What's Cropping Up?

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Silage Properties - Moisture and Particle Size

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Fermented silages, whether they are corn silage or haylage, can differ significantly and inconsistently from their unfermented counterparts. A recent silage evaluation review concluded that there is no one parameter that effectively describes silage quality, and that there is no practical procedure for predicting animal responses to silage. There are things we can do, however, to improve our chances for success. Favorable fermentation depends greatly on moisture content and availability of soluble carbohydrates. In general these factors make it relatively easy to make corn silage, more difficult to make alfalfa haylage, and most difficult to make grass haylage. Particle size also is critical, both in terms of proper fermentation and animal response. Particle size of silages can vary greatly depending on forage species and type of harvesting equipment. While a wide range of silage quality parameters affects animal response, two parameters that we can exert considerable control over are moisture and particle size.

Moisture

Accurate determination of forage moisture content in the field is critical for successful silage making. Optimum moisture for silage is between 50 and 70%, depending on the type of silage and the storage structure. Accurate determination of silage moisture content at feed out is essential for successful ration balancing. Relatively small errors in determining moisture content of silage can significantly affect animal performance on a ration balanced with those numbers. For corn silage, moisture can be monitored reasonably well by following grain maturation. Other forages that are wilted prior to ensiling must rely on other methods of estimating moisture content.

Several methods of moisture determination for fresh forage were evaluated by the Prairie Agricultural Machinery Institute in Manitoba, Canada. The Koster forage moisture tester provided sufficiently accurate estimates of forage moisture in about 30 minutes, although it was recommended to dry multiple samples for improved accuracy. The Koster tester is a miniature forced-air oven that can char samples if care is not taken, due to the high drying temperature. Electronic moisture meters that estimate moisture based on conductance or capacitance gave readings that were too variable to base harvest decisions on.

Microwave ovens have been evaluated by numerous individuals and found to be very accurate for estimating moisture content of high moisture forage, if correct procedures are followed. A small scale accurate to 1 gram is required, as well as a microwave oven having at least 600 watts at full power. Although there are guidelines as to drying times, microwave drying of samples is an art that takes practice. It is very easy to char samples or even ignite samples in the final stages of drying, and samples must be sufficiently chopped up to allow for more uniform heating.

Particle Size

Cows consuming diets that have sufficient NDF, but that are finely chopped, can develop a variety of metabolic disorders, while long particle size can have problems for packing and oxygen exclusion during ensiling. A number of sieving methods have been developed to evaluate particle size of chopped forage and silage, but until recently, none were suited to on-farm use. The Penn State Particle Size Separator was recently developed for evaluating particle size of forages and total mixed rations. The separator has three sieves which separate particles of >0.75 in., 0.75-0.31 in., and <0.31 in. The hole

(see SILAGE, page 7)

Recommended forage particle sizes for the Penn State Particle Size Separator

	Fraction of Original Sample Remaining On:		
	Upper Sieve	Middle Sieve	Bottom Sieve
Corn Silage	2 to 4% (if not sole forage)	40 to 50%	40 to 50%
	10-15% (if chopped and rolled)	40 to 50%	40 to 50%
Haylage	10 to 15% (in sealed silo)	30 to 40%	40 to 50%
	15 to 25% (bunker silo, wetter)	30 to 40%	40 to 50%

(From Heinrichs, A.J. and Lammers, B.P., 1997, In: *Silage: Field to Feedbunk*, NRAES-99, Northeast Regional Agricultural Engineering Service, Ithaca, NY)

Water Quality

RECENT RESEARCH RESULTS IN NITRATE LEACHING: WHAT ARE THE IMPLICATIONS?

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Note: This article appeared earlier in a recent issue of Water Courses.

Recent research is providing us with a better understanding of the relationships between land use practices and nitrate losses to groundwater. Increases in nitrate concentrations are primarily related to two factors: higher intensity of animal-based agriculture and increased use of N fertilizer. The US Geological Survey National Water Quality Assessment Program (NAWQA), is providing us with answers about the extent of water quality degradation. Other studies provide answers to questions such as "Can crops be grown economically without nitrate contamination of groundwater?"; "Do inorganic N fertilizers pose a greater risk to groundwater contamination than organic sources of N?"; "Are there tradeoffs between preventing leaching losses of some chemicals (for example, nitrate and pesticides) and reducing surface losses of others (for example, phosphorus, nitrogen and pathogens?)". In this article, I will discuss whether these results warrant a change in our approach to preventing water quality degradation.

The NAWQA Program (http://wwwrvares.er.usgs.gov/nawqa/nawqa_home.html) was initiated in 1991 and builds on the existing base of water quality monitoring data from various sources. The results show that the highest groundwater nitrate concentrations are generally associated with agricultural areas, with 12 percent of the domestic supply wells exceeding the US Environmental Protection Agency (EPA) drinking water standard of 10 milligrams per liter (mg L^{-1}). Nitrate concentrations were inversely related to well depth and very few of the usually deeper public supply wells exceeded the standard. In addition, the monitoring data showed a clear relationship between groundwater nitrate concentrations and overlying soil type. High levels were much more frequent under well-drained coarse-textured soils (Hydrologic Group A) compared to poorly drained and fine-textured soils (Hydrologic Groups C and D). In terms of land use type, the highest concentrations were generally associated with areas of intense row crop cultivation and animal-based agriculture. All in all, 26 percent of the wells in areas with well-drained soils and intensive row crop production exceeded the drinking water standard. These results conform with those from other well surveys in the Northeastern US. Recent well samplings in a sandy outwash area near Malone, New York (NY) showed localized high groundwater nitrate concentrations which appeared to be linked to high fertilizer use on vegetable crops.

A multi-year intensive study of nitrate leaching at the Cornell University Willsboro research farm in northern NY shows general agreement with the results of the NAWQA Program. The study involved two research sites, on a loamy sand and a clay loam, respectively. Shallow groundwater was continually monitored by sampling subsurface drainage lines for a three-year period. The plots were converted from grass (loamy sand) and alfalfa (clay loam) to corn production and received either 20, 90 or 120 pounds per acre (lbs/ac) of fertilizer during the 1992, 1993, and 1994 growing seasons. The main results from this research were:

1. Nitrate leaching losses were generally greater under the sandy compared to the clay soil (Table 1). This can be attributed to greater volumes of percolating water as well as higher nitrate contents of this water for the sand.

2. Nitrate concentrations generally remained below the drinking water standard when moderate fertilizer rates were applied (90 lbs/ac in our case), but increased readily with

Table 1. N leaching losses for a clay and sand soil

	20 lbs/ac		90 lbs/ac		120 lbs/ac	
	clay	sand	clay	sand	clay	sand
	lbs/ac					
1993	5.4	7.6	6.0	10.0	11.7	18.2
1994	5.6	13.0	6.4	18.8	18.8	31.2

small amounts of overfertilization, especially on the sandy soil. In 1994, more than 40 percent of the additional 30 lbs/ac fertilizer applied over the 90 lbs/ac rate was lost through leaching (Table 1).

3. The greatest nitrate leaching losses were associated with an early-fall plowing of alfalfa sod and exceeded those of the N fertilizer treatments. Groundwater nitrate concentrations at the clay site increased from steady levels below 2 mg L^{-1} under active alfalfa production to above 15 mg L^{-1} during the late fall and spring following plowing.

What are the main implications of these results? First, some areas appear to be very susceptible to groundwater nitrate contamination and therefore may need special protection measures. Although nitrate contamination is not widespread, there are localized groundwater resources where high concentrations occur or may readily occur in the future. These areas are predictable, generally having coarse-textured soils, shallow groundwater, and intensive crop or animal operations. We can also conclude that crop production can be relatively safe if modest fertilizer rates are used, but groundwater nitrate concentrations increase significantly with overfertilization (Figure 1). Our studies provide compelling support to the notion that research-based nutrient management recommendations should be followed as closely as possible, especially on soils with high leaching potentials. Nitrogen uptake efficiency by crops rapidly decreases beyond the "optimum" fertilizer rate and residual nitrogen readily elevates groundwater nitrate levels. Nitrogen fertilizer rate recommendations for crops with high N requirements and shallow rooting systems (for example, leafy vegetables) were developed to insure high-quality crops, but may not prevent groundwater nitrate contamination. In such cases, economic and environmental tradeoffs may exist, depending on the local hydrogeology and surrounding land use patterns.

Finally, our data show that organic sources of N (especially green and animal manures) may be of greater concern than inorganic sources. Besides applying them in appropriate amounts, the *timing* of application may be very critical. For example, application in the period from late summer to mid fall may allow for considerable N mineralization (that is, release of nitrate), while crop uptake is minimal or nonexistent, thereby causing leaching during the winter and spring. In the case of animal manure, this may imply a tradeoff between preventing surface runoff losses (in which case a late-season application provides low risk for losses) and preventing nitrate losses through leaching. Therefore, manure application scheduling and design of storage structures may need to be linked to local water quality objectives. We are currently performing research that will provide better quantification of nutrient losses under different application schedules.

In conclusion, programs aiming at preventing groundwater nitrate contamination in vulnerable areas need to insist on the use of research-based fertilizer recommendation. Also, we need to pay greater attention to water quality tradeoffs associated with the application of organic nutrient sources, especially the potential for highleaching losses.

[1]The opinions expressed in this article are mostly based on research involving Larry Geohring, Greg Poe, Robert Schindelbeck, Charissa Yang, Jean Sogbedji, and Stu Klausner at Cornell University.

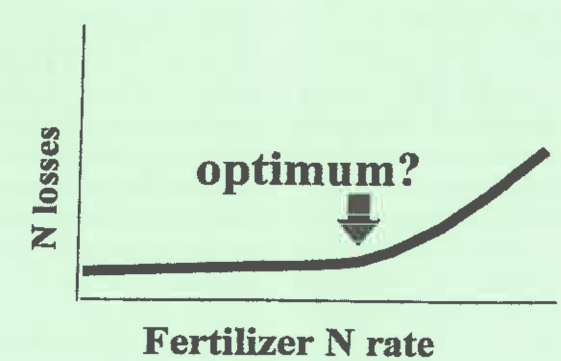

Figure 1: N Losses and Fertilizer Rates

Soil Management

Construction Rights-of-Way Through Commercial Farms For Large Gas Transmission Pipelines

Recent Developments in Land Sustainability, and A Look at What's on the Regional Horizon

John Lacey, NYS Department of Agriculture & Markets

The natural gas industry includes gas drillers and suppliers at the source end; gas transmission companies with an infrastructure of compressor stations and tens of thousands of miles of underground pipeline, strategic underground gas-storage operations, local distributing utility and transporter companies, steel pipe manufacturers, and the pipeline constructor companies. Here, New York State's land resources, including its commercial farmlands, are transected with thousands of miles of transmission pipelines. The construction of future pipelines is inevitable. The open questions in each individual case are . . . along what route and by what methods?

PAST AND UNFOLDING LESSONS

Knowledgeable in the dynamics of our thin, glacial soils and abundant moisture, farmers, agricultural consultants, soil scientists, land improvement contractors, and resource technicians stand witness to the long lasting impacts of earlier transmission pipeline trenching and construction on crops, farm equipment operation, and overall land management; inversion of low fertility subsoil and substratum materials replacing the corridor's fertile topsoil; severe soil compaction; water boils along trench lines and poorer overall field drainage; severed stone and tile drain lines; chronic rock litter; interference with the engineering and installation of new tile drains; safety hazards at locations overlying stretches of shallow pipe; etc.

Canadian Prelude. Beginning in the late 1970's, the commercial farming community throughout New York State resoundingly made its concerns over chronic right-of-way damages to agriculture's land base understood. During this same period, in southeastern Canada, representatives of the gas transmission industry, affected commercial farmers, field research consultants, and government were beginning to develop agricultural rehabilitation methods for pipeline rights-of-way in glaciolacustrine soils with persistent crop and land damages. By the early eighties, right-of-way construction methods which help minimize such impacts were being employed on some pipeline transmission projects in southern portions of Ontario and Quebec. In the years that followed, these Canadian efforts were recognized as a significant milestone. Back here, concerned associates in the natural gas transmission industry together with land resource specialists familiar with the Northeast's own characteristic terrain, soils, and climate have made significant strides. They have helped in noticeably changing the potential impacts of many of the newer pipeline constructions from the old status of "permanent farmland resource damage" to the new status of "temporary disturbance of the land followed by restoration to its full, productive level of sustainability."

The Nineties. Since the early 1990's, between seven and eight hundred miles of transmission pipeline have been installed in New York. Cumulatively, about one-half of the total miles were constructed through commercial farmlands, all of which were monitored. About one-third of the affected fields failed to receive the basic level of initial restoration as originally submitted and incorporated under the projects' certified plans. These lands lacked the fundamental agricultural mitigation needed to return to commercial use and were clearly out of basic compliance. Major farmland rehabilitation, including massive cleanups of waste rock, very intensive subsoiling, or the importing of topsoil . . . was ultimately (and responsibly) carried out by the respective gas transmission companies with the assistance of qualified agricultural field specialists and restoration subcontractors. The remaining two-thirds of the affected farmlands ranged between "marginal" and "satisfactory" in their compliance with initial restoration. Some of these favorable results are representative of entire (or major) portions of the agricultural acreages along individual multi-county pipeline projects. At the sites rated "marginal," monitoring by farmers and project agricultural specialists helped ensure the necessary follow up, e.g.: supplemental rock cleanup, additional soil profile decompaction, or managed control of water boils and soil saturation with intercept drain lines . . . until virtually all affected commercial farmlands achieved restoration to their full, sustainable level of productivity. Local soil and water conservation district technicians provided reliable field assistance in many instances of farmland restoration and soil drainage re-engineering. At the sites rated "satisfactory," crop monitoring showed recovery of between 90 and 100 percent of pre-project yields for vegetable and field crops alike, within one to two years after initial right-of-way restoration.

Outreach. By the middle of this decade more of the natural gas transmission industry was taking note not only of the means for putting a halt to permanent land damages but also of the speedy crop recovery rates on many of New York State's commercial farms. Such improvements have been and can continue being accomplished through adaptive, farmland oriented methods of right-of-way construction, initial restoration, and follow up monitoring as well as field-specific measures of remediation, accomplished within two years (or in difficult situations within three years) after pipeline construction. These regionally adaptive construction and monitoring improvements were presented by the NYS Department of Agriculture & Markets to regional and national gas industry representatives, consultants and various state and federal regulators at the Interstate Natural Gas Association of America (INGAA) Foundation's 1996 roundtable conference on rights-of-way, held in neighboring Pennsylvania.

RECENT NATURAL GAS TRANSMISSION INITIATIVES

The land grading, trenching, steel pipe welding and burial of new transmission pipelines across counties and states is the responsibility of a large, diverse and highly mobile pipeline construction trade. Its competitive companies bid on jobs constructed with a tight delivery schedule, all over the country and continent.

What is the likelihood of new transmission pipelines? The Northeast Region (particularly metropolitan areas near or along the coast) presents potential markets for more natural gas competition and the upgrading of portions of the gas transmission pipeline network. From the large, distant natural gas sources, the Northeast's interior with an expanding infrastructure of pipeline corridors and underground natural gas storage capabilities is the "bridge" to in-region markets and a "link" to other regions. Among the newer proposals is a transmission pipeline extension from southern Quebec through northern New England to northeastern Massachusetts. Another project would transmit natural gas from a source area off the coast of Nova Scotia, through that province and New Brunswick, and continue across Maine.

Most recently, planning began from southern Ontario and Lake Erie across New York State's bordering counties in the Allegheny Plateau, the southern Catskills, and the lower Hudson areas, for a transmission pipeline connecting downstate in the northern part of the greater metropolitan area. Elsewhere, in and around these environs, gas transmission pipelines are in various stages of planning and review in the central Southern Tier and western New York State; as well as across northern Ohio into adjoining northern Pennsylvania.

Although some of the recent initiatives or portions thereof will include development of single-pipeline corridors, others are likely to parallel along older existing facilities, resulting in multiple pipeline corridors across affected lands.

MULTI PIPELINE CORRIDORS ACROSS FARMLANDS

Opinions of the farming community about cross country right-of-way projects are heavily influenced by the legacy of impacts ever since the pipelines of earlier vintage were trenched and installed. Who has the most serious concerns today? Those present day farmers whose commercial agricultural operations felt the long-term (20 to 50 years) impacts of past episodes of pipeline construction and who are now solicited for surveying and constructing new pipelines along the same general corridors are most concerned.

Why build a new pipeline along an earlier one? Transmission pipeline companies seeking a route for a new project along an old corridor do so for various reasons:

- At least some semblance of a right-of-way is already there.
- An old pipeline may be planned for abandonment and a replacement line installed.
- The use of existing rights-of-way are negotiated between different companies.
- As a means of minimizing the use of new lands, regulatory and certifying commissions encourage the industry's consideration of the "add-on" use of an existing right-of-way for new construction, during the evaluation of alternatives.
- A new transmission pipeline along an existing corridor may be efficiently tied in with an existing pipeline system's infrastructure.
- Varieties of earlier signed "grantee and grantor" agreements made with the landowners tend to allow for future facilities.

RIGHT-OF-WAY COMBAT OR MUTUAL OPPORTUNITY?

Public hearings and the legal proceedings of agencies or commissions which govern such projects — based on the proposed need and effects on the environment — are becoming increasingly well monitored by individuals and groups who are weary of the same commercial farms "taking the hit" each time. They articulate, very openly, on the points of "utility-saturation" and of multi-decades of cumulative environmental impacts to farmlands. As gas transmission companies candidly note, the soil resource damages left behind on farms from some of the earlier pipeline constructions have made numbers of older and younger generation farmers, rural communities,

(See PIPELINE, page 7)

Crop Management

Fall Wheat Management

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New York wheat growers produced an exceptional crop in 1997 with many growers reporting average yields of 70 to 80 bu/acre. The New York State average yield may exceed 56 bu/acre, the state record set in 1992. Wheat prices also remain favorable with the July 1998 futures approaching $4/bu. Consequently New York wheat growers may plant more acres to wheat this year. Let's review some of the basics of fall wheat management so we achieve vigorous fall wheat stands with high yield potential.

Wheat requires moderately well-drained to well drained fields with a soil pH above 6.0. Wheat tolerates "wet feet" in the fall, but heaves out or drowns out under wet conditions in late winter or early spring. The probability of wet conditions in late winter or early spring is high in New York so avoid somewhat poorly-drained fields.

Excellent preceding crops to winter wheat include peas, barley, oats, early-planted snap beans, and early-planted sweet corn because the July-August harvest of these crops allows for Roundup application (if necessary) or deep tillage (if necessary) in August or early September. Other preceding crops that wheat follows successfully in most years include corn silage, dry beans, or soybeans. This year, most central and western New York locations are about 150 GDD below normal from May through August. Consequently, if these locations receive average temperatures during September, harvest of these crops will occur 10 to 15 days later than normal. A significant number of late-planted wheat fields yielded poorly or even winter-killed in 1996 and 1997 because of exceptionally cold Novem-bers (-5 F) in both years. If wheat follows October-harvested crops, plant the field immediately after harvest to avoid a further delay in planting date.

The ideal planting time for wheat in New York is from about mid-September until October 1. Wheat yields well when planted in early October, but usually less than September-planted wheat (Table 1). Planting wheat during late October is often successful (except for the last 2 years!), but is very risky because of the uncertainty of November and December conditions. We do not recommend planting wheat in November because insufficient fall growth makes the crop vulnerable to winter-kill. Likewise, we do not recommend planting wheat before mid-September because of increased barley yellow dwarf virus (BYDV) incidence (Table 1) and potential Hessian fly problems.

Table 1. Planting date effects on soft white winter wheat yields and barley yellow dwarf virus (BYDV) in 1996 and on yields in 1997 at the Aurora Research Farm.*

Planting Date	Yield bu/acre	BYDV incidence %
	1996	
Sept. 6	65	64
Sept. 21	73	20
Oct. 6	68	12
LSD 0.05	5	-
	1997	
Sept. 16	89	-
Oct. 7	81	-
LSD 0.05	6	-

* Adapted from G Bergstrom studies

We recommend seeding rates of about 2 bu/acre for soft white varieties if planted in September. If planting is delayed until October, plant soft white wheat at 2½ bu/acre before October 15 and at 3 bu/acre after October 15. We recommend slightly lower seeding rates for soft red varieties (1.75, 2.25, and 2.75 bu/acre, respectively). Although we have conducted seeding rate studies on winter wheat (Table 2), we continue seeding rate recommendations in bu/acre rather than seeds/acre because of wheat's compensation ability to seeding rates. Consequently, in most years, seeding rates of ±25% have virtually no effect on timely-planted wheat in New York.

Finally, select a recommended variety and use a recommended seed treatment (see Cornell Recommends). Likewise, use a starter fertilizer (especially P) at planting time to insure that the crop develops a good root system during the fall. Also, scout the field for winter annual weeds in October and early November and treat with a recommended herbicide if necessary (see Cornell Recommends). Good fall management has been essential to successful wheat crops in 1996 and 1997. If wheat prices remain favorable, the extra 10 to 15 bu/acre yield from good full management could result in an extra $40 to 60/acre profit.

Table 2. Yield of five winter wheat varieties at four seeding rates in 1994, 1995, and 1996.

Seeds/acre	Batavia	Geneva	P2510	P2737W	P2545
			Bu/acre		
			1994		
1 M	53	61	54	54	
1.4 M	62	58	56	59	
1.8 M	60	51*	53	61	
2.2 M	61	52*	55	66	
			1995		
1 M	76	76	81	81	85
1.4 M	78	78	81	76	87
1.8 M	79	77	75	83	85
2.2 M	75	78	78	84	85
			1996		
1 M	39	27**	41	49	51
1.4 M	49	32**	45	52	61
1.8 M	56	39	51	59	62
2.2 M	57	41	55	56	65

* significant lodging
** significant winter-kill

(Pipeline, from page 5)

and some broad-based farming organizations into either very intense scrutinizers of, or combative opponents against, new pipelines; especially when the same or nearby farms are the primary ones considered for routing another line.

Sharing Knowledge. What some farm operators are not aware of, and indeed some pipeline project sponsors are not up to speed with, is that both agriculture and the natural gas transmitters now have the technical means for predicting likely right-of-way impacts to farmed glacial soils. Even more important, the means are available for planning and applying the fully mitigative right-of-way construction and restoration techniques, rather than depending on old, inadequate and damaging practices of pipelining.

As proposals for new cross-country projects emerge, the sharing of technical knowledge between the farming community and project proponents must expand. There are recent and positive examples. In two separate cases, the county Farm Bureau was the initiator and facilitator. Farmers along proposed pipeline routes were contacted, as were the pipeline project's engineering and environmental representatives, to share in open technical review and dialogue. County agricultural staff of Cornell Cooperative Extension identified key points of consideration for assessing the diversity of temporary economic effects of a construction alignment on a farm's normal field operations. Agriculture & Market's staff identified major long-term considerations of soil management and restoration, comparing conventional pipelining with the improved techniques tailored for the local soils. Both the farmers and project proponents emerged more, rather than less, aware of each other's main requisites; and a technical base was established for field compensation assessments and land restoration, should either pipeline be constructed. Elsewhere, similar technical discussions have been facilitated by county Farmland Protection Boards.

The more progressive gas transmission enterprises — those that have adopted, or are in the process of adopting the modern methods of agricultural right-of-way construction and complete agricultural restoration consistent with the actual glacial till, outwash, and lacustrine soils — realize positive long-term results. They see long-term pluses, both in the accomplishment of a transmission pipeline and in the payoff for the sustainability of the affected land resource, better relations with commercial farming enterprises along each operating pipeline right-of-way, and a notable drop in the perennial damage claims and litigation. Besides that, they are in compliance with the agricultural component of their authorizing certificate.

Coming Full Circle. Some forward-looking gas transmission companies who are proposing new pipelines on existing right-of-ways, are going one step further than total soil protection, complete decompaction and rock cleanup, together with intercept tile drain control of new wet seeps. They are taking more serious note of the farmlands' perennial impacts along the old pipeline itself. For instance, during corridor review for the new pipeline, the water seepages and notably "soft," soggy farm ground over the old line are inventoried. The field observations are cross referenced with newer corridor-data on the soil solum and substratum, as well as with data on the drainage dynamics of respective soils. When such soils are once again altered by extensive trenching, the plans at these locations include special post-construction monitoring for new seepages and emergent water boils. Where impacts are field confirmed, plans include the mitigation of these manmade drainage problems with an intercept drain line system, incorporated simultaneously for both the old and the new pipeline.

For more information you can contact John Lacey at (607) 255-1756.

(SILAGE, from page 1)

sizes were selected to match the expected distribution of particle sizes based on more sophisticated separators. Suggested ranges in particle size are shown in the table. While particle size distribution of silage is important, the particle size distribution in the total mixed ration that the animal consumes is what ultimately impacts animal performance.

All procedures for determining moisture content and particle size are useless if a representative sample is not collected. Although forage quality parameters certainly are important, most of the problems associated with silage are due to moisture and particle size issues. Control of these factors are the prerequisite to making and feeding good silage.

Calendar of Events

October 14	Field Crop Dealer Meeting, Albany, NY
October 15	Field Crop Dealer Meeting, Vernon, NY
October 16	Field Crop Dealer Meeting, Batavia, NY
October 17	Field Crop Dealer Meeting, Waterloo, NY
October 26-31	American Society of Agronomy Meetings, Anaheim, CA
December 10-11	CCA Training, Triphammer Lodge and Conference Center, Ithaca, NY

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