What's Cropping Up?

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Nitrogen Management for Brown Mid Rib Sorghum Sudangrass: Results of the 2002 Mt. Pleasant Trial

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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 the cold and wet 2000 growing season on a Hoosic soil in Columbia County. Nitrogen application increased yields but little was gained by increasing the N application *at planting* beyond 100 lbs/acre. The greatest yields (15 tons/acre at 35% dry matter) were obtained when 200 lbs N/acre were applied *in split applications*. Split-applications increased the N fertilizer uptake efficiency (% of the fertilizer application that is taken up by the crop) and favors environmental stewardship. The highest N application in that study was 200 lbs N/acre and a yield plateau was not achieved at that application rate. Thus, further research was needed to determine optimum economic (split) N application rates.

Materials and Methods

In the 2002 growing season, we conducted a study at the Mt Pleasant Research Farm in Tompkins County, NY. The soil was a silt loam Bath-Volusia soil, representative of a large portion of Southern Tier New York soils. The pH of the soil was 6.2 and the soil organic matter content was 3.2%. The site was classified as medium in phosphorus (5 lbs/acre Morgan extractable P), medium in zinc (0.54 lbs Morgan extractable Zn/acre), and high in potassium, calcium and magnesium (142 lbs K/acre, 2355 lbs Ca/acre and 375 lbs Mg/acre). We investigated the effects of N application rate (0, 100, 200, 300, 400 and 500 lbs/acre split-applied in two applications) and three potassium application rates (0, 200, 400 lbs K_2O/acre split-applied in two equal applications as well) on yield and quality. 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 was done on June 14, 2002, using a John Deer grain drill at 60 lbs of seed per acre.

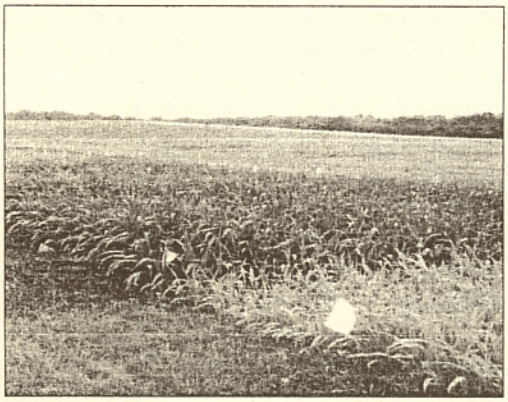

Figure 1: 2002 brown mid rib sorghum sudangrass NxK trial at Mt Pleasant, NY.

Late planting as a result of wet soil conditions in the early part of the season and drought mid to late season limited our management system to two cuts. First cut (3-3.5 inch cutting height) took place on July 30. The second cut was done on September 25. Harvesting was done when the plots that received 150 lbs N/acre per cut or more had reached a stand-height of 38-42 inches. Based on earlier field trials conducted in Columbia and in Delaware County (see the article by Cerosaletti and others in "What's Cropping Up?" (2002) 12(3): 1-3), we expected this stand height to provide optimum forage quality. We determined yield and took subsamples to determine moisture content, nutrient concentrations and forage feed quality. All samples were analyzed for total N, P, K, Ca, Mg, lignin, sugar, nonstructural carbohydrates (NSC), neutral detergent fiber (NDF), digestibility of neutral detergent fiber (dNDF at 30 hr), and in vitro total digestibility (IVTD at 30 hr) at the forage laboratory of DairyOne Cooperative Inc. in Ithaca, NY. Milk2000 version 7.4, a software model developed at the University of Wisconsin, was used to estimate milk yields in lbs per ton and in lbs per acre. We used the alfalfa-grass Milk2000 worksheet with standard values for neutral deter-

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gent 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 P, K, Ca, Mg, nitrate and soluble salts. In this article, we present and discuss the results of our N rate study. The effects of K application are discussed on pages 6-7 of this issue.

Results and Discussion

Yields increased from less than 5 tons/acre (35% dry matter) without the addition of N to 10 tons/acre with N applications of 200-250 lbs of N per cut (Figure 2). Nitrogen application increased predicted milk yields (Table 1) mostly due to an increase in yield. The highest yields (this is not the same as the economic optimum yield) were obtained with a 200-250 lbs N application per cut.

Forage quality, expressed in milk per ton, was not affected by applications over 100 lbs N/acre per cut. Nirogen addition did increase crude protein and lowered NDF but did not affect dNDF, IVTD and lignin concentration (Table 2). Milk per acre values strongly reflected the sorghum sudangrass silage yield with a correlation of 0.999 (R^2=0.97) between milk per acre and dry matter yield per acre. We, therefore, conclude that N fertilizer application rates did not affect overall forage quality and that it is reasonable to evaluate the economics based on yield alone or a combination of yield and quality (milk per acre predictions).

Nitrogen uptake efficiencies were low (Table 1) and comparable to those observed with the study in Columbia County in 2000. In 2000, heavy rains early in the season may have been responsible for the low N uptake efficiency whereas in 2002 the low N uptake efficiencies were most likely due to the severe drought. The residual N level (N left in the soil profile following the second cut) is an environmental concern with application rates greater than 200 lbs N per cut.

Conclusions

Nitrogen fertilization of BMR sorghum sudangrass did not affect lignin, digestibility or fiber digestibility of the forage, but reduced the NDF concentration. As expected, fertilization of a grass with N resulted in a significant increase in crude protein content. Since dry matter yield was highly correlated with milk yield, the changes in NDF and CP due to N fertilization had little impact on milk yield. The results of this year's trial suggest that the optimum N rate where no manure is applied is less than 200 lbs/acre per cut in a 2 cut system but N uptake efficiencies were low. The drought may have impacted fertilizer response and a slightly earlier planting date would likely increase N utilization and yield. Continuation of N trials on multiple sites (soil types, manure histories, and climatic conditions) and over multiple years and an economic analysis of the results are needed to determine optimum economic and environmental N rates. This trial will be repeated in the 2003 growing season.

References

1. Cerosaletti, P., Q.M. Ketterings and T. Kilcer (2002). 2001 Delaware County BMR sorghum sudangrass trials "What's Cropping Up?" 12(3): 1-3.

2. Guyer, P.Q. and D.D. Duey (1986). Estimating corn and sorghum silage value. Univ. of Neb. Coop. Ext. Publ. G74-99-A, Univ. of Nebraska, Lincoln, NE.

3. Kilcer, T.F., Q.M. Ketterings, T.W. Katsvairo and J.C. Cherney (2002). Nitrogen management for sorghum sudangrass: how to optimize N uptake efficiency? "What's Cropping Up?" 12(5): 6-9.

4. National Research Council (2001). Nutrient requirements of dairy cattle. 7th edition. National Research Council. National Academy Press, Washington, D.C. 408 pages.

Acknowledgments

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For Further Information

For further information on BMR sorghum sudangrass projects in New York contact Thomas Kilcer at the Rensselaer Cooperative Extension Office at tfk1@cornell.edu or 518-272-4210. You could also visit the BMR sorghum sudangrass website at http://nmsp.css.cornell.edu/projects/bmr.asp.

Table 1: Yield, predicted milk production, nitrogen uptake, nitrogen uptake efficiency, post-harvest soil nitrate and soluble salts as affected by N application rates in a 2-cut brown mid rib sorghum sudangrass trial at Mt Pleasant, NY, 2002.

Total N applied	Yield (35% dm)	Estimated Milk Production		N uptake	N uptake efficiency	Post harvest soil nitrate	Soluble Salts
lbs/acre	tons/acre	lbs/ton	lbs/acre	Lbs/acre	%	ppm	mmho
0	4.7 e	2672 b	5098 e	40 e	-	0 b	17 d
100	6.5 d	2717 b	7148 d	70 d	30 c	0 b	21 d
200	8.1 c	2774 ab	9088 c	109 c	34 b	0 b	25 d
300	8.9 b	2788 a	10032 b	151 b	36 ab	5 b	34 c
400	10.0 a	2803 a	11254 a	198 a	39 a	26 a	61 a
500	10.1 a	2843 a	11569 a	209 a	34 bc	26 a	50 b

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 ($\alpha = 0.05$)

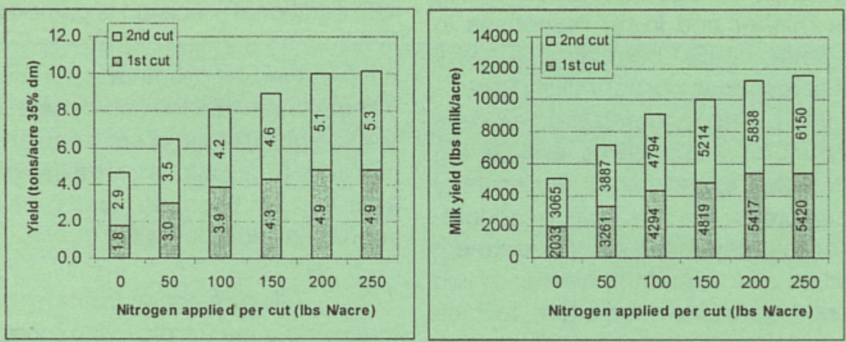

Figure 2: Brown mid rib sorghum sudangrass dry matter yield (left) and milk yield per acre (right) as affected by nitrogen rate at the Mt Pleasant Research Farm, NY, in 2002.

Table 2: Effect of N application on quality of BMR sorghum sudangrass grown at the Mt Pleasant Research Farm, NY, 2002.

N applied per cut	Crude Protein	IVTD	Lignin	NDF	dNDF
lbs N/acre	------------------------------% dm			------------------------------	% NDF
First Cut					
0	8.61 f	81.5 a	4.78 a	66.2 a	71.8 a
50	9.75 e	79.9 a	4.65 a	66.1 a	69.7 a
100	11.22 d	80.4 a	4.83 a	66.2 a	70.3 a
150	14.76 c	80.6 a	4.57 a	63.8 b	69.7 a
200	16.48 b	80.0 a	4.63 a	62.2 c	68.2 a
250	19.08 a	81.8 a	4.68 a	62.1 c	70.3 a
Second Cut					
0	7.05 e	77.9 a	4.10 a	66.7 a	66.9 a
50	9.62 d	80.3 a	3.65 b	64.0 b	69.3 a
100	12.77 c	80.5 a	3.94 ab	62.5 b	69.0 a
150	15.46 b	81.2 a	3.64 b	60.6 c	69.2 a
200	18.87 a	81.7 a	3.68 ab	59.5 c	69.3 a
250	18.79 a	81.8 a	3.83 ab	59.4 c	69.3 a

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

Crop Management

Robust Designs for Simple Agronomic Field Experiments

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Most agronomic studies involve relatively simple experiments and are implemented through randomized complete block designs. Use of blocks is in most cases justified due to spatial variability in fields, and this layout is an attractive way to organize replications.

Traditional approaches to experimental design use random allocation of treatments to plots (within blocks). The randomization process is used to ensure that a treatment is not continually favored or handicapped in successive replications by some extraneous source of variation (Cochran and Cox, 1950). Although this process is intuitively attractive, it has been shown to cause biases and imprecision under most field conditions (van Es and van Es, 1993). The reason for this is the fact that the underlying soil characteristics are typically non-random (van Es, 2002) and show field trends (higher and lower responses in different parts of the field), spatial correlation (nearby locations showing similar response), or periodicity (repetitive patterns across a field). The randomization process does not explicitly account for field patterns, and certain realizations of a randomized experimental design may result in undesirable outcomes. For example, a randomized plot allocation process may result in one treatment always being allocated on one side of the blocks; or two treatments always being adjacent to each other. In such cases, the researcher is left with either abandoning the randomization principle, or allowing incorrect outcomes of the experiment.

The solution to this dilemma is the development of experimental designs that are inherently insensitive (robust) to non-random field variability. This approach of *spatially-balanced design* (van Es and van Es, 1993) uses dummy indicators in standard experimental designs, and the treatments are subsequently randomly assigned to the indicators. In other words, treatments are randomly allocated to well-balanced designs, rather than to plots. This approach guarantees that the design is insensitive to field trends, spatial correlation, and periodicity, but the random assignnment of treatments still insures against the possibility of favoring certain outcomes. The use of standard designs also prevents the need for complicated randomized design methods.

How to Use Standard Designs

We developed standard spatially-balanced block designs for experiments with up to six treatments and six replicates, as well as seven, eight or nine treatments with up to four replicates (Table 1). The designs were developed for multiple non-random variability structures by (i) balancing the average distance of treatment comparison (e.g., treatments 1 and 2 are adjacent in Block I, but were explicitly moved apart in Block II; van Es and van Es, 1993), and (ii) insuring that treatments were allocated to different relative locations in the blocks among the replicates. The recommended procedure for the use of these designs is as follows:

1. Decide on the number of treatments and replications to be used in the design. With this, the general rule of thumb is that three replicates is a minimum. If time and space are not constrained, more replicates are better, but little additional precision is gained after four replications.

2. Find the optimum experimental design (Table 1) by using the layout for the appropriate number of treatments by starting from the left of each design for the chosen number of blocks (replications). The design needs to be selected from the left because spatial balancing is based on a sequential block layout.

3. Allocate actual treatments to the dummy indicators using a die (or dice with more than 6 treatments), or simple random number generators from statistical texts or computer spreadsheets (e.g., Excel's RAND function). Once the treatments have been allocated to plots, the chosen blocks may be laid out in the field in any arrangement.

For split-plot designs, a combination of designs may be used. For example, blocks with four treatments are designed first, and subplot treatments are allocated using the indicators from the two-treatment design.

Conclusion

The use of standard designs in experiments provides insurance against bias and imprecision from non-random spatial variability in fields, while also being appropriate in random domains. Deliberate favoring of treatments is addressed through the random allocation of actual treatments to the dummy indicators in the designs. It is hoped that the use of these designs will facilitate good field experimentation and remove concerns about undesirable designs.

References

Cochran, W.G., and G.M. Cox. 1950. Experimental design. John Wiley and Sons, Inc., New York.

van Es, H.M. 2002. Sources of soil variability. *In*: J. Dane and C. Topp (Eds.), Methods of Soil Analysis, Part 4: Physical Properties, Soil Sci. Soc. Am., Madison WI.

van Es, H.M., and C.L. van Es. 1993. The spatial nature of randomization and its effects on the outcome of field experiments. Agron. J. 85: 420-428.

Table 1. Spatially-balanced block designs for experiments involving two to nine treatments. For a given number of treatments, blocks should be selected starting from the left.

2 treatments
| 12 | 21 | 21 | 12 | 12 | 21 |

3 treatments
| 123 | 231 | 312 | 321 | 213 | 132 |

4 treatments
| 1234 | 3142 | 4132 | 3241 | 4231 | 3142 |

5 treatments
| 12345 | 35142 | 43251 | 25314 | 31425 | 45123 |

6 treatments
| 123456 | 426153 | 451632 | 613425 | 341562 | 512463 |

7 treatments
| 1234567 | 4617253 | 5427316 | 1635427 |

8 treatments
| 12345678 | 46281735 | 63827154 | 38417652 |

9 treatments
| 123456789 | 647291835 | 739418625 | 527483619 |

Nutrient Management

Potassium Management for Brown Mid Rib Sorghum Sudangrass: Results of the 2002 Mt. Pleasant Trial

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Introduction

Brown mid rib sorghum sudangrass has shown promise as a replacement for corn in situations where low corn yields are expected due to e.g. a combination of late planting and low fertility soils. However, fertilizer trials need to be conducted 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 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 the previous article 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

The pH of the soil at the Mt Pleasant site was 6.2 at the onset of the trial and the soil organic matter content was 3.2%. The site was classified as medium in phosphorus (5 lbs/acre Morgan extractable P), medium in zinc (0.54 lbs Morgan extractable Zn/acre), and high in potassium, calcium and magnesium (142 lbs K/acre, 2355 lbs Ca/acre and 375 lbs Mg/acre). 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 was done on June 14 using a John Deer grain drill at 60 lbs of seed per acre.

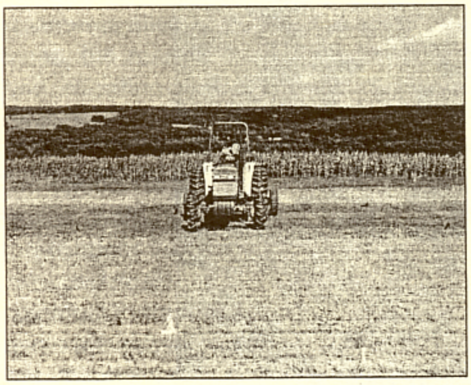

Figure 1: Potassium fertilizer applications to brown mid rib sorghum sudangrass at the Mt. Pleasant farm, NY, took place at seeding and directly following the first cut.

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. All samples were analyzed for total N, P, K, Ca, Mg, lignin, sugar, non-structural carbohydrates (NSC), neutral detergent fiber (NDF), digestibility of neutral detergent fiber (dNDF at 30 hr), and in vitro total digestibility (IVTD at 30 hr) at the forage laboratory of DairyOne Cooperative Inc. in Ithaca, NY. Soil samples (0-8 inches) were taken at planting and immediately after the first and second harvests. Samples were analyzed for pH, Morgan extractable P, K, Ca, Mg, nitrate and soluble salts.

Results and Discussion

A significant NxK interaction was observed for several soil and a few forage quality parameters. This resulted from a lack of a response to K application where no or very little N had been applied. There were no NxK interactions at N levels greater than 100 lbs/acre. Because the optimum economic N application rate in this study was likely greater than 100 lbs/acre per cut, we focused our study of the effects of K on yield and quality to plots that had received 150 lbs N/acre per cut or more.

The application of potassium did not significantly increase first or second cut yields (Table 1). The overall yield did show a slight increase from 9.3, without the addition of K, to 10.0 tons/acre (35% dry matter) where 200 lbs of K_2O had been applied. Yields obtained without K addition and those obtained with 400 lbs of K_2O/acre applications did not differ significantly. Potassium uptake efficiency showed an increase with N application rate but overall efficiencies were very low suggesting that K may not have been a limiting nutrient at the site (Table 2). Sugar, lignin, NDF, dNDF, and IVTD were unaffected by K application. In the second cut, an application of 400 lbs of K_2O reduced the crude protein concentration of the dry matter by 1.3%. The uptake of K_2O was greatly affected by K application rate. These results support the observation that potassium fertilization often alters elemental concentrations in forage, but generally does not impact forage quality parameters such as CP, IVTD or dNDF (Cherney et al., 2003).

The K concentration in the forage decreased with an increase in N rate where no K had been applied (Table 2). In grasses, K concentration will increase with increasing N rates if there is excess soil K available, but K concentration will decrease with increasing N rates if the soil K level is limiting (Cherney et al., 1998).

This year's results demonstrate that low K forage (<2.5 % K on a dry matter basis) necessary to prevent metabolic disorders in non-lactating cows, was obtained with N rates of just over 50 lbs N per acre per cut. The additions of 200 and 400 lbs K_2O per acre increased soil test K levels from an average of 142 lbs K/acre at the onset of the trial to 176 and 220 lbs K/acre after the second cut, respectively.

Conclusions

The addition of K at this site did not significantly increase dry matter yields of the individual first and second cuts but resulted in a slight increase in overall dry matter production. Potassium uptake efficiencies were low suggesting that K was not a limiting nutrient at this site. This was not surprising as the site tested high in K at the onset of the trial. 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 decrease in crude protein in the second cut which occurred upon addition of 200 lbs of K_2O/acre. Low K forage necessary for dry cows to reduce the possibility of metabolic disorders after calving was obtained with N rates of about 50 lbs N per acre per cut.

Table 1: Yield, predicted milk production, N uptake, N uptake efficiency, post-harvest soil nitrate and soluble salts as affected by K application rates in a 2-cut brown mid rib sorghum sudangrass trial at Mt Pleasant, NY, 2002.

Total K_2O applied lbs per acre	Yield (35% dm) tons per acre	Crude protein % of dm	Sugar % of dm	Lignin % of dm	NDF % of dm	dNDF % of NDF	IVTD % of dm	K_2O uptake lbs per acre
	First cut							
0	4.5 a	16.8 a	11.1 a	4.6 a	62.3 a	69.3 a	80.8 a	91.2 c
200	4.8 a	16.2 a	9.7 a	4.6 a	62.8 a	69.8 a	81.2 a	111.8 b
400	4.7 a	16.3 a	10.3 a	4.7 a	63.0 a	69.1 a	80.4a	125.3 a
	Second cut							
0	4.8 a	18.4 a	13.5 a	3.6 a	59.0 a	69.8 a	82.0 a	81.1c
200	5.3 a	17.7 ab	12.6 a	3.7 a	60.6 a	69.0 a	81.3 a	102.5 b
400	4.9 a	17.1 b	13.0 a	3.9 a	59.9 a	69.0 a	81.3 a	112.2 c

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 lbs N/acre per cut.

Although the 2002 results of this trial show that the yield benefits from the addition of 200 lbs K_2O were minimal, recommendations should not be based on the results of one season and one site only. We plan to continue this trial in 2003.

Table 2: Effects of N and K application rates on K concentrations in BMR sorghum sudangrass, K fertilizer uptake efficiency and end of season soil available K levels.

N applied	K_2O applied	K concentration (% of dry matter)		Morgan soil test K (lbs K per acre)		K uptake efficiency
lbs per acre per cut		1st cut	2nd cut	At planting	After 2nd cut	%
0	0	2.60 a	2.09 a	144 a	144 b	-
	100	2.74 a	2.16 a	152 a	166 ab	2 a
	200	2.75 a	2.31 a	128 a	246 a	1 a
50	0	2.52 b	1.99 a	154 a	132 b	-
	100	2.73 ab	2.17 a	148 a	160 b	8 a
	200	2.93 a	2.31 a	146 a	232 a	7 a
100	0	2.34 b	2.16 b	142 a	146 b	-
	100	2.54 ab	2.26 b	140 a	152 b	9 a
	200	2.98 a	2.51 a	144 a	212 a	14 a
150	0	2.34 a	1.86 c	138 a	122 c	-
	100	2.68 b	2.25 b	130 a	170 b	28 a
	200	3.03 c	2.60 a	136 a	230 a	18 a
200	0	2.14 b	1.90 b	138 a	140 b	-
	100	2.50 ab	2.13 b	162 a	162 b	30 a
	200	2.84 a	2.43 a	148 a	238 a	16 a
250	0	2.28 b	1.80 b	138 a	106 b	-
	100	2.52 ab	2.09 ab	134 a	198 a	29 a
	200	2.89 a	2.48 a	136 a	196 a	25 a

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

References

1. Cerosaletti, P., Q.M. Ketterings and T. Kilcer (2002). 2001 Delaware County BMR sorghum sudangrass trials "What's Cropping Up?" 12(3): 1-3.

2. Cherney, J.H., D.J.R. Cherney, and M.D. Casler (2003). Low intensity harvest management of reed canarygrass. Agronomy Journal (May-June).

3. Cherney, J.H., D.J.R. Cherney, and T.W. Bruulsema (1998). Chapter 6. Potassium management. *In* J.H Cherney and D.J.R. Cherney (editors). Grass for dairy cattle. CAB International.

4. Ketterings, Q.M., T.W. Katsvairo, J.C. Cherney and T. Kilcer (2003). Nitrogen management for brown mid rib sorghum sudangrass. Results of the 2002 Mt Pleasant trials. "What's Cropping Up?" 13(2): 1-3.

5. Kilcer, T., Q.M. Ketterings, T.W. Katsvairo and J.C. Cherney (2002). Nitrogen management for sorghum sudangrass: How to optimize N uptake efficiency? "What's Cropping Up?" 12(5): 6-9.

6. National Research Council (2001). Nutrient requirements of dairy cattle. 7th edition. National Research Council. National Academy Press, Washington, D.C. 408 pages.

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Nutrient Management

N Sidedress N Rates On Corn Following Soybeans

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Soybeans occupy about 150,000 acres in New York. Corn follows soybeans on close to 15% of the total corn acreage in New York. Cornell currently recommends similar N rates for corn following soybeans as for corn following corn in the rotation due to a lack of research on corn response to N application when following soybean.

We initiated a 3-year study in 2000 at the Aurora Research Farm to evaluate the response of corn to sidedress N rates (with 25 lbs N/acre in the starter) of 0, 50, 100, 150, and 200 lbs/acre when following soybeans in rotation. We used liquid urea-ammonium nitrate (UAN) as an N source and injected it about 4 inches deep when corn was at the 4-5 leaf stage in each year of the study. The corn was harvested with a small plot combine at grain moistures between 20 and 25%.

The 2000 growing season can be characterized as cool and wet, the 2001 growing seasons as warm and somewhat dry, and the 2002 growing season as excessively wet in the spring and excessively dry in the summer (Table 1). Soybean yields on the fields in those years were 30 bu/acre in 1999, 45 bu/acre in 2000 and 39 bu/acre in 2001. Corn yields reflected growing conditions with high yields in 2000, average yields in 2001, and low yields in 2002 (Fig. 1). Maximum corn yields were obtained with a sidedress N rate of 100 lbs/acre in 2000, 50 lbs N/acre in 2001, and 0 lbs N/acre in 2002 (Fig. 1). When averaged across the 3 years, maximum corn yields were obtained with a sidedress N rate of 85 lbs N/acre or a total N application of about 110 lbs N/acre (25 lbs N/acre as a starter and 85 lbs N/acre sidedressed). The Cornell N recommendation for corn following corn at the experimental site (Honeoye silt loam soil) was 120-140 lbs N/acre. These data suggest that N recommendations can be reduced for corn following soybean as compared to corn following corn but it is obvious that growing conditions have a major impact on the yields and N requirements.

Conclusion

A direct comparison with corn following corn was not done making it hard to compare the two systems. However, our results suggest that optimum N recommendations for corn following soybean are 20-40 lbs lower than what Cornell University currently recommends for corn following corn and that optimum rates may be considerably lower in drought years

Table 1. Precipitation and growing degree days (GDD) at the Aurora Research Farm during the growing season in 2000, 2001, and 2002.

	PRECIPITATION				GDD (86/50 system)			
Month	2000	2001	2002	Mean	2000	2001	2002	Mean
	---in.---				---°F---			
April	4.84	1.07	3.30	3.07	-	-	-	-
May	4.45	2.20	4.76	3.80	346	355	221	307
June	4.37	3.31	4.53	4.07	493	495	515	501
July	2.56	2.52	0.81	1.96	527	563	680	590
August	3.23	2.91	1.52	2.55	549	677	643	623
September	-	-	-	-	378	393	493	421
Total	19.45	12.01	14.92	15.46	2293	2483	2552	2443

versus "normal" years. The results of this study are similar to those from a study conducted from 1993-1997 where optimum N recommendations for corn following soybean were 40-50 lbs N/acre less than for corn following corn in 3 of the 5 years. Thus, we conclude that total N applications at the experimental site for corn following soybean may be 20-40 lbs N/acre lower than current recommendations for N for continuous corn at the site.

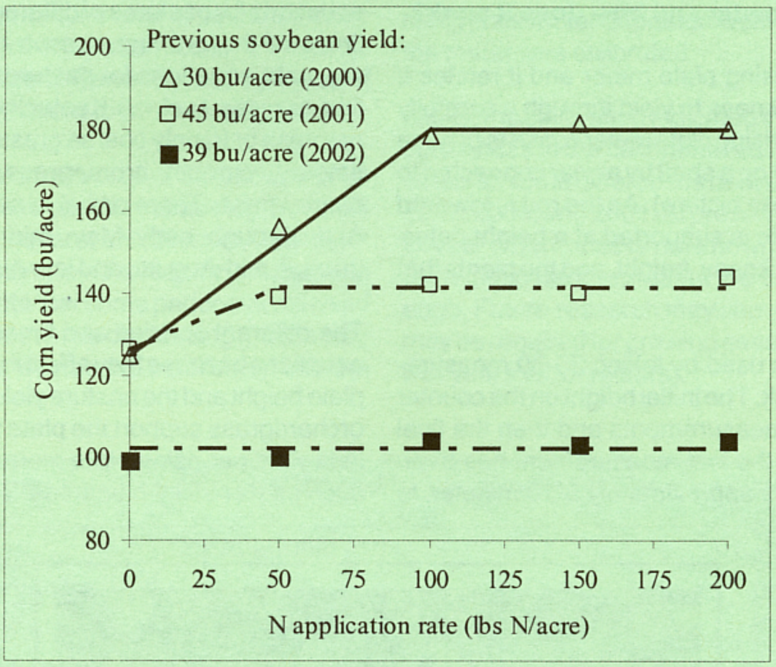

Figure 1: Corn yields following soybean in 2000 (a wet year), 2001 (a dry year) and 2002 (an extremely dry year). All treatments received 25 lbs N/acre in a starter fertilizer. Currently, the recommendation for nitrogen for continuous corn at this site is 120-140 lbs N/acre.

Pasture Management

Device Calibrated To Help Farmers Manage Pasture

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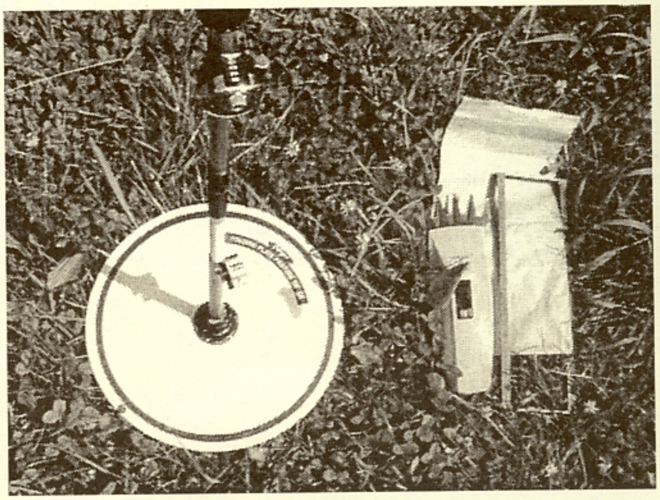
Farmers have been turning to pasture in order to attain high forage quality at low cost. However, many have found that using pasture isn't as easy as just opening the gate and letting the animals graze. In order to get the maximum benefit from pasture, farmers need to be able to judge when pasture is ready to be grazed and make plans to ensure that an adequate supply of high quality pasture is available for the entire grazing season. A tool developed in New Zealand and recently calibrated for the Northeast helps farmers with these sometimes difficult pasture management decisions.

What is a rising plate meter and how does it work?

The device is called a rising plate meter and it relates a pastures height and thickness to yield through a carefully calibrated equation. The rising plate meter consists of a thin aluminum plate mounted on a shaft by a gear connected to a mechanical counter (see picture). As the rod is lowered into the pasture, the plate is supported at a height determined by the sward's thickness, height, and the plants that compose it.

The rising plate meter is used by taking 25-30 measurements in a single paddock. The initial height on the counter is recorded before the measurements and then the final height is recorded after the last measurement has been taken. Generally, it takes approximately 5-10 minutes to take 25-30 measurements in a paddock. The difference between the final and initial reading is the total accumulated height, which, when divided by the number of readings taken, gives the average height. This average height is then placed in an equation that gives the yield for the paddock.



The FILIP's Folding Pasture Plate Meter and other equipment (electric clippers, clipping frame, and sample bag) used to calibrate the meter.

A commercially available version of the rising plate meter called the FILIP's Folding Pasture Plate Meter (currently available from Kencove; www.kencove.com) was calibrated on several New York dairy farms during 1997, 2000, and 2001. Previous research on rising plate meters indicated that they needed to be calibrated to account for different plant species and for different times of the growing season. Since the FILIP's meter was developed in New Zealand where there are different pasture types and growing conditions, separate equations were needed from those developed by the manufacturer.

Calibration for Northeast conditions

The calibration done on New York pastures found different equations for pastures of different species and for different times of the growing season (see Table 1). There are separate equations for pastures containing either mainly fine grasses such as Kentucky bluegrass and perrenial ryegrass or mainly coarse grasses such as orchardgrass, timothy, smooth bromegrass, quackgrass, and reed canarygrass. There are also separate equations for late April through early May, mid-May through June, July through mid-August, and late August through September.

The different species and times of year require different equations because they affect the relationship between the plate height and the pasture yield. Coarse grasses such as orchardgrass support the plate more readily so they have less yield per rising plate meter height than fine grasses such as Kentucky bluegrass. The different times of year may correspond to different stages of grass growth during the year such as early spring vegetative growth, stem elongation and heading, vegetative growth after heading, and growth into the fall in preparation for the winter. These different grass growth stages likely affect the rising plate meter height to yield relationship as well.

Accuracy of the meter and its uses

The equations described here are accurate enough to be useful to farmers making management decision about pasture. The exact accuracy of these equations is still being evaluated but we think they will estimate yield within 10-15%. This level is more accurate than visual assessment or the grazing stick and is accurate enough to make it worthwhile for farmers to spend the time taking measurements with the device.

The primary use for the rising plate meter is to determine whether pastures are ready to be grazed and to make pasture budgeting plans. The equations report the pasture yield in pounds of dry matter per acre, which is an important characteristic for pasture management. Animals are not able to maximize their dry matter intake of pasture if there is less than 1000 pounds of dry matter per acre available and 1500-2000 pounds is ideal. Generally, 2000 pounds of dry matter per acre is equivalent to 6-8 inch tall pasture.

By taking regular measurements of all of the paddocks on the farm, it is also possible to assess the average amount of dry matter per acre for the farm and determine whether pasture growth is increasing or decreasing. Increasing pasture growth may indicate that some paddocks will need to be set aside for hay harvest while decreasing growth may indicate that additional acres need to be brought into the grazing system or supplemental feeding needs to be increased.

Our research along with that of others indicates that there are some conditions that are not appropriate for using the rising plate meter. The meter gives the best results when it is used on pasture that will be grazed in the next several days. It is not accurate when used on recently grazed pastures or those with lots of weed pressure (especially newly seeded pastures with areas of bare ground and annual weeds). Care should also be taken when using the rising plate meter on pastures different than those on which the meter was calibrated.

Lastly, the calibration indicated that there are year-to-year differences in the calibration equations. Our investigation detected some differences between the equations found in 1997, 2000, and 2001. At present, the cause of these year-to-year differences is not known and the averaged equations given here represent the best of our current knowledge. Future research may show that separate equations may be required for growing seasons of different types (ie., wet years vs. dry years).

Table 1. Equations developed for the Northeast for use with the FILIP's rising plate meter.

Time period	Equations[1]	R-Square
Mainly Coarse Grasses[2]		
April- early May	Yield= 170 + 70.2*RPM HT	70
mid-May-June	Yield= 232 + 65.0*RPM HT	52
July- mid-August	Yield= -76.4 + 87.0*RPM HT	60
Late August-Sept.	Yield= 66.9 + 83*RPM HT	66
Mainly Fine Grasses[3]		
April- early May	Yield= -131 + 67.8*RPM HT	61
mid May-June	Yield= -83.8 + 81.4*RPM HT	67
July- mid August	Yield= -118.8 + 97.3*RPM HT	62
Late August-Sept.	Yield= 66.9 + 83*RPM HT	79

[1] Yield is pounds of dry matter per acre. RPM HT is the final rising plate meter height reading minus the initial reading divided by the number of measurements (25-30 is recommended)
[2] Coarse grasses include orchardgrass, timothy, quackgrass, reed canary grass, and smooth bromegrass.
[3] Fine grasses include Kentucky bluegrass and perennial ryegrass.

Calendar of Events

June 5	Small Grains Management Field Day, Musgrave Research Farm, Aurora, NY
June 29-July 2	Northeastern Branch American Society of Agronomy Meeting, Burlington, VT
July 8	Weed Science Field Day, Valatie, NY
July 15	Weed Science Field Day, Aurora, NY
July 16	Weed Science Field Day, Freeville, NY
October 21	Field Crop Dealer Meeting, Comfort Suites, Clifton Park, NY
October 22	Field Crop Dealer Meeting, Ramada Inn, New Hartford, NY
October 23	Field Crop Dealer Meeting, Batavia Party House, Batavia, NY
October 24	Field Crop Dealer Meeting, Holiday Inn, Waterloo, NY
November 2-6	American Society of Agronomy Annual Meeting, Denver, CO

What's Cropping Up? is a bimonthly newsletter distributed by the Crop and Soil Sciences Department at Cornell University. The purpose of the newsletter is to provide timely information on field crop production and environmental issues as it relates to New York agriculture. Articles are regularly contributed by the following Departments at Cornell University: Crop and Soil Sciences, Plant Breeding, Plant Pathology, and Entomology. **To get on the mailing list, send your name and address to Pam Kline, 234 Emerson Hall, Cornell University, Ithaca, NY 14853.**

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