Potassium management for brown mid rib sorghum sudangrass: Results of two years of studies at the Mt Pleasant Research Farm

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Introduction

There has been a growing interest in brown mid rib (BMR) sorghum sudangrass as a replacement for corn, often in situations where low corn yields are expected due to delayed planting because of poorly drained soils. Fertilizer trials were conducted these past couple of years to determine best management practices under New York soil and weather conditions. In this article, we report the results of a field trial on the effects of potassium (K) addition on brown mid rib sorghum sudangrass yield and forage feed quality. The trial was conducted in 2002 and 2003 on a Bath-Volusia soil at the Mt Pleasant Research farm in Tompkins County, NY. We investigated the effects of K application rate (0, 200, 400 lbs K_2O/acre split-applied in two equal applications) and nitrogen (N) application rate (0, 100, 200, 300, 400 and 500 lbs/acre split-applied in two applications) on forage yield and quality. In a previous article (Ketterings et al., 2004) we reported on the effects of N rate on yield and quality. In this article, we present and discuss the effects of K application rate.

Materials and Methods

A site description was given in Ketterings et al. (2003). Potassium was applied in the form of muriate of potash (60% K_2O). Nitrogen applications were in the form of ammonium sulfate (21% N). All plots received the equivalent of 45 lbs of P_2O_5/acre and the entire trial was replicated four times. Planting occurred on June 14, 2002, and June 9, 2003, using a John Deere grain drill and 60 lbs of seed/acre. In 2002, first and second harvest took place on July 30 and September 25, respectively. Both times, cutting height was 3-3.5 inch and harvest was initiated when the plots that received 150 lbs N/acre per cut had reached a height of 38-42 inches. In 2003, the first harvest occurred on July 31 (35 inch stand height) and the second cut on September 26 (stand height of 45 inches). All samples were analyzed for total N and K, neutral detergent fiber (NDF), and NDF digestibility (dNDF at 30 hr) at the forage laboratory of DairyOne Cooperative Inc. in Ithaca, NY. The alfalfa-grass spreadsheet of Milk2000 version 7.54 (http://www.uwex.edu/ces/forage/pubs/milk2000.xls) was used to estimate milk yields. We used standard values for neutral detergent insoluble crude protein (NDICP; 2.4% on a dry matter basis) and ether extract (3.6% on a dry matter basis) as reported for sorghum sudangrass silage in the 2001 Nutrient Requirements for Dairy Cattle (National Research Council, 2001). The 30 hour dNDF was multiplied by 1.16 to obtain an estimate of the dNDF at 48 hours (J.H. Cherney, unpublished, 2003). Soil samples (0-8 inches) were taken at planting and immediately after the first and second harvests. Samples were analyzed for pH, Morgan extractable K, nitrate and soluble salts.

Results and Discussion

Similar to results obtained in 2002, a significant NxK interaction was observed for several soil parameters and a few forage quality indicators where no or very little N had been applied. There were no NxK interactions at N levels of 100 lbs/acre per cut or greater.

Because the optimum economic N application rate in this study was between 100 and 150 lbs/acre per cut and a yield decrease was seen with greater applications, we focused our study of the effects of K to plots that had received 100 or 150 lbs N/acre per cut.

The application of potassium did not significantly increase first or second cut dry matter yields in any of the two years (Table 1). NDF increased with K addition (2-year average) while dNDF and crude protein levels were unaffected.

Table 1: Yield, predicted milk production, crude protein, NDF, digestibility of NDF and K_2O uptake as affected by K application rates in a 2-cut brown mid rib sorghum sudangrass trial at Mt Pleasant, NY, in 2002 and 2003. All plots received 100-150 lbs N/acre per cut.

K_2O applied per cut	Yield (35% dm)	Estimated milk production		Crude protein	NDF	dNDF
lbs/acre	tons/acre	lbs/ton	lbs/acre	% of dm	% of dm	% of NDF
0	9.1 a	3153 a	10052 ab	13.2 a	61.3 b	77.2 a
100	9.7 a	3112 a	10581 a	12.8 a	61.8 ab	78.0 a
200	9.1 a	3048 a	9636 b	12.7 a	62.1 a	77.3 a

Note 1: Milk yield was predicted using Milk 2000 (http://www.uwex.edu/ces/forage/articles.htm#milk2000).
Note 2: Average values *within columns* with different letters (a,b,c) are statistically different ($\alpha = 0.05$)
Note 3: The initial soil test K was 142 lbs Morgan K/acre. N application was 100 or 150 lbs N/acre per cut.

The change in NDF did not significantly impact forage quality expressed as milk production per ton of silage. As expected, the K concentrations in the forage were greatly affected by K application rate (Table 2). Without K addition in the two year period, K concentrations in the forage decreased from 2.3% for the first cutting in 2002 to 1.5% for the second cut in 2003. These results support the observation that K fertilization often alters elemental concentrations in forage, but generally does not impact forage quality parameters such as CP or dNDF (Cherney et al., 2003).

Table 2: Effects of K application rates on K concentrations in BMR sorghum sudangrass and K uptake. All plots received 100-150 lbs N/acre per cut. Yields were reported in Table 1.

K_2O applied	1st cut 2002	2nd cut 2002	1st cut 2003	2nd cut 2003
lbs/acre per cut	K concentration in the forage (% of dry matter)			
0	2.3 c	2.0 b	2.1 c	1.5 b
100	2.6 b	2.3 b	2.8 b	2.1 ab
200	3.0 a	2.6 a	3.4 a	2.3 a
	K uptake (lbs K_2O/acre)			
0	79 a	73 a	73 c	74 b
100	88 a	84 a	103 b	120 a
200	94 a	90 a	128 a	108 a

Note 1: Average values *within columns* with different letters (a,b,c) are statistically different ($\alpha = 0.05$).

Soil test potassium levels were greatly impacted by K application rate as well (Table 3). Without the addition of K, the soil went from a classification of high in the 2002 growing season to low after the first cut in 2003 and remained low at the end of the second season. Where 100 lbs K_2O/acre per cut were applied soil test K levels went from high in 2002 to medium in 2003 and with the addition of 200 lbs of K_2O/acre per cut, soil test K levels remained high. The soil supplied about 70 to 80 lbs of K_2O when no K fertilizer was applied. Harvest removed 80-130 lbs of K_2O with K fertilizer application.

Table 3: Effects of potassium application rates soil available K levels. All plots received 100-150 lbs N/acre per cut. Yields were reported in Table 1.

K_2O applied	Soil test K Cornell Morgan Extraction					
	2002 Growing Season			2003 Growing Season		
Per cut	At planting	After 1st cut	After 2nd cut	At planting	After 1st cut	After 2nd cut
lbs/acre	--lbs K/acre--					
0	140 a	127 a	134 b	107 b	73 c	74 b
100	132 a	131 a	160 b	136 b	103 b	106 b
200	140 a	155 a	221 a	194 a	141 a	160 a

Note 1: Average values *within columns* with different letters (a,b,c) are statistically different ($\alpha = 0.05$)
Note 2: For this soil, a soil test of 45-79 lbs K/acre is classified low in K, 80-119 lbs K/acre is medium, 120-199 lbs K/acre is high and >199 lbs K/acre is classified as very high in K.

Conclusions

Under optimum N management, the addition of K at this site (initially high in K) did not significantly increase dry matter yields. Potassium addition did increase forage K concentrations. Soil test K levels decreased over the two years with K applications of 100 lbs K_2O/acre per cut or less. Addition of K may be needed to obtain higher yields on soils testing lower for available K or when soil test K needs to be maintained at high levels. Feed quality was not affected by K addition with the exception of a slight increase in NDF upon addition of 200 lbs of K_2O/acre per cut. Low K forage necessary for dry cows to reduce the possibility of metabolic disorders after calving was obtained without K addition. Second cuttings had lower K concentrations than first cuttings. We plan to continue this trial in 2004.

References

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Acknowledgments

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