What's Cropping Up?

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Estimated Milk Yields of Corn Silage Hybrids

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Dairy farmers grow corn silage to ultimately produce milk. The amount of milk that is produced per ton of corn silage can be estimated from the in vitro true digestibility (IVTD) and neutral detergent fiber (NDF) concentrations of the corn silage. The amount of milk produced per acre of corn silage is the product of the silage yield and estimated amount of milk that is produced. We used this method to estimate milk yields of the different hybrids that we tested in 1998 and 1999. We were particularly interested in evaluating 1) milk yields of Bt hybrids vs. their normal counterparts, and 2) milk yields of brown midrib and leafy hybrids vs. other commercial hybrids. We evaluated all hybrids at two harvest populations (27000 and 34000 plants/acre) because the brown midrib and leafy hybrids had recommended harvest populations of 26000 plants/acre instead of our normal 30000 to 34000 plants/acre for silt loam soils.

The Bt hybrids (37R71, DK493Bt, and DK580Bt) and their normal counterparts (37M81, DK493, DK580) produced similar milk yields in all six comparisons across the 2 years (Tables 1 and 2). Corn borer pressure was low in both growing seasons, which is typical for most locations in NY. Consequently, we do not recommend the use of Bt hybrids, especially given their additional seed costs, under typical NY growing conditions. If corn borer pressure is expected to be high in a certain location, we would recommend the use of Bt hybrids.

The brown midrib hybrids (F867, F657, XB667, and 397) were among the hybrids that produced the least silage yields in both growing seasons. For example, F657, a 110-d hybrid, produced about 20% less silage yield in both years when compared with 33V08, a 111-d hybrid. Likewise, XB667, a 105-d hybrid, produced about 20% less silage yield in 1999 when compared with 105 and 106-d hybrids (NK4687Bt, RX601, RX505Bt, 35N05, 34G81, 34G82, and TMF106). The brown midrib hybrids, however, averaged about 5 more percentage units in IVTD concentrations compared with the hybrid mean in both growing seasons. Interestingly, F657, the hybrid with the lowest silage yield, and 33V08, the hybrid with the greatest silage yield, were among the hybrids that produced the greatest milk yields in 1998 and 1999. The greater IVTD and lower NDF concentrations of F657 offset its lower silage yields, resulting in similar milk yields between F657 and 33V08. In 1999, however, three brown midrib hybrids (F867, XB667, and 397) were among the hybrids with the least milk yields. Consequently, we currently do not recommend extensive use of the brown midrib hybrids, especially given their additional seed cost. We expect to see some excellent corn silage hybrids in the near future, however, as the brown midrib hybrids are further developed.

The leafy hybrids (TMF99, TMF100, TMF106, TMF108, NK4687Bt) generally produced similar silage and milk yields as hybrids with the same relative maturity (RM). Overall, the TMF hybrids compared with hybrids of the same RM in 1998 and 1999 had similar milk yields in about 25 comparisons, less milk yield in 2 comparisons, and more milk yield in 2 comparisons. The leafy hybrids also had less crude protein concentrations compared with the hybrid mean (data not shown). Currently, we do not recommend leafy hybrids more than other commercial hybrids for silage use. The leafy hybrids also have low grain concentration in the silage, which makes them poor choices for high moisture corn use. As with the brown midrib hybrids, however, we expect to see some excellent corn silage hybrids in the near future as the leafy hybrids are further developed.

When averaged across hybrids, milk yields averaged more at harvest densities of 34000 plants/acre compared with 27000 plants/acre in 1998. The greater milk yields reflected the 1.4 ton/acre silage yield advantage at 34000 vs. 27000 plants/acre because harvest densities did not affect silage quality in 1998. In 1999, however, a year when silage yields did not differ between harvest densities, milk yields averaged more at 27000 vs. 34000 plants/acre. The 0.6% percentage unit decrease in IVTD and 1.0% percentage unit increase in NDF at 34000 vs. 27000 plants/acre resulted in the lower milk yields at 34000 plants/acre in 1999. The 1999 growing season was excessively dry so we will continue to recommend harvest populations of 24000 to 26000 plants/acre on droughty soils in New York. Likewise, we will continue to recommend harvest populations of 30000 to 34000 plants/acre on silt loam soils, as supported by the 1998 data. Finally, we did not observe any hybrid x harvest density interactions for milk yields so we recommend these densities for all hybrids, including the brown midrib and leafy hybrids.

Table 1. Corn silage yield (65% H_20), in vitro true digestibility (IVTD), neutral detergent fiber (NDF) and estimated milk yields of 20 hybrids at two harvest plant densities at the Aurora Research Farm in 1998.

	SILAGE YIELD		IVTD		NDF		MILK YIELD		
Hybrid	27000	34000	27000	34000	27000	34000	27000	34000	Avg.
33V08	25.7	27.7	79.9	79.5	40.0	40.5	21194	23723	22454
F657	21.3	23.7	84.7	84.0	38.4	38.1	20320	20942	20631
35N05	24.8	28.4	76.7	77.1	40.5	41.5	19639	20959	20299
DK580Bt	25.0	24.7	78.6	79.3	42.7	40.7	19232	20127	19680
RX505Bt	23.5	26.8	78.0	78.0	41.8	41.1	18037	20966	19502
RX502	22.6	23.1	80.3	81.1	41.3	39.2	18698	20130	19414
DK493RR	22.7	23.3	80.2	78.9	38.9	39.0	19405	19300	19353
DK580	24.0	27.3	76.9	76.4	40.7	41.6	18415	20236	19326
RX601	22.2	23.6	78.9	79.1	37.8	38.6	18767	19810	19289
DK493GR	21.4	23.8	79.9	81.5	40.7	39.5	17881	20691	19287
DK493Bt	23.2	22.7	79.8	80.1	41.0	39.3	19024	19261	19143
DK493	22.2	23.8	76.8	79.4	37.9	40.4	18990	18377	18684
F867	21.3	22.1	84.0	81.4	44.7	43.4	16867	19819	18344
3523	26.5	25.7	74.8	75.8	47.0	45.4	18131	18337	18234
TMF108	25.3	25.1	76.4	76.8	43.7	42.9	17870	18227	18074
TMF106	23.5	26.9	76.3	77.7	44.2	45.0	16478	19150	17814
TMF99	23.7	24.4	76.8	77.4	45.0	44.7	17533	17548	16996
37R71	23.1	23.2	74.7	75.2	40.7	41.6	16602	16596	16599
37M81	23.0	23.6	71.4	75.1	42.7	41.7	15558	16844	16201
T286602	22.4	24.7	74.6	74.5	46.3	46.0	14137	15675	14806
	23.5	24.9	78.1	78.2	41.7	41.5	17431	18560	
LSD 0.05	0.5		NS		NS		365		2230

Table 2. Corn silage yield (65% H_20), in vitro true digestibility (IVTD), neutral detergent fiber (NDF) and estimated milk yields of 29 hybrids at two harvest plant densities at the Aurora Research Farm in 1999.

	SILAGE YIELD		IVTD		NDF		MILK YIELD		
Hybrid	27000	34000	27000	34000	27000	34000	27000	34000	Avg.
RX601	11.7	10.7	84.5	83.3	37.6	37.8	11255	10046	10651
34G82	11.3	11.2	85.2	82.6	39.1	39.1	10783	10150	10467
DK580Bt	10.8	11.2	85.1	85.3	40.0	39.5	10191	10612	10402
F657	9.8	9.8	91.7	91.0	39.9	40.8	10559	10221	10391
33V08	11.8	11.9	84.3	84.9	43.1	45.2	10358	10141	10250
N58-D1	12.4	10.2	84.8	84.3	40.6	42.3	11449	8996	10223
RX502	10.6	10.2	86.7	83.8	37.6	38.2	10677	9629	10153
DK580RR	10.7	10.5	86.2	85.1	40.1	39.2	10312	9979	10145
3523	11.2	11.4	84.2	85.1	42.9	42.4	9790	10303	10047
TMF108	11.6	10.7	85.0	84.6	42.5	46.0	10702	9300	10001
34G81	11.1	10.9	83.4	84.2	39.4	41.6	10154	9806	9980
D580	10.5	10.4	86.1	82.1	38.9	38.6	10282	9344	9813
34B23	11.4	11.6	83.9	82.7	42.4	44.4	10027	9512	9769
35N05	11.0	10.8	85.0	83.9	43.8	45.0	9668	9148	9408
TMF100	11.8	10.6	84.6	84.9	44.1	49.1	10343	8430	9387
F867	9.5	10.0	90.1	89.1	45.3	46.2	9113	9301	9207
37R71	8.9	10.0	84.1	84.1	37.7	37.0	8471	9610	9041
37M81	8.6	9.3	84.9	84.8	37.2	35.9	8393	9254	8824
XB667	8.6	9.1	89.6	89.2	41.9	42.8	8504	8897	8731
NK4687Bt	11.4	11.0	85.1	84.2	48.9	51.2	9171	8204	8688
DK493RR	9.2	9.2	84.8	84.7	39.7	41.3	8776	8564	8690
DK493	9.1	9.4	84.6	83.2	39.2	40.9	8497	8453	8520
TMF106	11.4	10.6	84.2	84.5	49.9	49.7	8841	8234	8518
DK493Bt	9.3	9.5	83.9	82.9	38.7	41.3	8657	8320	8489
RX505Bt	10.1	9.2	83.5	84.4	42.1	43.0	8844	8100	8472
DK493GR	9.2	9.2	83.9	84.3	40.2	40.6	8422	8383	8403
TMF99	9.5	10.0	85.1	84.9	49.4	48.4	8407	8385	8396
397	8.3	7.9	87.0	88.4	38.0	39.6	8441	7996	8204
2720	11.5	10.9	81.9	81.6	51.5	52.5	8309	7694	8001
LSD 0.05	NS		0.5		0.4		268		1390

Nutrient Management

Phosphorus and Agriculture V: The New York P Index

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This fifth article on phosphorus and agriculture describes the efforts to develop a Phosphorus Index specific to conditions in New York State. Previous articles in this series examined the underpinnings of environmental concerns over agricultural phosphorus, the principles of soil phosphorus chemistry, factors affecting non-point source phosphorus pollution, and the National Phosphorus Project.

The New York P Index

The phosphorus (P) Index is a planning tool for agronomic nutrient management that assesses agricultural sites with respect to their vulnerability to P loss. When applied across the entire farm, the P Index helps a manager target areas where management should be improved. These are called "critical source-areas," which are specific identifiable areas within a watershed that are most vulnerable to P loss in runoff. These areas are dependent on the coincidence of transport (runoff, erosion, leaching, and channel processes) and source or site management factors (functions of soil, crop, and management). Transport factors are what translate potential P sources into actual loss from a field or watershed. Source or site management factors relate to fields or watershed areas that have a high potential to contribute to P export. These are typically well defined and reflect land use patterns related to soil P status, fertilizer and manure P inputs, and tillage.

The P Index complements and should be used in conjunction with "Cornell Recommends" to determine fertilizer additions and manure spreading strategies that meet crop requirements while minimizing the risk of P loss in runoff. Common agricultural practices and best management practices, such as method and timing of manure applications, are included to assist land managers in designing a nutrient management plan that will be suitable for the whole farm operation and pose limited risk to the environment. Preliminary versions of the P Index, such as those in use for several years in the New York City watershed, relied heavily upon expert knowledge to estimate the relative risk of P loss from agricultural fields that poses a threat to water quality. Although research on the complicated processes that combine to determine P loss in runoff is still far from complete, a committee is working to update and improve the New York P Index by incorporating recent research results from New York and other parts of the Northeast.

Principles for development

The New York P Index is being structured in accordance with several principles.

I. The developers are participants in the national initiative to develop a framework from which to construct P Indices for all states. The basic structure of the New York P Index is designed in accordance with that framework.

II. Developers of the New York P Index are in strong agreement that the structure of the P Index should reflect the physical processes that govern P loss from agriculture soils. Because losses of soluble P and particulate P differ, these components of P loss are evaluated separately, and then assessed in combination for an overall assessment of environmental risk. Where our understanding of the physical and chemical processes of P loss permits, mathematical functions are derived to fit those processes.

III. The P Index is an objective assessment of P loss that poses a risk to water bodies. There is no attempt to weight factors for the purpose of portraying certain sets of conditions or combinations of management practices as having either more negative or less negative environmental effects than is warranted by current knowledge.

IV. Estimates of P loss potential are based upon available data. As ongoing research (e.g., National P Project) expands our understanding of P loss potential, future results will be incorporated as refinements in subsequent versions of the P Index.

Structure of the P Index

The P index accounts for and ranks transport and site management factors controlling P loss in runoff and identifies sites where the risk of P movement is expected to be higher than that of others. A simplified version of the P Index, showing the general structure but without detailed explanation of the variables included in the source and transport factors, is shown in Figure 1. Both transport and source factors will be the subjects of future articles so they will not be explained in detail here, but they do accommodate best management practices that reduce these values.

Site Characteristic	Low (<33)	Med. (34 - 66)	High (67 – 100)	V. High (>100)
P Source Factor =	Soil test P + (P additions x Method of application x Timing)			
P Transport Factor =	Degree of hydrological activity x Management practices			
P Index =	P SOURCE x P TRANSPORT			

Figure 1. Generalized version of the P index showing the relationship between source and transport variables.

HIGH TRANSPORT/ LOW SOURCE		LOW TRANSPORT / HIGH SOURCE	
P TRANSPORT	1.0	P TRANSPORT	0.2
P SOURCE	40	P SOURCE	200
P INDEX =	40	P INDEX =	40

P SOURCE of 40 corresponds to near optimum levels for crop growth. P SOURCE of 200 far exceeds crop requirements. Both scenarios result in a P INDEX value that falls within the medium class due to the differences in hydrological activity. A chance for an adverse impact to surface water exists. Some remedial action to lessen the probability of P loss should be taken, and excessive rates of manure or P fertilizers should be avoided to prevent P accumulation.

Figure 2. Sample calculations illustrating interactions between transport and source variables.

The overall P Index is scaled from 0 to 100, which is the limit between the high and very high vulnerability. Beyond 100, there is no limit to the numerical value of the index. Although low, medium, high and very high vulnerability classes define the levels of site vulnerability to P loss, the index is a continuous function that is indicative of risk levels within each class. As previously mentioned, the calculation of these factors incorporates a variety of site characteristics and management practices not shown in Figure 1. An overall P index value, representing cumulative site vulnerability to P loss, is obtained by multiplying the resulting values for the transport and source factors.

The numerical calculation of transport and source factors for the P Index is quite different. Transport factors are scaled from 0 to 1, where 0 indicates a site that is not hydrologically active and 1 indicates a hydrologically active site where conditions are most conducive to P transport. Source factors are scaled from 0 to 100 from low through high in the same manner as the overall P Index, and maximum values are unrestricted. This factor represents the potential loading of P at a site, which theoretically has no ceiling. Thus, the factors are potentially offsetting (see Figure 2 for sample calculations). Managing P applications with the aim of minimizing the P Index across all areas of the farmscape will result in minimal risk of P loss and reduced threat to water quality.

Risk and management implications

The four risk classes in the New York P Index are designed to assist the user in assessing the relative environmental risk associated with various land conditions and management practices. These classes also carry meaning with respect to recommended site management as proposed by the Natural Resources Conservation Service. Some general recommendations are given in Figure 3; however, P management is very site-specific and requires a well-planned, coordinated effort between farmers, extension agronomists, and soil conservation specialists. Ultimately, the P index is an educational tool that brings interaction between the planner and farmer in assessing environmental management decisions required for improving the farming system on a watershed rather than political basis.

Automation and integration

The goal of the P Index development committee is to complete the next draft of the New York P Index this summer and have it programmed into the comprehensive nutrient management software that is currently under development. In the near future, farm managers and planners should have access to a computer-based planning tool that will provide recommendations for whole-farm nutrient management from feed and fertilizer purchases to manure management with seamless integration of the P Index as a guide to responsible and environmentally safe nutrient management.

P index	Interpretation of the P index
Low < 33	**LOW** potential for P loss. If current farming practices are maintained there is a low probability of adverse impacts on surface waters. Manure applications are based on N content.
Medium 30 – 67	**MEDIUM** potential for P loss. The chance for adverse impacts on surface waters exists, and some remediation should be taken to minimize the probability of P loss. Manure applications are based on N content.
High 67 – 100	**HIGH** potential for P loss and adverse impacts on surface waters. Soil and water conservation measures and P management plans are needed to minimize the probability of P loss. Manure and P fertilizer applications are limited to P removed by the crop.
Very high > 100	**VERY HIGH** potential for P loss and adverse impacts on surface waters. All necessary soil and water conservation measures and a P management plan must be implemented to minimize the P loss. No manure or P fertilizer is applied.

Figure 3. Generalized interpretations of the P Index.

Calendar of Events

August 12-16	American Phytopathological Society Meeting, New Orleans, LA
August 16-17	NYSABA Summer Tour, Hudson Valley
October 24	Field Crop Dealer Meeting, Clifton Park, NY
October 25	Field Crop Dealer Meeting, New Hartford, NY
October 26	Field Crop Dealer Meeting, Batavia, NY
October 27	Field Crop Dealer Meeting, Waterloo, NY
November 1-3	Northeast Division of American Phytopathological Society Meeting, Cape Code, MA
November 5-9	ASA-CSSA-SSSA Annual Meeting, Minneapolis, MN

What's Cropping Up? is a bimonthly newsletter distributed by the Department of Soil, Crop and Atmospheric Sciences 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 subscribe, send a check for $8.00 along with the form at the right.**

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