Kansas Agricultural Experiment Station Research Reports

Volume 0
Issue 1 *Cattleman's Day (1993-2014)*

Article 183

2005

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Recommended Citation

Hale, R.L.; Thompson, C.T.; MacKown, C.T.; and Dumler, Troy J. (2005) "A comparison of forage yield and quality in a simulated graze-out for twelve varieties of hard red and white winter wheat," *Kansas Agricultural Experiment Station Research Reports*: Vol. 0: Iss. 1. https://doi.org/10.4148/2378-5977.1586

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K-STATE Research and Extension

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Abstract

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Keywords

Cattlemen's Day, 2005; Kansas Agricultural Experiment Station contribution; no. 05-144-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 943; Beef; Forage yield; Hard red winter wheat; White winter wheat

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This Research Report article is available in Kansas Agricultural Experiment Station Research Reports: https://newprairiepress.org/kaesrr/vol0/iss1/183

A COMPARISON OF FORAGE YIELD AND QUALITY IN A SIMULATED GRAZE-OUT FOR TWELVE VARIETIES OF HARD RED AND WHITE WINTER WHEAT

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Summary

Six hard white winter wheat varieties (Burchett, Lakin, NuFrontier, NuHills, Nu-Horizon, and Trego) and six hard red winter wheat varieties (2137, Jagalene, Jagger, OK101, Stanton, and Thunderbolt) were planted in two southwestern Kansas counties, Clark and Stanton, to compare simulated graze-out forage yield and quality. Four replicated plots were planted in September 2003 for each variety at each location. Forage samples were collect from each plot during December 2003, March 2004, and April or May 2004. Dry matter content, dry matter yield, crude protein, acid detergent fiber (ADF), neutral detergent fiber (NDF), total digestible nutrients (TDN), net energy (NEm, NEg), relative feed value (RFV), and nitrate nitrogen were determined. Significant location-by-variety interactions were observed for most factors. Although significant differences in crude protein and energy were detected, it is unlikely that the performance of stock cattle would differ when grazing each of the varieties because the lowest crude protein concentration would support excellent gain, and because the differences in energy were relatively small.

Introduction

It has been estimated that as much as 6 million acres of winter wheat in Kansas are grazed during a good forage-producing year. Wheat pasture provides an economical, high-quality forage for livestock during a time of year that few other grazable forage sources are available. Winter wheat can be grazed until the formation of the first hollow stem (jointing) without reducing grain yield. Dual-purpose wheat programs (forage and grain) permit producers to more effectively and profitably utilize their land. At times, producers will forgo a grain harvest and graze out the wheat to maximize profitability. Although hard red winter wheat varieties dominate, it is anticipated that the use of hard white winter wheats will increase substantially because of economic incentives associated with white wheat milling, end uses, and market opportunities. Kansas Agricultural Statistics Service reported increased white-wheat acres of 0.2, 0.8, 1.1, 2.7, and 4.9% of total wheat acres for the years 2000 to 2004, respectively, but research examining forage yield and quality of white wheat has been limited. This experiment examined the forage yield and quality in a simulated graze out of six popular hard white winter wheat varieties and six hard red winter wheat varieties.

Procedures

Six hard white winter wheat varieties (Burchett, Lakin, NuFrontier, NuHills, Nu-Horizon, and Trego) and six hard red winter wheat varieties (2137, Jagalene, Jagger,

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OK101, Stanton, and Thunderbolt) were planted in two locations in southwestern Kansas, specifically in Clark and Stanton counties. Producers prepared the land and applied 65 lbs of nitrogen (Clark) or 80 lbs of nitrogen (Stanton) per acre before wheat planting. On September 16, 2003, 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 lbs seed per acre at the dryland Clark County plots and 120 lbs per acre at the irrigated Stanton County plots. Eleven lbs of nitrogen and 52 lbs of P_2O_5 per acre were applied with the seed. Soil type at both locations was a silt loam. On March 26, 2004, liquid urea ammonium nitrate was applied at 30 lbs nitrogen per acre at both sites.

Forage samples were collected on December 31, 2003, March 19, 2004, and April 29, 2004, at Clark County and December 30, 2003, March 25, 2004, and May 4, 2004, at Stanton County. Cuttings were collected from the same 6 feet of closely clipped row length in each plot. Samples were immediately dried at the Garden City Research and Extension Center and then sent to a commercial laboratory for analysis of crude protein (CP), acid detergent fiber (ADF), and neutral detergent fiber (NDF). Relative feed value (RFV), total digestible nutrients (TDN), and net energy contents (maintenance - NEm, gain - NEg) were calculated from the laboratory analyses. Nitrate-nitrogen assays were performed at the USDA-ARS laboratory in El Reno, OK. Data from the three cuttings were summed for statistical analysis.

Results and Discussion

Wheat varieties had different yields and compositions at the two locations, so values are presented for each variety at each location (Tables 1 to 4).

A wide range in forage dry matter yields (3553 to 5672 lb/acre) was observed across varieties at both locations. The varieties producing the most were Lakin, Jagalene, Trego, and NuFrontier at Clark County, yet they did not differ statistically from seven other location-by-variety combinations. Clark County tended to have more top yielding varieties than Stanton County did.

Dry matter content differed from the greatest to the least by 5.4 percentage units. It is interesting that the 12 driest forages all came from Clark County, with Trego having the greatest dry matter content in Clark County, but having the least in Stanton County.

Crude protein in the forage ranged from 17.9 to 24.0%. The eight variety/location combinations with the most crude protein ranged from 21.4 to 24.0%, and they were significantly different than the six with the least, which ranged from 17.9 to 19.7% crude protein. Seven of the eight variety/location combinations with the most crude protein were from Stanton. NuHills was the only variety in the top group from both locations.

Acid detergent fiber (ADF), a measure of cellulose and lignin plant fractions, increases as a plant matures. Greater ADF is associated with lesser nutrient digestibility and energy availability. Acid detergent fiber ranged from 23.3 to 25.8% across all location-by-variety combinations, and was relatively evenly distributed across locations. Jagalene and NuHorizon in both counties, and NuHills in Clark County, had significantly less ADF than the five locations-by-variety combinations with the greatest ADF concentrations (Thunderbolt, Burchett, OK101, and Jagger in Clark County and Trego in Stanton County).

Neutral detergent fiber (NDF) measures hemicellulose, cellulose, and lignin. As NDF increases, feed intake tends to decrease. Although NDF ranged from 43.5 to 48.8%, there was no location-by-variety interaction. Jagger, Stanton, Lakin, Thunderbolt, and OK101

all had greater NDF than Jagalene, NuHills, and NuHorizon did.

Total digestible nutrients (TDN), related to digestible energy, ranged from 72.3 to 74.6%. Jagalene and NuHorizon in both locations had greater TDN than Jagger, Burchett, and OK101 had in Clark County or Trego had in Stanton County. Net energy for maintenance (NEm), ranging from 0.68 to 0.71 Mcal/lb, differed by variety only. NuHills, NuHorizon, and Jagalene had greater NEm than Jagger, Burchett, OK101, Stanton, and Thunderbolt had. Net energy for gain (NEg) concentrations ranged from 0.44 to 0.48 Mcal/lb. Jagalene at both locations and NuHills and NuHorizon in Clark County had greater NEg than Jagger, Thunderbolt, Burchet, Lakin and OK101 had in Clark County and Trego had in Stanton County. Relative feed value (RFV) is an index value calculated from ADF and NDF, and it is a quality-based factor commonly used in marketing of alfalfa hay. A greater RFV indicates that the forage is expected to yield greater animal intake and digestibility. RFV ranged from 135 to 153. NuHills, NuHorizon, and Jagalene in both locations had greater RFV than Jagger, Thunderbolt, Burchet, Lakin, and OK101 had in Clark County and Trego and 2137 had in Stanton County.

Nitrate-nitrogen ranged from 101 to 527 ppm, with Stanton County varieties tending to have more nitrates. The greatest nitrates in an individual plot was 1503 ppm. All were less than Kansas State University's "generally safe" recommendation of 3000 ppm.

The number of location-by-variety interactions makes it difficult to draw broad conclusions, but there seemed to be location differences in yield and quality factors that might be explained by differences in the stage of growth at the two locations. Clark County plots had somewhat higher yields but lower nutritional quality. Although the Stanton County location was irrigated and Clark County location was not, other factors such has a higher elevation and fewer growing degree units in Stanton County could have suppressed forage production. Stanton County forages may have been less mature and, therefore, slightly greater in nutritional quality. Although there was variation between locations, Jagalene tended to be a good yielder, and Jagalene, NuHills, NuHorizon, and NuFrontier tended to have greater energy concentrations, regardless of location.

The varieties evaluated are among the more popular wheats planted, but they do not represent all wheat varieties. Also, our experiment did not evaluate all growing conditions or cultural practices. Factors not examined in our experiment will influence yield and quality. They include moisture, soil type, fertility, and management practices, and they should be considered when selecting a wheat variety for grazing or grain production. Cattle performance would be expected to be the same when grazing each of the different varieties because the least crude protein concentration would support excellent growth, and because the energy differences among varieties were relatively small. Variety differences between locations were most probably related to plant maturity, which would have more impact on nutritional content and stocker gain than the protein and energy differences observed in our experiment would have.

Table 1. Wheat Forage Dry Matter Yield and Dry Matter and Crude Protein Contents by Location and Variety

		Yield, lbs DM/acre			Dry Matter, %			Crude Protein, %		
		Location		Variety	Location		Variety	Location		Variety
Variety	Color	Clark	Stanton	Mean	Clark	Stanton	Mean	Clark	Stanton	Mean
2137	Red	5282^{cd}	4130^{ab}	4706	27.7^{cde}	24.6^{a}	26.1	19.3^{abc}	19.7^{abc}	19.5
Burchett	White	4810^{bcd}	4614^{bc}	4712	29.0^{efgh}	25.0^{a}	27.0	20.0^{bcd}	22.9^{fg}	21.4
Jagalene	Red	5669^{d}	4585^{bc}	5127	29.2^{fgh}	25.1^{a}	27.1	19.3^{abc}	24.0^{g}	21.7
Jagger	Red	5256^{bcd}	3553^{a}	4405	28.1^{cdefg}	26.6^{bc}	27.3	20.4^{bcde}	22.3^{ef}	21.4
Lakin	White	5672^{d}	4474^{b}	5073	29.5^{gh}	25.3^{ab}	27.4	17.9^{a}	21.0^{bcde}	19.5
NuFrontier	White	5312^{d}	4301^{ab}	4806	27.0^{cd}	25.1^{a}	26.1	20.0^{bcd}	21.4^{def}	20.7
NuHills	White	4046^{ab}	3661^{a}	3853	27.7^{cde}	24.7^{a}	26.2	21.9^{ef}	23.8^{g}	22.9
NuHorizon	White	4742^{bc}	4864^{bcd}	4803	28.7^{efgh}	25.1^{a}	26.9	19.8^{bcd}	22.0^{ef}	20.9
OK101	Red	4660^{bc}	3802^{ab}	4231	28.3^{defgh}	25.3^{ab}	26.8	19.2^{ab}	20.5^{bcde}	19.8
Stanton	Red	4945^{bcd}	4121^{ab}	4533	28.4^{efgh}	24.5^{a}	26.4	20.0^{bcd}	20.9^{bcde}	20.4
Thunderbolt	Red	5140^{bcd}	4480^{b}	4810	27.9^{cdef}	24.7^{a}	26.3	20.6^{bcde}	22.8^{fg}	21.7
Trego	White	5656^{d}	5156^{bcd}	5406	29.6^{h}	24.1^{a}	26.9	18.3^{a}	21.0^{cde}	19.7

^{abcdefgh}Means having differing superscripts within each measurement differ significantly (P<0.05).

Table 2. Wheat Forage Acid Detergent Fiber, Neutral Detergent Fiber, and Total Digestible Nutrients by Location and Variety

		Acid Detergent Fiber, %			Neutral Detergent Fiber, %			Total Digestible Nutrients, %		
		Location		Variety	Location		Variety	Location		Variety
Variety	Color	Clark	Stanton	Mean	Clark	Stanton	Mean	Clark	Stanton	Mean
2137	Red	25.0^{cdef}	25.0^{cdef}	25.0	47.1	45.3	46.2^{j}	73.1^{abcd}	73.1^{abcd}	73.1
Burchett	White	25.2^{def}	24.7^{bcdef}	25.0	47.1	45.4	46.2^{j}	72.9^{ab}	73.4^{abcdef}	73.1
Jagalene	Red	24.1^{abc}	23.3^{a}	23.7	45.2	43.5	44.4^{h}	73.9^{defg}	74.6^{g}	74.3
Jagger	Red	25.8^{f}	24.4^{bcde}	25.1	48.0	46.0	47.0^{jkl}	72.3^{a}	73.7^{bcdef}	73.0
Lakin	White	24.9^{cdef}	24.4^{bcde}	24.7	48.3	46.2	47.3^{kl}	73.2^{abcde}	73.6^{bcdef}	73.4
NuFrontier	White	24.2^{abcd}	24.4^{bcde}	24.3	46.8	45.9	46.4^{j}	73.8^{cdefg}	73.6^{bcdef}	73.7
NuHills	White	24.0^{ab}	24.4^{bcde}	24.2	45.8	44.5	45.1^{hi}	74.0^{efg}	73.7^{bcdef}	73.8
NuHorizon	White	23.7^{ab}	24.2^{abc}	23.9	45.5	44.9	45.2^{i}	74.2^{fg}	73.8^{cdefg}	74.0
OK101	Red	25.2^{def}	24.9^{cdef}	25.1	48.2	46.7	47.4^{l}	72.9^{ab}	73.2^{abcd}	73.0
Stanton	Red	24.8^{cdef}	24.7^{bcdef}	24.8	47.5	46.0	46.7^{jkl}	73.2^{abcde}	73.3^{abcdef}	73.3
Thunderbolt	Red	25.1^{def}	24.4^{bcde}	24.8	48.8	45.7	47.3^{kl}	73.0^{abc}	73.7^{bcdef}	73.3
Trego	White	24.3^{abcde}	25.4^{ef}	24.9	46.5	46.4	46.5^{jk}	73.8^{bcdefg}	72.7^{ab}	73.2

^{abcdefg}Means having differing superscripts within each variable differ significantly (P<0.05).
^{hijkl}Overall variety means having differing superscripts differ significantly (P<0.05).

Table 3. Wheat Forage Net Energy Concentrations by Location and Variety

		Net Energy Maintenance, Mcal/lb			Net Energy Gain, Mcal/lb		
		Location			Location		
Variety	Color	Clark	Stanton	Variety Mean	Clark	Stanton	Variety Mean
2137	Red	0.695	0.695	0.695^{fg}	0.457^{bcd}	0.455^{abc}	0.456
Burchett	White	0.690	0.697	0.694^{f}	0.455^{abc}	0.460^{bcd}	0.457
Jagalene	Red	0.705	0.710	0.707^{h}	0.470^{de}	0.477^{e}	0.474
Jagger	Red	0.682	0.702	0.692^{f}	0.442^{a}	0.465^{cde}	0.454
Lakin	White	0.695	0.700	0.697^{fg}	0.455^{abc}	0.462^{bcd}	0.459
NuFrontier	White	0.702	0.697	0.700^{fgh}	0.470^{de}	0.462^{bcd}	0.466
NuHills	White	0.705	0.700	0.702^{gh}	0.470^{de}	0.465^{cde}	0.467
NuHorizon	White	0.710	0.702	0.706^{h}	0.470^{de}	0.467^{cde}	0.469
OK101	Red	0.692	0.695	0.694^{f}	0.455^{abc}	0.457^{bcd}	0.456
Stanton	Red	0.692	0.695	0.694^{f}	0.460^{bcd}	0.457^{bcd}	0.459
Thunderbolt	Red	0.690	0.697	0.694^{f}	0.450^{ab}	0.467^{cde}	0.459
Trego	White	0.702	0.690	0.696^{fg}	0.465^{cde}	0.450^{ab}	0.457

^{abcde}Means having differing superscripts within each variable differ significantly (P<0.05).
^{fgh}Overall variety means having differing superscripts differ significantly (P<0.05).

Table 4. Wheat Forage Relative Feed Value and Nitrate-Nitrogen Content by Location and Variety

		Relative Feed Value			Nitrate Nitrogen, ppm		
		Location			Location		
Variety	Color	Clark	Stanton	Variety Mean	Clark	Stanton	Variety Mean
2137	Red	142^{cde}	145^{defg}	143	231^{abcde}	162^{ab}	196
Burchett	White	141^{bcd}	144^{defg}	143	205^{abcde}	312^{cdef}	258
Jagalene	Red	150^{hi}	153^{i}	152	132^{a}	527^{g}	329
Jagger	Red	137^{ab}	143^{cdef}	140	196^{abcd}	300^{cdef}	248
Lakin	White	138^{abc}	143^{cdefg}	141	101^{a}	278^{bcdef}	189
NuFrontier	White	141^{bcd}	143^{cdefg}	142	198^{abcd}	256^{bcdef}	227
NuHills	White	146^{efgh}	147^{gh}	146	245^{bcdef}	310^{cdef}	277
NuHorizon	White	147^{fgh}	147^{gh}	147	142^{ab}	296^{cdef}	219
OK101	Red	138^{abcd}	140^{bcd}	139	179^{abc}	233^{abcde}	206
Stanton	Red	139^{abcd}	142^{cdef}	141	195^{abcd}	350^{ef}	272
Thunderbolt	Red	135^{a}	144^{defg}	139	178^{abc}	381^{f}	280
Trego	White	145^{defg}	141^{bcde}	143	175^{abc}	332^{def}	253

^{abcdefghi}Means having differing superscripts within each variable differ significantly (P<.05).