What's Cropping Up?

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Economics of Narrow and Twin-Row Corn Silage Production in New York

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Only a limited number of dairy producers in New York have converted from conventional (30-inch) to narrow-row (15-inch) corn silage production, despite economic analyses in the 1990s that indicated expected increases in profit. Potential mechanical damage to corn in narrow rows, if applying postemergence herbicides or sidedress N, has deterred many dairy producers from converting to narrow rows. Twin rows (7 ½ inches apart on 30-inch centers) are compatible with postemergence herbicide and sidedress N applications, but it is not known if twin rows yield and increase profit more than conventional rows. We conducted a field scale study (12 acres in size) on the Table Rock Farm in Wyoming Co. in 2003 and 2004 to compare the yield, quality, and economics of corn silage production in conventional, narrow, and twin rows. The field crew at Table Rock performed all field operations, except for the planting of twin-row corn with a Precision Drill, which was done by the field crew at the neighboring Southview Farms.

Narrow-row corn yielded 3% more than twin, which yielded 3.6% more than conventional-row corn (Table 1). The 6.6% yield advantage for narrow vs. conventional rows is consistent with other studies in New York. Row spacing did not affect in vitro true digestibility (IVTD) which is also consistent with other studies that reported no effect of row spacing on overall corn silage quality (Table 1). Narrow rows, however, also had 1.2 percentage unit greater dry matter content at harvest, whereas twin and conventional rows did not differ (Table 1).

Narrow and twin vs. conventional row systems have greater ownership and operating costs, associated with equipment requirements (Tables 2 and 3). For example, the Precision Drill, which costs $83,000 vs. $62,000 for the 12-row Kinze planter, also requires a 215 instead of a 170 hp tractor for planting, which also costs $18,000 more.

Table 1. Dry matter (DM) content at harvest, silage yield, and in vitro true digestibility (IVTD) of two corn hybrids under three row spacings, averaged across the 2003 and 2004 growing seasons on a dairy farm in Castile, NY.

	DM CONTENT			DM YIELD			IVTD		
Row Spacing	36N70	3681FQ	Avg.	36N70	3681FQ	Avg.	36N70	3681FQ	Avg.
	----------%--------			---tons/acre (65%)-----			-------%--------		
30 in.	32.0	30.9	31.4	21.3	21.1	21.2	82.6	82.1	82.4
Twin	32.1	30.7	31.4	22.2	21.7	21.9	81.8	81.4	81.6
15 in.	33.3	32.0	32.6	23.2	21.9	22.6	82.3	82.3	82.3
Avg.	32.5	31.1		22.2	21.6		82.2	81.9	
LSD 0.05		0.4†	0.5‡		NS†	0.5‡		NS†	NS‡

Compares means between hybrids.
Compares means among row spacings.

Crop Management

Table 2. Annual ownership and operating costs for 12-row (30 in. spacing), twin-row (7.5 in. spacing on 30 in. centers) and 23-row (15 in. spacing) corn planters (field capacity = 0.08 h/acre) and their associated tractors for 650 acres of corn silage.

COSTS	12-ROW†	TWIN-ROW‡	23-ROW
		$	
PLANTER			
Initial capital	62000	83000	77000
Depreciation and Interest	6058	8109	7523
Insurance (0.85%)	264	353	327
Housing (1.5%)	465	623	578
Total Annual Fixed	6786	9085	8428
Repair/h	13.00	15.70	16.40
Repair/acre	1.04	1.26	1.31
TRACTOR			
Initial Capital	112000	133000	112000
Depreciation and Interest	9597	11396	9597
Insurance (0.85%)	476	565	476
Housing (1.5%)	840	998	840
Total Annual Fixed	10913	12959	10913
Repair/h	5.40	6.40	5.40
Fuel and Lube/h	11.99	15.16	11.99

† Kinze 12 or 23-row twinline planter (Model 3600, 40% salvage value, 5% interest rate, 15 years expected useful life, and 6000 expected hours owned), pulled by a 170 hp John Deere tractor (Model 8120).
‡ Great Plains Precision Drill (Model 3N-3010P, 40% salvage value, 5% interest rate, 10 years expected useful life, and 600 hours expected hours owned), pulled by a 215 hp John Deere tractor (Model 8320, 23% salvage value, 5% interest rate, 15 years expected useful life, 6000 expected hours owned).

age silage price in New York ($26/ton), changes in fixed and variable costs, and expected changes in profit in converting from conventional to narrow, conventional to twin, or narrow to twin-row corn silage systems. The added income for conversion from conventional to narrow-row corn silage (1.4 tons/acre more x $26/ton x 650 or 1300 acres) exceeds the additional fixed and variable costs, resulting in an expected change in

Likewise, narrow-row corn silage requires a rotary harvesting head, which costs $18000 more than a conventional harvesting head.

Table 4 lists changes in income, based on silage yield differences and aver-

Table 3. Annual ownership and operating costs for a 6-row conventional corn forage harvester head and a 15 ft. wide rotary corn forage harvester head (field capacity = 0.14 h/acre) for 650 acres of corn silage.

COSTS	6-ROW HEAD†	ROTARY HEAD‡
	$	
Initial Capital	33000	51000
Depreciation and Interest	3378	5220
Insurance (0.85%)	140	217
Housing (1.5%)	248	383
Total Annual Fixed	3766	5820
Repair/h	4.90	7.50
Repair/acre	0.69	1.05

† New Holland 6-row (Model 360N6, 50% salvage value, 5% interest rate, 8 years expected life, and 800 hours expected owned) conventional corn silage head for conventional and twin-row corn.
‡ New Holland rotary (Model R1450, 50% salvage value, 5% interest rate, 8 years expected useful life, and 800 hours expected hours owned) corn silage head for narrow-row corn.

profit of $18201 for 650 acres and $38317 for 1300 acres of corn silage. Based upon this economic analyses, dairy producers can improve profit by converting from conventional to narrow-row corn silage systems. In fact, the expected change in profit by converting from conventional to a narrow-row corn silage system would be even greater on many dairy farms in New York because many producers have already purchased the rotary head harvester for conventional row corn.

Table 4. Partial budget analyses for dairy farms that produced 650 and 1300 acres of corn silage, based on added fixed (ownership) and variable (operating) costs for required corn silage planting and harvesting machinery, mean corn silage price ($26/ton) in New York for 2003 and 2004, and additional corn silage production for 15 in. vs. 30 in., 30 in. twin vs. 30 in., and 30 in. twin vs. 15 in. row spacing.

	15 vs. 30 in.		Twin vs. 30 in		Twin vs. 15 in.	
Partial Budget	650	1300	650	300	650	1300
	$/yr					
Income Change	23660	47320	11830	23660	-11830	-23660
Fixed Costs Changes						
Tractor	-	-	230	802	230	802
Planter	1642	2249	2299	3149	657	900
Harvester	2054	3200	-	-	-2054	-3200
Variable Costs Changes						
Tractor	-	-	240	480	240	480
Planter	177	354	140	281	-37	-73
Harvester	236	473	-	-	-237	-473
Hauling/Filling	1350	2727	675	1364	-675	-1364
Total Costs Change	5459	9003	3584	6076	-1875	-2928
Expected Profit Change	18201	38317	8246	17584	-9955	-20732

The added income for converting from conventional to twin-row corn silage systems also exceeded additional fixed and variable costs, resulting in an expected change in profit of $8246 for 650 acres and $17584 for 1300 acres of corn silage. If narrow-corn silage producers convert to twin rows, however, the expected change in profit would be -$9955 for 650 acres and -$20,732 for 1300 acres of corn silage mostly because of the 0.5 ton/acre lower silage yields.

Based upon the economic analyses reported, the conversion from conventional to narrow-row corn silage systems provides the greatest expected increase in profit. In addition to economic analyses, dairy producers will likely consider the economics and efficiency of the overall farm operation. For example, the use of Roundup Ready corn in twin row instead of preemergence herbicides on narrow-row corn may delay herbicide application until mid-June increasing the probability of a timely first cut of perennial forages. On the other hand, narrow vs. twin-row corn dries down more rapidly allowing for an earlier harvest, which could result in greater silage yields and quality in cool wet years with early frosts. Dairy producers should consider corn silage economics as well as the overall management of the farm when deciding on corn silage row spacing systems.

Nutrient Management

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

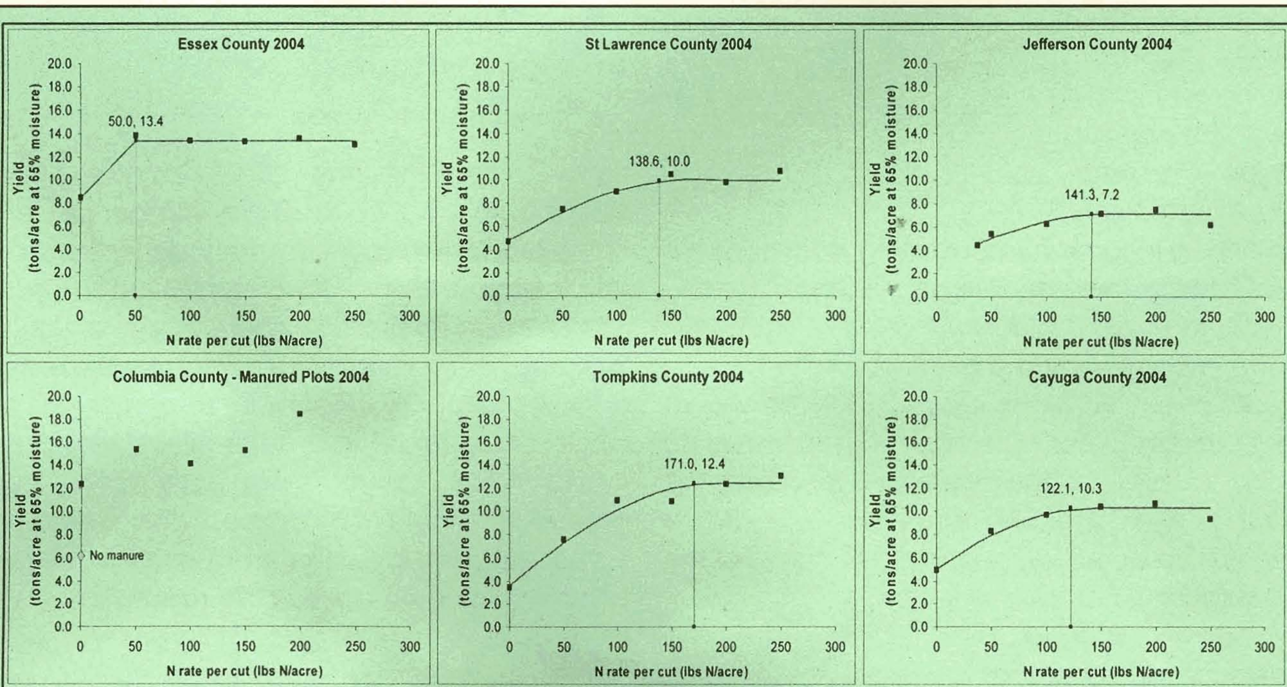

Figure 1: Optimum economic N rates for BMR sorghum sudangrass. The Essex County site followed plowdown of a legume containing sod. The Jefferson County site was one cut only (versus 2 cuts at the other two sites). The data in the Columbia County site were too variable to fit a fertilizer response curve 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)	Return per acre at OENR	Yield at OENR	Reported corn yield potential
	lbs N/acre per cut (N uptake efficiency)	$/acre	tons/acre	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.

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

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.

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.

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).

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), you can visit their website at: 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 the Rensselaer Cooperative Extension Office 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 Cornell Cooperative Extension agriculture 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.

Calendar of Events

Jul. 6, 2005	Weed Science Field Day, Valatie, NY
Jul. 13, 2005	Weed Science Field Day, Aurora, NY
Jul. 14, 2005	Weed Science Field Day, Freeville, NY
Jul. 15, 2005	Musgrave Research Farm Field Day, Aurora, NY
Jul. 30-Aug. 3, 2005	American Phytopathological Society Annual Meeting, Austin, TX
Oct. 5-7, 2005	Northeastern Division of American Phytopathological Society, Geneva, NY
Oct. 25, 2005	Field Crop Dealer Meeting, Comfort Suites, 7 Northside Drive, Clifton Park, NY
Oct. 26, 2005	Field Crop Dealer Meeting, Ramada Inn, 141 New Hartford St., New Hartford, NY
Oct. 27, 2005	Field Crop Dealer Meeting, Batavia Party House, 5762 East Main Road, Batavia, NY
Oct. 28, 2005	Field Crop Dealer Meeting, Auburn Holiday Inn, 75 North Street, Auburn, NY
Nov. 15-16, 2005	National Soybean Rust Symposium, Nashville, TN

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