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Assessment of Protein and Fiber Content of Kansas Grasslands Enrolled in the Conservation Reserve Program

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Abstract

The objective was to assess the nutrient composition of standing Conservation Reserve Program (CRP) forages across Kansas throughout the year in relation to various environmental and management factors impacting forage quality. Forage samples (n = 294) were collected from a total of 25 different sites across 16 counties in Kansas over a two-year period. Samples were collected monthly and analyzed in a single commercial laboratory to determine changes in nutrient composition throughout the year. Crude protein, acid detergent fiber, neutral detergent fiber, and total digestible nutrients are reported. While nutrient composition varied considerably by month, protein and fiber content, and subsequent energy measurements generally followed typical seasonal patterns for warm-season forages. In May, forage samples collected from eastern Kansas were greater in total digestible nutrients ($P \leq 0.05$) compared to northwest Kansas. Understanding the nutrient composition of CRP forages is essential for effective livestock management and to make informed policy decisions. These data will help address a significant gap in the current literature.

Introduction

Throughout the United States, the number of acres of intact native prairie grasslands has decreased considerably in recent years. The Conservation Reserve Program (CRP) was established by the U.S. Department of Agriculture in the 1985 Food Security Act. Managed through the Farm Service Agency, the CRP program contracts with participants who remove highly erodible land from agricultural production and instead establish grassland forage species in return for financial payment. In 2024, Kansas was among the top five states for land in CRP acreage. Each year, CRP lands may be released for livestock grazing or haying primarily due to drought or other similar events that reduce forage availability. Although CRP lands are a critical forage resource for beef cattle, nutrient composition data of standing CRP forages are not readily available. Nutrient content information is essential for effective nutrition management of beef cattle when utilizing CRP forages. Growing season length, soil type, years of enrollment in CRP, average annual precipitation, and management practices may all affect forage quality. The objective of this collaborative, statewide field study was to measure the nutrient content of standing CRP forages throughout the year relative to factors that may influence sample quality.

Experimental Procedures

This project was a collaborative initiative among Kansas State University Research and Extension agents and Extension Beef Cattle specialists within the Livestock Program Focus Team. Preliminary data from this project were reported previously (Schwartz et al., 2025). Agents and specialists identified cooperating producers located within local Extension units throughout Kansas that owned or directly managed lands enrolled in the CRP program and requested permission to access lands for sample collection. A total of 12 different agents and specialists representing 19 different producers across 16 counties throughout Kansas participated in the project. Of the counties from which samples were collected, an equal proportion (n = 8/region) were from the eastern and northwestern regions of the state. Eastern region counties included Chase, Greenwood, Jackson, Jefferson, Montgomery, Nemaha, Pottawatomie, and Wabaunsee. Northwestern region counties included Barton, Cheyenne, Gove, Logan, Phillips, Rooks, Thomas, and Trego. A total of 294 samples were collected during a 23-month period, from February 2023 to December 2024, and analyzed.

All personnel used 0.96 ft^2 sampling hoops, and hand clipped all forage within the hoop to a height of approximately 1-in. above the ground surface. All nutrient composition data presented are the result of both current and any previous year's vegetation from all forage species, except woody species. All samples were analyzed by a commercial laboratory (SDK Laboratories, Inc., Hutchinson, KS) for wet chemistry analysis of protein, fiber components, and macrominerals. Units of energy composition were subsequently calculated from fiber content.

Data were analyzed using SAS (SAS, Inc., Cary, NC), and the MEANS procedure was used to calculate simple means, standard deviations, and minimum and maximum values for all nutrients analyzed. Structured mean comparisons were made between regions for the primary growing season months (April – September) with the sample as the experimental unit for analysis of crude protein (CP) and total digestible nutrients (TDN). For these comparisons, a mixed effects model was used with the MIXED procedure. The model included the fixed effect of region with Extension personnel, year, producer, precipitation, soil type, and previous management history as random effects. For these comparisons, means were declared significant at a P-value ≤ 0.05, and tendencies were declared at a P-value > 0.05 and ≤ 0.10.

Results and Discussion

Counties from both the eastern and northwestern regions of the state were included in the analysis, representing substantially different precipitation gradients, soil types, and growing season lengths. Data for CP are reported in Table 1 and demonstrate that concentrations generally increase during the growing season and decrease during the winter months. During the primary growing season months, samples analyzed did not differ ($P \geq 0.05$) in CP content, but peaked earlier for samples collected from eastern Kansas (Figure 1). Acid detergent fiber and neutral detergent fiber concentrations (Table 2) on a dry matter (DM) basis were generally highest during winter months when forages were dormant and appeared to decrease as plants entered the vegetative stage during the growing season. This matches the general increase in CP concentration during this time. As with CP, forage TDN for samples from eastern Kansas appeared to reach maximal concentrations (approximately 50%, DM basis) in May, while concentrations peaked in June for samples from northwestern Kansas (Figure 2). During May, TDN concentrations (% DM basis) were higher ($P \leq 0.05$) for eastern (51.1) relative

to northwestern (39.6) Kansas. Interestingly, statistical differences were not observed during other months.

Implications

Understanding the nutrient composition of Kansas CRP forages that may be released for livestock grazing or haying is critical for: 1) assisting producers in making informed management decisions, 2) guiding Extension personnel and nutritionists in developing sound nutrition programs, and 3) aiding CRP land management personnel when making local forage accessibility decisions. These data are valuable for improving the completeness and accuracy of feedstuff composition tables, specifically for diet formulation software programs used by Extension and industry personnel.

Acknowledgments

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References

Schwartz, A.G., B.J. Fraser, J.W.L. Banks, S.K. Johnson, and J.M. Warner. 2025. Assessment of nutrient content of Kansas grasslands enrolled in the Conservation Reserve Program. Kansas Agricultural Experiment Station Research Reports 11(1) *https://doi.org/10.4148/2378-5977.8660*

Table 1. Descriptive statistics of crude protein content (% dry matter basis) of Conservation Reserve Program forage samples collected for analysis by region and month

	Samples (number)	Mean	Median	Standard deviation	Minimum	Maximum
Eastern Kansas						
January	2	3.5	---	0.1	3.4	3.6
February	4	2.9	---	0.6	2.2	3.6
March	12	4.1	3.8	1.3	2.7	7.4
April	15	5.2	4.2	2.7	2.0	12.6
May	17	7.4	6.5	3.0	4.1	16.0
June	14	6.4	---	1.5	4.0	9.6
July	21	5.0	4.8	1.2	3.5	8.6
August	11	5.2	---	1.6	3.0	8.1
September	20	3.9	3.5	1.8	1.7	9.3
October	17	4.0	3.8	2.1	1.7	10.0
November	15	3.9	3.2	1.8	2.3	7.9
December	11	3.3	3.2	1.9	1.6	8.2
Northwestern Kansas						
January	---	---	---	---	---	---
February	6	3.0	---	0.6	2.2	3.7
March	15	3.5	3.1	2.3	1.8	10.8
April	13	3.5	2.4	2.0	1.9	7.8
May	18	3.7	3.2	2.2	1.8	11.7
June	4	6.6	---	6.4	2.3	16.0
July	23	4.0	---	1.0	2.8	6.4
August	18	3.9	---	0.9	2.7	5.6
September	12	3.0	3.0	0.8	2.2	5.3
October	11	3.3	3.1	1.2	2.2	6.5
November	8	3.2	---	0.7	2.2	4.6
December	7	3.2	---	0.6	2.2	4.0

Table 2. Descriptive statistics of acid detergent fiber (ADF) and neutral detergent fiber (NDF) content of Conservation Reserve Program forage samples collected for analysis by region and month[1] (% dry matter basis)

Number of samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
East	2	4	12	15	17	14	21	11	20	17	15	11
Northwest	---	6	15	13	18	4	23	18	12	11	8	7
ADF East												
Mean	48.9	48.1	49.3	46.7	39.7	39.2	41.2	45.4	44.8	45.4	44.0	49.4
Standard deviation	1.9	1.9	2.5	6.1	5.8	5.6	4.0	1.9	3.2	4.7	4.3	4.9
Minimum	47.6	46.8	46.3	30.7	27.3	30.3	33.5	41.4	37.6	39.0	37.8	38.5
Maximum	50.3	50.9	53.9	52.9	50.0	45.7	48.5	47.7	50.8	54.9	51.1	56.8
ADF Northwest												
Mean	---	50.9	50.6	50.0	46.3	40.9	45.8	45.1	47.3	47.7	49.3	51.2
Standard deviation	---	2.2	2.5	3.6	5.6	11.2	4.3	3.6	5.1	2.9	4.6	1.9
Minimum	---	48.4	45.3	41.5	36.2	24.1	39.2	37.4	40.5	42.0	40.4	47.8
Maximum	---	53.9	54.4	53.4	56.2	47.5	52.3	50.5	57.5	50.4	54.0	53.4
NDF East												
Mean	72.2	66.9	66.9	67.6	63.1	62.9	65.1	64.6	64.9	67.7	69.6	68.4
Standard deviation	1.3	3.1	4.2	6.0	4.9	4.3	3.4	6.0	4.1	5.6	4.8	5.4
Minimum	71.3	64.2	60.5	54.4	51.9	57.3	59.6	51.3	58.9	48.4	58.1	59.0
Maximum	73.2	71.4	74.1	73.9	70.1	67.4	70.6	71.9	75.7	75.8	74.3	73.5
NDF Northwest												
Mean	---	70.3	68.4	69.8	68.3	62.1	66.4	65.4	67.8	67.9	69.3	70.4
Standard deviation	---	4.1	5.0	4.7	5.4	14.9	3.6	3.3	5.4	2.5	4.7	2.1
Minimum	---	64.2	61.0	60.7	58.7	40.8	61.7	60.8	61.8	64.4	60.5	66.2
Maximum	---	74.0	75.5	75.5	75.9	72.5	73.8	71.6	77.5	71.8	74.5	72.3

[1]Jan = January; Feb = February; Mar = March; Apr = April; Jun = June; Jul = July; Aug = August; Sep = September; Oct = October; Nov = November; Dec = December.

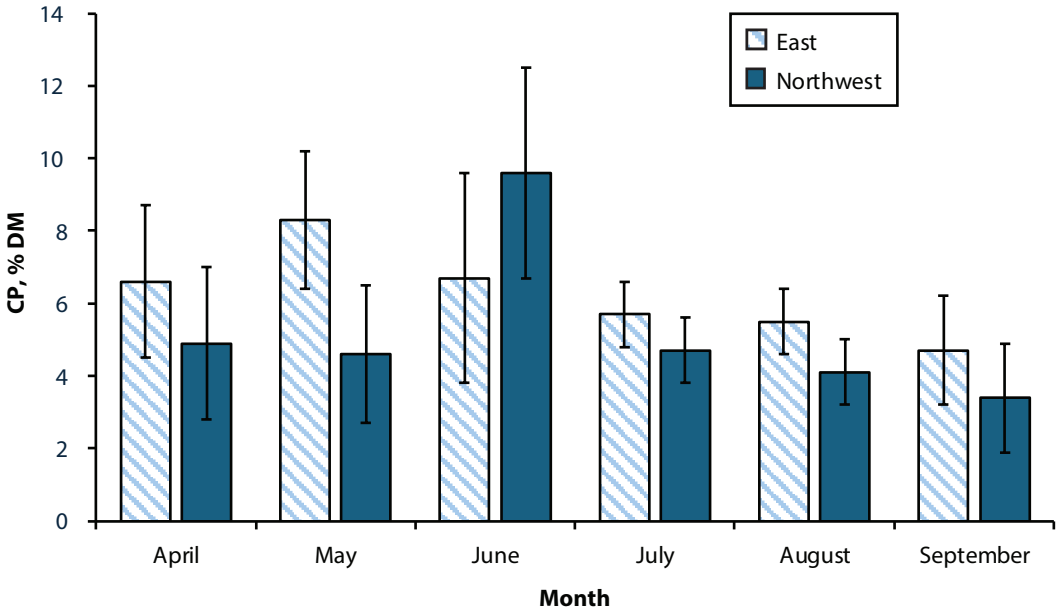

Figure 1. Conservation Reserve Program forage crude protein (CP) content (% dry matter [DM] basis) in Kansas by region during key growing season months. Means within a month without superscript labels are not different at $P > 0.10$.