NUTRITIONAL PARAMETERS OF SEVEN IMPROVED GRASSES ON THE TEXAS HIGH PLAINS

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ABSTRACT

Seven improved grass species were evaluated for nutritional parameters of new growth at 30-day intervals and regrowth 30 days after initial harvest. The species were Blackwell switchgrass (Panicum virgatum), El Reno sideoats grama (Bouteloua curtipendula), Morpa weeping lovegrass (Eragrostis curvula), and four old world bluestem selections including Caucasian (Bothriochloa caucasica), WW517 (B. intermedia var. indica), Ganada (B. ischaemum var. ischaemum), and WWspar (B. ischaemum var. ischaemum). Established stands located in Garza county (Post) on a fine sand and in Lubbock (Lubbock) and Terry counties (Brownfield) on sandy loam soils were sampled monthly from May to September and in December. Samples were analyzed for crude protein and in vitro digestible organic matter (IVDOM). Crude protein declined through the season with no single species consistently different from the others. However, sideoats grama did not decline as rapidly as other species during July and August. The IVDOM for all species declined through the season but not as rapidly as did crude protein. The decrease averaged about 20 percentage points from May to December for standing phytomass and 10 percentage points for 30-day regrowth. Regardless of nutritional parameter, quantities measured were below maintenance requirements for 500 lb steers by July.

INTRODUCTION

Since the inception of the Conservation Reserve Program in 1986, about 2,967,000 acres have been returned to grass cover (ASCS, 1989). This acreage was planted on land classified as marginal for successful row crop production. At the end of the 10-year lay out period this grassland can be grazed or returned to marginal crop production with its inherent erosion problems. However, if these grassland areas are grazed, this conversion to high yielding forage species has been shown to increase the potential for economic gains (Cotter and Dahl, 1984).

In addition to the quantity of forage available, the nutritional quality influences grazing animal performance. The nutritional value of grass changes with season, developmental stage, and environmental conditions (Blaser, 1964; Cogswell and Kamstra, 1976). The rapid change in forage nutrition should be considered when using improved grasses in a grazing system. Two basic measures of quality are considered reasonable indicators of animal performance. These are crude protein and **in vitro** digestible organic matter (IVDOM) (Minson, 1980; Marten, 1981). If the quality as well as the quantity of available forage is considered when making management decisions, optimal use of the resource is possible.

MATERIALS AND METHODS

Study Areas

Three areas with coarse-textured soils were chosen for this project. The first site was in Lubbock county (Lubbock). The soil is an Acuff loam (Blackstock, 1979), which is a fine loamy mixed thermic Aridic Paleustolls. The second site was located in Terry county (3 miles north of Brownfield). The soil at this site is a loamy fine sand of the Amarillo series (Sanders, 1962) which is a loamy fine mixed thermic Aridic Paleustalfs. The third site, located in Garza county (Post), is more undulating and sandier than the other sites. The soil at this site is a fine sand of the Brownfield Series and classified as a loamy mixed thermic Arenic Aridic Paleustalfs (Richardson et al., 1975).

The climate of the southern High Plains is warm temperate, subtropical and characterized by dry winters, long summers, high winds, and high evaporation. The average frost free period is 211 days from early April to early November (NOAA, 1981). Annual precipitation averages 18 inches with about 75% occurring as convection storms from April to October. However, monthly and annual totals vary greatly. In the three counties included in this study, annual precipitation has ranged from 3.18 to 43.31 inches.

During this study annual rainfall varied from 22.20 inches at Post in 1981 to 14.84 inches at Brownfield in 1982 (Marietta 1985). These totals were from 3.39 inches above the long-term average to 2.36 inches below average. Overall, 1981 had the most precipitation during the study. In addition, the distribution of rainfall during the 1981 growing season was more beneficial for plant growth than in 1982 or 1983. Late July and August rains resulted in increased growth late in the growing season. In 1983, heavy October rains resulted in excellent greenup and regrowth.

Forage Analysis

Seven species were selected for evaluation and included two native and five introduced grasses. The native grasses were Blackwell switchgrass (**Panicum virgatum** L.) and El Reno sideoats grama [**Bouteloua curtipendula** (Michx.) Torr.]. Introduced grasses were Morpa weeping lovegrass [**Eragrostis curvula** (Schrad.) Nees.] and four old world bluestems (OWB) which included Caucasian [**Bothriochloa caucasica** (Trin.) C.E. Hubb.], WWspar [**B. ischaemum** (L.) Keng var. **ishchaemum**], Ganada [**B. ischaemum (L.) Keng var. ischaemum**] and WW517 [**B. intermedia** (R.Br.) var. **indica**]. Each of the introduced grasses used were adapted to the region and recommended for this area (Dalrymple, 1978). All species were seeded in both 1981 and 1982. Plots were sampled one year following the establishment year.

Samples for chemical analysis were obtained from forage yield samples. Two subsamples for each species, at each sampling period, location, and treatment were obtained. The chemical analysis samples were composed of all above ground phytomass. Thus, the samples contained leaf tissue, culms, reproductive culms, and fruits in proportion to their occurrence in the field.

The samples were ground in a Wiley mill to pass a 40 mesh screen and stored in air-tight containers. Percent crude protein on a dry weight basis was determined using standard micro-Kjeldahl techniques (AOAC, 1980). Percent IVDOM was determined using the first stage of the modified Tilley and Terry (1963) procedure followed by neutral detergent extraction (Van Soest et al. 1966; Van Soest and Wine, 1967). The values were adjusted for percent organic matter and dry weight (Harris, 1970). Fresh weights were recorded for the Lubbock samples and were used to calculate moisture content on a fresh weight basis. All samples were dried to a constant weight in a forced air drier at 122°F and weighed.

Statistical analysis of the quality measures consisted of analysis of variance and LSD ($P<0.05$) mean separation test (Cramer and Walker, 1982) among species for each treatment, location, sample period, and year. Analysis across locations and years were performed.

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RESULTS

Crude Protein

Crude protein concentrations varied among locations for both standing phytomass and 30-day-old regrowth at each sample date in 1982 and 1983 (Tables 1 to 3). Plants from Lubbock had the highest values followed by Post. At Brownfield crude protein levels averaged across species were from 32 to 47% less in 1982 and 18 to 38% less in 1983 than those at Lubbock for standing phytomass. The reduction in regrowth crude protein from Lubbock to Brownfield averaged 35% in 1982 and 30% in 1983.

As the season progressed the crude protein levels generally decreased for all samples. For the standing phytomass samples, crude protein levels decreased rapidly with maturity of the plants. The regrowth crude protein levels also decreased but at a slower rate. One exception was for standing phytomass of weeping lovegrass at Lubbock in 1982 when crude protein increased from 5.7% in June to 7.4% in July. This was due to production of new shoots and leaves after seed shatter in June.

When increases were observed in regrowth crude protein, it was due in part to a reduction in the quantity of material present. In addition, when production was low the material was primarily leaf tissue. One example of this was weeping lovegrass at Brownfield in 1982 where from July to August to September crude protein values increased from 4.3 to 6.7 to 7.5% while production decreased from 360 to 220 to 40 lb/ac.

At Lubbock crude protein levels in 1982 ranged from 20.7% for switchgrass to 12.0% for weeping lovegrass in May (Table 1). A portion of this variability can be attributed to differences in growth stage since the switchgrass sample was composed only of leaf tissue whereas the weeping lovegrass had already flowered; thus, the samples contained stem and reproductive tissue. The remaining species were developmentally intermediate and had intermediate crude protein levels. In May 1983 the species did not develop in the same sequence. The switchgrass had begun growth earlier than the other species and was more mature in 1983 than in 1982; thus, the crude protein level was reduced to 13.8%. Weeping lovegrass initiated growth later in 1983; thus, its crude protein level was 14.0% which was two percentage points higher than in 1982.

By mid-July the range of crude protein values was from 8.3 to 5.3% in 1982 and from 7.6 to 4.5% in 1983. For the most part, crude protein would be deficient for most classes of livestock by this time since 8.5% is considered the amount needed for maintenance for 500 lb steers (NRC, 1976). The regrowth values were generally above the 8.5% threshold value.

The relative rank of the species changed with sampling date and year for the standing phytomass. No single species or group of species was consistently better or worse than the other species. Sideoats grama crude protein level did not change as rapidly as the other species from July to August and was generally intermediate to the other species.

Crude protein content was higher at Lubbock and lower at Brownfield across species as well as months and years. Only during May did crude protein at Brownfield average above 8.5% (Table 2) and with few exceptions was deficient for livestock by mid-June. During 1982, May was the

Table 1. Monthly crude protein (%) content of standing biomass and 30-day-old regrowth for 1982 and 1983 at Lubbock.

Treatment	Date	Species						
		Switch-grass	Side-oats grama	Weeping love-grass	WWspar OWB	WW517 OWB	Ganada OWB	Cauca-sian OWB
Standing biomass (crude protein %)	May/82	20.7_{a}[1]	13.1_{c}	12.0_{c}	16.2_{b}	15.5_{b}	16.0_{b}	14.0_{bc}
	Jun/82	9.3_{a}	9.0_{b}	5.7_{c}	8.9_{b}	11.8_{a}	12.2_{a}	12.1_{a}
	Jul/82	8.3_{a}	7.2_{a}	7.4_{a}	5.3_{b}	8.2_{a}	7.4_{a}	6.9_{a}
	Aug/82	5.3_{ab}	6.5_{a}	5.5_{ab}	4.3_{ab}	6.6_{ab}	3.2_{b}	4.6_{ab}
	Sep/82	3.1_{b}	3.4_{ab}	4.3_{a}	3.5_{ab}	3.8_{ab}	4.0_{ab}	4.4_{a}
	May/83	13.8_{b}	13.2_{bc}	14.0_{ab}	15.7_{a}	12.6_{bc}	14.0_{b}	11.9_{c}
	Jun/83	10.5_{bc}	11.3_{ab}	9.2_{c}	11.3_{ab}	11.8_{ab}	12.5_{a}	9.0_{c}
	Jul/83	7.1_{ab}	7.0_{ab}	4.5_{c}	6.0_{bc}	6.4_{b}	7.6_{a}	5.6_{bc}
	Aug/83	5.7_{ab}	7.2_{a}	2.4_{c}	5.2_{ab}	5.7_{ab}	6.8_{a}	3.7_{bc}
	Dec/83	3.5_{c}	7.1_{ab}	7.1_{ab}	8.2_{a}	9.1_{a}	5.1_{bc}	5.9_{b}
30-day-old regrowth (crude protein %)	May/82	20.7_{a}	13.1_{c}	12.0_{c}	16.2_{b}	15.5_{b}	16.0_{b}	14.0_{bc}
	Jun/82	13.3_{ab}	11.4_{abc}	9.6_{c}	11.5_{abc}	11.6_{abc}	13.7_{a}	10.1_{bc}
	Jul/82	12.3_{a}	10.6_{a}	11.3_{a}	10.6_{a}	12.1_{a}	12.0_{a}	11.6_{a}
	Aug/82	9.8_{ab}	8.1_{b}	9.1_{ab}	8.7_{ab}	8.5_{b}	10.7_{a}	9.9_{ab}
	Sep/82	10.7_{b}	9.4_{c}	12.3_{a}	11.1_{b}	8.8_{c}	9.1_{c}	9.5_{c}
	Dec/82	4.3_{c}	4.0_{c}	8.7_{b}	10.8_{ab}	13.3_{a}	8.1_{b}	7.8_{b}
	May/83	13.8_{b}	13.2_{bc}	14.0_{ab}	15.7_{a}	12.6_{bc}	14.0_{b}	11.9_{c}
	Jun/83	15.0_{b}	13.4_{bc}	17.6_{a}	13.3_{bc}	14.2_{bc}	14.1_{bc}	12.5_{c}
	Jul/83	10.9_{abc}	10.9_{abc}	11.9_{a}	10.0_{bc}	9.0_{cd}	11.2_{ab}	8.0_{d}
	Aug/83	10.1_{a}	8.0_{cd}	10.5_{a}	8.7_{bc}	8.4_{bc}	9.6_{ab}	6.7_{d}
	Dec/83[2]		12.0_{b}	16.3_{a}	17.3_{a}	16.1_{a}	16.7_{a}	11.1_{b}

[1] Within each row the means followed by the same letter were not significantly different at $P<0.05$ as determined by LSD test.

[2] Ninety-day-old regrowth.

only sample period in which there was a difference between species for crude protein.

At Post in May 1982 standing phytomass of Ganada OWB was highest with 16.5% crude protein while weeping lovegrass was lowest with 8.9% (Table 3). During both May and June crude protein was above 8.5% for all species and averaged 11.8% in May and 10.7% in June. The regrowth crude protein averaged above 8.5% until September except for weeping lovegrass and Caucasian OWB which were below 8.5% in July and August, respectively. Seeding failure in 1982 was due to low levels of precipitation and resulted in only one year of data collection for the Post study area.

Table 2. Monthly crude protein (%) content of standing biomass and 30-day-old regrowth for 1982 and 1983 at Brownfield.

Treatment	Date	Species						
		Switch-grass	Side-oats grama	Weeping love-grass	WWspar OWB	WW517 OWB	Ganada OWB	Caucasian OWB
Standing biomass (crude protein %)	May/82	9.5_{a}[1]	8.9_{ab}	6.7_{c}	9.6_{a}	8.0_{b}	9.3_{a}	9.0_{ab}
	Jun/82	6.7_{b}	7.4_{ab}	6.0_{b}	5.8_{b}	6.7_{b}	8.7_{a}	6.7_{b}
	Jul/82	3.1_{c}	4.1_{ab}	6.2_{ab}	5.0_{abc}	4.6_{abc}	6.4_{a}	5.2_{abc}
	Aug/82	2.7_{b}	3.2_{b}	2.4_{b}	2.6_{b}	3.4_{ab}	4.4_{a}	2.7_{b}
	Sep/82	1.7_{bc}	2.1_{abc}	3.2_{a}	2.7_{ab}	1.8_{abc}	1.6_{bc}	0.9_{c}
	Dec/82	1.2_{a}	1.9_{a}	1.5_{a}	1.4_{a}	1.3_{a}	11.5_{a}	1.3_{a}
	May/83	12.4_{ab}	11.2_{abc}	9.1_{c}	10.7_{bc}	10.5_{bc}	13.4_{a}	11.0_{bc}
	Jun/83	6.3_{c}	8.5_{b}	4.3_{d}	7.4_{bc}	6.9_{c}	11.0_{a}	8.7_{b}
	Jul/83	6.0_{a}	5.3_{ab}	2.7_{c}	4.8_{ab}	5.5_{ab}	6.3_{a}	3.8_{bc}
	Aug/83	4.3_{a}	4.2_{a}	3.8_{a}	4.5_{a}	4.6_{a}	4.0_{a}	3.6_{a}
	Dec/83	3.1_{bc}	3.7_{bc}	2.3_{c}	4.6_{b}	6.4_{a}	4.9_{ab}	3.9_{bc}
30-day-old regrowth (crude protein %)	May/82	9.5_{a}	8.9_{ab}	6.7_{c}	9.6_{a}	8.0_{b}	9.3_{a}	9.0_{ab}
	Jun/82	6.7_{b}	5.8_{b}	5.7_{b}	7.4_{ab}	6.5_{b}	8.8_{a}	5.8_{bc}
	Jul/82	8.3_{ab}	7.9_{ab}	4.3_{c}	8.9_{a}	9.9_{a}	7.8_{ab}	6.3_{bc}
	Aug/82	8.5_{a}	7.7_{a}	6.7_{a}	7.9_{a}	7.9_{a}	8.1_{a}	7.3_{a}
	Sep/82	7.5_{a}	6.4_{ab}	7.5_{a}	5.7_{ab}	7.1_{ab}	5.2_{b}	5.3_{b}
	Dec/82	3.6_{a}	3.6_{a}	4.6_{a}	4.9_{a}	4.0_{a}	3.7_{a}	4.3_{a}
	May/83	12.4_{ab}	11.2_{abc}	9.1_{c}	10.7_{bc}	10.5_{bc}	13.4_{a}	11.0_{bc}
	Jun/83	9.2_{bc}	10.8_{ab}	8.1_{c}	9.8_{b}	9.2_{bc}	12.1_{a}	9.3_{bc}
	Jul/83	9.6_{a}	7.5_{b}	7.6_{b}	6.9_{bc}	7.1_{bc}	7.8_{b}	5.8_{c}
	Aug/83	8.5_{a}	7.0_{cd}	6.0_{a}	7.0_{d}	7.4_{bc}	7.5_{b}	6.3_{a}
	Dec/83[2]	5.4_{c}	5.7_{c}	6.0_{bc}	10.0_{ab}	11.9_{a}	12.9_{a}	7.7_{bc}

[1] Within each row the means followed by the same letter were not significantly different at P<0.05 as determined by LSD test.

Table 3. Monthly crude protein (%) content of standing biomass and 30-day-old regrowth for 1982 at Post.

Treatment	Date	Species						
		Switch-grass	Side-oats grama	Weeping love-grass	WWspar OWB	WW517 OWB	Ganada OWB	Caucasian OWB
Standing biomass (crude protein %)	May/82	12.6_{b}[1]	10.3_{cd}	8.9_{d}	11.5_{bc}	11.5_{bc}	16.5_{a}	11.7_{bc}
	Jun/82	12.2_{a}	9.7_{ab}	9.4_{b}	10.8_{ab}	10.5_{ab}	12.2_{a}	10.4_{ab}
	Jul/82	7.6_{a}	6.3_{a}	6.4_{a}	7.7_{a}	7.4_{a}	7.8_{a}	6.3_{a}
	Aug/82	4.9_{ab}	4.4_{b}	3.8_{b}	6.2_{a}	5.3_{ab}	5.2_{ab}	4.0_{b}
	Sep/82	3.3_{ab}	3.8_{a}	3.3_{ab}	3.6_{a}	3.3_{ab}	3.2_{ab}	2.4_{b}
	Dec/82	1.5_{a}	2.3_{a}	1.6_{a}	1.5_{a}	1.6_{a}	2.7_{a}	1.6_{a}
30-day-old regrowth (crude protein %)	May/82	12.6_{b}	10.3_{cd}	8.9_{d}	11.5_{bc}	11.5_{bc}	16.5_{a}	11.7_{bc}
	Jun/82	11.7_{abc}	10.6_{cd}	8.9_{d}	14.4_{a}	11.3_{bcd}	13.8_{ab}	13.5_{ab}
	Jul/82	11.3_{b}	8.7_{c}	7.5_{c}	8.7_{c}	8.3_{c}	13.1_{a}	8.8_{c}
	Aug/82	10.4_{a}	8.5_{bcd}	7.9_{cd}	8.8_{abc}	8.7_{abc}	10.2_{ab}	6.9_{d}
	Sep/82	5.7_{abc}	5.6_{abc}	5.3_{bc}	6.7_{a}	5.7_{abc}	6.2_{ab}	4.7_{c}
	Dec/82[2]	2.6_{c}	2.5_{c}	6.7_{a}	4.7_{ab}	6.0_{a}	3.3_{bc}	3.9_{bc}

[1] Within each row the means followed by the same letter were not significantly different at P<0.05 as determined by LSD test.

Ninety-day-old regrowth.

IVDOM

The IVDOM levels generally decreased as the season progressed but not as rapidly as the crude protein values. The decrease averaged about 20 percentage points from May to December for the standing phytomass and about 10 percentage points for the regrowth (Tables 4 to 6). Year was not as important as with crude protein.

Using Minson's (1980) conversion equation for metabolizable energy to IVDOM, 56% IVDOM was needed for maintenance of 550 lb steers. This was equivalent to 4.4 Mcal/lb of metabolizable energy. As with crude protein, IVDOM levels were below NRC (1976) standards for livestock production by mid-July for standing phytomass but were generally sufficient for the regrowth samples.

At Lubbock the IVDOM levels of the species were varied in June and July 1982 and June, July, and December 1983 for the standing phytomass (Table 4). Species differed for regrowth in August and September 1982 and in July 1983. Weeping lovegrass was lower in IVDOM than the remaining species and the OWBs were generally higher. The same trends were maintained in the regrowth but sideoats grama was reduced to levels similar to that of weeping lovegrass.

Species were different in IVDOM at Brownfield for standing phytomass in May through September 1982 and in July, August, and December 1983 (Table 5). As at Lubbock, weeping lovegrass was generally lower in IVDOM than the other species. The IVDOM levels of 30-day regrowth were

Table 4. Monthly IVDOM (%) of standing biomass and 30-day-old regrowth for 1982 and 1983 at Lubbock.

Treatment	Date	Species						
		Switch-grass	Side-oats grama	Weeping love-grass	WWspar OWB	WW517 OWB	Ganada OWB	Caucasian OWB
Standing biomass (IVDOM %)	May/82	67.0_{a}[1]	57.0_{bc}	51.2_{c}	62.0_{ab}	60.2_{abc}	63.1_{ab}	62.6_{ab}
	Jun/82	57.7_{a}	48.7_{b}	39.8_{c}	55.1_{ab}	56.4_{a}	57.7_{a}	54.0_{ab}
	Jul/82	45.1_{bc}	44.5_{bc}	41.1_{c}	45.8_{bc}	52.4_{a}	50.1_{ab}	48.8_{ab}
	Aug/82	40.3_{b}	39.1_{b}	41.1_{ab}	46.8_{ab}	49.4_{a}	42.6_{b}	40.8_{ab}
	Sep/82	35.2_{b}	32.9_{b}	34.0_{b}	39.3_{ab}	43.6_{a}	38.9_{ab}	38.4_{ab}
	May/83	66.2_{a}	62.2_{a}	59.2_{a}	64.4_{a}	59.4_{a}	60.6_{a}	63.7_{a}
	Jun/83	54.0_{b}	56.1_{ab}	43.4_{c}	58.2_{ab}	61.4_{a}	60.0_{a}	58.8_{ab}
	Jul/83	53.6_{a}	48.8_{ab}	33.1_{b}	49.1_{ab}	48.6_{ab}	53.5_{a}	50.9_{ab}
	Aug/83	38.3_{bc}	31.7_{cd}	26.5_{d}	46.5_{ab}	50.2_{a}	43.5_{ab}	31.5_{cd}
	Dec/83	41.9_{bc}	38.4_{c}	41.7_{bc}	47.2_{ab}	50.6_{a}	45.4_{abc}	50.5_{a}
30-day-old regrowth (IVDOM %)	May/82	67.0_{a}	57.0_{bc}	51.2_{c}	62.0_{ab}	60.2_{abc}	63.1_{ab}	62.6_{ab}
	Jun/82	59.0_{a}	51.9_{ab}	48.2_{b}	56.5_{ab}	56.8_{ab}	56.8_{ab}	54.5_{ab}
	Jul/82	58.5_{a}	51.2_{a}	53.3_{a}	59.8_{a}	58.7_{a}	59.7_{a}	57.2_{a}
	Aug/82	58.7_{a}	49.4_{b}	47.6_{b}	60.5_{a}	60.3_{a}	60.7_{a}	60.7_{a}
	Sep/82	59.9_{ab}	55.9_{b}	51.0_{c}	60.8_{a}	62.0_{a}	61.9_{a}	63.5_{a}
	Dec/82	27.5_{b}	44.0_{a}	41.7_{ab}	59.3_{a}	53.4_{a}	59.0_{a}	59.0_{a}
	May/83	66.2_{a}	62.2_{a}	59.2_{a}	64.4_{a}	59.4_{a}	60.6_{a}	63.7_{a}
	Jun/83	57.2_{ab}	56.3_{b}	59.8_{ab}	60.9_{ab}	63.9_{a}	61.7_{ab}	60.0_{ab}
	Jul/83	60.7_{a}	45.2_{c}	51.4_{bc}	57.3_{ab}	56.1_{ab}	57.0_{ab}	51.2_{bc}
	Aug/83	52.2_{a}	51.4_{a}	48.0_{ab}	51.0_{a}	54.7_{a}	49.4_{ab}	41.6_{b}
	Dec/83[2]		53.4_{b}	57.2_{ab}	61.2_{a}	61.8_{a}	62.5_{a}	60.5_{a}

[1] Within each row the means followed by the same letter were not significantly different at P<0.05 as determined by LSD test.

[2] Ninety-day-old regrowth.

Table 5. Monthly IVDOM (%) of standing biomass and 30-day-old regrowth for 1982 and 1983 at Brownfield.

Treatment	Date	Species						
		Switchgrass	Sideoats grama	Weeping lovegrass	WWspar OWB	WW517 OWB	Ganada OWB	Caucasian OWB
Standing biomass (IVDOM %)	May/82	59.9$_a$[1]	51.5$_{cd}$	47.5$_c$	56.9$_{ab}$	60.3$_a$	61.3$_a$	55.3$_{ab}$
	Jun/82	51.2$_b$	40.6$_c$	42.9$_c$	56.5$_{ab}$	57.9$_{ab}$	59.1$_a$	54.3$_{ab}$
	Jul/82	42.7$_b$	39.2$_b$	40.1$_b$	49.3$_{ab}$	55.5$_a$	55.1$_a$	41.8$_b$
	Aug/82	39.8$_b$	42.6$_{ab}$	20.9$_c$	49.7$_a$	48.2$_{ab}$	50.5$_a$	19.9$_c$
	Sep/82	37.6$_{dc}$	39.1$_{bcd}$	25.5$_e$	48.1$_{abc}$	51.9$_a$	49.3$_{ab}$	36.3$_d$
	Dec/82	29.2$_a$	36.2$_a$	26.5$_a$	40.4$_a$	40.9$_a$	41.1$_a$	37.9$_a$
	May/83	67.6$_a$	59.7$_{bc}$	55.1$_c$	62.4$_{abc}$	60.3$_{abc}$	62.9$_{ab}$	60.3$_{abc}$
	Jun/83	54.0$_{ab}$	52.0$_{ab}$	40.1$_b$	46.6$_{ab}$	62.6$_a$	63.0$_a$	53.4$_{ab}$
	Jul/83	48.0$_a$	46.4$_a$	26.8$_b$	49.9$_a$	46.7$_a$	52.2$_a$	45.5$_a$
	Aug/83	46.2$_{bcd}$	37.1$_{cd}$	26.0$_e$	39.5$_{bcd}$	44.4$_{abc}$	49.2$_a$	34.3$_{de}$
	Dec/83	43.9$_{ab}$	20.8$_c$	16.5$_c$	49.7$_{ab}$	54.6$_a$	51.8$_{ab}$	38.2$_b$
30-day-old regrowth (IVDOM %)	May/82	59.9$_a$	51.5$_{cd}$	47.5$_c$	56.9$_{ab}$	60.3$_a$	61.3$_a$	55.3$_{ab}$
	Jun/82	56.7$_{ab}$	44.4$_c$	46.4$_c$	57.6$_{ab}$	58.2$_a$	58.1$_a$	53.4$_b$
	Jul/82	60.1$_a$	51.1$_b$	43.0$_b$	60.4$_a$	60.8$_a$	61.9$_a$	47.5$_{ab}$
	Aug/82	58.9$_a$	50.2$_{bc}$	44.1$_c$	60.4$_a$	60.5$_a$	61.2$_a$	55.1$_{ab}$
	Sep/82	54.6$_b$	52.2$_b$	42.7$_c$	54.7$_b$	59.7$_a$	53.7$_b$	54.1$_b$
	Dec/82	46.8$_{ab}$	46.7$_{ab}$	37.5$_b$	57.4$_a$	56.4$_a$	50.1$_{ab}$	52.1$_{ab}$
	May/83	67.6$_a$	59.7$_{bc}$	55.1$_c$	62.4$_{abc}$	60.3$_{abc}$	62.9$_{ab}$	60.3$_{abc}$
	Jun/83	61.3$_{ab}$	56.0$_{ab}$	51.8$_b$	58.4$_{ab}$	60.4$_{ab}$	62.8$_a$	61.1$_{ab}$
	Jul/83	54.2$_a$	51.6$_a$	46.2$_a$	51.1$_a$	55.0$_a$	55.2$_a$	50.7$_a$
	Aug/83	50.9$_{ab}$	46.8$_{ab}$	33.0$_c$	48.8$_{ab}$	44.7$_b$	54.9$_a$	43.7$_b$
	Dec/83[2]	54.0$_a$	44.9$_b$	35.1$_c$	55.6$_a$	60.3$_a$	57.9$_a$	52.8$_{ab}$

[1] Within each row the means followed by the same letter were not significantly different at P<0.05 as determined by LSD test.

[2] Ninety-day-old regrowth.

Table 6. Monthly IVDOM (%) of standing biomass and 30-day-old regrowth in 1982 at Post.

Treatment	Date	Species						
		Switchgrass	Sideoats grama	Weeping lovegrass	WWspar OWB	WW517 OWB	Ganada OWB	Caucasian OWB
Standing biomass (IVDOM %)	May/82	63.9$_c$[1]	58.0$_{dc}$	54.5$_d$	60.4$_{abc}$	59.9$_{bc}$	62.9$_{ab}$	62.8$_{ab}$
	Jun/82	58.1$_{ab}$	52.2$_{bc}$	51.5$_c$	59.6$_a$	61.9$_a$	61.6$_a$	58.1$_{ab}$
	Jul/82	43.3$_{bc}$	38.7$_c$	35.0$_c$	49.0$_{ab}$	52.7$_a$	56.3$_a$	51.1$_{ab}$
	Aug/82	50.7$_a$	49.0$_a$	36.7$_b$	52.0$_a$	55.0$_a$	54.6$_a$	50.7$_a$
	Sep/82	42.3$_{ab}$	43.8$_{ab}$	36.3$_b$	45.4$_a$	49.5$_a$	46.3$_a$	45.6$_a$
	Dec/82	28.8$_b$	37.2$_{ab}$	31.8$_b$	43.5$_a$	38.5$_{ab}$	41.8$_a$	35.4$_{ab}$
30-day-old regrowth (IVDOM %)	May/82	63.9$_c$	58.0$_{dc}$	54.5$_d$	60.4$_{abc}$	59.9$_{bc}$	62.9$_{ab}$	62.8$_{ab}$
	Jun/82	61.6$_a$	55.3$_b$	49.7$_c$	61.5$_a$	62.6$_a$	63.7$_a$	62.1$_a$
	Jul/82	57.2$_{ab}$	53.9$_{ab}$	50.8$_b$	59.8$_a$	59.9$_a$	61.8$_a$	57.9$_{ab}$
	Aug/82	58.5$_{ab}$	55.7$_b$	47.9$_c$	61.0$_{ab}$	60.2$_{ab}$	63.7$_a$	58.0$_b$
	Sep/82	54.0$_b$	53.6$_b$	47.4$_c$	57.5$_{ab}$	57.9$_{ab}$	61.2$_a$	41.8$_c$
	Dec/82[2]	41.2$_a$	39.2$_a$	40.4$_a$	48.8$_a$	47.4$_a$	50.2$_a$	47.8$_a$

[1] Within each row the means followed by the same letter were not significantly different at P<0.05 as determined by LSD test.

[2] Ninety-day-old regrowth.

different for species in June, August, and September 1982 and August and December 1983. Weeping lovegrass was from 6 to 16 percentage points below the average IVDOM levels.

At Post IVDOM over species varied in May through August for standing phytomass and in June, August, and September for regrowth (Table 6). As at Brownfield, IVDOM was lower for weeping lovegrass over the season and for sideoats grama early in the season.

Moisture Content

There was a difference between species at each sampling period and between years in moisture content at Lubbock (Table 7). The general trend was a reduction in moisture content as the season progressed. The largest monthly decrease was between July and August which coincided with summer dormancy. The moisture content was generally higher for switchgrass and lower for sideoats grama compared to the other species.

Table 7. Monthly moisture content (%) of fresh weight yield samples of standing biomass and 30-day-old regrowth in 1982 and 1983 at Lubbock.

Treatment	Date	Species						
		Switch-grass	Side-oats grama	Weeping love-grass	WWspar OWB	WW517 OWB	Ganada OWB	Cauca-sian OWB
Standing biomass (moisture %)	May/82	78.3_{a}[1]	69.5_{c}	73.4_{b}	70.4_{c}	69.5_{c}	66.1_{de}	68.7_{cd}
	Jun/82	71.5_{a}	56.3_{d}	59.0_{c}	67.3_{b}	68.2_{b}	67.8_{b}	68.1_{b}
	Jul/82	69.0_{a}	55.9_{e}	62.9_{c}	60.0_{d}	65.7_{b}	58.8_{d}	59.7_{d}
	Aug/82	51.5_{a}	25.6_{e}	37.5_{b}	27.9_{de}	34.4_{bc}	31.2_{cd}	28.4_{de}
	Sep/82	44.9_{a}	19.8_{c}	29.7_{b}	23.5_{bc}	26.4_{bc}	22.3_{bc}	28.7_{b}
	May/83	71.0_{a}	58.2_{d}	65.7_{b}	63.5_{bc}	59.7_{bcd}	61.1_{bcd}	65.0_{b}
	Jun/83	70.7_{a}	59.3_{e}	61.9_{d}	71.5_{a}	68.2_{b}	70.6_{a}	66.2_{c}
	Jul/83	59.7_{a}	49.2_{d}	50.3_{cd}	53.0_{bcd}	54.2_{bc}	53.4_{bcd}	56.0_{ab}
	Aug/83	50.5_{a}	36.3_{b}	38.5_{b}	36.1_{b}	34.5_{b}	35.8_{b}	34.5_{b}
30-day-old regrowth (moisture %)	May/82	78.3_{a}	69.5_{c}	73.4_{b}	70.4_{c}	69.5_{c}	66.1_{de}	68.7_{cd}
	Jun/82	74.8_{a}	59.1_{d}	65.1_{c}	71.1_{b}	69.9_{b}	69.6_{b}	70.1_{b}
	Jul/82	77.3_{a}	64.3_{d}	69.1_{c}	75.9_{a}	75.1_{ab}	72.9_{b}	75.8_{a}
	Aug/82	63.3_{a}	52.8_{d}	60.2_{ab}	55.7_{cd}	59.1_{bc}	57.6_{bc}	60.7_{ab}
	Sep/82	50.5_{a}	41.8_{ab}	51.5_{a}	39.4_{b}	32.6_{b}	34.3_{b}	38.7_{b}
	May/83	71.0_{a}	58.2_{d}	65.7_{b}	63.5_{bc}	59.7_{bcd}	61.1_{bcd}	65.8_{b}
	Jun/83	75.0_{a}	62.1_{d}	72.9_{b}	73.8_{ab}	70.7_{c}	72.6_{b}	70.1_{c}
	Jul/83	64.4_{ab}	56.8_{c}	63.2_{abc}	60.9_{abc}	59.4_{bc}	61.3_{abc}	75.8_{a}
	Aug/83	54.4_{a}	40.8_{bc}	51.2_{a}	38.3_{c}	41.6_{bc}	49.6_{ab}	40.2_{c}

[1] Within each row the means followed by the same letter were not significantly different at $P<0.05$ as determined by LSD test.

DISCUSSION

The samples were composed of all above ground phytomass; thus, the chemical quality measures would be lower than the quality of the diet livestock would select since portions of the above ground phytomass normally would not be consumed by livestock. The selectivity of livestock was observed by Krueger and Curtis (1979) when monocultures of switchgrass were grazed beginning at the late-joint stage. The steers selectively grazed the leaves and top plant parts, improving their crude protein intake over the level of the clipped samples. Working with Blackwell switchgrass and Caucasian OWB, Anderson and Matches (1983) concluded that whole plant IVDMD (**in vitro** dry matter disappearance) may not predict the actual performance of cattle as a result of selective grazing or problems with the IVDMD procedure. Selective grazing would be of greater concern with switchgrass and the OWBs than the other species since these species had a larger percentage of stem tissue.

As the plants matured the quality decreased for all species for both the standing phytomass and regrowth. This was consistent with the trends reported in the literature. Voight et al. (1981) measured daily decreases in IVDMD of 0.46 percentage points per day from jointing to anthesis for four weeping lovegrass selections. The IVDMD of regrowth continued to decrease 0.02 percentage points over the season despite equal aged material. The crude protein and IVDMD levels were higher than those measured in the present study. This was probably due to earlier initial harvests and nitrogen fertilization. The daily decline in IVDOM measured in the present study were less in 1982 and similar in 1983 to the decline measured by Voight et al. (1981) for weeping lovegrass. The differences were probably the result of varying developmental stages since Voight calculated decline based on growth stages that occurred before the first harvest in the present study. The regrowth IVDOM of weeping lovegrass did not decline in 1982; however, in 1983 a decline of 0.06 units was measured. Averaged over years this rate of decline was similar to that measured by Voight et al. (1981).

The same trend in quality was observed for Blackwell switchgrass and Caucasian OWB by Anderson and Matches (1983). The IVDMD decreased 2.0 percentage units per week for every week the initial harvest was delayed; concurrently the crude protein declined from 1.0 to 1.6 units. The weekly decline in IVDOM was generally greater for Caucasian OWB and similar for switchgrass in the present study. The varying responses of these species was probably the result of harvest date and growth stage differences. Holt and Dalrymple (1978) measured decreases in IVDMD of weeping lovegrass from April to August of 10 to 20 units which was similar to the decline in the present study.

The OWBs decreased in quality with maturity (Horn and Taliaferro, 1979) and by August the IVDMD, cell contents, and crude protein levels had decreased enough to affect feeding value. Caucasian OWB was consistently lower in quality than Plains OWB. However, the variability among harvest dates was often larger than the difference between selections (Horn and Jackson 1979). This relationship was also found in studies by Taliaferro et al. (1984).

The moisture content of forages can be an indicator of preference and/or intake. Hyder et al. (1966) indicated that moisture contents below 50% on a fresh weight basis can reduce intake and cause loss of feed efficiency. At Lubbock moisture content dropped below 50% by August for all species except switchgrass which generally had the highest moisture content. The moisture content of the regrowth was higher but was below 50% in September 1982 and August 1983 for sideoats grama and the OWBs.

The response of these species to fertility would explain a portion of the variation in crude protein and IVDOM levels among locations in the present study. Soils similar to those of the Lubbock study area are used extensively in row crop agriculture and are considered highly fertile. The stand at the Post study area was established in a small area of native range recently cleared which had not been farmed previously. The Brownfield stand was established on highly eroded soils with a long history of row crop production. Generally, increases in fertility increased the crude protein and IVDMD levels as well as total production of these species when grown in monocultures (Denman et al., 1953; McMurphy et al. 1975; Taliaferro et al., 1975; Perry and Baltensperger, 1979). The increase was usually greater for crude protein than IVDMD. Seasonal average crude protein levels of Morpa weeping lovegrass and Plains OWB increased from about 7 to 11% and 7 to 9%, respectively, when 300 lb/ac of nitrogen was added (Taliaferro et al., 1975). The IVDMD increased about 4 and 1 percentage points, respectively. Similar trends were maintained for successive harvest dates for both switchgrass and weeping lovegrass (McMurphy et al., 1975).

Due to the decrease in quality as the forage matures, a grazing management scheme that harvests the spring growth early in the season and encourages regrowth would be most effective with these species. The timing of first harvest will vary between species but should be completed before heading (Voight et al., 1981; Anderson and Matches 1983). The length of time between harvests which would optimize the quality and yield would vary between years, seasons, and species. The harvest interval should seldom exceed seven weeks for the OWBs (Taliaferro et al., 1984) and four weeks for weeping lovegrass (Voight et al., 1981). Longer intervals may be used with the native species, switchgrass, and sideoats grama.

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