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**FINAL STUDY REPORT**
**James E. "Bud" Smith Plant Materials Center**
**Knox City, Texas**

# Winter Stockpiling of Warm Season Grasses in North-Central Texas and Southwestern Oklahoma

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## ABSTRACT

*Cattle grazing on pasture. Photo: USDA NRCS.*

Native grasses provide many conservation benefits such as soil conservation and wildlife habitat. Although native grasses have forage value during the growing season, there is limited information on the forage attributes of these grasses as stock piled forage. Objective of this study is to evaluate how forage yield and quality of native and introduced warm season grasses change from early fall to late winter under different forage management regimes. 'Alamo' switchgrass (*Panicum virgatum* L.), 'San Marcos' eastern gamagrass [*Tripsacum dactyloides* (L.) L.], 'Lometa' Indiangrass [*Sorghastrum nutans* (L.) Nash], 'Selection 75' Kleingrass (*Panicum coloratum* L.), 'WW-B.Dahl' old world bluestem [*Bothrichloa bladhii* (Retz) S.T. Blake], and OK Select germplasm little bluestem [*Schizachyrium scoparium* (Michx.) Nash] were evaluated as stockpiled forage at the James E. "Bud" Smith Plant Materials Center (PMC), Knox City, Texas. Grasses were fertilized annually with 30 lb N/acre at green up. Forage production and quality estimates of percent *in vitro* dry matter digestibility and crude protein were determined annually beginning 15 October to 15 February 2013-2016 at 30-day intervals from simulated grazed and ungrazed management scenarios. Grasses clipped 1 July simulated early season grazing management compared to unclipped forages representing the ungrazed management scenario. Exposure of the biomass to winter weathering did not affect yield of Indiangrass and little bluestem while eastern gamagrass and old world bluestem in the grazed management exhibited significant yield loss during the winter months (~48%). Eastern gamagrass crude protein was highest in the fall at 8% compared to the other forages that averaged ~5%, but CP decreased following the first killing frost. The digestibility of all forages remained near or above 50% in both grazing management scenarios from October to February with kleingrass and old world bluestem having highest digestibility and switchgrass the lowest. Native warm season grasses can provide winter grazing needs while also preforming other valuable services such as improving wildlife habitat, providing protection from soil erosion, and restoring the landscape to native grasslands.

## INTRODUCTION

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A successful pasture planting not only provides forage during the growing season, but also provides grazing options during the dormant time of the year. Accumulation of forage at one time of the year for grazing later, or stockpiling, is a grazing management practice commonly used in cattle production (Lemus, 2008). Stockpiling of warm-season perennial grasses for grazing after frost could potentially reduce input cost in Texas by decreasing winter feeding cost. In Texas, the annual production costs per cow can range from $325 to $522. A rancher can estimate 35-47% of these costs are incurred with grazing and winter feeding (Evers, Redmon and Provin, 2004). Extensive grazing evaluations have been conducted with perennial grasses such as bermudagrass [*Cynodon dactylon* (L.) Pers.] to determine forage quality and quantity both in the growing and dormant season. Other warm season perennial grasses such as switchgrass, Indiangrass, eastern gamagrass, and old world bluestem have potential as a standing hay crop for winter grazing. After freezing temperatures kill the top growth of these grasses, they can be grazed with little effect on the plant health and productivity the following year. Because winter pastures are lower in nutritional value, additional supplements need to be added to meet livestock requirements (Mitchell and Anderson, 2008). Crude protein of WW-B Dahl ranges from 9-12% during the active growing season (May-July), but declines to 3.5-4% during December to January (Allen and Brown, 2011). Previous forage quality evaluations at the James E. "Bud" Smith Plant Materials Center in Knox City, Texas found San Marcos eastern gamagrass and Selection 75 kleingrass provided sufficient crude protein and digestibility to meet the requirements of a 1200 lb lactating cow during the growing season and into early fall in the southern great plains (Ziehr et al., 2008). These warm season grasses have the capability to produce significant biomass for livestock consumption in pasture and range plantings. The objective of this study is to evaluate how forage yield and quality of native and introduced warm season grasses change from early fall to late winter under different forage management regimes.

## MATERIALS AND METHODS

Seed of six warm season grasses: 'Alamo' switchgrass, 'Lometa' Indiangrass, 'San Marcos' eastern gamagrass, 'Selection 75' kleingrass, OK select germplasm little bluestem and 'WW-B Dahl' old world bluestem were evaluated in this study. Seed was planted in the greenhouse 24 February 2012 in 72-cell transplant trays containing Sunshine mix 1 peat moss®. The trays were placed in the greenhouse and moistened as needed to encourage seedling emergence and growth. Two weeks prior to transplanting to the field, trays were moved to the shade house to acclimate plants to climatic conditions. Plugs were transplanted 1 May 2012 in a randomized complete design with four replications on a Miles fine sandy loam at the PMC near Knox City, Texas. The plot consisted of sixteen rows spaced eight inches apart and twenty feet long. Plots were irrigated as needed with overhead sprinklers in 2012. In subsequent years, no irrigation water was applied. Weeds were controlled chemically and mechanically as needed to maintain pristine plots. Soil samples taken 19 March 2012 were used to adjust soil nutrient levels according to soil test

Switchgrass grazed vs ungrazed, James E. "Bud" Smith PMC, Knox City, Texas recommendations. On 20 April 2012, 35 and 30 lb/acre of N and P, respectively were broadcast applied over the plots.

In April 2013, 30 lb/acre N, as ammonium sulfate (21-0-0), was broadcast when plants were actively growing. Grazing simulation was conducted July 1 by harvesting a 20-ft x 64-inch swath from the center of the plot to a height of 6-inches using a Carter forage harvester (Brookston, IN). Harvested residue was removed from the plot. Regrowth from the July harvest (grazed) and ungrazed treatments were harvested ~October 15 and at 30-day intervals until February 15, 2013-2015. Grab samples for dry matter yield determination and forage quality estimates were dried in a forced-air dryer (Shel-Lab, Cornelius, OR) for 24 hours at 55°C. Dried samples were ground to pass through a 1-mm screen and analyzed for N concentration and *in vitro* dry matter disappearance (IVDMD). The IVDMD rates were determined for 48 h using an ANKOM Daisy II Incubator (ANKOM Technologies, Macedon, NY, USA) inoculated with rumen liquid extracted from rumen-fistulated steers. This system emulates the Tilley and Terry (1963) 2-stage in vitro digestibility technique (Coblentz et al., 1997) but washes the sample in a neutral detergent (Van Soest et al., 1991) instead of a pepsin solution. Residues were corrected for residual ash and sodium sulphite was omitted. Crude protein (CP) was estimated by multiplying N content by 6.25.

Yield and forage quality estimates were analyzed using the analysis of variance procedure for general linear models in Statistix 8 ® (Tallahassee, FL). Means were separated using the least significant difference test at $P<0.05$).

## RESULTS AND DISCUSSION

All six warm season grasses, with the exception of little bluestem, produced more total forage in grazed than the ungrazed scenario (Table 1). The old world bluestem and eastern gamagrass produced over twice as much forage in the grazed scenario compared to the ungrazed. Kleingrass, Indiangrass, and switchgrass also produced significantly more biomass when grazed early compared to ungrazed or season long deferment.

Table 1. 3-year average total forage production of warm season grasses from October-February under simulated grazed and ungrazed scenarios. USDA-NRCS James E. “Bud” Smith Plant Materials Center in Knox City, TX.

| | Grazed[1/] | Ungrazed[2/] |
|---|---|---|
| | ----------------lb/acre------------- | |
| Switchgrass | 18 260 a[3/] | 12 044 b |
| Kleingrass | 11 133 a | 6 222 b |
| Eastern Gamagrass | 12 551 a | 5 049 b |
| Indiangrass | 10 288 a | 6 095 b |
| Old World Bluestem | 11 902 a | 4 709 b |
| Little Bluestem | 5 810 a | 4 004 a |

[1/]Grazed is biomass produced from spring green up to July 1 combined with biomass produced from July 1 to mid-October.
[2/]Ungrazed is biomass produced from spring green up in the spring to mid-October.
[3/]Values within a specie followed by different lower-case letters differ between management scenarios ($P\leq0.05$).

Forage production of warm season grass varied by management scenario during the dormant season (Table 2). Most grasses experienced significant yield loss in both management scenarios except Indiangrass and little bluestem in the ungrazed scenario, and switchgrass and kleingrass in the grazed scenario. Eastern gamagrass and old world bluestem experienced the greatest yield loss from October to February. During this period, both grasses lost >50% of their biomass due to winter weathering. The least amount of biomass loss occurred in the grazed and un-grazed scenarios of Indiangrass and switchgrass (<20% in either scenario).

Table 2. 3-year (2013-2016) mean forage production of 6 warm season grasses during dormant season and season average. USDA-NRCS James E. "Bud" Smith Plant Materials Center Knox City, TX.

| | Clipping Date | | | | |
|---|---|---|---|---|---|
| | October | November | December | January | February |
| | ---------------- ------------------------lb/acre------------------------------------- | | | | |
| Switchgrass | | | | | |
| Grazed[1/] | 3745 a[3/] | 3235 a | 2861 a | 2807 a | 3027 a |
| Ungrazed[2/] | 12,044 a | 11,502 ab | 9,898 ab | 8,900 b | 9,700 ab |
| Kleingrass | | | | | |
| Grazed | 3062 a | 2831 a | 3146 a | 2240 a | 2126 a |
| Ungrazed | 6222 a | 5929 a | 6284 a | 4547 ab | 3727 b |
| Eastern Gamagrass | | | | | |
| Grazed | 3002 a | 2276 ab | 2090 ab | 1523 b | 1449 b |
| Ungrazed | 5049 ab | 5466 a | 5965 ab | 3946 bc | 3647 c |
| Indiangrass | | | | | |
| Grazed | 2402 a | 2643 a | 1785 a | 2066 a | 2130 a |
| Ungrazed | 6095 a | 5682 a | 5167 a | 5543 a | 4929 a |
| Old World Bluestem | | | | | |
| Grazed | 3383 a | 2923 ab | 2990 abc | 1866 bc | 1600 c |
| Ungrazed | 4909 a | 4573 ab | 3232 c | 3728 abc | 3495 bc |
| Little Bluestem | | | | | |
| Grazed | 1006 a | 1010 a | 645 a | 729 a | 624 a |
| Ungrazed | 4004 a | 3801 a | 3376 a | 3118 a | 3018 a |

[1/]Grazed is biomass produced from July 1st to mid-October.
[2/]Ungrazed is biomass produced from spring greenup in the spring to mid-October.
[3/]Values within rows followed by different lower-case letters differ between management ($P \leq 0.05$).

Percent crude protein of the six warm season grasses declined under both scenarios from October to February by at least 1%, but remained relatively unchanged after the first killing frost in November (Table 3). Eastern gamagrass had the highest CP in both scenarios and maintained the highest level of CP in the grazed scenario. Ziehr et al. (2014) reported similar CP levels for San Marcos eastern gamagrass harvested in late fall. These authors also reported that Selection 75 kleingrass exhibited respectable CP in late fall and ranged from 6-8% depending on year of harvest. However, in this study, CP of kleingrass was slightly lower, but increased in the simulated grazing scenario because regrowth from the July harvest produced younger forage with higher leaf composition compared to the ungrazed scenario. The National Research Council's Nutrient Requirements for Beef Cattle records CP minimum requirements at or above 7% for most classes of cattle (National Research Council, 2000). To prevent protein deficiencies, supplementation during the dormant season is necessary to meet nutritional requirements.

Table 3. 3-year (2013-2016) mean crude protein percentage of 6 warm season grasses during dormant season and season average. USDA-NRCS James E. “Bud” Smith Plant Materials Center, Knox City, TX.

| | Clipping Date | | | | |
|---|---|---|---|---|---|
| | October | November | December | January | February |
| | ---------------------------- | ---------- | % | ---------- | ---------------------------- |
| Switchgrass | | | | | |
| Grazed[1/] | 7a[3/] | 6b | 5b | 6b | 6b |
| Ungrazed[2/] | 5a | 4b | 3b | 3b | 4b |
| Kleingrass | | | | | |
| Grazed | 6a | 5a | 5a | 5a | 5a |
| Ungrazed | 5a | 4b | 4b | 4b | 4b |
| Eastern Gamagrass | | | | | |
| Grazed | 8a | 7ab | 7b | 7ab | 7ab |
| Ungrazed | 8a | 6b | 6b | 6b | 5b |
| Indiangrass | | | | | |
| Grazed | 6a | 5b | 5b | 5b | 5b |
| Ungrazed | 5a | 4b | 5b | 4b | 5b |
| Old World Bluestem | | | | | |
| Grazed | 6a | 6b | 5b | 6ab | 6b |
| Ungrazed | 5a | 5ab | 5ab | 5ab | 5b |
| Little Bluestem | | | | | |
| Grazed | 5a | 4b | 4c | 4bc | 4b |
| Ungrazed | 5a | 4bc | 4b | 4b | 4b |

[1/]Grazed is biomass produced from July 1st to mid-October.
[2/]Ungrazed is biomass produced from spring greenup in the spring to mid-October.
[3/]Values within rows followed by different lower-case letters differ between management ($P \leq 0.05$).

The IVDMD of the warm season grasses was higher in the grazed scenario compared to the un-grazed scenario, which exhibited acceptable digestibility (Table 4). All grasses exhibited respectable IVDMD percentages in late fall and their values remained exceptionally high throughout the dormant season. Previous evaluations by Ziehr et al (2014) reported IVDMD percentages of 40-55% for warm season grasses in the late fall at this location.

The IVDMD in the grazed and ungrazed little bluestem declined from 62% in October to 52% at the end of the dormant season. There was a noticeable decline in IVDMD in the ungrazed switchgrass scenario where digestibility decreased from 56% in October to 48% by mid-February.

Table 4. Table 3. 3-year (2013-2016) mean *in vitro* dry matter disappearance of 6 warm season grasses during dormant season and season average. USDA-NRCS James E. "Bud" Smith Plant Materials Center, Knox City, TX.

| | Clipping Date | | | | |
|---|---|---|---|---|---|
| | October | November | December | January | February |
| | ----------------------------%------------------------------ | | | | |
| Switchgrass | | | | | |
| Grazed[1/] | 60a[3/] | 60a | 56a | 56a | 54a |
| Ungrazed[2/] | 56a | 53ab | 53ab | 51ab | 48b |
| Kleingrass | | | | | |
| Grazed | 63a | 58a | 55a | 54a | 56a |
| Ungrazed | 58a | 55a | 53a | 53a | 53a |
| Eastern Gamagrass | | | | | |
| Grazed | 59a | 60a | 57a | 56a | 54a |
| Ungrazed | 56a | 53a | 51a | 52a | 52a |
| Indiangrass | | | | | |
| Grazed | 62a | 62a | 60a | 59a | 58a |
| Ungrazed | 59a | 56a | 57a | 56a | 57a |
| Old World Bluestem | | | | | |
| Grazed | 63a | 59a | 58a | 58a | 58a |
| Ungrazed | 58a | 58a | 57a | 56a | 55a |
| Little Bluestem | | | | | |
| Grazed | 62a | 61ab | 54ab | 56ab | 52b |
| Ungrazed | 62a | 57ab | 54ab | 55ab | 52b |

[1/]Grazed is biomass produced from July 1st to mid-October.
[2/]Ungrazed is biomass produced from spring greenup in the spring to mid-October.
[3/]Values within rows followed by different lower-case letters differ between management ($P \leq 0.05$).

## CONCLUSION

Range and pasture plantings should be designed and managed to provide optimal grazing in the growing season as well as the dormant season. Native warm season grasses provide alternative forage for winter grazing needs while performing other valuable services such as improving wildlife habitat, providing protection from soil erosion, and restoring the landscape to native grasslands.

These six warm-season grasses produced higher yields during the growing season in the grazed compared to the ungrazed scenario. The quality of forage decreased under both management scenarios during the dormant season; however, pastures grazed during the early growing season, provide a higher quality winter forage.  While these grasses provide ample forage, protein supplement must be considered as part of the grazing plan and to ensure the forage quality meets the nutritional needs of the livestock.

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