

## **2001 Delaware County BMR Sorghum Sudangrass Trials**

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### **Introduction**

For the last two years we have been exploring the use of Brown Mid Rib (BMR) sorghum sudangrass as a forage crop in New York State. There are several reasons this crop is being investigated and recommended as an alternative to corn. Under optimum management, BMR sorghum sudangrass can be of high feed quality. Results from research conducted in 1999 in Columbia County, NY, showed that a BMR sorghum sudangrass crop can produce the same or more milk per acre than a corn silage crop, yet does not appear to suffer the yield penalty associated with late planted corn, nor the challenges of harvesting a high quality feed in fall weather as harvest is complete by early September. This crop provides flexibility as it does not require corn harvest equipment and can be harvested as round bale silage (baleage) as well as grazed (if adhering to grazing height restrictions). With a later planting date BMR sorghum sudangrass can be used as a double crop after first cut hay crop harvest, and with an early September harvest, it provides ground cover in the fall without the need of a rye seeding. The USDA NRCS estimated soil loss potential of sorghum-sudan is less than half that of conventionally tilled corn; the C factor for 3<sup>d</sup> year conventionally tilled corn is 0.40 versus 0.19 for BMR sorghum sudangrass (USDA NRCS Field Office Technical Guide, 1995), due to greater crop vegetative soil cover with BMR sorghum sudangrass. From a manure nutrient management perspective the 2- or 3-cut system allows for manure applications during the summer when the risk of runoff is considerably reduced. Splitting N applications throughout the summer may also reduce nitrogen losses. Furthermore, labor, equipment availability, and soil trafficability are much less of a constraint during the summer.

Studies are ongoing in New York to determine optimum management for BMR sorghum sudangrass. In 2001 we conducted a replicated trial to examine forage quality of this crop as a function of stand height for the first cutting. This article summarizes the results of this study.

### **Methods**

The research plot was located on a valley shelf field in Davenport NY. The soil was classified as a Chenango gravelly silt loam. The pH was 5.8 and the site tested high in phosphorus (33 lbs/acre Morgan P) and potassium (415 lbs/acre of Morgan K). This was the second year of sorghum sudangrass after grass sod. Additionally, the field had a recent history of dairy manure applications. The BMR was seeded at a rate of 60 lbs per acre on June 6, 2001 using a conventional grain drill, cover chains and packer (following the drill). Starter nitrogen fertilizer was applied through the drill at a rate of 30 lbs N per acre. Previous manure applications were estimated to supply approximately 50 lbs of N per acre. No herbicide was used to control weeds. First cut harvests took place on July 9, 17, 23, and August 2 when the sorghum sudangrass was 36, 48, 60, and 72 inches tall, respectively. Samples were analyzed for dry matter (DM) content, neutral detergent fiber (NDF), lignin, sugar, crude protein, phosphorus and potassium using wet chemistry procedures as

well in vitro true dry matter and NDF digestibility. All samples were analyzed at the DairyOne Forage Testing Laboratory, Ithaca, NY.

## Results and Discussion

Table 1 presents yield and quality results from this study. Dry matter yields increased with plant height. More dry matter accumulated per inch of growth in the last two harvest height intervals (155 and 188 lbs DM) than in the first interval (43 lbs DM). Despite the lower yields for the first cut at shorter plant heights, earlier harvest may allow for a 3-cut system and additional yield. The yields obtained for first cutting were lower than those reported by Kilcer (personal communication) for this crop in Eastern NY, possibly as a result of low rainfall in 2001 and sub optimal nitrogen rates. Additionally, weed pressure may have reduced BMR yield. Weed dry matter yield for this trial average 1.7 tons per acre (35% DM) across all harvest heights, approximately 30% of the average BMR yield across the trial.

Neutral detergent fiber levels ranged between 50 and 60% of dry matter. This is a typical harvest target range for high quality cool season grasses. After 34 inches NDF content did not significantly increase, suggesting that fiber deposition is retarded as maturity advances. This same trend is seen in NDF digestibility and reflects the fact that at all harvest heights the lignin content remained the same. These results imply that with regards to fiber, this crop holds quality as it matures. In comparison, NDF digestibility of corn silage typically ranges from 40-55%. Increased fiber digestibility will result in greater production of rumen microbial protein, thus reducing the need for additional purchased protein.

In addition to high fiber digestibility, BMR sorghum sudangrass also has high sugar levels. In this study, sugar content increased with cutting height/maturity, with the highest sugar level nearing 20% of dry matter. These data suggest that this crop may increase sugar production after it stops increasing fiber content. After harvest and during storage in a silo some of these sugars will be oxidized and fermented, so BMR sorghum sudangrass silage, like all silages, would be expected to be lower in energy content than the values show here for fresh forage. Good silage harvest management practices such as rapid dry down and quick filling and packing will help retain sugar and energy levels.

Both a high fiber digestibility and high sugar content contribute to the energy value of this crop. When fiber digestibility is analyzed and accounted for (using invitro digestibility analyses), net energy of lactation values for this crop averaged 0.71 Mcal/lb of dry matter, rivaling that of good quality corn silage. Energy content in this trial did decrease with harvest plant height, with the greatest drop occurring between the last two harvest heights. Given that energy content of the crop will decrease after fermentation, these data suggest that BMR sorghum sudangrass be harvested at less than 59" to obtain a fermented feed with energy content comparable to good quality corn silage. Table 1 also includes energy values predicted without invitro digestibility data, using industry standard equations (regular NeL). These predictions were substantially lower than the invitro adjusted energy values, averaging 0.61 Mcal/lb of dry matter across all heights, and there were no statistical differences in regular NeL values across all heights as there were for invitro adjusted NeL values. These data suggest that the energy content of this crop may be severely underestimated using the standard equations at the present time and that these equations are not sensitive to changes in maturity across the range of plant height examined in this study.

**Table 1. Yield and forage quality data from the first cutting of BMR sorghum sudangrass at the Delaware County research plot (planting date: June 6, 2001).**

Harvest date:	Cutting Height, inches			
	34"	46"	59"	69"
	July 9, 2001	July 17, 2001	July 23, 2001	August 2, 2001
Dry matter, %	10.8 <sup>a</sup>	11.1 <sup>a</sup>	15.0 <sup>b</sup>	20.2 <sup>c</sup>
Yield, tons/acre @ 35% DM <sup>1</sup>	3.0 <sup>a</sup>	3.8 <sup>a</sup>	6.7 <sup>b</sup>	9.3 <sup>c</sup>
NDF <sup>2</sup> content, % DM	51.6 <sup>a</sup>	55.5 <sup>b</sup>	57.7 <sup>b</sup>	58.0 <sup>b</sup>
Lignin, % DM	3.0 <sup>a</sup>	2.9 <sup>a</sup>	3.5 <sup>a</sup>	3.1 <sup>a</sup>
dNDF <sup>3</sup> , % NDF	78.3 <sup>a</sup>	77.1 <sup>a</sup>	76.8 <sup>a</sup>	66.9 <sup>b</sup>
IVTD <sup>4</sup> , % DM	88.8 <sup>a</sup>	87.3 <sup>a</sup>	86.6 <sup>a</sup>	80.8 <sup>b</sup>
In vitro adj. NeL <sup>5</sup> , Mcal/lb	0.74 <sup>a</sup>	0.72 <sup>a,b</sup>	0.71 <sup>b</sup>	0.66 <sup>c</sup>
Regular NeL <sup>6</sup> , Mcal/lb	0.62 <sup>a</sup>	0.61 <sup>a</sup>	0.60 <sup>a</sup>	0.61 <sup>a</sup>
Sugar, % DM	4.2 <sup>a</sup>	7.7 <sup>a,b</sup>	9.8 <sup>b</sup>	17.8 <sup>c</sup>
Crude Protein, %	18.3 <sup>a</sup>	13.5 <sup>b</sup>	10.5 <sup>c</sup>	7.9 <sup>d</sup>
Phosphorus, % DM	0.39 <sup>a</sup>	0.36 <sup>a,b</sup>	0.22 <sup>b,c</sup>	0.15 <sup>c</sup>
Potassium, % DM	3.33 <sup>a</sup>	3.45 <sup>a</sup>	2.50 <sup>a,b</sup>	1.68 <sup>b</sup>
Phosphorus removal, lbs P/acre <sup>7</sup>	8.3 <sup>a</sup>	9.2 <sup>a</sup>	10.5 <sup>a</sup>	9.9 <sup>a</sup>
Nitrogen removal, lbs N/acre	62 <sup>a</sup>	57 <sup>a</sup>	78 <sup>b</sup>	83 <sup>b</sup>

a,b,c – average values *within rows* with different letters *are* statistically different (95% confidence interval)

<sup>1</sup> – first cutting yield on a 35% dry matter (DM) basis

<sup>2</sup> – neutral detergent fiber

<sup>3</sup> – digestible NDF

<sup>4</sup> – in vitro true dry matter digestibility

<sup>5</sup> – net energy of lactation adjusted for in vitro digestibility

<sup>6</sup> – net energy of lactation unadjusted for invitro digestibility analysis data

<sup>7</sup> – multiply by 2.3 to obtain lbs of P<sub>2</sub>O<sub>5</sub>/acre removed in the first cutting

Protein content of BMR sorghum sudangrass in this trial decreased with cutting height, following a trend common for cool season grasses. The first two plant harvest heights had protein levels greater than typical corn silage whereas protein levels at the tallest plant harvest height were similar to corn. These data suggest that BMR sorghum sudangrass harvested at heights less than 59" could result in high protein forage thus reducing the need for purchased protein. However, these results may be affected by N supply. Currently, Cornell University recommends nitrogen rates for sorghum sudangrass similar to or slightly less than corn. Preliminary research in the Hudson Valley indicates that optimum economic N rates may be much higher than for corn. Field trials will be conducted this growing season at the Valatie research farm and at the Mt Pleasant farm to assess optimum N rates for BMR sorghum sudangrass.

Over the full range of cutting heights, phosphorus and potassium levels of the forage in this trial showed a downward trend as the plants got taller. Phosphorus (P) levels are consistent with other forages, and, at the taller heights, are similar to corn silage. Lower P levels can make it easier to implement diets that meet but do not exceed animal requirements for P, thus providing an environmental benefit. Phosphorus removal rates for the first cutting ranged from 19.0 and 21.0 lbs P<sub>2</sub>O<sub>5</sub>/acre at 34 and 46 inches to 24.2 and 22.7 lbs P<sub>2</sub>O<sub>5</sub>/acre at 59 and 69 inches, respectively. Potassium concentrations in the forage are similar to those for cool season grass forages in New York State. However, like cool season grasses, BMR sorghum sudangrass is a luxury consumer of potassium and high soil test potassium levels will result in high forage potassium concentrations. There is interest in BMR sorghum sudangrass as forage for dry cows. The potassium concentrations in the first cutting in this trial are not conducive to low potassium dry cow diets, except for perhaps the forage harvested at the 69 inches. If BMR sorghum sudangrass is rotated on fields that receive regular manure applications, the resulting forage may not meet low potassium forage standards for dry cow forage.

## Conclusions

The yield and quality results of this trial suggest that the optimum stand height for first cutting is less than 59 inches. Research conducted elsewhere in New York suggests that the optimum cutting height is less than 48 inches. Further research will be conducted this growing season to fine-tune these recommendations under different climatic conditions.

BMR sorghum sudangrass grows at a very fast rate (approximately 12 inches per week) in warm weather. This fast rate of growth (and chemical maturity) has implications for the harvest management of this crop, requiring frequent scouting and rapid harvest once it reaches the desired range of height for harvest.

Forage analysis of this crop should include in vitro digestibility analysis to avoid underestimating energy content. Industry standard energy prediction equations will need to be adjusted to account for the increased digestibility of this crop.

If you have any questions on this trial please contact Paul Cerosaletti at the Cooperative Extension office at 607-865-6531 or pec6@cornell.edu.