Chemical Composition of Six Southern Great Plains Grasses as Related to Season and Precipitation

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Highlight: *This research determined the effect of season and precipitation on the chemical composition of six grasses of the High Plains of Texas. Seasonal influences caused variations in crude protein, ether extract, ash, crude fiber, and water. Nitrogen-free extract did not show a seasonal trend. Crude protein, crude fiber, and water content were directly influenced by the rainfall pattern during the growing season; but rainfall did not appear to significantly affect the other chemical components.*

This study was undertaken to determine the seasonal differences in relative nutritive values of six grasses and to ascertain whether erratic rainfall affects the percentage of the chemical fractions. Proximate analyses of six grasses commonly found in the Southern Great Plains were studied. Sideoats grama (*Bouteloua curtipendula* [Mich.] Torr.) and western wheatgrass (*Agropyron smithii* Rydb.) are common in many areas and contribute significantly to the grazing capacity of the rangeland. The other four grasses analyzed, silver bluestem (*Andropogon saccharoides* Swartz), sand dropseed (*Sporobolus cryptandrus* [Torr.] Gray), red threeawn (*Aristida longiseta* Steud.) and tumble windmillgrass (*Chloris verticillata* Nutt.) are usually considered weedy species that contribute little to the diets of grazing animals. Sideoats grama and western wheatgrass are normally found in the more advanced successional stages while the other four are common in the early stages of succession.

Study Area and Methods

The six grasses sampled are common to the deep hardland range site of the High Plains of Texas. Pullman silty clay loam is the dominant soil of this site. The climate is typified by spring and late summer rainfall and dry winters. High winds and high temperatures during the growing season result in high evaporation rates which reduce the moisture available to plants. Moisture is the most critical factor controlling forage production.

The research was conducted at the Texas Tech University Research Center near Amarillo, Texas. The Center is located on the Llano Estacado, a nearly level, elevated, but treeless area covering much of northwest Texas and eastern New Mexico.

Plant samples were collected monthly by hand plucking to simulate grazing. Each sample was weighed following collection, heated at 105 C for 5 minutes; then dried at 70 C for 24 hours. The samples were ground in a Wiley mill and preserved as described by Davies et al. (1948). Water content was calculated as the percent weight loss of the sample due to drying in the oven. Other chemical fractions were expressed as percentage of the oven-dry weight. The proximate analysis was conducted according to the methods of the AOAC (1960).

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Results

Crude Protein

Trends in crude protein percentage were the same for all species throughout the year. Western wheatgrass generally had the highest crude protein content during the growing season whereas tumble windmillgrass contained more during the winter period, since it is a cool season grass. Crude protein was highest when the rainfall was adequate and the plants were making rapid growth. The lowest content occurred during the winter period (Fig. 1).

Crude protein content was highest in the spring when rainfall was high and the plants were just beginning growth. A low occurred in the protein content of all grasses during August when no rainfall was received. Rainfall in September stopped the decline of protein content in sand dropseed, silver bluestem, and sideoats grama. The percentage increased slightly in the other species during September and October. After dormancy occurred in October, protein content slowly declined until the resumption of growth in March.

The quality of hand plucked forage to simulate that obtained by grazing animals seldom approaches that which the animals actually select (Van Dyne and Torell, 1964). Animals seem to have the ability to select quality forage. It could be assumed, then, that cattle grazing rangelands containing the grasses analyzed would gain a higher percentage of protein than the values reported in this paper. Nevertheless, these data should give a good indication of trends in protein content throughout the year.

These analyses bear out the apparent livestock need for protein supplementation beginning with dormancy of the major species in November. The necessity for protein supplements increases as plant protein declines during the winter season. This decline is broken only by the resumption of spring growth. The presence of a cool season grass such as western wheatgrass will help maintain higher protein levels, but it too is limited in growth by the dry winter period common in this region.

Ether Extract

Western wheatgrass contained a much higher percentage of ether extract than the other grasses throughout the year. The slight differences in the other five grasses were not significant. Seasonal variation was high in western wheatgrass, but low in the other species. The highest amounts occurred in all species during the summer months and the lowest in December. There was no apparent correlation between the rainfall pattern and percentage of ether extract. It seemed more affected by season than by the rainfall pattern (Fig. 1).

Ash

Among the six species, the percent ash content was generally highest in tumble windmillgrass and lowest in sand dropseed throughout the year. The ash fraction increased from June to the following April in all species (Fig. 1).

Ash content and rainfall pattern were apparently not correlated. Highest ash contents occurred just before new growth began in the spring, whereas the lowest percentages occurred in new plant material in the spring.

Crude Fiber

Crude fiber content was generally higher in red threeawn, sand dropseed, and silver bluestem than in the other grasses. Crude fiber content was quite stable throughout the year in tumble windmillgrass, but was much more variable in the other species. Highest percentages of crude fiber occurred during the dormant season, while the lowest occurred when the plants were making rapid growth in the spring and early summer.

The rainfall pattern during the growing season seemed to affect the crude fiber content. Rains in the spring and late summer resulted in a flush of new growth which had a lower percentage of fibrous material than the plant material present during a dry period (Fig. 1).

Nitrogen-Free Extract

Nitrogen-free extract was quite variable in all species (Fig. 1). Theoretically, the nitrogen-free extract content of a sample is a mixture of the sugars and starches. Nitrogen-free extract is the difference between the sample weight and the sum of the weights of the other components that were chemically determined. The calculated value of this fraction is affected by any errors in the other analyses and also the ability of the crude fiber analysis to separate out the different functional categories of carbohydrates (Crampton and Harris, 1969).

No direct relationship was detected in comparing the nitrogen-free extract content with season of growth and rainfall pattern. The numerical value of this fraction is automatically affected by the several factors that may influence the other chemical constituents of the sample.

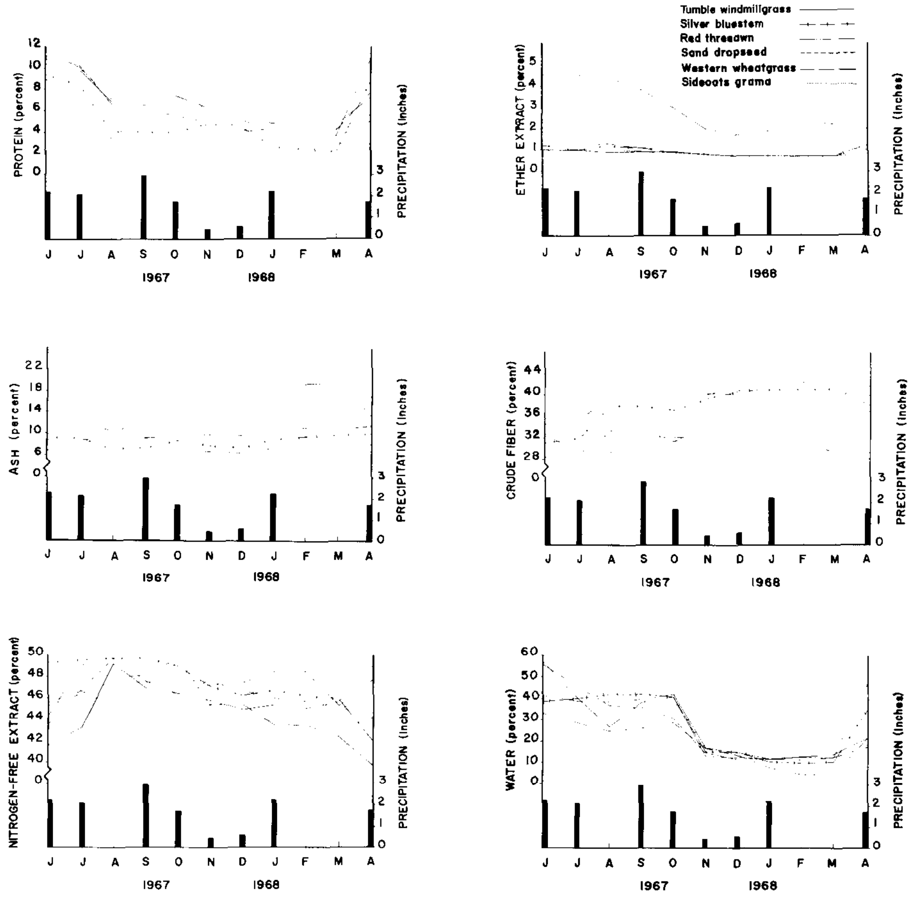

Fig. 1. *Percentage fractions of the proximate amalysis of six grasses showing effect of season and precipitation.*

Water

The percentage of water in the fresh forage responded both to the season and to the rainfall pattern. The water content was highest during the growing season when the plants were green and lowest throughout the dormant period. As early spring rains replenished soil mositure, new growth was high in water content. The dry month of August resulted in a partial drying-out of plant material. Fall rains, however, induced additional growth and uptake of water. With the cessation of growth in the dormant season, water uptake ceased and the percent water content decreased gradually to a low in March just before spring green-up (Fig. 1).

Hyder (1967) reported that the moisture content of forage is a satisfactory index of forage intake when the amount of available forage is not limited. He reported that moisture contents below 50% indicated a progressive decrease in forage intake by grazing animals, coupled with a loss in efficiency of feed utilization. Applying this reasoning to our data, it appears that forage intake and efficiency of feed utilization would be greater during the growing season than during the dormant period. The combined effects of reduced protein content, reduced forage intake, and reduced efficiency of feed utilization would indicate a definite need for winter supplemental feeding on rangelands where these species are dominants.

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