# PERFORMANCE OF WARM-SEASON ANNUAL FORAGE GRASSES

**Thomas C. Griggs**[1]

## ABSTRACT

Warm-season annual forage grasses may have potential as rotation crops for short-season forage production following spring utilization of cool-season annuals. Forage sorghum, sudangrass, sorghum x sudangrass, pearlmillet, and silage corn cultivars were seeded in southeastern Idaho on June 19 following removal of an Italian ryegrass stand. Herbage masses averaging 8.34 tons/ac in late September were almost three times those in mid-August. Regrowth following a mid-August harvest was negligible. Forage nitrate concentrations in many cultivars were at potentially toxic levels in August and September, but had dropped to safer levels by December. Protein and energy levels were high in forage sampled in August and in September regrowth, decreased gradually between mid-August and early December, and energy levels remained at levels that were at least adequate to meet maintenance requirements of cattle grazing stockpiled forage. Warm-season annual grasses can contribute to forage production, improved seasonal growth distribution, and extension of the grazing season in integrated pasture-livestock systems.

**Key Words: Sorghum, sudangrass, pearlmillet, nitrate, forage quality**

## INTRODUCTION

Complementary cropping systems that integrate cool- and warm-season annual forage grasses in conjunction with annual vegetable crop residues and perennial pasture grasses and legumes may support more livestock and provide more uniform seasonal distribution of forage production than systems with fewer pasture components. Warm-season annual forage grasses including sorghum, sudangrass, sorghum x sudangrass hybrids, pearlmillet, and corn offer potential for short-season forage production following spring utilization of cool-season annuals such as winter cereals. We evaluated the performance and quality of various warm-season annual forage grasses that were planted following a spring harvest of Italian ryegrass in its second year of production. Objectives were to determine the forage potential of summer-seeded warm-season annual grasses at the end of the growing season, and as stockpiled winter forage for extension of the grazing season in southeastern Idaho.

## PROCEDURES

A field that had been seeded to Italian ryegrass in Spring, 2002 near Preston, (Franklin Co.), ID was harvested for hay in early June, 2003, then disked, harrowed and smoothed, and planted on June 19 to three replications of small plots of forage sorghum, sudangrass, sorghum x sudangrass, pearlmillet, and silage corn cultivars (Table 1). Some cultivars contained the brown midrib (BMR) trait of reduced concentration and/or altered composition of lignin for improved

[1] T. Griggs, Extension Agronomy Specialist, Dept. of Plants, Soils, & Biometeorology, Utah State University, 4820 Old Main Hill, Logan, UT 84322-4820; Email: tgriggs@ext.usu.edu. **In**: Proceedings, 2006 Western Alfalfa & Forage Conference, December 11-13, 2006, Reno, Nevada. Sponsored by the Cooperative Extension Services of AZ, CA, CO, ID, MT, NV, NM, OR, UT, WA, WY. Published by: UC Cooperative Extension, Agronomy Research and Extension Center, Plant Sciences Department, University of California, Davis 95616. (See http://alfalfa.ucdavis.edu for this and other alfalfa proceedings.)

fiber digestibility. Rows were spaced 1 ft apart in Battle Creek silty clay loam with adequate soil test levels of P, K, and S. The ryegrass had received 118 lb N/ac on April 14 and plots received an additional 34 lb N/ac on July 21. Plots were sprinkle-irrigated with handlines. Separate rows of each plot were harvested to approximately 2.5-inch stubble height on August 14, September 24 (original growth and regrowth from the August harvest), and December 5. Herbage mass was determined by drying samples to constant weight at 60° C. Forage quality was determined with near-infrared reflectance spectroscopy following instrument calibration with data from reference lab analyses of plot samples for crude protein (CP), neutral detergent fiber (NDF), in vitro true dry matter digestibility (IVTDMD), and digestibility of neutral detergent fiber (NDFD). For the latter two analyses, disappearance of dry matter (DM) and fiber were determined following incubation of samples in buffered rumen fluid for 48 hours. Forage nitrate-N ($NO_3$-N) concentration was determined solely by lab analysis on a single replication at each harvest.

## RESULTS

Cultivars are ranked by decreasing herbage mass from the September 24 harvest (Table 1) representing the end of the growing season. Herbage masses on September 24 (averaging 8.34 tons DM/ac) were almost three times those on August 14. Regrowth following the August 14 harvest was negligible. Forage quality levels are ranked by decreasing IVTDMD for samples of original growth on August 14, September 24, and December 5, along with those for regrowth in September and December (Tables 2-4). Forage $NO_3$-N levels were at surprisingly high, and potentially toxic (>2200 ppm), levels in many samples, particularly those of original growth on August 14 and regrowth on September 24. These high levels may have been induced by plant stress resulting from inadequate irrigation, particularly in plot areas that were too tall for effective distribution of water from handline sprinklers. Nitrate concentrations had dropped to much safer (<1500 ppm) levels in most samples of original growth and regrowth in December.

Protein and energy levels were indicative of good-to-excellent quality in forage sampled in August and in September regrowth, and decreased gradually in stockpiled forage between August 14 and December 5. Throughout the sampling period, energy levels were at least adequate to meet maintenance requirements of cattle grazing stockpiled forage. Warm-season annual forage grasses can contribute to forage production, improved seasonal growth distribution, and extension of the grazing season in integrated pasture-livestock systems.

Table 1. Herbage mass of cultivars harvested on August 14 (H1) and September 24 (H2).

| Species | Cultivar | H1 | H2 original | H2 regrowth | H1+regrowth |
|---|---|---|---|---|---|
| | | | | Tons DM/ac | |
| Forage sorghum | DK FS25E | 2.93 | **11.50** | 0.31 | 3.26 |
| Sorghum x sudangrass | Nutri + Plus BMR | 3.25 | **10.94** | 0.59 | 3.86 |
| Forage sorghum | HT 110 BMR | 3.53 | **10.76** | 0.45 | 4.00 |
| Pearlmillet | PP-202M | 1.19 | **10.28** | 0.36 | 1.56 |
| Sorghum x sudangrass | Greentreat BMR | 3.76 | **9.67** | 0.70 | 4.48 |
| Corn | Croplan N48-V8 (98 day) | 2.27 | **9.50** | -- | -- |
| Forage sorghum | Silo + Plus BMR | 3.38 | **9.27** | 0.43 | 3.82 |
| Sorghum x sudangrass | Hiyield Choice | 3.14 | **8.88** | 0.48 | 3.64 |
| Sorghum x sudangrass | Special Effort | 3.09 | **8.56** | 0.60 | 3.71 |
| Sorghum x sudangrass | UAP Dynagraze 222 | 3.34 | **8.32** | 1.22 | 4.59 |
| Sorghum x sudangrass | MS 505 x DS Sudan BMR | 3.88 | **8.28** | 0.77 | 4.67 |
| Sorghum x sudangrass | Greentreat Plus | 4.28 | **7.76** | 0.70 | 4.32 |
| Forage sorghum | Redtop + Plus BMR | 3.93 | **7.35** | 0.32 | 4.27 |
| Pearlmillet | Graze King | 0.91 | **7.09** | 0.72 | 1.66 |
| Sudangrass | Trudan 8 | 2.27 | **6.94** | 0.74 | 3.03 |
| Sorghum x sudangrass | UAP Danny Boy BMR | 2.78 | **6.93** | 0.75 | 3.55 |
| Pearlmillet | Hy-Mil-444 | 1.41 | **4.25** | 1.03 | 2.47 |
| Corn | NK N09-A4 (74 day) | 1.86 | **3.68** | -- | -- |
| Mean | | **2.85** | **8.34** | **0.63** | **3.53** |
| Significance (P) | | 0.10 | 0.01 | 0.25 | 0.37 |
| LSD (0.05) | | 2.20 | 3.78 | NS | NS |
| LSD (0.30) | | 1.14 | 1.95 | NS | NS |
| CV (%) | | 47 | 27 | 59 | 44 |

Table 2. Forage quality of cultivars at Harvest 1 (Aug. 14). Nitrate determination was not replicated.

| Species | Cultivar | CP | NDF | IVTDMD | NDFD | $NO_3$-N |
|---|---|---|---|---|---|---|
| | | | % of DM | | % of NDF | Ppm |
| Sorghum x sudangrass | Greentreat Plus | -- | -- | -- | -- | -- |
| Pearlmillet | PP-202M | 17.5 | 56.3 | **87.7** | 77.1 | 1275 |
| Pearlmillet | Graze King | 18.1 | 54.2 | **86.2** | 75.1 | 3517 |
| Pearlmillet | Hy-Mil-444 | 20.6 | 53.2 | **86.0** | 73.0 | 6660 |
| Sorghum x sudangrass | Hiyield Choice | 15.4 | 57.5 | **84.2** | 70.6 | 4483 |
| Forage sorghum | HT 110 BMR | 15.4 | 55.2 | **84.0** | 69.5 | 6044 |
| Forage sorghum | Silo + Plus BMR | 16.4 | 55.8 | **83.2** | 66.2 | 5289 |
| Sorghum x sudangrass | MS 505 x DS Sudan BMR | 10.2 | 52.3 | **82.9** | 67.7 | 2654 |
| Sorghum x sudangrass | Greentreat BMR | 11.5 | 57.8 | **82.6** | 67.3 | 3151 |
| Sorghum x sudangrass | Nutri + Plus BMR | 13.8 | 53.5 | **82.2** | 66.5 | 2293 |
| Corn | Croplan N48-V8 (98 day) | 12.1 | 59.8 | **82.2** | 68.5 | 1515 |
| Forage sorghum | Redtop + Plus BMR | 13.9 | 54.1 | **81.8** | 65.6 | 868 |
| Sorghum x sudangrass | UAP Danny Boy BMR | 15.8 | 55.1 | **81.6** | 65.8 | 3108 |
| Corn | NK N09-A4 (74 day) | 13.3 | 58.6 | **81.4** | 67.5 | 2485 |
| Forage sorghum | DK FS25E | 12.1 | 57.3 | **80.4** | 64.6 | 2262 |
| Sorghum x sudangrass | UAP Dynagraze 222 | 9.1 | 57.1 | **75.9** | 58.9 | 1299 |
| Sudangrass | Trudan 8 | 11.8 | 60.7 | **73.6** | 56.4 | 2938 |
| Sorghum x sudangrass | Special Effort | 11.3 | 58.8 | **73.6** | 53.9 | 2163 |
| Mean | | **14.0** | **56.2** | **81.9** | **67.1** | **3059** |
| Significance (P) | | 0.03 | 0.02 | 0.10 | 0.03 | N/A |

Table 3. Forage quality of cultivars at Harvest 2 (Sept. 24). Nitrate determination was not replicated.

| | | Original growth | | | | | Regrowth from Aug. 14 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Species & Cultivar** | | **CP** | **NDF** | **IVTD** | **NDFD** | **$NO_3$-N** | **CP** | **NDF** | **IVTD** | **NDFD** | **$NO_3$-N** |
| | | % of DM (NDFD = % of NDF) | | | | Ppm | % of DM (NDFD = % of NDF) | | | | Ppm |
| SxS | Hiyield Choice | 8.1 | 58.8 | **83.2** | 70.2 | 486 | 20.1 | 55.3 | 84.5 | 70.7 | 2998 |
| FS | Redtop + Plus BMR | 7.7 | 54.5 | **81.6** | 68.1 | 233 | 23.1 | 52.9 | 83.8 | 70.6 | 5800 |
| FS | Silo + Plus BMR | 8.6 | 51.3 | **81.3** | 65.9 | 2039 | 24.2 | 51.2 | 86.5 | 72.8 | 5519 |
| SxS | Nutri + Plus BMR | 9.9 | 54.6 | **80.8** | 66.7 | 1827 | 20.1 | 54.4 | 82.0 | 67.7 | 2148 |
| C | Croplan N48-V8 (98 day) | 8.4 | 55.9 | **80.4** | 66.6 | 975 | -- | -- | -- | -- | -- |
| SxS | UAP Danny Boy BMR | 8.6 | 58.5 | **80.1** | 65.6 | 95 | 19.9 | 53.0 | 82.6 | 64.6 | 1976 |
| SxS | Greentreat Plus | 9.6 | 60.0 | **80.0** | 65.2 | 4616 | 21.9 | 52.5 | 84.3 | 69.6 | 7245 |
| SxS | Greentreat BMR | 8.7 | 60.9 | **79.9** | 63.9 | 2498 | 22.1 | 56.2 | 84.8 | 71.6 | 5883 |
| C | NK N09-A4 (74 day) | 9.4 | 54.8 | **79.5** | 58.7 | 2610 | -- | -- | -- | -- | -- |
| FS | HT 110 BMR | 9.0 | 57.3 | **78.5** | 63.7 | 4149 | 24.4 | 50.5 | 84.1 | 68.5 | 6955 |
| PM | PP-202M | 7.3 | 60.8 | **78.1** | 63.7 | 367 | 15.9 | 55.5 | 87.3 | 76.8 | 660 |
| PM | Graze King | 12.6 | 61.0 | **78.1** | 62.1 | 3765 | 19.6 | 57.1 | 86.3 | 76.5 | 3307 |
| FS | DK FS25E | 7.8 | 56.2 | **77.9** | 60.4 | 1252 | 21.0 | 54.7 | 84.1 | 71.4 | 4616 |
| PM | Hy-Mil-444 | 13.7 | 61.5 | **77.8** | 63.6 | 1677 | 21.0 | 56.1 | 84.8 | 73.5 | 2730 |
| SxS | MS 505 x DS Sudan BMR | 7.7 | 52.2 | **77.4** | 55.1 | 810 | 22.4 | 53.6 | 82.6 | 67.9 | 3500 |
| SxS | Special Effort | 7.3 | 57.8 | **73.5** | 52.4 | 1653 | 21.4 | 55.9 | 80.6 | 64.6 | 6272 |
| SxS | UAP Dynagraze 222 | 7.0 | 59.5 | **71.5** | 51.6 | 2517 | 20.1 | 55.9 | 80.9 | 66.0 | 6933 |
| S | Trudan 8 | 7.3 | 59.8 | **70.7** | 50.0 | 512 | 19.8 | 55.7 | 79.2 | 62.3 | 2125 |
| Mean | | **8.8** | **57.5** | **78.3** | **61.8** | **1782** | **21.0** | **54.4** | **83.6** | **69.7** | **4292** |
| Significance (P) | | 0.05 | <0.01 | <0.01 | <0.01 | N/A | 0.02 | <0.01 | <0.01 | <0.01 | N/A |

Table 4. Forage quality of cultivars sampled on December 5. Nitrate determination was not replicated.

| | | Original growth | | | | | Regrowth from Aug. 14 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Species & Cultivar** | | **CP** | **NDF** | **IVTD** | **NDFD** | **$NO_3$-N** | **CP** | **NDF** | **IVTD** | **NDFD** | **$NO_3$-N** |
| | | % of DM (NDFD = % of NDF) | | | | Ppm | % of DM (NDFD = % of NDF) | | | | Ppm |
| FS | Silo + Plus BMR | 8.4 | 58.6 | **78.3** | 63.4 | 712 | 15.3 | 62.4 | 79.7 | 62.9 | 1030 |
| SxS | UAP Danny Boy BMR | 7.1 | 67.3 | **77.6** | 64.1 | 502 | 10.7 | 64.5 | 78.8 | 63.1 | 24 |
| SxS | Greentreat BMR | 8.6 | 70.1 | **77.6** | 62.2 | 949 | 15.0 | 68.0 | 77.3 | 62.9 | 738 |
| SxS | Nutri + Plus BMR | 8.4 | 61.9 | **77.3** | 61.7 | 66 | 12.7 | 63.1 | 77.3 | 61.3 | 20 |
| PM | Graze King | 12.2 | 67.6 | **76.1** | 63.8 | 876 | 11.6 | 66.4 | 76.7 | 64.3 | 577 |
| FS | Redtop + Plus BMR | 8.0 | 64.6 | **75.9** | 60.5 | 39 | 14.6 | 64.7 | 73.8 | 59.4 | 194 |
| SxS | Hiyield Choice | 6.6 | 63.7 | **74.8** | 58.9 | 80 | 13.4 | 67.0 | 79.2 | 65.6 | 81 |
| C | Croplan N48-V8 (98 day) | 8.4 | 62.9 | **74.1** | 60.0 | 928 | -- | -- | -- | -- | -- |
| FS | HT 110 BMR | 7.4 | 63.4 | **73.4** | 56.5 | 2843 | 17.3 | 61.2 | 83.4 | 68.6 | 1220 |
| FS | DK FS25E | 9.0 | 65.6 | **73.3** | 56.6 | 88 | 13.7 | 66.7 | 74.2 | 58.4 | 149 |
| SxS | Greentreat Plus | 7.8 | 69.9 | **72.5** | 58.9 | 1283 | 11.8 | 64.5 | 76.0 | 59.8 | 1210 |
| PM | Hy-Mil-444 | 11.3 | 69.5 | **71.8** | 59.7 | 1637 | 13.8 | 68.4 | 78.2 | 70.6 | 517 |
| SxS | MS 505 x DS Sudan BMR | 6.9 | 64.6 | **71.5** | 54.9 | 102 | 10.8 | 66.7 | 71.0 | 55.6 | 386 |
| S | Trudan 8 | 6.8 | 62.7 | **71.0** | 54.4 | 141 | 13.6 | 62.0 | 73.2 | 61.7 | 219 |
| SxS | UAP Dynagraze 222 | 6.3 | 64.2 | **69.0** | 50.9 | 1542 | 11.2 | 67.4 | 74.2 | 59.2 | 1484 |
| SxS | Special Effort | 6.9 | 65.2 | **67.8** | 48.5 | 2329 | 14.3 | 66.8 | 73.6 | 56.5 | 878 |
| PM | PP-202M | 8.1 | 69.3 | **66.9** | 50.8 | 30 | 14.4 | 66.8 | 78.8 | 69.1 | 210 |
| C | NK N09-A4 (74 day) | 5.6 | 69.0 | **65.9** | 47.8 | 907 | -- | -- | -- | -- | -- |
| Mean | | **8.0** | **65.5** | **73.0** | **57.4** | **836** | **13.3** | **65.4** | **76.8** | **62.6** | **559** |
| Significance (P) | | <0.01 | 0.18 | 0.18 | 0.10 | N/A | 0.39 | <0.01 | 0.03 | 0.57 | N/A |