Ketterings, Q.M., G. Godwin, T.F. Kilcer, P. Barney, M. Hunter, J.H. Cherney, and S. Beer (2005). Nitrogen management for BMR sorghum sudangrass. Results of six NY field studies in 2004. What's Cropping Up? 15(4):4-7.

Nitrogen management for brown midrib sorghum sudangrass: Results of six NY field studies in 2004

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Introduction

In an article by Kilcer and others published in "What's Cropping Up?" (2002) 12 (5): 6-9, we showed the results of a brown mid rib sorghum sudangrass (BMR) nitrogen (N) trial conducted in Columbia County. That trial showed that nitrogen application increased yields but little was gained by increasing the N application *at planting* beyond 100 lbs N/acre. The greatest yields (15 tons/acre at 35% dry matter) were obtained when 200 lbs N/acre were applied with two applications, one at planting and one after the first cut. Split application furthermore increased N fertilizer uptake efficiency (% of the fertilizer application that is taken up by the crop) and hence favors environmental stewardship. In the 2002 and 2003 growing season, we conducted a study at the Mt Pleasant Research Farm in Tompkins County, NY, to determine optimum economic N rates for yield, quality and environmental risk indicators ("What's Cropping Up?" (2004) 14 (2): 5-6). These trials suggested optimum N rates for fields with no sod or manure history to vary between 100 and 150 lbs of N/acre per cut. However, additional trials were needed covering a wider range of soils and weather.

2004 Field Trials

Six trials were conducted in 6 different counties in New York State. The trial in Columbia County had received manure (5,600 gallons per acre plowed down within 5 hours resulting in an application of 120 lbs/acre available N assuming 65% availability of inorganic N and an organic N release of 35%) and had 5 N treatments (0, 50, 100, 150, and 200 lbs N/acre per cut) as well as a control that had not received any manure or fertilizer since 2002. N applications were done using urea. All other trials had 6 treatments (0, 50, 100, 150, 200, 250 lbs N/acre per cut) and N applications in the form of ammonium sulfate (21% N) to minimize N volatilization losses. Pre-plant fertilizer was applied according to soil tests following Cornell guidelines (Essex trial: 80 lbs K_2O/acre and 20 lbs P_2O_5/acre; Cayuga trial: 60 lbs K_2O/acre and 30 lbs P_2O_5/acre; Tompkins trial: 20 lbs K_2O/acre and 20 lbs P_2O_5/acre). No additional P or K was added in Columbia County. The trials in St Lawrence and Jefferson Counties received 30 lbs K_2O/acre and 45 lbs of P_2O_5/acre. Each trial was replicated four times. Cutting height was 3-3.5 inches and harvest was initiated when the plots that received 150 lbs N/acre per cut had reached 35-45 inches. At each site, two harvests were done with the exception of the site in Jefferson Country where only one cut was feasible due to late planting.

Results and Discussion

Optimum economic yields varied from 7.2 tons/acre (65% moisture) for the site in Jefferson County (one cut only) to 13.4-13.8 tons/acre in Columbia and Essex Counties (Figure 1). The economic optimum fertilizer N rates assuming fixed costs of $178/acre, a nitrogen fertilizer cost of $0.32 per pound and a forage value of $35 per ton (65% dry matter), were 140 lbs N/acre for the one-cut trial in Jefferson County and the 2-cut trial in St Lawrence County, <50 lbs N/acre per cut in Columbia (manured site) and in Essex County (first year crop following grass/alfalfa

plowdown), 120 lbs N/acre per cut in Cayuga County, and 170 lbs N/acre per cut in Tompkins County (see Table 1). However, returns per acre at optimum economic yield were very variable ($27, $82, $267, $259, $104, and $147/acre for Jefferson, St Lawrence, Columbia, Essex, Cayuga, Tompkins Counties, respectively). This does not include the expense of sod kill or manure application in the trials in Essex and Columbia Counties. Residual N levels (N left in the soil profile following the second cut) were of environmental concern with application rates greater than 150 lbs N/cut in the trials in Jefferson, St Lawrence and Columbia County. Nitrogen uptake efficiencies at the optimum economic N rate were low in all trials except for the Essex and Columbia County trials. Uptake efficiencies steadily declined with N application beyond the economic optimum N rate for all trials except for the Jefferson County trial where there was no clear relationship between N uptake efficiency and N rate.

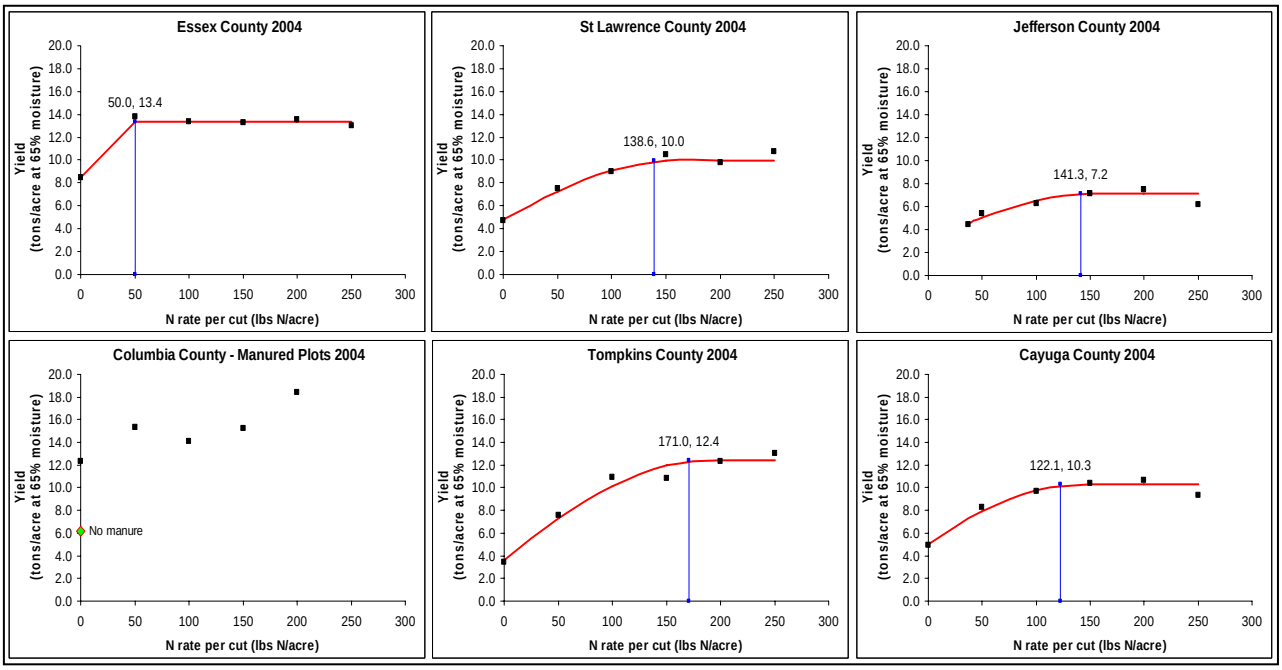

Figure 1: Optimum economic N rates for BMR sorghum sudangrass. The Essex County site followed plowdown of a legume containing sod. The Jefferson County site was one cut only (versus 2 cuts at the other two sites). The data in the Columbia County site were too variable to fit a fertilizer response curve but clearly indicated a response to the manure application.

Table 1: Optimum economic N rates, return per acre and yield at the optimum economic N rate as well as reported corn yield potential[†] for 6 New York State sites.

	Optimum economic N rate (OENR) lbs N/acre per cut (N uptake efficiency)	Return per acre at OENR $/acre	Yield at OENR tons/acre	Reported corn yield potential tons/acre Undrained/Drained
Jefferson	141 (37%)	27	7.2	17.9 / 20.4
St Lawrence	139 (39%)	82	10.0	18.7 / 21.3
Columbia	<50 (91%)	267	13.8	17.9 / 17.9
Essex	<50 (60%)	259	13.4	17.9 / 20.4
Cayuga	122 (35%)	104	10.3	23.0 / 23.8
Tompkins	171 (50%)	147	12.4	21.3 / 21.3

[†]Yields and yield potentials are given in 35% dry matter.

Crude protein increased with N application in all trials (Table 2) with percentages ranging from 6.1% without N addition in Essex County to 22.6% with the addition of 200 lbs of N/acre in addition to manure application in Columbia County. Digestibility of NDF was high and only declined with N application for the second cuts. Estimated milk yields were directly related to dry matter yields although silage quality declined slightly when stands became too tall.

Although no direct comparison was done, yields seemed lower than would have been expected for corn in such a good growing season as we had in 2004 but silage quality expressed as milk production per ton of silage might have been higher than would be expected for corn (direct comparisons with corn are needed).

Table 2: Effect of N application on CP of BMR sorghum sudangrass grown at 6 sites in New York State (2004 season).

N applied per cut lbs N/acre	Crude Protein (% of DM)					
	First Cut					
	Jefferson[‡]	St Lawrence	Columbia[§]	Essex	Cayuga	Tompkins
0	.	10.2 c	10.8 d	6.1 b	9.7 b	9.6 a
0+M	.	.	14.3 cd	.	.	.
37	5.7 bc	.	.	.	.	.
50	5.2 c	12.3 bc	18.1 bc	8.9 ab	10.3 b	8.9 a
100	5.6 bc	11.3 bc	21.2 ab	12.6 ab	11.7 ab	11.1 a
150	8.7 b	14.5 ab	20.2 ab	12.8 ab	12.4 ab	13.5 a
200	12.5 a	16.9 a	22.6 a	14.0 a	13.7 a	13.9 a
250	13.9 a	17.0 a	.	12.0 ab	14.5 a	10.7 a
	Second Cut					
	Jefferson	St Lawrence	Columbia[‡]	Essex	Cayuga	Tompkins
0	.	8.4 d	8.2 c	7.9 bc	8.8 c	9.9 d
0+M	.	.	11.4 bc	.	.	.
37	.	.	.	.	.	.
50	.	9.6 cd	13.8 b	7.2 c	8.4 c	11.5 cd
100	.	11.9 bc	18.9 a	9.2 ab	8.9 c	13.3 bc
150	.	14.3 ab	20.4 a	9.8 a	11.4 b	13.7 bc
200	.	15.7 a	20.8 a	10.0 a	11.7 b	15.6 ab
250	.	16.5 a	.	10.9 a	14.2 a	17.6 a

[†]Average values *within columns* with different letters (a,b,c) are statistically different ($\alpha = 0.05$)

[‡]All plots received a base N application of 37 lbs N/acre.

[§]All plots that received fertilizer N also received manure.

Conclusions

Optimum N rates ranged from less than 50 lbs N/acre per cut in the manured field in Columbia County and in the field with a recent sod history in Essex County, 120-140 lbs N/acre per cut for the three sites in Jefferson, St Lawrence and Cayuga County, to 170 lbs N/acre per cut at a site with no manure or sod history in Tompkins County. Preliminary results to date suggest that this crop needs to be fertilized as a grass rather than as a corn crop using split applications ranging from 100-150 lbs N/acre per cut in fields without a sod or manure history to no more than 50 lbs N/acre per cut where manure or sod N credits are expected. The results of these 6 trials need to be combined with our previous years of work on N rate studies to be able to draw conclusions across a wider number of years. Direct comparison studies under different growing conditions

(2004 was an exceptionally good corn growing year but not warm enough for high BMR sorghum sudangrass yields) are needed to conclude if this crop can compete with corn in yield and quality.

References

1. Ketterings, Q.M., G. Godwin, J.H. Cherney, S. Beer, and T.F. Kilcer (2004). Nitrogen management for brown mid rib sorghum sudangrass. Results of two years of studies at the Mt Pleasant Research Farm. "What's Cropping Up?" 14(2): 5-6.
2. Kilcer, T.F., Q.M. Ketterings, T.W. Katsvairo and J.H. Cherney (2002). Nitrogen management for sorghum sudangrass: how to optimize N uptake efficiency? "What's Cropping Up?" 12(5): 6-9.

Acknowledgments and for Further Information

This research was funded with grants from the Northern New York Agricultural Development Program (NNYADP – http://www/nnyagdev.org), the Northeast Region Potash and Phosphate Institute, and Garrison & Townsend Inc. Ammonium sulfate was donated by Honeywell Inc. and seed was supplied by Agriculver in Trumansburg, NY. For further information contact Thomas Kilcer at Rensselaer Cooperative Extension at tfk1@cornell.edu or 518-272-4210 or Quirine Ketterings at Cornell University (qmk2@cornell.edu or 607-255-3061). You could also visit the Nutrient Management Spear Program website at http://nmsp.css.cornell.edu/projects/bmr.asp or the Rensselaer County CCE website at: http://www.cce.cornell.edu/rensselaer/Agriculture/new%20bmr_sorghum.htm.

Nutrient Management Spear Program
http://nmsp.css.cornell.edu/

A collaboration among the Department of Crop and Soil Sciences, Pro-Dairy, and Cornell Cooperative Extension.
