previously covered for protein value. Considering the data within this category, the values for TDN% that resulted from the different fertilizer treatments provided a level of response that fails to meet the level of significance, P>(.05), for a two-tailed t-test. The critical value of 2.776 was not attained.

Acid Detergent Fiber Evaluation

Before examining the data for Acid Detergent Fiber (ADF), it may serve the reader well to be reminded that the percent ADF is indicative of the percentage of the plant material that is largely and mainly indigestible. It is composed primarily of cellulose, lignin and silica. Therefore, the lower the ADF value, the more highly digestible the feed (Ensminger et al., 1990). While the percent ADF is largely determined by the stage of plant maturity, differences may occur between treatments. The bluestem and indiangrass samples from the blended fertilizer plots were the most digestible at 37.33% and 36.88% respectively. The switchgrass plot that was the most digestible however, was the control at 35.78%, which represents the highest degree digestibility of all three species and all treatments. See Table 6.

Table 6- Acid Detergent Fiber Evaluation

	BBS-F	**BBS-C**	**BBS-N**
Acid Detergent Fiber %	37.33	38.86	39.43
	IG-F	**IG-C**	**IG-N**
Acid Detergent Fiber %	36.88	38.03	37.14

	SW-F	SW-C	SW-N
Acid Detergent Fiber %	37.55	35.78	38.27
mean	37.25	37.56	38.28
t-test	.270	.550	

Considering the data within this category, the values for Acid Detergent Fiber % that resulted from the different fertilizer treatments provided a level of response that fails to meet the level of significance, P>(.05), for a two-tailed t-test. The critical value of 2.776 was not attained.

Energy Evaluation

Energy levels of feeds can vary depending on numerous factors, but it is largely determined by the level of maturity of the plant fibers. It stands to reason then, that the higher ADF levels mentioned above, will correspond to lower energy levels. Ruminant digestion, when used to its advantage, is one which is based upon the digestion of plant fibers. Net Energy (NE) is categorized into three segments: Lactation (L), Maintenance (M), and Gain (G). These values are the mega-calories that can be apportioned to the respective bodily function. See Table 7.

Table 7- Energy Evaluation

	BBS-F	BBS-C	BBS-N
NE-L mcal/lb.	.58	.56	.56
NE-M mcal/lb.	.59	.56	.55
NE-G mcal/lb.	.33	.30	.29

Table 7- Energy Evaluation (con't)

	IG-F	IG-C	IG-N
NE-L mcal/lb.	.59	.57	.58
NE-M mcal/lb.	.59	.57	.59
NE-G mcal/lb.	.33	.31	.33
	SW-F	**SW-C**	**SW-N**
NE-L mcal/lb.	.58	.60	.57
NE-M mcal/lb.	.58	.61	.57
NE-G mcal/lb.	.32	.35	.31

Means (t-test values)

NE-L	mean	.583		.577		.570
	t-test		.000		.000	
NE-M	mean	.587		.580		.570
	t-test		.000		.000	
NE-G	mean	.327		.320		.310
	t-test		.000		.000	

Considering the data within this category, the values for Net Energy that resulted from the different fertilizer treatments provided a level of response that fails to meet the level of significance, P>(.05), for a two-tailed t-test. The critical value of 2.776 was not attained.

Summary

The research goal of this study was to determine the effect of fertility treatment on selected native warm grass species. Considering the data for the response of the three species of grass in the study for the nutritional parameters and applying the two-tailed critical values of t (2.776), none of the nutritional parameters specified in the study to measure nutrient density showed a significant response at the P>(.05) level.

CHAPTER V

SUMMARY, CONCLUSIONS and RECOMMENDATIONS

This chapter will provide a summary of the research data gathered, determine if the research questions were answered and make recommendations for further study or possible changes in management of this forage resource.

Summary

The interest in native warm season grass production, cultural practices and their uses in livestock production has intensified over the past five to seven years. Much of the knowledge base that has been available regarding these species, their cultural practices and uses has been developed in the Great Plains. Local practices and protocols are yet to be established. The establishment requirements for some of these species is difficult at best and the results have been mixed. Current costs of establishment have quadrupled since these plots were established due to increased popularity and in a large part due to government program requirements to include these NWSG species in qualified government program plantings. Local experience in feeding NWSG species to cattle and corresponding laboratory analysis of the forages indicate that feed value may be less than we are accustomed to feeding our wintering cattle. Yet the interest in the NWSG species remains due to the lure of production during hot, dry weather which is no stranger to eastern Virginia.

The problem of the study was to measure the response of three native warm season grasses, as measured by nutrient density, to two different synthetic fertilizer treatments. The three species of NWSG were big bluestem (Bothriochloa gerardi), indiangrass (Sorghastrum nutans) and switchgrass (Panicum virgatum). The two experimental treatments were applied on May 10, 1999 and consisted of: Treatment A, 400 lbs./A of 5-10-10, Treatment B, 40 lbs/A of actual N from a source known as 30% liquid nitrogen; and Treatment C, control. Initial soil test results were provided by the Soil Testing Lab at the Virginia Polytechnic Institute & State University. The question was to determine if the NWSG would respond to the fertility by increasing nutrient density compared to a control.

Fresh forage samples were collected and prepared on June 10, 1999, by cutting eight (8) grab samples at random from the treatment areas. The samples were cut at nine inches (9") in height, collected and combined for preparation and submission to the forage testing lab at Virginia Polytechnic Institute & State University. Standard nutrient analysis was performed.

Environmental limitations presented many challenges during the evaluation period. There was a marked deficiency of rainfall prior to and during the testing period.

Standard statistical analysis was performed to the P>(.05) level in order to determine the significance of the findings using a t-test method. The two-tailed method was used to determine the critical value of 2.776.

Conclusions

The response of the various grasses in the test to the fertility treatments displayed variability both between and within species. No discernable pattern evolved as the data was analyzed which may indicate a difference in response due to treatment or species.

Data collected provided answers to the research goal.

H_0: Does the nutrient content of native warm season grasses vary with differing amounts of nutrients provided by synthetic sources?

The findings of this study would indicate that there was no significant response to either fertilizer treatment, when compared to the control, for any of the nutrient density parameters. T-test results for treatments A and B respectively, protein evaluation: CP; .556 and .520, DP; .614 and .590, TDN; .310 and .640, ADF; .270 and .550 and all energy evaluations .000. Both of the fertilizer treatments, A and B, failed to show a significant difference (P>.05) considering the two-tailed t-test critical value of 2.776 by any of the four nutrient density values.

Recommendations

While much has been written to tout the benefits of native warm season grasses for their uses as livestock feed, wildlife benefits, carbon metabolism and fertility efficiency, the universal application of these species to vast areas of land still remains in doubt. While the shortage of rainfall may have provided the limiting factor, one of the most frequently cited benefits of these species is their ability to perform in such adverse conditions. Another year with normal rainfall may provide different results since the degree of mineralization of the fertilizer that was applied was not able to be determined.

As seasons progress, depending on subsequent fertilizer applications, and as soil fertility levels subside, more response may be detected between treated plots and controls. The "high" and "very high" demarcations may indicate that the plots were already at sufficient levels to mitigate any limitations caused by additional fertility.

These forages, while being used for wildlife enhancement, are also being touted for use in beef cattle production. Part of the equation in livestock nutrition is to match the nutritional needs of the animal to the feed or visa versa. If in fact we have difficulty raising the nutrient density of the feeds to meet the level required of the cow, perhaps changing the nutrient requirements of the target population is the next task at hand. These forages flourished with the migrating herds of buffalo grazing them down and then moving on. The indigenous buffalo herds were calving in the spring and experienced peek nutrient requirements in the early summer when these native forages would perhaps be lush and at peak nutrient quality. Cow herds that calve in the fall experience their peak nutrient demand in the winter when stored feeds must provide the lion's share of their nutrition. If these feeds are to be used more extensively, matching them to herds that can mimic the native conditions and needs may be the best scenario.

In light of the mixed findings in this study, the researcher believes that there is merit to examining this topic further. Until practices can be established to insure optimizing nutrient density with these species, using existing stands to provide seed production plots may be the best return on investment considering the recent increases in seed value.

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Appendix A- Soil Test Results

Virginia Cooperative Extension Service

Soil Test Report

Virginia Tech Soil Testing Laboratory
P.O. Box 10664
Blacksburg, VA 24062-0664

NOTES:
1 3

LIDDINGTON KELLY
PO BOX 152
WARSAW VA 22572

SAMPLE HISTORY

SAMPLE No.	NO. OF AC.	SOIL TYPE	SLOPE	SOIL PROD. GROUP	LAST CROP NAME	LAST CROP YIELD	LAST CROPS FERTILIZATION, lb/A N	P_2O_5	K_2O	LAST LIME APPLICATION MO. PREV.	T/A
01	0	CLAYEY	LEV	3		0	0	0	0		

LAB TESTS

SOIL pH	P lb/A	K lb/A	Ca lb/A	Mg lb/A	OM %	SS ppm	NO_3-N ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	B ppm
6.5	144 VH	180 H-	912 M-	192 H	1.7 M			3.3	6.8	0.5	17.3	0.1

FERTILIZER & LIME RECOMMENDATIONS

FIRST CROP:	LIME, TONS/A AMT	TYPE	FERTILIZER, LBS/A N	P205	K20
TALL GRASS PASTURE	0.00		40- 60	0	0

*122. P205 AND K20 RECOMMENDATIONS ARE FOR ANNUAL APPLICATION. HOWEVER, RATES CAN BE DOUBLED AND APPLIED EVERY OTHER YEAR IF DESIRED.

*131. IF ADDITIONAL PRODUCTION IS NEEDED LATER ON, APPLY 40 TO 60 LBS/A OF N DURING THE GRAZING SEASON. IF YOU ARE PLANNING TO OVERSEED A LEGUME INTO THE STAND, OMIT THE N RECOMMENDATION.

SECOND CROP:	LIME, TONS/A AMT	TYPE	FERTILIZER, LBS/A N	P205	K20
TALL GRASS PASTURE	0.00		40- 60	0	0

*900. THE FOLLOWING COMMENT(S) FROM THE FIRST CROP APPLY TO THIS CROP ALSO:
122 131

Appendix B- Forage Analysis Reports

Va Tech Forage Testing Lab
320 Litton-Reaves
Blacksburg, VA 24061-0322
(540) 231-6870

SAMPLE : 02112

GS75838

BBS-F

RICHMOND

KELLY J LIDDINGTON
PO BOX 152
WARSAW VA 22572 0000

Date Sampled: 06/10
Date Received: 06/17
Date Mailed: 06/24

		DRY BASIS	AS FED BASIS
Dry Matter	%	31.73	
Crude Protein	%	6.55	2.07
Heat Damaged Protein	%		
Available Protein	%		
Digestible Protein	%	2.56	.81
Acid Detergent Fiber	%	37.33	11.84
Neutral Detergent Fiber	%		
TDN (Estimated)	%	59.70	18.94
NE Lactation	MCAL/LB	.58	.18
NE Maintenance	MCAL/LB	.59	.18
NE Gain	MCAL/LB	.33	.10
P	%		
Ca	%		
K	%		
MG	%		
Soluble Protein	%		
Dry Matter Classification		2	
Protein Index		48	
Energy Index		101	

NOTICE-Proper sampling techniques and complete sample identification are critical to ensure a representative analysis of your crops!
Requested Wet Chemistry Mineral Analysis will be mailed when completed

Va Tech Forage Testing Lab
320 Litton-Reaves
Blacksburg, VA 24061-0322
(540) 231-6870

SAMPLE : 02113

GS75838

BBS-C

RICHMOND

PAGE 2
for
KELLY J LIDDINGTON

Date Sample : 06/10
Date Received: 06/17
Date Mailed : 06/24

		DRY BASIS	AS FED BASIS
Dry Matter	%	32.28	
Crude Protein	%	8.39	2.70
Heat Damaged Protein	%		
Available Protein	%		
Digestible Protein	%	4.27	1.37
Acid Detergent Fiber	%	38.86	12.54
Neutral Detergent Fiber	%		
TDN (Estimated)	%	57.99	18.71
NE Lactation	MCAL/LB	.56	.18
NE Maintenance	MCAL/LB	.56	.18
NE Gain	MCAL/LB	.30	.09
P	%		
Ca	%		
K	%		
MG	%		
Soluble Protein	%		
Dry Matter Classification	2		
Protein Index	62		
Energy Index	98		

NOTICE-Proper sampling techniques and complete sample identification are critical to ensure a representative analysis of your crops!
Requested Wet Chemistry Mineral Analysis will be mailed when completed

Va Tech Forage Testing Lab
320 Litton-Reaves
Blacksburg, VA 24061-0322
(540) 231-6870

SAMPLE : 02114

GS75838

BBC-N

RICHMOND

PAGE 3
for
KELLY J LIDDINGTON

Date Sample : 06/10
Date Received: 06/17
Date Mailed : 06/24

		DRY BASIS	AS FED BASIS
Dry Matter	%	32.06	
Crude Protein	%	7.89	2.52
Heat Damaged Protein	%		
Available Protein	%		
Digestible Protein	%	3.80	1.21
Acid Detergent Fiber	%	39.43	12.64
Neutral Detergent Fiber	%		
TDN (Estimated)	%	57.35	18.38
NE Lactation	MCAL/LB	.56	.17
NE Maintenance	MCAL/LB	.55	.17
NE Gain	MCAL/LB	.29	.09
P	%		
Ca	%		
K	%		
MG	%		
Soluble Protein	%		
Dry Matter Classification		2	
Protein Index		58	
Energy Index		97	

NOTICE-Proper sampling techniques and complete sample identification are critical to ensure a representative analysis of your crops!
Requested Wet Chemistry Mineral Analysis will be mailed when completed

Va Tech Forage Testing Lab
320 Litton-Reaves
Blacksburg, VA 24061-0322
(540) 231-6870

SAMPLE : 02115

GS75838

IG-N

RICHMOND

PAGE 4
for
KELLY J LIDDINGTON

Date Sample : 06/10
Date Received: 06/17
Date Mailed : 06/24

		DRY BASIS	AS FED BASIS
Dry Matter	%	32.46	
Crude Protein	%	7.82	2.53
Heat Damaged Protein	%		
Available Protein	%		
Digestible Protein	%	3.74	1.21
Acid Detergent Fiber	%	37.14	12.05
Neutral Detergent Fiber	%		
TDN (Estimated)	%	59.91	19.44
NE Lactation	MCAL/LB	.58	.18
NE Maintenance	MCAL/LB	.59	.19
NE Gain	MCAL/LB	.33	.10
P	%		
Ca	%		
K	%		
MG	%		
Soluble Protein	%		
Dry Matter Classification		2	
Protein Index		57	
Energy Index		101	

NOTICE-Proper sampling techniques and complete sample identification are critical to ensure a representative analysis of your crops!
Requested Wet Chemistry Mineral Analysis will be mailed when completed

Va Tech Forage Testing Lab
320 Litton-Reaves
Blacksburg, VA 24061-0322
(540) 231-6870

SAMPLE : 02116

GS75838

IG-F

RICHMOND

PAGE 5
for
KELLY J LIDDINGTON

Date Sample : 06/10
Date Received: 06/17
Date Mailed : 06/24

		DRY BASIS	AS FED BASIS
Dry Matter	%	34.04	
Crude Protein	%	7.37	2.50
Heat Damaged Protein	%		
Available Protein	%		
Digestible Protein	%	3.32	1.13
Acid Detergent Fiber	%	36.88	12.55
Neutral Detergent Fiber	%		
TDN (Estimated)	%	60.20	20.49
NE Lactation	MCAL/LB	.59	.20
NE Maintenance	MCAL/LB	.59	.20
NE Gain	MCAL/LB	.33	.11
P	%		
Ca	%		
K	%		
MG	%		
Soluble Protein	%		
Dry Matter Classification		2	
Protein Index		54	
Energy Index		102	

NOTICE-Proper sampling techniques and complete sample identification are critical to ensure a representative analysis of your crops!
Requested Wet Chemistry Mineral Analysis will be mailed when completed

Va Tech Forage Testing Lab
320 Litton-Reaves
Blacksburg, VA 24061-0322
(540) 231-6870

SAMPLE : 02117

GS75838

IG-C

RICHMOND

for
KELLY J LIDDINGTON

Date Sample : 06/10
Date Received: 06/17
Date Mailed : 06/24

		DRY BASIS	AS FED BASIS
Dry Matter	%	35.03	
Crude Protein	%	7.07	2.47
Heat Damaged Protein	%		
Available Protein	%		
Digestible Protein	%	3.04	1.06
Acid Detergent Fiber	%	38.03	13.32
Neutral Detergent Fiber	%		
TDN (Estimated)	%	58.92	20.63
NE Lactation	MCAL/LB	.57	.19
NE Maintenance	MCAL/LB	.57	.19
NE Gain	MCAL/LB	.31	.10
P	%		
Ca	%		
K	%		
MG	%		
Soluble Protein	%		
Dry Matter Classification		3	
Protein Index		52	
Energy Index		99	

NOTICE-Proper sampling techniques and complete sample identification are critical to ensure a representative analysis of your crops!
Requested Wet Chemistry Mineral Analysis will be mailed when completed

Va Tech Forage Testing Lab
320 Litton-Reaves
Blacksburg, VA 24061-0322
(540) 231-6870

SAMPLE : 02118

GS75839

SW-N

RICHMOND

PAGE 7
for
KELLY J LIDDINGTON

Date Sample : 06/10
Date Received: 06/17
Date Mailed : 06/24

		DRY BASIS	AS FED BASIS
Dry Matter	%	29.93	
Crude Protein	%	7.28	2.17
Heat Damaged Protein	%		
Available Protein	%		
Digestible Protein	%	3.24	.96
Acid Detergent Fiber	%	38.27	11.45
Neutral Detergent Fiber	%		
TDN (Estimated)	%	58.65	17.55
NE Lactation	MCAL/LB	.57	.17
NE Maintenance	MCAL/LB	.57	.17
NE Gain	MCAL/LB	.31	.09
P	%		
Ca	%		
K	%		
MG	%		
Soluble Protein	%		
Dry Matter Classification		1	
Protein Index		53	
Energy Index		99	

NOTICE-Proper sampling techniques and complete sample identification are critical to ensure a representative analysis of your crops!
Requested Wet Chemistry Mineral Analysis will be mailed when completed

Va Tech Forage Testing Lab
320 Litton-Reaves
Blacksburg, VA 24061-0322
(540) 231-6870

SAMPLE : 02119

GS75839

SW-F

RICHMOND

for
KELLY J LIDDINGTON

Date Sample : 06/10
Date Received: 06/17
Date Mailed : 06/24

		DRY BASIS	AS FED BASIS
Dry Matter	%	28.52	
Crude Protein	%	6.86	1.95
Heat Damaged Protein	%		
Available Protein	%		
Digestible Protein	%	2.85	.81
Acid Detergent Fiber	%	37.55	10.70
Neutral Detergent Fiber	%		
TDN (Estimated)	%	59.45	16.95
NE Lactation	MCAL/LB	.58	.16
NE Maintenance	MCAL/LB	.58	.16
NE Gain	MCAL/LB	.32	.09
P	%		
Ca	%		
K	%		
MG	%		
Soluble Protein	%		
Dry Matter Classification		1	
Protein Index		50	
Energy Index		100	

NOTICE-Proper sampling techniques and complete sample identification are critical to ensure a representative analysis of your crops!
Requested Wet Chemistry Mineral Analysis will be mailed when completed

Va Tech Forage Testing Lab
320 Litton-Reaves
Blacksburg, VA 24061-0322
(540) 231-6870

SAMPLE : 02120

GS75839

SW-C

RICHMOND

PAGE 9
for
KELLY J LIDDINGTON

Date Sample : 06/10
Date Received: 06/17
Date Mailed : 06/24

		DRY BASIS	AS FED BASIS
Dry Matter	%	31.91	
Crude Protein	%	6.46	2.06
Heat Damaged Protein	%		
Available Protein	%		
Digestible Protein	%	2.48	.79
Acid Detergent Fiber	%	35.78	11.41
Neutral Detergent Fiber	%		
TDN (Estimated)	%	61.43	19.60
NE Lactation	MCAL/LB	.60	.19
NE Maintenance	MCAL/LB	.61	.19
NE Gain	MCAL/LB	.35	.11
P	%		
Ca	%		
K	%		
MG	%		
Soluble Protein	%		
Dry Matter Classification		2	
Protein Index		47	
Energy Index		104	

NOTICE-Proper sampling techniques and complete sample identification are critical to ensure a representative analysis of your crops!
Requested Wet Chemistry Mineral Analysis will be mailed when completed