Chemical Composition of Native Range Grasses Growing on Saline Soils of the South Texas Plains

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Abstract

During the growing seasons of 1976 and 1977, six native range grass species and a composite of miscellaneous grasses growing on Saline Clay and Rolling Hardland range sites (both sites have saline soils) in south Texas were analyzed for percentage content of crude protein (CP), P, Ca, Mg, K, and Na. Levels of CP, P, K, and Na were generally highest after periods of adequate rainfall in late spring, summer, and early fall and lowest in late fall as the grasses went into dormancy. Levels of Ca and Mg remained relatively stable through the growing season and showed little relationship to rainfall. Grasses from the Saline Clay site had slightly higher levels of the chemical constituents than those grasses from the Rolling Hardland site.

Over 2 million ha of rangeland within the South Texas Plains is seriously affected by soil salinity (Godfrey et al. 1973). The area with the greatest percentage of salt-affected soils occurs primarily on the Neuces, Frio, and Rio Grande River watersheds (Fanning et al. 1965). Appreciable concentrations of soluble salts in the upper profile of these soils limit plant growth (Davis and Spicer 1965; Fanning et al. 1965). The range sites made up of these soils are characterized by large bare soil areas or "slicks" with surface deposits of Na and Ca salts which decrease herbaceous biomass production. Attempts at reseeding these sites with improved grasses have generally been unsuccessful (Fanning et al. 1965). Thus, cattle grazing on these sites are primarily dependent on native vegetation for forage.

Little information is available on the nutrient content of native grasses growing on the saline range soils of south Texas. A knowledge of the nutritive value of the grasses growing on these soils would greatly enhance the management of these ranges. Our objective was to characterize the crude protein (CP) and mineral composition throughout the growing season for a 2-year period for six grasses growing on a Saline Clay range site and six grasses growing on a Rolling Hardland range site.

Study Area and Methods

This study was conducted on the Manges Ranch, 25 km north of Roma, Texas, in Starr County. The climate is mild with short winters and relatively warm temperatures throughout the year. The average length of the growing season is 300 days (USDC 1970). Summer temperatures and evaporation rates are high. The average annual rainfall is 43 cm. Average rainfall is lowest in January or February and highest in May or June and September. The topography is nearly level to gently undulating with a few hilly areas broken by caliche and gravely ridges. Two major range sites occur on the ranch: Saline Clay and Rolling Hardland. Both are made up of saline soils. The saline Clay site is comprised of Catarina soils (Palleustollic Torrents) whereas the Rolling Hardland site is made up of Maverick soils (Ustollic Camborthids).

Both sites are dominated by a variety of woody plants and grasses. The vegetation of these sites is similar to that described by Thompson et al. (1972). The most abundant grasses from each site were selected for chemical analyses. Six species of grasses plus a composite of miscellaneous species were sampled monthly from each range site during the growing seasons of 1976 and 1977. The six grasses collected from the Saline Clay site were curly mesquite *(Hilaria belangeri)*, whorled dropseed *(Sporobolus pyramidatus)*, plains bristlegrass *(Setaria macrostachya)*, pink pappusgrass *(Pappophorum bicolor)*, Arizona cottontop *(Digitaria californica)*, and white tridents *(Tridens albescens)*. The six grasses collected from the Rolling Hardland site were red grama *(Bouteloua trifida)*, curly mesquite, whorled dropseed, pink pappusgrass, Arizona cottontop, and plains bristlegrass. Red grama and whorled dropseed are generally considered as invader species on these sites. However, their abundance warranted determining their nutritive status. The other grasses are classified as having fair-to-good grazing values (Thompson et al. 1972). Cattle grazed both sites intermittently throughout the year.

Composited samples from 15 or more plants were collected at random for each grass species at the end of each collection month. Due to heavy grazing, plant collection at specific stages of growth was difficult. Most species were in early leaf and vegetative stages of growth in March, April, and May, and reached maturity in June or July. Most grasses remained in the mature stage through September or October and reached dormancy by November. Whole grass samples (both leaves and stems) were clipped 2 to 3 cm above ground, air dried at 65° C for 48 hours, ground in a wiley mill through a 1-mm mesh screen, thoroughly mixed, and stored in sealed jars. An attempt was made to sample grazed plants. Rainfall was recorded monthly during the 2-year period.

Plant samples were analyzed for crude protein (CP), P, Ca, Mg, K, and Na. Total N was determined by the Kjeldahl method (Peech et al. 1947). Nitrogen levels were multiplied by 6.25 and expressed as % CP. Levels of Ca, Mg, K, and Na were determined by atomic absorption spectrometry (Boettner and Grunder 1968). Lanthanum oxide was added to Ca and Mg samples to reduce interference. Phosphorus was determined by the rapid digestion method (Bolin and Stramberg 1944). Samples were analyzed in duplicate.

Soil samples were taken for salinity analyses in June 1976, December 1976, and April 1977. Five samples were taken at random from each site, each at 15-cm increments to a 60-cm depth. Soil salinity was determined on the saturated extract using a conductivity meter (U.S. Salinity Laboratory Staff 1954). The mean electrical conductivity (ECe) value and standard deviation were determined for each increment on each date.

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Table 1. Electrical conductivity (ECe) of the soil extracts from Rolling Hardland and Saline Clay range sites in Starr County, Texas. Values are expressed in 15-cm increments in soil depth.

Range site and Sampling date	ECe of soil extracts (mmhos/cm)							
	0–15 cm		15–30 cm		30–45 cm		45–60 cm	
	$\bar{X}$[1]	S.D.[2]	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.
Rolling hardland								
June 1976	6.8	2.6	11.6	3.9	13.4	3.2	14.0	3.1
December 1976	9.7	3.3	12.9	4.2	14.2	2.8	13.4	2.6
April 1977	10.0	3.1	15.3	3.5	16.9	3.0	16.4	1.2
Saline clay								
June 1976	4.4	2.2	9.4	3.4	13.5	2.5	15.4	2.1
December 1976	5.6	1.6	11.0	3.0	16.0	1.8	17.9	1.4
April 1977	5.7	2.5	10.5	3.3	15.4	2.6	17.9	1.3

[1] $\bar{X}$ = Mean
[2] S.D. = Standard deviation

Nutrient data for Ca, Mg, K, and Na were summarized for all sampling dates for the 2 years. The mean and standard deviation for each of these minerals were determined for each species.

Results and Discussion

Soil Salinity

Table 1 shows the soil salinity in 15-cm increments from 0 to 60-cm depth for the Saline Clay and Rolling Hardland range sites for three dates during the study. The ECe values of the saturated soil extracts were similar for both sites; however, the 0 to 15-cm and 15 to 30-cm increments on the Rolling Hardland site had higher ECe values than those on the Saline Clay site. The 0 to 15-cm depth on the Rolling Hardland site had an average ECe value of 8.8 as compared with 5.2 from the Saline Clay site. The ECe values, as related to the effect on plant growth by the U.S. Salinity Laboratory Staff (1954) are as follows: above 8.0 mmhos/cm, only moderately salt-tolerant species grow well; and above 12.0 mmhos/cm, only the most salt-tolerant species survive. Based on these guidelines, the average ECe values for both sites would be considered in the high salinity range.

Crude Protein (CP)

Among the grasses sampled from both sites, whorled dropseed and plains bristlegrass usually contained the highest CP levels (Fig. 1). Grasses were generally highest in CP after periods of adequate rainfall during late spring, summer, or early fall, and lowest during late fall or periods of low rainfall and high temperatures during the summer. These findings generally agree with those reported in other south Texas studies (Varner and Blankenship 1978; Everitt et al. 1980). The grasses sampled from the Rolling Hardland site did not always respond with increased CP content following increased rainfall. This was particularly evident in July 1976. This phenomenon may be related to the higher salinity levels in the upper soil profiles on this site combined with the high summer temperatures. Crude protein levels in grasses did not vary greatly between the two years even though rainfall during the 1977 growing season was about one-half of that received during the 1976 growing season.

Phosphorus

Whorled dropseed contained the highest P levels among the grasses sampled from the Saline Clay site, whereas on the Rolling Hardland site, whorled dropseed, Arizona cottontop, and plains bristlegrass had the highest P levels (Fig. 2). Phosphorus levels followed the same general trend as CP, being highest following periods of higher rainfall during the growing season and lowest during late fall and during periods of low rainfall and high temperatures in summer. Phosphorus levels in those grasses from the Saline Clay site were consistently higher during both years of the study than in grasses from the Rolling Hardland site.

Calcium, Magnesium, Potassium, and Sodium

The 2-year average content of Ca, Mg, K, and Na for each of the grasses sampled from both range sites is presented in Table 2. Individual monthly data is not shown for these minerals. Plains bristlegrass contained the highest levels of Ca among the grasses analyzed from both sites. Calcium levels of grasses from both sites showed little or no relation to either season of year or rainfall and remained relatively stable throughout the growing season. These

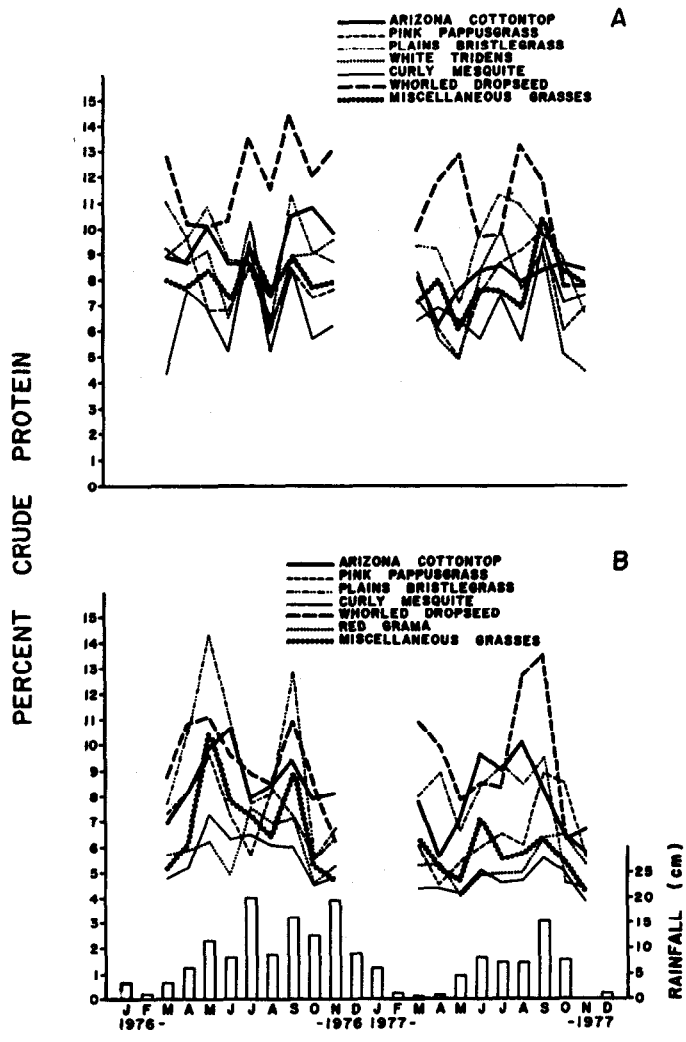

Fig. 1. *Monthly (March–November) crude protein content of six grass species and a composite of miscellaneous grasses growing on Saline Clay (A) and Rolling Hardland (B) range sites in Starr County, Texas, during the growing seasons of 1976 and 1977.*

Table 2. Average content of calcium, magnesium, potassium, and sodium in range grasses growing on Rolling Hardland and Saline Clay range sites in Starr County, Texas.

Range site and species	Ca		Mg		K		Na	
	$\bar{X}$[1]	S.D.[2]	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.
	(% dry matter)							
Rolling hardland								
Plains bristlegrass	0.69	0.19	0.16	0.03	1.06	0.31	1.40	0.41
Arizona cottontop	0.56	0.12	0.14	0.02	1.39	0.44	0.08	0.04
Pink pappusgrass	0.50	0.16	0.09	0.02	1.21	0.43	0.17	0.12
Whorled dropseed	0.62	0.11	0.14	0.03	0.78	0.35	1.01	0.33
Red grama	0.66	0.15	0.07	0.02	0.56	0.19	0.03	0.01
Curly mesquite	0.53	0.11	0.08	0.02	0.68	0.33	0.04	0.03
Misc. grasses	0.64	0.09	0.14	0.02	0.97	0.27	0.29	0.09
Saline clay								
Plains bristlegrass	0.68	0.13	0.16	0.03	1.23	0.33	1.26	0.28
Arizona cottontop	0.58	0.16	0.13	0.02	1.46	0.38	0.07	0.03
Pink pappusgrass	0.61	0.18	0.11	0.02	1.47	0.36	0.06	0.03
White tridens	0.67	0.15	0.11	0.03	1.53	0.41	0.18	0.14
Whorled dropseed	0.60	0.10	0.17	0.03	1.15	0.29	1.32	0.36
Curly mesquite	0.51	0.15	0.10	0.03	0.87	0.29	0.05	0.02
Misc. grasses	0.63	0.13	0.17	0.04	0.93	0.14	0.48	0.20

[1] $\bar{X}$ = Mean
[2] S.D. = Standard deviation

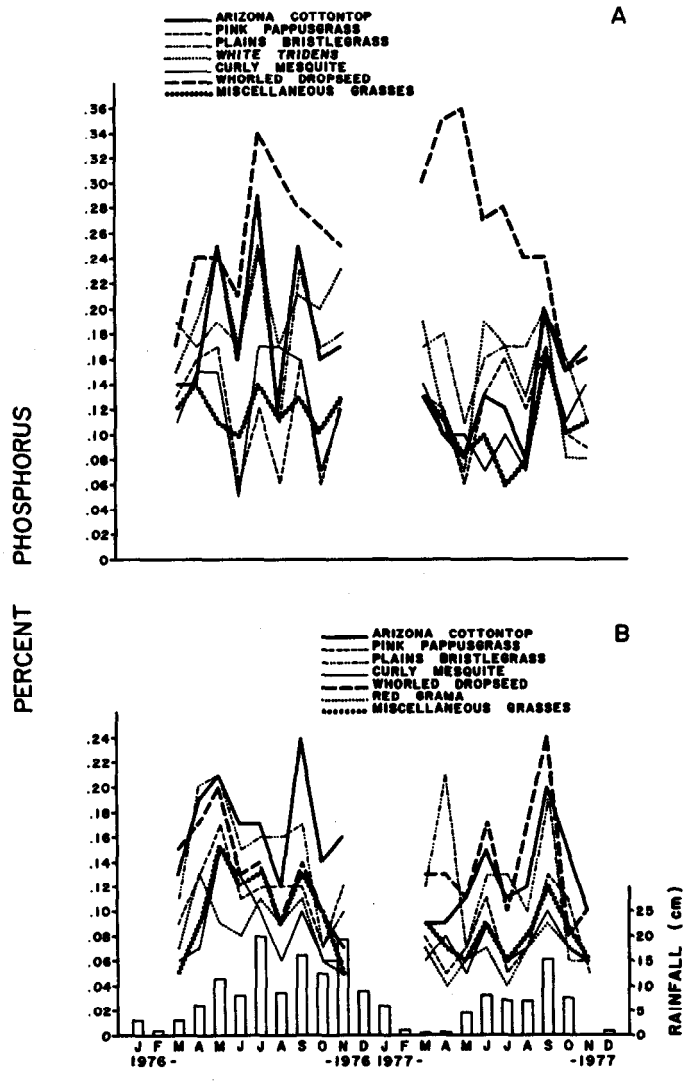

Fig. 2. *Monthly (March–November) phosphorus content of six grass species and a composite of miscellaneous grasses growing on Saline Clay (A) and Rolling Hardland (B) range sites in Starr County, Texas during the growing seasons of 1976 and 1977.*

results are in close agreement to those reported by Nelson et al. (1970) and Everitt et al. (1980).

The mean Mg content of grasses ranged from 0.07% in red grama from the Rolling Hardland site to 0.17% in whorled dropseed and miscellaneous grasses from the Saline Clay site. Except for a slight decrease in several species during the fall, Mg levels were generally stable throughout the growing season and showed little relationship to season. Other workers have reported similar findings (Nelson et al. 1970; Munshower and Neuman 1978; Everitt et al. 1980).

Lawton and Cook (1954) in their review of the role of K in plant nutrition indicated that most grasses contained between 0.80 and 1.50% K. Most of the grasses analyzed in this study contained K levels within this range. Potassium levels had the same general monthly trend as that shown for CP and P.

Sodium content of grasses was quite variable among the species sampled from both sites. Plains bristlegrass and whorled dropseed contained the highest levels of Na among the grasses sampled from both sites. Except in red grama and curly mesquite, Na levels of grasses followed the same general monthly trend as that shown for CP and P. These findings are in general agreement with those reported for grasses growing on sandy and red sandy loam range sites in south Texas (Everitt et al. 1980). However, studies in New Mexico and Idaho have shown no relation between date and Na content of grasses (Nelson et al. 1970; Murray et al. 1978).

These results are indicative rather than definitive since data were collected from only a single study area for each site. Moreover, sample selection by researchers has often shown to underestimate the quality of food selected by livestock (Van Dyne and Torell 1964). However, since the vegetation of the study areas was typical to that described for the Saline Clay and Rolling Hardland sites (Thompson et al. 1972), these data should provide a general index to the nutrional quality of comparable grass species growing on these sites in south Texas.

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