FIELD DAY 2006

Southwest Research–Extension Center

FORAGE RESEARCH SUPPLEMENT

Report of Progress
961-S

Kansas State University
Agricultural Experiment Station
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EFFECT OF GRAZING ON GRAIN YIELD AND QUALITY OF HARD RED AND WHITE WINTER WHEAT VARIETIES - YEAR TWO COMPARISON

by

***Ron Hale, Curtis Thompson, Troy Dumler, Alan Schlegel, and Tim Herrman*[1]**

SUMMARY

Six hard red (2137, Jagalene, Jagger, OK101, Stanton, and Thunderbolt) and six hard white (Burchett, Lakin, NuFrontier, NuHills, NuHorizon, and Trego) winter wheat varieties were evaluated for grain yield and quality in the second year of the study. A split-plot design was used with four grazed and four ungrazed plots of each variety in two southwestern Kansas counties. Cattle were allowed to graze the wheat after it was well established. Cattle were removed before wheat began jointing in Stanton County, but were not removed until after jointing in Clark County. Grain was harvested from the grazed and ungrazed plots. Grazing did not influence grain yields in Stanton County. In Clark County, grazing reduced average yield by 9 bu/acre. Grazing decreased test weights in Clark County, but increased test weights in Stanton County. Grazing increased crude protein content of 10 varieties in Clark County. In Stanton County, the protein response was less consistent. Grazing seemed to more significantly affect kernel weight, diameter, and hardness in Clark County than in Stanton County. Although variety differences occurred, grain yield and quality do not seem to be related to wheat color.

INTRODUCTION

The use of winter wheat as a source of forage for livestock allows producers to more effectively and profitably utilize their land. Wheat provides economical, high-quality forage at a time of the year when few other comparable forages are available. Wheat can be used as a forage source, or in a dual forage and grain program. Research has shown that grazing winter wheat can occur up to wheat jointing without reducing grain yield. An estimated 6 million acres of Kansas winter wheat may be grazed during a good forage-producing year. Little is known about the effect of grazing on grain yield and quality of the hard white winter wheat varieties. This experiment examined the effect of grazing on grain yield and quality of six hard red and six hard white winter wheat varieties. Results from the first year's experiment indicated that varieties may respond differently to grazing, and that heavy grazing may reduce crude protein. Grain yields were generally not reduced by light or heavy grazing, as long as the cattle were removed before jointing occurred.

PROCEDURES

Six hard white winter wheat varieties (Burchett, Lakin, NuFrontier, NuHills, NuHorizon, and Trego) and six hard red winter wheat varieties (2137, Jagalene, Jagger, OK101, Stanton, and Thunderbolt) were planted in two locations in southwestern Kansas. Producers had prepared the soil and applied 65 lb of nitrogen (Clark County) or 80 lb of nitrogen (Stanton County) per acre before wheat planting. On September 15, 2004, each variety was planted in four replicated plots at each location, in 10-inch rows at a depth of approximately 1.75 inches. The planting rates were 90 lb seed/acre at the Clark County plots and 120 lb seed/acre at the Stanton County plots. Eleven pounds of nitrogen (N) and 52 lb of P_2O_5/acre were applied with the seed. Soil type at both locations was a silt loam. Heavy rainfall and subsequent crusting of the soil surface after planting prevented the emergence of all varieties. All plots were sprayed with glyphosate to kill emerged wheat, and plotswere then replanted on October 16, 2005. The same planting rates were used, but N and P_2O_5 were not reapplied. In late March 2005, liquid urea ammonium nitrate was applied at 30 lb N/acre at both locations. Stanton County plots received an estimated 4 inches of irrigation water in late April and May. Clark County plots were located in a dryland field. Total precipitation from January through May was similar in the two counties (Clark, 7.88 inches; Stanton, 7.95 inches). In June, Clark

[1] Texas Agricultural Experiment Station, College Station.

received 4.80 inches of rain, whereas Stanton County received 0.93 inches.

A split-plot design used grazing/ungrazed as the main plots and varieties as the subplots. All treatments were replicated four times at each location. The experiments were located within the producers' wheat fields, where stocker cattle were allowed to graze after wheat was well rooted and had sufficient tillering. Cattle were removed from the plots in Stanton County before wheat jointing began, but not until after jointing in Clark County. Grain was harvested in Clark County on June 22 and in Stanton County on June 27, 2005. Grain yield, moisture, and test weight were determined on the day of harvest. Grain samples were sent to the K-State grain laboratory for measurement of kernel diameter, hardness, moisture, and 1000-kernel weight. These traits are part of the single-kernel characterization system (SKCS) used to determine grain quality. Samples were also analyzed at the K-State soil laboratory for crude protein (CP) content.

RESULTS AND DISCUSSION

Grazing did not affect grain variety yields in Stanton County, but reduced grain yields in Clark County by an average of 9 bu/acre (Table 1). Stanton County yields ranged from 47 to 59 bu/acre and were significantly higher than yields for Clark County, which ranged from 21 to 47 bu/acre. The yield difference may be attributed to cattle removal before jointing in Stanton County and after jointing in Clark County. Heavier stocking rates were used in the Clark County experiment. Published research indicates that yields can be expected to decline 1 to 2 bu/acre per day when wheat is grazed during the first week after onset of the first hollow stem. The varieties responded differently in the two counties. For example, Jagger was one of the top producers in Stanton County, but the poorest in Clark County, regardless of grazing condition. The variety by grazing interaction was primarily due to the grazing effects observed in Clark County and to the presence of Hessian fly.

Grain moisture at harvest (Table 2) differed between the two locations for grazed and ungrazed wheat. In Clark County, grain had higher moisture content when grazed than when ungrazed, which is commonly observed when wheat is grazed after first hollow stem. Grazing did not affect grain moisture in the Stanton County experiment. Test weights (Table 3) were higher in Clark County, but lower in Stanton County, for the grazed wheat. In both counties, Burchett, Jagalene, NuHills, and Thunderbolt had higher test weights, whereas 2137 and OK101 had lower weights. Test weights of the other six varieties were not consistent between the two locations. Crude protein content (Table 4) differed between the varieties in each county, depending on the grazing conditions. Overgrazing in Clark County increased the CP in 10 of the varieties and reduced CP in 2 varieties. Protein was not affected in 8 varieties, was reduced in 2, and was increased in 2 with the early removal of cattle in Stanton County. Crude protein was higher in Stanton County than in Clark County.

Single-kernel characteristics of each variety were affected by gazing differently in each county. Grazing reduced the SKCS 1000-kernel weight (KWT) of Jagalene, NuHills, NuHorizon, and Thunderbolt in both counties (Table 5). Jagger and Stanton 1000 KWT were unaffected by grazing in either county. All other varieties responded differently to grazing in each county, such as having a higher kernel weight when grazed in Clark but a lower weight when grazed in Stanton County. Grazing generally seemed to reduce kernel weight more in Clark County than in Stanton County. Stanton wheat kernel diameter (Table 6) was not affected by grazing in either county. At both locations, NuFrontier and NuHorizon had smaller kernel diameters when grazed. Changes in diameter of the other 9 varieties were not consistent between counties or grazing system. There was a general tendency for the wheat grazed in Clark County to have smaller kernel diameter. All but two samples were within the medium kernel size classification (≥2.24 to ≤2.92 mm). Stanton wheat single kernel hardness (Table 7) was greater when grazed at both locations. Grazing decreased hardness of 2137, Jagger, and Lakin, and increased hardness of the other 9 varieties in Clark County. In Stanton County, grazing increased the hardness of the Stanton wheat variety, but did not affect hardness of the other 11 varieties. None of the Clark County wheats were indexed as 'very hard' (80 to 89), and none of the Stanton County wheats were 'medium soft' (60 to 64) or 'medium hard' (65 to 79).

Grazing had a greater impact on grain yield and quality in Clark County than in Stanton County. Visual observation suggested that the wheat in Clark County was grazed more heavily than wheat in Stanton County. Grazing continued after jointing in Clark, but did not in Stanton County. Although the total January through July precipitation was higher in Clark County, the experiment in Stanton County received an estimated 4 inches of irrigation water. The red and white varieties used in this study are not representative of all wheat varieties, but were selected because of their popularity or potential in southwestern Kansas. There did not seem to be any grain traits evaluated in these experiments that were strongly related to wheat color.

Table 1. The effect of grazing on wheat variety grain yield (bu/acre at 13% moisture), 2005.

		Clark			Stanton					
Variety	Color	Grazed	Not grazed	Variety	Grazed	Not grazed	Variety	Grazed	Not grazed	Variety
2137	Red	33	37	35	50	50	50	42	44	43
Burchett	White	30	38	34	52	51	52	41	45	43
Jagalene	Red	28	40	34	55	54	55	41	47	44
Jagger	Red	21	28	24	55	58	57	38	43	40
Lakin	White	29	37	33	51	47	49	40	42	41
NuFrontier	White	34	40	37	50	51	51	42	46	44
NuHills	White	30	44	37	57	58	57	43	51	47
NuHorizon	White	28	47	37	52	55	54	40	51	46
OK101	Red	31	44	37	53	53	53	42	48	45
Stanton	Red	35	35	35	59	58	59	47	47	47
Thunderbolt	Red	30	41	35	52	47	50	41	44	43
Trego	White	31	37	34	52	50	51	42	44	43
Mean		30	39	34	53	53	53	42	46	44

	LSD (P<.05)
Variety	-
Location	-
Grazing	-
Variety * Location	4
Variety * Grazing	4
Location * Grazing	2
Variety * Location * Grazing	NS

Table 2. The effect of grazing on wheat variety grain moisture (%), 2005.

		Clark			Stanton					
Variety	Color	Grazed	Not grazed	Variety	Grazed	Not grazed	Variety	Grazed	Not grazed	Variety
2137	Red	10.0	9.1	9.5	9.2	9.3	9.2	9.6	9.2	9.4
Burchett	White	9.8	10.1	9.9	9.3	9.1	9.2	9.5	9.6	9.6
Jagalene	Red	9.5	9.5	9.5	9.1	9.1	9.1	9.3	9.3	9.3
Jagger	Red	9.6	9.9	9.7	9.2	9.3	9.2	9.4	9.6	9.5
Lakin	White	9.7	9.4	9.5	9.3	9.3	9.3	9.5	9.3	9.4
NuFrontier	White	9.6	9.3	9.4	9.4	9.4	9.4	9.5	9.3	9.4
NuHills	White	9.7	10.1	9.9	9.4	9.4	9.4	9.5	9.8	9.6
NuHorizon	White	9.4	9.4	9.4	9.1	9.3	9.2	9.3	9.4	9.3
OK101	Red	10.4	9.7	10.0	9.3	9.4	9.3	9.8	9.5	9.7
Stanton	Red	10.6	9.5	10.0	9.1	9.2	9.1	9.9	9.3	9.6
Thunderbolt	Red	9.7	10.0	9.8	9.1	9.3	9.2	9.4	9.6	9.5
Trego	White	10.2	9.4	9.8	9.3	9.5	9.4	9.7	9.5	9.6
Mean		9.8	9.6	9.7	9.2	9.3	9.3	9.3	9.4	9.4

	LSD (P<.05)
Variety	NS
Location	-
Grazing	-
Variety * Location	NS
Variety * Grazing	NS
Location * Grazing	0.18
Variety * Location * Grazing	NS

Table 3. The effect of grazing on wheat variety grain test weight (lb/bu), 2005.

		Clark			Stanton					
Variety	Color	Grazed	Not grazed	Variety	Grazed	Not grazed	Variety	Grazed	Not grazed	Variety
2137	Red	56.8	56.0	56.4	61.1	61.5	61.3	58.9	58.8	58.9
Burchett	White	60.1	59.0	59.5	62.5	62.1	62.3	61.3	60.5	60.9
Jagalene	Red	59.5	59.2	59.3	61.9	62.1	62.0	60.7	60.6	60.6
Jagger	Red	57.3	56.8	57.1	61.5	61.7	61.6	59.4	59.2	59.3
Lakin	White	57.0	56.5	56.7	62.0	61.8	61.9	59.5	59.1	59.3
NuFrontier	White	57.0	57.5	57.3	61.3	61.7	61.5	59.1	59.6	59.4
NuHills	White	59.1	59.4	59.3	62.4	62.9	62.6	60.7	61.2	60.9
NuHorizon	White	58.1	57.7	57.9	61.2	62.0	61.6	59.7	59.8	59.7
OK101	Red	56.2	55.4	55.8	61.6	62.1	61.8	58.9	58.7	58.8
Stanton	Red	59.3	57.7	58.5	61.7	62.1	61.9	60.5	59.9	60.2
Thunderbolt	Red	60.3	59.6	59.9	62.4	62.8	62.6	61.3	61.2	61.3
Trego	White	58.9	58.8	58.9	61.7	62.3	62.0	60.3	60.6	60.5
Mean		58.3	57.8	58.0	61.8	62.1	61.9	60.0	59.9	60.0

	LSD (P<.05)
Variety	-
Location	-
Grazing	-
Variety * Location	0.6
Variety * Grazing	NS
Location * Grazing	0.2
Variety * Location * Grazing	NS

Table 4. The effect of grazing on wheat variety grain crude protein content (% of DM), 2005.

		Clark			Stanton					
Variety	Color	Grazed	Not grazed	Variety	Grazed	Not grazed	Variety	Grazed	Not grazed	Variety
2137	Red	12.5	12.8	12.7	14.1	14.0	14.0	13.3	13.4	13.3
Burchett	White	14.9	13.8	14.3	15.5	16.0	15.8	15.2	14.9	15.1
Jagalene	Red	14.6	14.2	14.4	15.2	15.4	15.3	14.9	14.8	14.8
Jagger	Red	15.3	14.9	15.1	15.6	15.7	15.6	15.5	15.3	15.4
Lakin	White	12.6	12.0	12.3	14.4	14.7	14.5	13.5	13.4	13.4
NuFrontier	White	13.4	12.7	13.0	14.2	13.9	14.1	13.8	13.3	13.6
NuHills	White	14.1	13.2	13.7	15.3	15.4	15.4	14.7	14.3	14.5
NuHorizon	White	13.9	12.6	13.3	14.8	14.6	14.7	14.4	13.6	14.0
OK101	Red	13.0	12.3	12.7	13.8	13.8	13.8	13.4	13.1	13.2
Stanton	Red	13.3	13.7	13.5	13.6	13.2	13.4	13.4	13.4	13.4
Thunderbolt	Red	14.8	14.1	14.5	15.8	15.6	15.7	15.3	14.9	15.1
Trego	White	13.5	13.1	13.3	14.5	14.5	14.5	14.0	13.8	13.9
Mean		13.8	13.3	13.6	14.7	14.7	14.7	14.3	14.0	14.1

	LSD (P<.05)
Variety	-
Location	-
Grazing	-
Variety * Location	-
Variety * Grazing	-
Location * Grazing	-
Variety * Location * Grazing	0.2

Table 5. The effect of grazing on wheat variety grain SKCS 1000-kernel weight (gm), 2005.

		Clark			Stanton					
Variety	Color	Grazed	Not grazed	Variety	Grazed	Not grazed	Variety	Grazed	Not grazed	Variety
2137	Red	28.2	27.3	27.8	28.0	28.7	28.4	28.1	28.0	28.1
Burchett	White	27.4	29.0	28.2	28.4	27.6	28.0	27.9	28.3	28.1
Jagalene	Red	28.9	30.2	29.5	28.8	29.5	29.1	28.8	29.8	29.3
Jagger	Red	27.2	27.4	27.3	28.7	28.6	28.6	27.9	28.0	28.0
Lakin	White	27.5	27.6	27.5	28.6	27.5	28.1	28.1	27.6	27.8
NuFrontier	White	23.6	27.3	25.4	25.7	26.0	25.8	24.6	26.6	25.6
NuHills	White	27.0	29.7	28.4	28.7	29.3	29.0	27.8	29.5	28.7
NuHorizon	White	23.5	28.3	25.9	26.8	27.9	27.4	25.2	28.1	26.7
OK101	Red	28.8	28.3	28.5	29.6	30.1	29.8	29.2	29.2	29.2
Stanton	Red	30.2	30.2	30.2	31.1	31.1	31.1	30.7	30.6	30.7
Thunderbolt	Red	28.3	29.6	29.0	28.1	28.7	28.3	28.2	29.2	28.7
Trego	White	27.6	29.9	28.8	27.6	27.5	27.5	27.6	28.7	28.1
Mean		27.4	28.7	28.0	28.3	28.5	28.4	27.8	28.6	28.2

	LSD (P<.05)
Variety	-
Location	-
Grazing	-
Variety * Location	-
Variety * Grazing	-
Location * Grazing	-
Variety * Location * Grazing	0.4

Table 6. The effect of grazing on wheat variety grain SKCS kernel diameter* (mm), 2005.

		Clark			Stanton					
Variety	Color	Grazed	Not grazed	Variety	Grazed	Not grazed	Variety	Grazed	Not grazed	Variety
2137	Red	2.33	2.25	2.29	2.35	2.39	2.37	2.34	2.32	2.33
Burchett	White	2.33	2.39	2.36	2.43	2.39	2.41	2.38	2.39	2.38
Jagalene	Red	2.44	2.49	2.46	2.48	2.47	2.47	2.45	2.48	2.47
Jagger	Red	2.28	2.31	2.29	2.43	2.42	2.43	2.35	2.37	2.36
Lakin	White	2.26	2.26	2.26	2.34	2.31	2.32	2.30	2.28	2.29
NuFrontier	White	2.09	2.31	2.20	2.25	2.26	2.25	2.17	2.28	2.23
NuHills	White	2.30	2.44	2.37	2.45	2.48	2.47	2.38	2.46	2.42
NuHorizon	White	2.10	2.35	2.22	2.35	2.42	2.38	2.22	2.38	2.30
OK101	Red	2.33	2.28	2.31	2.49	2.50	2.49	2.41	2.39	2.40
Stanton	Red	2.47	2.45	2.46	2.58	2.56	2.57	2.55	2.50	2.51
Thunderbolt	Red	2.42	2.42	2.42	2.48	2.44	2.46	2.44	2.43	2.44
Trego	White	2.30	2.39	2.35	2.31	2.31	2.31	2.31	2.35	2.33
Mean		2.30	2.36	2.33	2.41	2.41	2.41	2.36	2.38	2.37

	LSD (P<.05)
Variety	-
Location	-
Grazing	-
Variety * Location	-
Variety * Grazing	-
Location * Grazing	-
Variety * Location * Grazing	0.02

* SCKS kernel diameter: <2.24 mm, small; ≥2.24 mm - ≤2.92 mm, medium; >2.92 mm, large.

Table 7. The effect of grazing on wheat variety grain SKCS kernel hardness index*, 2005.

		Clark			Stanton					
Variety	Color	Grazed	Not grazed	Variety	Grazed	Not grazed	Variety	Grazed	Not grazed	Variety
2137	Red	53	55	54	74	73	73	64	64	64
Burchett	White	69	67	68	81	80	81	75	74	74
Jagalene	Red	71	67	69	81	80	80	76	74	75
Jagger	Red	64	66	65	80	80	80	72	73	73
Lakin	White	53	55	54	73	74	74	63	64	64
NuFrontier	White	59	53	56	78	78	78	69	66	67
NuHills	White	72	66	69	83	82	82	77	74	76
NuHorizon	White	70	59	65	84	84	84	77	71	74
OK101	Red	52	50	51	72	71	71	62	61	61
Stanton	Red	63	60	62	73	71	72	68	66	67
Thunderbolt	Red	65	59	62	74	73	73	69	65	67
Trego	White	63	58	61	76	77	77	70	67	69
Mean		63	59	61	77	77	77	70	68	69

	LSD (P<.05)
Variety	-
Location	-
Grazing	-
Variety * Location	-
Variety * Grazing	-
Location * Grazing	-
Variety * Location * Grazing	1.0

* SKCS hardness index: 40-59, medium soft; 60-64, medium hard; 65-79, hard; 80-89, very hard.

Southwest Research-Extension Center

FORAGE YIELD AND QUALITY OF HARD RED AND WHITE WINTER WHEAT VARIETIES – YEAR TWO COMPARISON

by

Ron Hale, Curtis Thompson, Troy Dumler, Alan Schlegel, and Charles MacKown[1]

SUMMARY

This report discusses the second year's results comparing forage yield and quality of six hard white winter wheat varieties (Burchett, Lakin, NuFrontier, NuHills, NuHorizon, and Trego) and six hard red winter wheat varieties (2137, Jagalene, Jagger, OK101, Stanton, and Thunderbolt). Experiments were planted in two southwestern Kansas counties, Clark and Stanton, in September 2004. The plots were replanted in October due to poor emergence caused by heavy rainfall after planting. Forage samples were collect from each plot during March and May 2005. Dry matter (DM) content, DM yield, crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), net energy for maintenance (NEm), net energy for gain (NEg), total digestible nutrients (TDN), relative feed value (RFV), and nitrate nitrogen were determined. Forage yield at the May harvests was higher than in March in both counties. Stanton County also had the lowest March and highest May yields. Forage quality was better at the March harvest than in May in both counties. May forage quality was higher at Stanton than in Clark County. High forage nitrate concentrations were found in both experiments with the May harvest. Although yield and quality differences existed between varieties, they did not seem to be related to wheat kernel color.

INTRODUCTION

Wheat pasture provides economical, high-quality forage for livestock during a time of year that few other quality forages are available. Research has shown that grazing winter wheat can occur up to the formation of the first hollow stem (onset of jointing) without reducing grain yield. Although hard red winter wheat varieties dominate in Kansas, some grazing of white wheats has occurred. Limited research has been conducted to examine forage yield and quality of white wheat varieties. This experiment is the second year's evaluation of the forage yield and quality of six hard white winter varieties and six hard red winter varieties popular in Kansas. Results from the first year's experiment showed location and variety differences in forage yield and quality. The variety differences did not seem to be associated with wheat color.

PROCEDURES

Six hard white winter wheat varieties (Burchett, Lakin, NuFrontier, NuHills, NuHorizon, and Trego) and six hard red winter wheat varieties (2137, Jagalene, Jagger, OK101, Stanton, and Thunderbolt) were planted in two locations in southwestern Kansas. Producers had prepared the soil and applied 65 lb of nitrogen (Clark County) or 80 lb of nitrogen (Stanton County) per acre before wheat planting. On September 15, 2004, each variety was planted in four replicated plots at each location, in 10-inch rows at a depth of approximately 1.75 inches. The planting rates were 90 lb seed/acre at the Clark County plots and 120 lb/acre at the Stanton County plots. Eleven lb of nitrogen (N) and 52 lb of P_2O_5/acre were applied with the seed. Soil type at both locations was a silt loam. Heavy rainfall and subsequent crusting of the soil surface after planting prevented uniform emergence in both counties. The experiment was sprayed with glyphosate to kill wheat, and was replanted on October 16, 2005. The same planting rate was used, but N and P_2O_5 were not reapplied. Stanton County plots received an estimated 4 inches of irrigation water in late April and May. Clark County plots were located in a dryland field. Total precipitation from January through May was similar in the two counties (Clark, 7.88 inches; Stanton, 7.95 inches).

[1] USDA ARS, El Reno, Oklahoma.

Forage samples were harvested on March 18, 2005, in both counties, and on May 12, 2005, at Clark County and May 13, 2005, at Stanton County. Fall forage growth was not sufficient to warrant an early-winter harvest, as in the first year's experiment. Cuttings were collected from the same 6 ft of closely clipped row length in each plot. Samples were dried, weighed for dry matter yield, and then sent to a commercial laboratory for CP, ADF, and NDF determination. Relative feed value, TDN, NEm, and NEg were calculated from the laboratory analysis, according to formulas shown in Table 1. Nitrate-nitrogen assays were performed at the USDA-ARS laboratory in El Reno, Oklahoma.

RESULTS AND DISCUSSION

Total forage production was greater in Stanton thanin Clark County (Table 2). Averaged over all locations and harvests, 2137, Stanton, Thunderbolt, and Trego were among the leading total forage producers, whereas Lakin was the only variety with a total yield less than 3000 lb/acre. May yields were higher than March yields in both experiments (Table 3). Averaged over locations, NuFrontier produced less forage in the first harvest than Jagger or Stanton did; all other varieties were similar. NuFrontier, Stanton, Thunderbolt, Trego, and 2137 produced the most May forage, exceeding 2400 lb/acre averaged over locations, whereas Lakin or NuHills were the lowest producers in May, with 2000 lb/acre or less. It is interesting to note that a variety like NuFrontier was the lowest March forage producer and one of the highest May forage producers. Variety differences at individual harvests and for total annual production do not seem to be related to kernel color because there were high- and low-yielding red and white wheat varieties.

Crude protein content ranged from 10.0 to 24.4% (Table 4). Averaged over all harvests and counties, Burchett, Jagalene, Lakin, NuHills, and Thunderbolt had higher crude protein than did OK101 and NuFrontier. March growth had the highest CP content in both locations. Forage in Clark County had both the highest March and lowest May CP. Crude protein did not seem to be related to wheat color.

Acid detergent fiber, a measure of cellulose and lignin plant fractions, increases as a plant matures. Greater ADF is associated with less forage digestibility and energy availability. Neutral detergent fiber (NDF) measures hemicellulose, cellulose, and lignin. As NDF increases, feed intake tends to decrease. Both March harvests had lower ADF (Table 5) and NDF (Table 6) values, indicative of higher quality, than did the forages harvested in late spring. Although ADF and NDF were similar for both counties in March, May ADF and NDF values were lowest in Stanton County.

Because NEm, NEg, and TDN are calculated from ADF, and RFV is calculated from ADF and NDF, these four energy-related values showed similar responses in this experiment. March-harvested forages from each county had small to no differences in NEm, NEg, TDN, and RFV values (Tables 7 through 10, respectively). March values were higher than values from the May harvests. The values were lower in Clark than in Stanton County in the May forage.

The lower CP and energy-related values from forages harvested in May were attributed to a later stage of plant maturity. The varieties were in various stages of late boot to early heading at this harvest. Clark County wheat was at a slightly more advanced growth stage than Stanton County wheat was. March forage quality was similar in the two counties, and was higher than the May forage quality. Dry matter yield increases as a plant matures. In this experiment, DM yield was negatively related ($P<.0001$) to CP ($r = -.60$), NEm ($r = -62$), NEg ($r = -.63$), and TDN ($r = -.62$), indicating that as yields increase, quality decreased. It should be remembered that forage quality of the May samples would be most applicable to wheat cut for hay at that time. If the forage had been properly grazed to sustain vegetative growth, the protein and energy values would have been closer to the March nutrient analysis.

High nitrate concentrations (>3000 ppm) were found in some of the forages (Table 11). The least nitrate content occurred at the March harvest in each county, but with Stanton County forage having less. The high May concentrations were similar for both experiments. Of the 192 forage samples tested, 82.8% (n=159) had less than 3000 ppm (1131 avg.), 16.7% (n=32) were between 3000 and 6000 ppm (3744 avg.), and 0.5% (n=1) had 6927 ppm.

The various wheat varieties exhibited different growing patterns, depending on the time of year. Total annual yield differed between counties and varieties. Forage quality was affect by the time of harvest and the associated stage of plant maturity. The varieties chosen in this experiment are among the more popular wheats planted in Kansas, but they do not represent all varieties, colors, growing conditions, or cultural practices. Forage traits seem to be related more to individual variety characteristics than to wheat kernel color.

Table 1. Formulas used to calculated TDN, NEm, NEg, and RFV from ADF and NDF.	
Item	Formula
TDN, %	95.88 – (0.911 x ADF%)
NEm, mcal/lb	0.995 – (0.0121 x ADF%)
NEg, mcal/lb	0.786 – (0.0132 x ADF%)
RFV	[(88.9 – (.779 x ADF%)) x (120 ÷ NDF%)] ÷ 1.29

Table 2. Total annual forage dry matter yield (lb DM\acre) by county and variety, 2005.

Variety	Color	Clark	Stanton	Variety
2137	Red	3541	3796	3669
Burchett	White	2946	3638	3292
Jagalene	Red	3074	3284	3179
Jagger	Red	2837	3919	3378
Lakin	White	3007	2927	2967
NuFrontier	White	2928	3757	3342
NuHills	White	2725	3408	3067
NuHorizon	White	2837	3599	3218
OK 101	Red	3308	3330	3319
Stanton	Red	3408	3880	3644
Thunderbolt	Red	3838	3765	3801
Trego	White	3166	3964	3565
Mean		3134	3605	3370

Total Yield	LSD (P<.05)
Variety	463
Location	189
Variety*Location	NS

Table 3. Forage dry matter yield (lb DM\acre) by county, harvest, and variety, 2005.

		Clark			Stanton			Harvest		
Variety	Color	March 18	May 12	County	March 28	May 13	County	March	May	Variety
2137	Red	1328	2213	1771	855	2941	1898	1092	2577	1834
Burchett	White	1338	1608	1473	789	2849	1819	1064	2229	1646
Jagalene	Red	1342	1732	1537	834	2450	1642	1088	2091	1589
Jagger	Red	1398	1439	1419	1029	2890	1959	1214	2165	1689
Lakin	White	1394	1613	1504	597	2329	1463	996	1971	1483
NuFrontier	White	927	2001	1464	766	2991	1879	847	2496	1671
NuHills	White	1358	1367	1363	775	2633	1704	1067	2000	1533
NuHorizon	White	1197	1640	1418	973	2627	1800	1085	2133	1609
OK 101	Red	1435	1873	1654	834	2496	1665	1134	2184	1659
Stanton	Red	1456	1952	1704	889	2991	1940	1172	2471	1822
Thunderbolt	Red	1568	2270	1919	747	3018	1882	1157	2644	1901
Trego	White	1192	1974	1583	847	3117	1982	1019	2546	1782
Mean		1328	1807	1567	828	2778	1803	1078	2292	1685

Harvest	LSD (P<.05)
Variety	-
Location	-
Harvest	-
Variety*Location	NS
Variety*Harvest	313
Location*Harvest	128
Variety*Location*Harvest	NS

Table 4. Crude protein (% of DM) by county, harvest, and variety, 2005.

Variety	Color	Clark March 18	Clark May 12	Clark County	Stanton March 28	Stanton May 13	Stanton County	Harvest March	Harvest May	Variety
2137	Red	23.8	11.5	17.6	21.4	14.2	17.8	22.6	12.9	17.7
Burchett	White	23.4	12.4	17.9	22.2	16.1	19.1	22.8	14.3	18.5
Jagalene	Red	23.6	12.9	18.3	22.3	16.7	19.5	22.9	14.8	18.9
Jagger	Red	23.5	12.1	17.8	21.0	14.4	17.7	22.2	13.2	17.7
Lakin	White	22.6	12.3	17.5	22.3	15.9	19.1	22.5	14.1	18.3
NuFrontier	White	22.4	10.0	16.4	19.7	14.3	17.0	21.1	12.4	16.7
NuHills	White	22.9	12.2	17.6	23.0	14.7	18.9	22.9	13.5	18.2
NuHorizon	White	23.3	12.8	18.1	20.0	15.6	17.8	21.7	14.2	17.9
OK 101	Red	22.9	10.6	16.8	20.4	14.0	17.2	21.7	12.3	17.0
Stanton	Red	24.4	10.9	17.6	21.3	14.2	17.7	22.8	12.6	17.7
Thunderbolt	Red	22.2	11.5	16.8	23.3	16.0	19.7	22.7	13.8	18.3
Trego	White	22.4	11.7	17.1	20.9	15.1	18.0	21.7	13.4	17.5
Mean		23.1	11.8	17.4	21.5	15.1	18.3	22.3	13.4	17.9

Harvest	LSD (P<.05)
Variety	1.0
Location	-
Harvest	-
Variety*Location	NS
Variety*Harvest	NS
Location*Harvest	0.6
Variety*Location* Harvest	NS

Table 5. Acid detergent fiber (% of DM) by county, harvest, and variety, 2005.

Variety	Color	Clark March 18	Clark May 12	Clark County	Stanton March 28	Stanton May 13	Stanton County	Harvest March	Harvest May	Variety
2137	Red	22.3	35.3	28.8	24.4	30.4	27.4	23.3	32.8	28.1
Burchett	White	21.9	34.0	28.0	21.2	31.9	26.6	21.6	33.0	27.3
Jagalene	Red	22.5	34.0	28.2	20.4	29.2	24.8	21.4	31.6	26.5
Jagger	Red	21.3	34.8	28.0	21.4	31.4	26.4	21.3	33.1	27.2
Lakin	White	23.7	35.8	29.7	19.4	29.9	24.7	21.6	32.9	27.2
NuFrontier	White	24.0	37.3	30.6	21.6	31.7	26.7	22.8	34.5	28.7
NuHills	White	21.1	33.9	27.5	21.3	31.2	26.3	21.2	32.5	26.9
NuHorizon	White	21.4	35.1	28.2	22.2	30.7	26.4	21.8	32.9	27.3
OK 101	Red	24.3	36.3	30.3	24.2	31.1	27.6	24.2	33.7	29.0
Stanton	Red	21.5	35.0	28.3	22.9	31.7	27.3	22.2	33.4	27.8
Thunderbolt	Red	22.1	34.3	28.2	21.7	29.7	25.7	21.9	32.0	26.9
Trego	White	21.7	34.9	28.3	25.4	31.2	28.3	23.5	33.1	28.3
Mean		22.3	35.1	28.7	22.2	30.8	26.5	22.2	32.9	27.6

Harvest	LSD (P<.05)
Variety	1.5
Location	-
Harvest	-
Variety*Location	NS
Variety*Harvest	NS
Location*Harvest	0.9
Variety*Location* Harvest	NS

Table 6. Neutral detergent fiber (% of DM) by county, harvest, and variety, 2005.										
		Clark			Stanton			Harvest		
Variety	Color	March 18	May 12	County	March 28	May 13	County	March	May	Variety
2137	Red	41.4	58.6	50.0	40.0	51.4	45.7	40.7	55.0	47.8
Burchett	White	37.2	54.2	45.7	37.1	52.3	44.7	37.2	53.2	45.2
Jagalene	Red	39.2	54.2	46.7	36.3	49.4	42.8	37.7	51.8	44.8
Jagger	Red	39.5	57.5	48.5	39.3	54.2	46.7	39.4	55.9	47.6
Lakin	White	38.7	60.8	49.7	39.6	52.1	45.9	39.2	56.4	47.8
NuFrontier	White	39.9	61.1	50.5	39.0	53.8	46.4	39.4	57.5	48.4
NuHills	White	38.4	54.2	46.3	40.5	53.0	46.8	39.4	53.6	46.5
NuHorizon	White	37.6	56.5	47.0	37.0	52.5	44.7	37.3	54.5	45.9
OK 101	Red	39.0	61.4	50.2	38.7	54.0	46.3	38.8	57.7	48.3
Stanton	Red	38.0	57.8	47.9	37.3	52.7	45.0	37.7	55.2	46.5
Thunderbolt	Red	38.2	56.9	47.6	42.0	52.1	47.0	40.1	54.5	47.3
Trego	White	39.4	56.6	48.0	39.9	53.1	46.5	39.6	54.8	47.2
Mean		38.9	57.5	48.2	38.9	52.5	45.7	38.9	55.0	46.9
Harvest			LSD (P<.05)							
Variety			-							
Location			-							
Harvest			-							
Variety*Location			NS							
Variety*Harvest			2.4							
Location*Harvest			1.0							
Variety*Location* Harvest			NS							

Table 7. Total digestible nutrients (% of DM) by county, harvest, and variety, 2005.										
		Clark			Stanton			Harvest		
Variety	Color	March 18	May 12	County	March 28	May 13	County	March	May	Variety
2137	Red	75.6	63.7	69.7	73.7	68.2	70.9	74.6	66.0	70.3
Burchett	White	75.9	64.9	70.4	76.6	66.8	71.7	76.3	65.8	71.0
Jagalene	Red	75.4	65.0	70.2	77.4	69.3	73.3	76.4	67.1	71.7
Jagger	Red	76.5	64.2	70.4	76.4	67.3	71.9	76.5	65.7	71.1
Lakin	White	74.3	63.3	68.8	78.2	68.6	73.4	76.2	66.0	71.1
NuFrontier	White	74.1	61.9	68.0	76.2	67.0	71.6	75.1	64.5	69.8
NuHills	White	76.6	65.0	70.8	76.4	67.5	72.0	76.5	66.3	71.4
NuHorizon	White	76.4	63.9	70.2	75.7	67.9	71.8	76.1	65.9	71.0
OK 101	Red	73.7	62.8	68.2	73.9	67.6	70.7	73.8	65.2	69.5
Stanton	Red	76.3	64.0	70.1	75.0	67.0	71.0	75.7	65.5	70.6
Thunderbolt	Red	75.8	64.6	70.2	76.2	68.8	72.5	76.0	66.7	71.4
Trego	White	76.1	64.1	70.1	72.8	67.5	70.1	74.5	65.8	70.1
Mean		75.6	63.9	69.8	75.7	67.8	71.7	75.6	65.9	70.7
Harvest			LSD (P<.05)							
Variety			1.4							
Location			-							
Harvest			-							
Variety*Location			NS							
Variety*Harvest			NS							
Location*Harvest			0.8							
Variety*Location* Harvest			NS							

Table 8. Net energy for maintenance (Mcals/100 lb DM) by county, harvest, and variety, 2005.										
		Clark			Stanton			Harvest		
Variety	Color	March 18	May 12	County	March 28	May 13	County	March	May	Variety
2137	Red	72.8	56.8	64.8	70.0	63.0	66.5	71.4	59.9	65.6
Burchett	White	73.0	58.3	65.6	73.8	60.8	67.3	73.4	59.5	66.4
Jagalene	Red	72.5	58.5	65.5	75.0	64.3	69.6	73.8	61.4	67.6
Jagger	Red	74.0	57.5	65.8	73.8	61.5	67.6	73.9	59.5	66.7
Lakin	White	70.8	56.0	63.4	75.8	63.3	69.5	73.3	59.6	66.4
NuFrontier	White	70.5	54.3	62.4	73.5	61.0	67.3	72.0	57.6	64.8
NuHills	White	74.0	58.5	66.3	73.8	61.8	67.8	73.9	60.1	67.0
NuHorizon	White	73.5	57.0	65.3	72.8	62.5	67.6	73.1	59.8	66.4
OK 101	Red	70.0	55.5	62.8	70.5	61.8	66.1	70.3	58.6	64.4
Stanton	Red	73.5	57.0	65.3	71.8	61.3	66.5	72.6	59.1	65.9
Thunderbolt	Red	72.8	58.0	65.4	73.5	63.3	68.4	73.1	60.6	66.9
Trego	White	73.3	57.0	65.1	68.8	61.8	65.3	71.0	59.4	65.2
Mean		72.5	57.0	64.8	72.7	62.2	67.4	72.6	59.6	66.1
Harvest			LSD (P<.05)							
Variety			0.1							
Location			-							
Harvest			-							
Variety*Location			NS							
Variety*Harvest			NS							
Location*Harvest			0.1							
Variety*Location* Harvest			NS							

Table 9. Net energy for gain (Mcals/100 lb DM) by county, harvest, and variety, 2005.										
		Clark			Stanton			Harvest		
Variety	Color	March 18	May 12	County	March 28	May 13	County	March	May	Variety
2137	Red	49.0	31.8	40.4	46.8	38.5	42.6	47.9	35.1	41.5
Burchett	White	49.8	33.8	41.8	50.8	36.3	43.5	50.3	35.0	42.6
Jagalene	Red	48.8	33.8	41.3	51.8	40.0	45.9	50.3	36.9	43.6
Jagger	Red	50.5	32.8	41.6	50.5	37.0	43.8	50.5	34.9	42.7
Lakin	White	47.5	31.3	39.4	52.8	39.3	46.0	50.1	35.3	42.7
NuFrontier	White	47.3	29.3	38.3	50.0	37.0	43.5	48.6	33.1	40.9
NuHills	White	50.8	34.3	42.5	50.5	37.8	44.1	50.6	36.0	43.3
NuHorizon	White	50.5	32.0	41.3	49.3	38.0	43.6	49.9	35.0	42.4
OK 101	Red	46.5	30.8	38.6	46.8	37.5	42.1	46.6	34.1	40.4
Stanton	Red	50.3	32.3	41.3	48.5	36.8	42.6	49.4	34.5	41.9
Thunderbolt	Red	49.5	33.3	41.4	50.3	39.3	44.8	49.9	36.3	43.1
Trego	White	50.0	32.5	41.3	45.3	37.3	41.3	47.6	34.9	41.3
Mean		49.2	32.3	40.7	49.4	37.9	43.6	49.3	35.1	42.1
Harvest			LSD (P<.05)							
Variety			0.1							
Location			-							
Harvest			-							
Variety*Location			NS							
Variety*Harvest			NS							
Location*Harvest			0.1							
Variety*Location* Harvest			NS							

Table 10. Relative feed value index by county, harvest, and variety, 2005.

		Clark			Stanton			Harvest		
Variety	Color	March 18	May 12	County	March 28	May 13	County	March	May	Variety
2137	Red	161	98	129	165	118	142	163	108	136
Burchett	White	180	108	144	183	114	149	181	111	146
Jagalene	Red	171	107	139	188	125	157	179	116	148
Jagger	Red	171	100	136	173	111	142	172	106	139
Lakin	White	170	94	132	174	117	145	172	105	138
NuFrontier	White	167	91	129	172	111	142	170	101	135
NuHills	White	176	108	142	166	114	140	171	111	141
NuHorizon	White	179	102	140	181	115	148	180	108	144
OK 101	Red	167	92	130	170	111	141	168	102	135
Stanton	Red	177	99	138	178	114	146	177	107	142
Thunderbolt	Red	175	102	138	160	118	139	168	110	139
Trego	White	172	102	137	164	113	139	168	107	138
Mean		172	100	136	173	115	144	172	106	140
Harvest			LSD (P<.05)							
Variety			8							
Location			-							
Harvest			-							
Variety*Location			NS							
Variety*Harvest			NS							
Location*Harvest			5							
Variety*Location* Harvest			NS							

Table 11. Nitrate-nitrogen (ppm, 100% DM basis) by county, harvest, and variety, 2005.

		Clark			Stanton			Harvest		
Variety	Color	March 18	May 12	County	March 28	May 13	County	March	May	Variety
2137	Red	1292	3427	2359	399	2218	1308	845	2823	1834
Burchett	White	987	3120	2053	306	2977	1641	646	3048	1847
Jagalene	Red	1437	2475	1956	265	2705	1485	851	2590	1721
Jagger	Red	940	2544	1742	297	2593	1445	618	2568	1593
Lakin	White	910	2989	1949	473	3295	1884	691	3142	1917
NuFrontier	White	423	1528	975	165	1728	946	294	1628	961
NuHills	White	1250	1955	1602	573	2458	1515	911	2206	1559
NuHorizon	White	752	1586	1169	117	2556	1337	434	2071	1253
OK 101	Red	1664	1566	1615	302	2193	1247	983	1880	1431
Stanton	Red	1232	2828	2030	202	2893	1547	717	2860	1789
Thunderbolt	Red	922	1592	1257	360	2341	1351	641	1967	1304
Trego	White	816	2983	1899	341	3660	2001	579	3321	1950
Mean		1052	2383	1717	316	2634	1476	684	2509	1596
Harvest			LSD (P<.05)							
Variety			NS							
Location			-							
Harvest			-							
Variety*Location			NS							
Variety*Harvest			NS							
Location*Harvest			373							
Variety*Location* Harvest			NS							

COOL-SEASON GRASS YIELDS FOR 2005 WITH UNPLANNED REDUCED IRRIGATION

by

***Ron Hale, Curtis Thompson, Troy Dumler, Tom Roberts, Tim Jones, and Monte Hampton*[1]**

SUMMARY

In 2002, nine varieties and a commercial mix of perennial cool-season grasses were established in experiments in Ford and Stevens counties in southwestern Kansas to evaluate yield and adaptability when produced under irrigation. The varieties were 'Achenbach' smooth bromegrass, 'Slate' intermediate wheatgrass, "Hycrest' crested wheatgrass, 'Kentucky 31' and 'Max-Q' tall fescue, 'Profile' orchardgrass, 'Hykor' festulolium, and 'Dixon' and 'Lakota' matua grass. The cool-season mix was Sharp Brothers' PM6. The experiments received a minimum of 22 inches of irrigation water during 2003 and 2004. Well problems in 2005 reduced irrigation to 12 inches of water in Ford County and 4 inches in Stevens County. The matuas winterkilled 100% in Ford County, with 2005 fall growth coming from previous years' seed production. Other spring forage yields ranged from 2963 to 6562 lbs/acre of dry matter. Fall yields ranged from 371 to 7779 lbs/acre. Spring yields in Ford County were typically poorer than in Stevens County. Precipitation from January through May totaled 7.1 inches in Ford County and 9.3 in Stevens County. Compared with each county's fall forage production, spring yields were generally poorer in Ford County and greater in Stevens County. Forage production seemed to be related to the amount of irrigation water provided because rainfall after the spring harvest was similar in each of the two counties.

INTRODUCTION

Irrigated plots established in southwest Kansas have been used to compare the yield and adaptability of various cool-season grass varieties. In 2003, annual yields ranged from 10,656 to 16,842 lbs dry matter (DM) in Ford County. Spring yields in Stevens County ranged from 672 to 5088 lbs DM per acre. Calves from the surrounding pasture in Stevens County gained access to the plots just before the fall harvest. Forage production in 2004 ranged from 5661 to 9032 and from 6189 to 14,552 lbs/a in Ford and Stevens, respectively. The results of these two years have been published in the 2005 K-State Cattlemen's Day report, 2005 Beef Cattle Research. This report discusses 2005 yields of the same grass varieties, as affected by much less irrigation water than previous years.

PROCEDURES

Nine varieties and one commercial mix of cool-season grasses were planted in two counties in southwestern Kansas in the fall of 2002. The varieties were 'Achenbach' smooth bromegrass, 'Slate' intermediate wheatgrass, 'Hycrest' crested wheatgrass, 'Kentucky 31' and 'Max-Q' tall fescue, 'Profile' orchardgrass, 'Hykor' festulolium, and 'Dixon' and 'Lakota' matua grass. Kentucky 31 was endophyte free, whereas Max-Q carries an endophyte that does not produce toxins harmful to livestock. Festulolium is a cross of tall fescue and perennial ryegrass. The matuas have been called bromegrass, but are actually a rescuegrass. Reportedly, Dixon is better adapted to southern climates, whereas Lakota has a northern adaptability. The mix was Sharp Brothers' 'Pasture Mix #6', a blend of smooth bromegrass, 'Regar' meadow bromegrass, Slate, Profile, and 'Garrison' creeping foxtail. Each variety and the mix were planted in four randomly assigned plots in both locations. The Ford County plots were under a 2.4-acre center-pivot sprinkler on a Ulysses silt loam soil. The Stevens County plots were under a 15-acre pivot on a Vona-Tivoli loamy fine sand.

Urea (150 lb N/acre) was applied to both experiments in the early spring before new growth began. During the summer an additional 100 lbs N/acre was applied as urea. The grasses were harvested when

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all varieties had reached an early-boot to early-head stage of maturity. Harvests occurred on May 26th in Ford County and on June 17th in Stevens Counties. Spring yields in both counties were indicative of dryland conditions because neither experiment had been irrigated before the harvest. Irrigation began in Ford County the week after spring harvest, with approximately 12 inches of water was applied through October. Irrigation did not occur in Stevens County until July 23rd, when the experiment received approximately 4 inches in the one and only watering.

Fall harvests occurred on October 21st and 31st in Ford and Stevens counties, respectively. Forage samples were clipped to a 4-inch height and collected from a 20-square-foot area of each plot. The samples were oven dried to determine moisture content and DM yields.

RESULTS AND DISCUSSION

Total annual forage yields (Table 1) in Ford County were greater for Hykor festulolium, Kentucky 31, Max-Q, orchardgrass, PM6 and smooth brome, poorer for crested wheatgrass, Dakota and Lakota, and equal for intermediate wheatgrass, compared with annual variety yields in Stevens County. The matuas had the poorest annual production in both counties. The yields of all other varieties in Stevens were similar. The annual variety yields in Stevens County, except crested wheatgrass, were considerably lower than in 2004. In Ford County, Kentucky 31 was the high yielding variety, although it did not differ statistically from PM6. Total forage production of each variety in Ford did not seem to be as high as in 2003, but tended to be as good as, or better than, 2004 for some varieties.

In Ford County, seven varieties (Hykor festulolium, Kentucky 31, Max-Q, orchardgrass, and PM6) had a poorer spring than fall production (Table 2). The Dixon and Lakota matua plots experienced 100% winterkill. Their fall production was due to new plant development from previous years' seed production. The other three varieties had better (crested wheatgrass and intermediate wheatgrass) spring than fall yields or equal (smooth brome) spring and fall yields. Well problems prevented irrigation until the week after spring harvest. Approximately 12 inches of water was then applied until the fall harvest. Ford County also received 13.1 inches of precipitation from June through October (Table 3). The difference between spring and fall forage production was the result of the additional irrigation water.

Spring forage production of each variety (2963 to 6562 lbs DM/acre) in Stevens County was higher than fall production (371 to 1792 lbs DM/acre). The county received 12.2 inches of precipitation from June through October. The plots received approximately 4 inches of water with a single irrigation on July 23rd. Irrigation was not possible until then because of well problems.

A comparison of the spring yields in both counties showed that Stevens yields were equal (Kentucky 31, PM6 and smooth brome) or greater (crested wheatgrass, Dixon, Hykor festulolium, intermediate wheatgrass, Lakota, Max-Q, and orchardgrass) than those in Ford County. The higher spring production in Stevens County seemed to be the result of more precipitation and a later harvest. Ford County fall yields, however, were equal to (crested wheatgrass, Dixon and Lakota) or greater than (Hykor festulolium, intermediate wheatgrass, Kentucky 31, Max-Q, orchardgrass, PM6, and smooth brome) Stevens fall yields.

County and harvest-date differences in the forage DM content of each variety were likely related to plant maturity at the time of cutting (Table 4).

This year's data are the result of unplanned reduced irrigation, which significantly restricted forage production. Ford County yields were more similar to previous years' values than were yields at Stevens County, although Stevens had better spring yields. The data suggest that timing of irrigation water is at least as important as the amount, and that severe water restriction will significantly reduce production.

Table 1. Total annual dry matter yield (lbs/acre).

Variety	Ford	Stevens
Crested wheatgrass	3,826	6,039
Dixon matua	1,282	3,456
Hykor festulolium	9,420	7,265
Intermediate wheatgrass	8,029	7,196
Kentucky 31 fescue	12,217	6,057
Lakota matua	1,106	3,773
Max Q fescue	9,945	6,862
Orchardgrass	9,889	6,645
Sharp's PM6	11,310	5,963
Smooth bromegrass	9,543	5,938
	LSD (P<.05)	
Location * Variety	1,900	

Table 2. Individual harvest dry matter yield (lbs/acre).				
	Ford		Stevens	
Harvest Date:	5/26/05	10/21/05	6/17/05	10/31/05
Crested wheatgrass	3,028	798	5,599	441
Dixon matua	0	1,282	2,963	492
Hykor festulolium	3,490	5,929	5,473	1,792
Intermediate wheatgrass	4,999	3,030	6,562	635
Kentucky 31 fescue	4,438	7,779	4,917	1,140
Lakota matua	0	1,106	3,402	371
Max Q fescue	3,313	6,631	5,810	1,052
Orchardgrass	4,225	5,665	5,622	1,023
Sharp's PM6	4,925	6,385	5,214	749
Smooth bromegrass	4,360	5,183	5,351	588
	LSD (P<.05)			
Location*Harvest*Variety	1,224			

Table 3. Average monthly precipitation (inches) during 2005*.												
County	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ford	1.85	1.05	1.64	1.05	2.04	4.42	1.30	2.63	1.22	3.50	0.39	0.29
Stevens	0.67	0.66	1.74	0.79	5.45	1.54	1.14	3.33	4.20	1.97	0.27	0.00
* K-State Weather Data Library: http://www.oznet.ksu.edu/wdl/												

Table 4. Individual harvest dry matter content (%).				
	Ford		Stevens	
Harvest Date:	5/26/05	10/21/05	6/17/05	10/31/05
Crested wheatgrass	41.2	47.6	39.3	39.1
Dixon matua	--	34.3	30.8	52.3
Hykor festulolium	41.8	40.6	26.6	40.0
Intermediate wheatgrass	39.6	49.7	32.9	39.1
Kentucky 31 fescue	38.0	38.6	26.8	41.1
Lakota matua	--	36.7	29.9	51.1
Max Q fescue	38.4	39.8	29.2	42.8
Orchardgrass	33.5	41.5	27.1	43.9
Sharp's PM6	38.4	41.3	31.4	39.4
Smooth bromegrass	39.0	46.5	32.1	39.1
	LSD (P<.05)			
Location*Harvest*Variety	5.7			

WARM-SEASON GRASS YIELDS FOR 2005 UNDER LIMITED OR NO IRRIGATION

by

Ron Hale, Curtis Thompson, Troy Dumler, Darl Henson, Tom Roberts, and Tim Jones

SUMMARY

Seventeen annual and perennial warm-season grasses of different species and varieties were planted in Grant and Stevens Counties in southwestern Kansas in 2002 to evaluate yield and adaptability under irrigation. The varieties included switchgrass, eastern gamagrass, crabgrass, buffalograss, seeded bermudagrass, and sprigged bermudagrass. This year's total annual bermudagrass yields in Grant County, without irrigation or fertilizer, ranged from 4083 to 5873 lbs of dry matter (DM) per acre, with no difference among varieties. Precipitation totaled 12.8 inches from January through August for the county. First-harvest variety yields in Grant County were higher than yields from the other two harvests which did not differ from each other. Annual Stevens County bermudagrass yields ranged from 3589 to 7065 lbs DM/acre, whereas the yields of the other five grass species were 711 to 15,527 lbs. Stevens County yields of all 10 bermudagrass varieties, buffalograss, and eastern gamagrass were greater at the first harvest than at the second, but did not differ at the third harvest for seven of these 12 varieties. Switchgrass was the only grass that had lower yields at each subsequent harvest. Eastern gamagrass had the highest yield of all the Stevens County grasses. 'CD-90160' had the highest and 'Quickstand' had the lowest bermudagrass yields. Crabgrass varieties' spring emergence was poor, resulting in only one harvest and the lowest forage yields. But 'Red River' yields were two times greater than the 'Variety Not Stated' (VNS) crabgrass. This year's yields were considerably lower than last year's because of the rain-fed-only condition in Grant County and the small amount of additional irrigation water in Stevens County. The increased third-harvest yields in Stevens were presumably the result of 3.3 inches of precipitation in August and approximately 4 inches of irrigation water on July 23.

INTRODUCTION

Irrigated plots established in southwestern Kansas have been used to compare the yields and adaptability of various warm-season grass species/varieties. In 2004, annual yields of bermudagrass ranged from 9529 to 12,030 lbs DM/acre in Grant County and from 6026 to 11,862 lbs in Stevens County. The other five grass species in Stevens County yielded from 1654 to 12,259 lbs/acre. The plots in both counties received a minimum of 22 inches of irrigation water in 2004. The results have been published in the 2005 K-State Southwest Research-Extension Center report. This report discusses 2005 forage yields of the same plots as affected by very little or no irrigation water.

PROCEDURES

Seventeen annual and perennial warm-season grasses of different species and varieties were planted in Grant and Stevens counties. Grasses were planted in four replicates, arranged in a randomized complete-block design, in 2002. Eastern gamagrass ('PMK-24'), switchgrass ('Blackwell'), crabgrass ('VNS' and 'Red River'), buffalograss ('Sharp's Improved Prime'), three seeded bermudagrasses ('Wrangler', 'Vaquero', and 'CD-90160'), and seven sprigged bermudagrasses ('Hardie', 'Midland 99', 'Ozark', 'Quickstand', 'Tifton 44', 'LCB84x19-16', and 'LCB84x16-66') were planted in Stevens County. Eight bermudagrasses (CD-90160, Hardie, Midland 99, Ozark, LCB84x16-66, LCB84x19-16, Wrangler, and 'World Feeder') were planted in Grant County. LCB84x16-66 and LCB84x19-16 are two experimental varieties being evaluated by Kansas State University and Oklahoma State University. Vaquero is a blend of CD-90160, 'Mirage', and 'Pyramid' bermudagrass varieties. The Stevens County plots were under a 15-acre pivot on a

Vona-Tivoli loamy fine sand. The Grant County plots were under a quarter-section center-pivot sprinkler on a Ulysses silt loam soil.

The Stevens County plots received a total of 300 lbs N/acre (as urea) in three split applications, before spring green-up and after the first and second harvests. Phosphorus and potassium were applied during the previous fall, with amounts based on soil test results and K-State recommendations. The plots received approximately 4 inches of irrigation water at one watering on July 23rd. The Grant County plots were not fertilized or irrigated during 2005. Well problems at both locations limited or eliminated irrigation.

Forage samples were collected from a 20-square-foot area of each plot. Bermudagrass and buffalograss samples were harvested to a height of 3 inches, switchgrass to 8 inches, eastern gamagrass to 10 inches, and crabgrass at ground level. Harvests were made on June 23, July 28, and September 1 in Grant County, and on June 24, July 29, and September 2 in Stevens County. All varieties were harvested three times, except crabgrass, which was harvested once on September 2 because of poor emergence and growth. Switchgrass and eastern gamagrass were harvested from the same section of row at each harvest. The samples were oven dried to determine DM content and yield.

Table 1. Total annual dry matter yield (lbs/acre).

	Bermuda type	Grant	Stevens
CD-90160	Seed	4,083	7,065
Hardie	Sprig	4,512	6,608
LCB84x16-66	Sprig	5,433	6,727
LCB84x19-16	Sprig	5,873	5,942
Midland 99	Sprig	4,244	6,161
Ozark	Sprig	4,956	6,288
Quickstand	Sprig	---	3,589
Tifton 44	Sprig	---	5,502
Vaquero	Seed	---	6,650
World Feeder	Sprig	5,270	---
Wrangler	Seed	4,108	4,490
Buffalograss	--	---	2,878
Eastern gamagrass	--	---	15,527
Switchgrass	--	---	9,440
Red River crabgrass	--	---	1,439
VNS crabgrass	--	---	711
LSD (P<.05)		Grant	Stevens
Variety		NS	1,272

RESULTS AND DISCUSSION

Total annual forage production ranged from 4083 to 5873 lbs DM/acre in Grant County, but did not differ among varieties (Table 1). First-harvest yields (1880 to 3272 lbs/acre) were all greater than the second (955 to 1192 lbs/a) (Table 2). Yields of the third (765 to 1620 lbs/acre) harvest were similar to the second. At the first harvest, LCB84x19-16 and World Feeder produced more DM than all other bermudagrass varieties. There were no differences in yield between varieties at the second harvest. The two experimental varieties, LCB84x16-66 and LCB84x19-16, had higher yields than Wrangler or World Feeder at the third harvest. Ozark, LCB84x19-16, and LCB84x16-66 were among the highest producers, with Wrangler and Hardie among the poorest producers at each of the three harvests. The Grant County plots should be considered as dryland because they were not irrigated during 2005. Total county rainfall from January through August was 12.8 inches (Table 3).

Eastern gamagrass and switchgrass had the highest total production in Stevens County. The highest-producing bermudagrass was CD-90160. Red River and VNS crabgrass had the lowest total yields, but these varieties were only harvested in September because of poor sprouting and growth. The next-poorest-yielding grass was buffalograss, which did not differ from Quickstand bermudagrass. There were few significant differences among the remaining bermudagrasses. Of the seeded bermudagrass varieties, CD-90160 and Vaquero were in the highest-producing bermudagrasses, whereas the Wrangler yield was among the lowest.

Table 2. Grant County individual harvest dry matter yield (lbs/acre), 2005.

		Harvest date		
	Bermuda type	Jun 23	Jul 28	Sep 1
CD-90160	Seed	1,880	1,158	1,045
Hardie	Sprig	2,399	955	1,158
LCB84x16-66	Sprig	2,706	1,107	1,620
LCB84x19-16	Sprig	3,272	1,192	1,409
Midland 99	Sprig	1,938	962	1,345
Ozark	Sprig	2,627	1,113	1,216
World Feeder	Sprig	3,258	1,099	913
Wrangler	Seed	2,246	1,097	765
	LSD (P<.05)			
Harvest*Variety		535		

Table 3. Average monthly precipitation (inches) during 2005.*												
County	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Grant	0.80	0.80	0.59	1.74	3.12	1.60	2.58	1.54	0.70	2.49	0.17	0.16
Stevens	0.67	0.66	1.74	0.79	5.45	1.54	1.14	3.33	4.20	1.97	0.27	0.00
* K-State Weather Data Library: http://www.oznet.ksu.edu/wdl/												

Stevens County variety yields at the first harvest were greater than at the second harvest (Table 4). Yields at the third cutting, except switchgrass, were equal to, or greater than, at the second cutting, with seven varieties having similar first- and third-harvest yields. These results were presumably related to 4 inches of July irrigation water and 3.3 inches of August precipitation. Total rainfall from January through August was 15.3 inches.

Eastern gamagrass had the highest production at each cutting in Stevens County. Switchgrass, CD-90160, and Vaquero were the second-highest-producing grasses at the first two harvests, but fell below the average of all varieties at the third harvest. Although the two top-producing bermudagrasses (CD-90160 and Vaquero) were seeded varieties, yields of Wrangler, also a seeded variety, were below average at each harvest. Red River crabgrass produced twice as much forage as VNS, and tended to produce more forage than switchgrass, Wrangler, and Quickstand at the third harvest. Changes in each variety's yield ranking at each harvest may indicate its ability to withstand drought conditions or its ability to respond to moisture.

Dry matter content of each variety was least at the first harvest and generally greatest at the second harvest in both counties (Tables 5 and 6). All bermudagrass varieties and buffalograss had greater DM content at the first harvest, and generally greater DM at the second and third harvests, than did eastern gamagrass or switchgrass. The lesser DM content of Red River, compared with that of VNS crabgrass, is assumed to be associated with the visually higher percentage of leaves than stems of Red River and more advanced stage of growth of VNS.

Grant County yields, although not intended to be dryland comparisons, must be considered as such because of the lack of irrigation water for the year. The additional moisture from precipitation and irrigation improved the Stevens County third-harvest yields of all varieties except switchgrass.

Table 4. Stevens County individual harvest dry matter yield (lbs/acre), 2005.				
		Harvest date		
	Bermuda type	Jun 24	Jul 25	Sep 2
CD-90160	Seed	3,681	1,558	1,826
Hardie	Sprig	3,052	1,247	2,310
LCB84x16-66	Sprig	2,909	1,134	2,685
LCB84x19-16	Sprig	2,524	912	2,507
Midland 99	Sprig	2,344	1,462	2,356
Ozark	Sprig	2,721	1,291	2,277
Quickstand	Sprig	1,814	526	1,250
Tifton 44	Sprig	2,482	1,180	1,840
Vaquero	Seed	3,215	1,788	1,646
Wrangler	Seed	2,294	1,050	1,146
Buffalograss	--	1,498	449	931
Eastern gamagrass	--	8,634	3,098	3,795
Switchgrass	--	7,018	1,632	790
Red River crabgrass	--	--	--	1,439
VNS crabgrass	--	--	--	711
	LSD (P<.05)			
Harvest*Variety	701			

Table 5. Grant County individual harvest dry matter content (%), 2005.				
		Harvest		
	Bermuda type	Jun 23	Jul 28	Sep 1
CD-90160	Seed	30.59	42.65	40.35
Hardie	Sprig	35.45	47.11	39.07
LCB84x16-66	Sprig	33.46	46.91	41.27
LCB84x19-16	Sprig	33.10	45.52	38.43
Midland 99	Sprig	33.73	46.24	36.29
Ozark	Sprig	32.74	45.64	39.22
World Feeder	Sprig	28.78	42.54	40.89
Wrangler	Seed	32.40	47.00	43.77
	LSD (P<.05)			
Harvest*Variety	2.52			

Table 6. Grant County individual harvest dry matter content (%), 2005.				
		Harvest		
	Bermuda type	Jun 24	Jul 29	Sep 2
CD-90160	Seed	27.30	35.48	31.80
Hardie	Sprig	30.61	45.78	39.68
LCB84x16-66	Sprig	29.48	43.50	38.63
LCB84x19-16	Sprig	28.98	41.34	32.68
Midland 99	Sprig	31.18	40.07	37.36
Ozark	Sprig	30.93	42.18	40.68
Quickstand	Sprig	31.79	46.12	41.66
Tifton 44	Sprig	31.03	41.65	37.73
Vaquero	Seed	29.23	37.17	40.10
Wrangler	Seed	30.46	45.05	43.24
Buffalograss	--	38.34	57.17	45.70
Eastern gamagrass	--	23.35	33.25	33.66
Switchgrass	--	21.20	30.61	32.08
Red River crabgrass	--	--	--	27.60
VNS crabgrass	--	--	--	35.26
	LSD (P<.05)			
Harvest*Variety	3.32			

CORN HARVEST RESIDUE DISAPPEARANCE DURING GRAZING

by
Ron Hale and Darl Henson

SUMMARY

Corn harvest residue was sampled on six irrigated corn fields in southwestern Kansas to measure the changes in stem, leaf and husk, cob, and grain during cattle grazing. The center-pivot irrigated fields were either 60 or 120 acres and were grazed for 30 to 86 days between Octomber 29, 2003, and January 23, 2004. The cow and first-calf heifer herds ranged from 27 to 111 head weighing an estimated 900 to 1200 lb. Five samples, collected from each field on each sampling day, were separated into the four plant parts, oven dried, and weighed. Samples were analyzed for crude protein (CP), acid detergent fiber (ADF), and neutral detergent fiber (NDF). Total residue averaged 11,196 lb of dry matter (DM) at the onset of grazing, and decreased over the entire grazing period. Leafs and husks accounted for the majority of this decrease, inasmuch as DM of stems essentially remained unchanged. Dry matter of cobs, although decreasing over time, was a smaller percentage of the total residue weight. Initial grain weight was low, at 36 to 475 lb/acre. Grain was not found in samples after an average 33 days of grazing, even though small amounts of whole and broken kernels could be seen in the manure for several more weeks. The small amount of grain did not significantly increase total residue energy.

INTRODUCTION

Corn harvest residue can be an inexpensive source of feed for cattle. It can supply a dry cow with a large portion of her nutrient requirements during early pregnancy. Part of the nutrient value of the residue comes from corn grain that was not harvested. Grain combine improvements have increased harvest efficiencies, and Bt (*Bacillus thuringiensis)* corn hybrids have reduced lodging. Both technologies have increased corn grain yields by reducing loss; loss that had been available to livestock. This survey examines the corn plant fractions available to livestock after grain harvest.

PROCEDURES

Samples of harvest residue were collected from six 60- or 120-acre irrigated corn fields in Grant County. The first sample from each field was taken the same day cattle were moved onto the field, and the last sample was collected within a day after cattle removal. The length of grazing was different for each field (30 to 86 days, 52 days average), with the sampling period beginning on October 29, 2003, and ending on January 23, 2004. Herd size ranged from 27 to 111 head of cows or first calf heifers weighing an estimated 900 to 1200 lbs (1034 lb average). Cattle were supplemented with mineral and protein blocks.

Five locations along the radius of each full- or half-circle field were sampled on each collection day. Samples were collected for 3, 4, or 5 days, depending on the length of grazing. There was an average of 15 days between collections while grain was present in the sample, and 29 days when grain was not found in any samples.

Plant residues were collected from a 42-inch diameter area and separated into stalks, leaves and husks, and cobs. Corn grain was collected from between two corn rows for 200 feet and separated from the cob. All samples were oven dried and weighed to determine dry matter weights. The samples were then combined by day and plant parts, and then sub-sampled for laboratory analysis of CP, ADF, and NDF.

Weights of the five field samples were averaged to 22 observations used in regression analysis of stalk, leaf and husk, cob, and grain as a percentage of the total weight. Total residue weight was also regressed. Day was included in all models, which also examined the number of animals per acre and the estimated average body weight of cattle on each pasture, as well as all possible cross-product and quadratic variables. Model selection was based on results of the SAS RSREG procedure, optimal r-squares for the fewest statistically significant variables, and minimal collinearity.

RESULTS AND DISCUSSION

Residue weights and weight changes during grazing are most accurately described as dry matter disappearance, of which animal intake is assumed to represent the major portion. Other causes of disappearance could include wind and trampling. Total residue weight averaged 11,196 lb/acre at the beginning of grazing and 9,067 lb/acre at the end (Table 1), with an average disappearance of 40.9 lb/acre per day. Leaf and husk weights decreased from a starting weight of 5,756 lb/acre to 3700 lb/acre at the end, with an average daily disappearance of 39.5 lb/acre. Cob weights decreased during grazing by an average of 5.7 lb/acre per day. Starting and ending weights were 1840 and 1544 lb/acre, respectively. Although it seems that stem weight increased during grazing, this is not realistic, and was probably the result of inherent sampling errors. Grain weights at the beginning of grazing ranged from 36 to 475 lb/acre. The high value came from a field that had a considerable amount of lodging. Lodging was not seen in the other five fields. Grain was not found in the samples after an average 33 days grazing, but a small amount of whole and broken kernels could be seen in some manure pats for several more weeks. Average daily disappearance for the 33 days was 4.4 lb/acre.

Regression equations for total weight of residue DM and percentage of each plant part are shown in Figure 1. The disappearance of total pounds of residue was largely affected by the number of grazing days and cattle per acre. The decrease in percentage of leaf and husk were more affected by head and weight than by day. The regression equation of the percentage of stalk predicts an increase over time. This would occur when stalk weight remained constant or when it decreased at a slower rate than total residue weight. From visual observations, the cattle did not seem to consume any significant amount of stalk. The beginning and ending stalk weights suggest that an increase occurred. It is likely that stalk weight remained somewhat constant, with total weight declining, thus causing the percentage increase. The grain regression predicts availability until day 49. It is interesting that although grain was not found in the samples after day 33, it could be seen in manure. The r-squares of these equations indicate that the selected model variables do at least a fair job of explaining the total weight and percentage changes. The r-square for cob was low, and no level of statistical significance was found for any of the models or variables tested.

Crude protein of leaf and stem was similar, at 3.7 and 3.6%, respectively (Table 1). Cob CP was less than half that of leaf or stem (1.6%). Protein was highest in the grain (8.9%). Cob tended to have higher NDF, TDN, NEm, and NEg values than leaf did, whereas stalk had lower values than leaf did. Stalk had higher and cob had lower ADF than did leaf. Table 2 shows TDN and net energy values calculated from residue weights, laboratory results for ADF, and NRC (1996) energy values for grain. The amount of grain available at the start of grazing (36 vs. 475 lbs) had little effect on total energy because it was a relatively small percentage of the total residue.

Assuming that the largest part of the DM disappearance is due to cattle intake, this survey suggests that cattle will quickly consume any available grain. It was apparent that the cattle were able to find small amounts of grain that were not found in the sampling procedure used in this survey. It also seemed that the cattle preferred leaves and husks over stalks, and may avoid stalks if enough leaves are available.

Table 1. Dry matter weight, percentage, and nutrient content of corn residue, Grant County, 2003-2004.

		Stem		Leaf		Cob		Grain		Total	
		Start	End	Start	End	Start	End	Start	End	Start	End
DM, lb/a	Average	3453	3820	5756	3700	1840	1544	148	4	11196	9067
	Range	2489 to 4789	2684 to 5019	4909 to 6515	2684 to 4480	1018 to 3249	828 to 2784	36 to 475	0 to 21	9922 to 13562	6196 to 11485
Crude protein, %	Average	3.6		3.7		1.6		8.9		---	
	Range	3.3-4.0		3.0-4.6		1.5-1.6		8.7-9.3		---	
ADF, %	Average	49		46.5		45.2		---		---	
	Range	47.1-50.4		44.8-48.9		44.7-46.0		---		---	
NDF, %	Average	78.7		81.5		90.5		---		---	
	Range	76.2-79.7		80.8-83.1		85.8-92.4		---		---	
TDN, %	Average	51.3		53.6		54.7		88*		---	
	Range	49.9-53.0		51.3-55.1		54.0-55.1		---		---	
NEm, Mcal/lb	Average	0.40		0.43		0.45		0.99*		---	
	Range	0.38-0.42		0.40-0.45		0.44-0.45		---		---	
NEg, Mcal/lb	Average	0.13		0.17		0.19		0.68*		---	
	Range	0.12-0.16		0.14-0.19		0.18-0.20		---		---	

* Nutrient values from NRC, 1996.

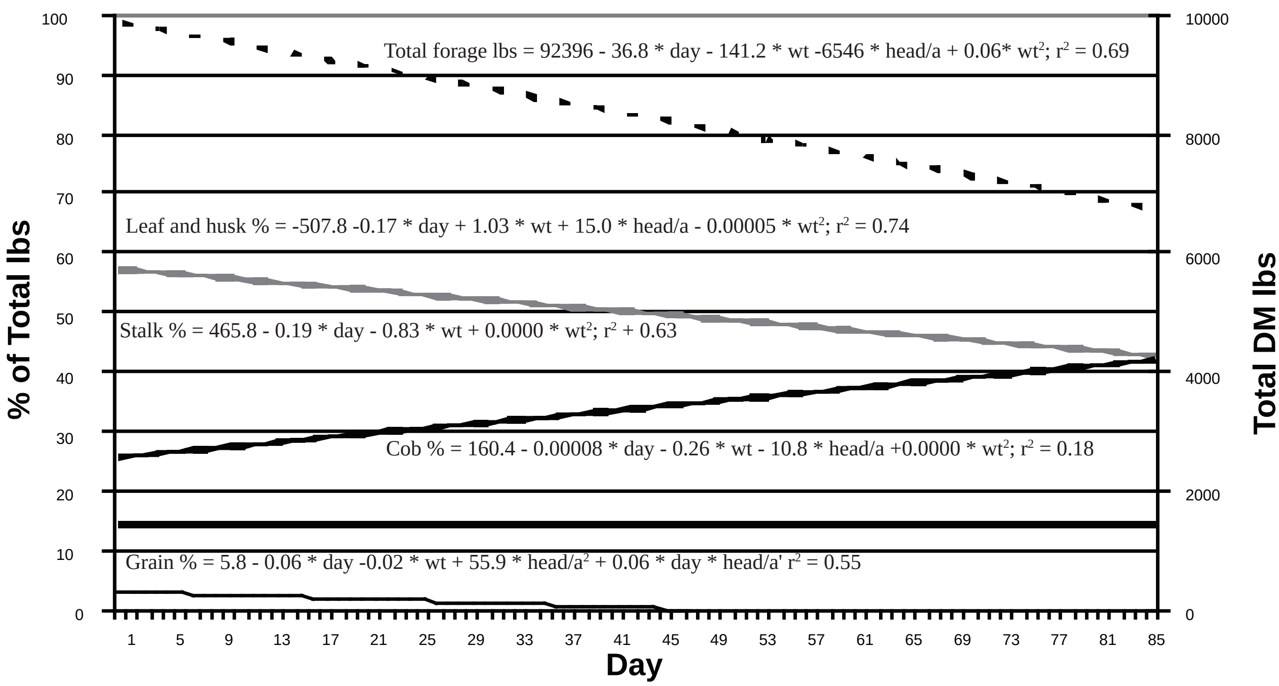

Table 2. Calculated TDN and NE values*.

Field	Plant parts: Grain (% / lbs)	Plant parts: Leaf (%)	Plant parts: Stem (%)	Plant parts: Cob (%)	Total residue: TDN (%)	Total residue: NEm (Mcal/lb)	Total residue: NEg (Mcal/lb)
1	4.2 / 475	55.3	25.7	14.9	54.6	0.45	0.18
2	0.3 / 36	45.6	30.2	24.0	53.3	0.43	0.16
3	0 / 0	58.9	26.6	14.5	53.1	0.42	0.16
4	0 / 0	39.0	36.8	24.2	53.0	0.42	0.16

* Grain values from NRC, 1996; stem, leaf and cob values from laboratory analysis.

Field Day 2006 Forage Research Supplement

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http://www.oznet.ksu.edu/library [type Field Day 2006 in the search box].

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