What's Cropping Up?

A NEWSLETTER FOR NEW YORK FIELD CROPS & SOILS

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INTEGRATED PEST MANAGEMENT: Environmentally Sound and Economically Efficient Crop Protection

J. Keith Waldron
IPM Coordinator, Dairy and Field Crops,

Integrated Pest Management (IPM) is an approach many growers use to better meet challenges of today's crop protection decisions. IPM is a management philosophy that utilizes short- and long-term crop protection strategies to minimize losses from pests while providing optimal net profit to the producer and minimal disruption to the environment.

The IPM approach considers many factors including: What pests (insects, diseases and weeds) are present or expected? When and at what level of infestation are they a problem? What different methods can be employed to control or avoid them? When should these control strategies be used? References like the *Cornell Recommendations for Field Crops*, the *Field Crops and Soils Handbook* and IPM scouting procedures contain the information necessary to make specific pest, by crop, control decisions under New York conditions. The purpose of this article is to outline a framework for how to incorporate this IPM information into ongoing crop management activities.

Implementing IPM is easy using these simple steps:

1) Identify problems correctly.
2) Determine the extent of the problem by sampling.
3) Critically assess problem importance.
4) Evaluate and select appropriate management alternative(s).
5) Implement selected management action(s) in a timely manner.
6) Re-evaluate the effectiveness of control action(s).

Correctly completing each step in the order presented is vital to the overall success of the IPM approach since each step builds on information and results of the previous step.

Steps to Using IPM

Identification

Correct identification is the cornerstone of successful IPM. Misidentification leads to mismanagement. If an unknown "pest" is frequently encountered or is suspected of causing a problem it should be correctly identified by a knowledgeable resource person. If in doubt, send a sample to Cornell Insect and Disease Diagnostic Laboratory at 4140 Comstock Hall, Cornell University, Ithaca, NY 14853.

Sampling

Is the pest found in isolated areas, associated with particular field patterns, abundant or rare throughout the field? Effective IPM sampling methods have been developed for many pests, particularly insects, to obtain a representative assessment of pest infestations.

Analysis

Healthy crops tolerate a modest amount of pest damage before net profitability is affected. Prior to reaching this damage level, the costs of control exceed actual crop losses. This *economic threshold* concept is basic to using IPM. Threshold guidelines to evaluate the potential impact of specific pests in New York are available in various Cornell publications.

Management Alternatives

A variety of cultural, biological, and chemical management alternatives are available to minimize pest impacts. Early detection of pest problems provides increased opportunities for using least toxic approaches to pest management. Choosing the most appropriate option should consider the short-term and long-term benefits and the implications of the proposed action.

Implementation

Once a management alternative has been chosen it must be implemented in a complete and timely manner to obtain the maximum benefit.

IPM can help improve the economic and environmental efficiency of pest control decisions if the steps outlined above are followed. It's never too late to start....

For more information on implementing an IPM program for alfalfa, field corn and dairy cattle contact the author at 5130 Comstock Hall, Cornell University, Ithaca, NY 14835. An IPM catalog of helpful materials is also available through the IPM Program Headquarters, NYS Agricultural Experiment Station, Geneva, NY 14456, (315) 787-2206. ▫

DISEASE MANAGEMENT

Gray Leaf Spot: A Limited Threat to New York Corn Production in the 90's

Gary C. Bergstrom
Plant Pathology

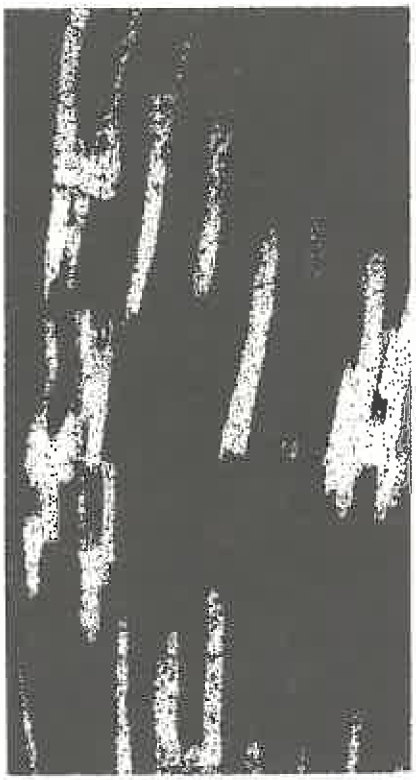
Gray leaf spot (GLS), a leaf-blighting disease of corn caused by the fungus *Cercospora zeae-maydis*, has been on the increase in eastern and central North America since the mid-1970's in association with regional increases in conservation tillage, continuous corn production. It is likely to increase in occurrence over much of New York in the 1990's and to reduce yields in certain locations.

The Disease

Gray leaf spot starts out as most leaf blights do, as small flecks with yellow halos. Mature leaf lesions are diagnostic of this disease, i.e., opaque (to transmitted light) rectangular lesions, 0.2 to 2 inches long, delimited by leaf veins. The lesions may have a grayish cast (for which the disease is named) caused by fungal sporulation. Even after the crop is harvested, telltale silhouettes of the lesions can still be seen in the leaf debris. Infection can occur at any stage but disease development is most pronounced following silking. Extensive blighting of leaves in the middle to upper levels of the crop canopy during August will significantly reduce grain fill. Yield loss also occurs indirectly as a result of GLS predisposing plants to stalk rot and lodging.

Epidemic Development

The GLS fungus overwinters in infected corn debris. Under moist, humid conditions, spores produced on debris are splashed by rain droplets onto the lower leaves of corn. Spores germinate in less than six hours in films of water on the leaves. A cumulative period of at least 48 hours of 95% relative humidity (may be interrupted by drier periods) is required for leaf infection to be completed. Spores produced on lower leaves may infect upper leaves. The fungus may produce only a few infection cycles each season. Some of the spores produced on debris and corn leaves is transported by air currents and infects corn several miles away. Corn infected by spores from remote sources typically develops GLS on the middle and upper leaves with no lesions apparent on the lower leaves.



Characteristic, rectangular shape of gray leaf spot lesions on a corn leaf.

Fields at Risk

To date, GLS has been detected in New York only in isolated fields in the Delaware, Hudson and Susquehanna River Valleys. Valley conditions, i.e., high humidities and extended dew periods, are most conducive for GLS epidemics. Recent epidemics in Kansas illustrate that overhead sprinkler irrigation also promotes GLS. Severe GLS which develops soon after silking and results in large yield losses is anticipated primarily in corn planted into debris of a previous corn crop. Once GLS becomes established, however, first-year and conventional-tillage corn in the area may also be affected. Because of the amount of corn residues left on the soil, corn in grain production areas is at more risk than corn in silage production areas.

Management

Detection of GLS this year is the key to preventing crop losses next year. If you find symptoms suggestive of gray leaf spot in your corn, please contact your Cornell Cooperative Extension field crop agent for positive identification and further information. Crop rotation and deep-plowing of infected corn residues are effective control strategies when the incidence of GLS is low. However, when inoculum levels (i.e., amount of infected corn debris) increase over the region, genetic resistance to GLS in hybrids will be necessary to prevent losses. While most hybrids currently recommended for New York are susceptible to GLS, GLS-resistant hybrids have begun to appear on the New York seed market. Hybrids produced from 'Iowa Stiff Stalk Synthetic'-derived inbreds (common female parents in hybrid seed production), in general, are more susceptible than those from inbreds of 'Lancaster' or other origins. Considerable progress has been made in developing resistant inbreds from temperate and tropical genetic sources for use in hybrid production. The challenge for New York will be the incorporation of resistance into early-maturing hybrids. Early evidence suggests that moderate levels of resistance, which reduce the rate of GLS epidemics, may be sufficient to prevent yield losses. If GLS appears on your farm this August or September, contact seed suppliers early to request GLS-resistant hybrids for 1992.

Between-Cropping Applications Control Broadleaf Perennial Weeds

WEED CONTROL

Russ Hahn
Soil, Crop and Atmospheric Sciences

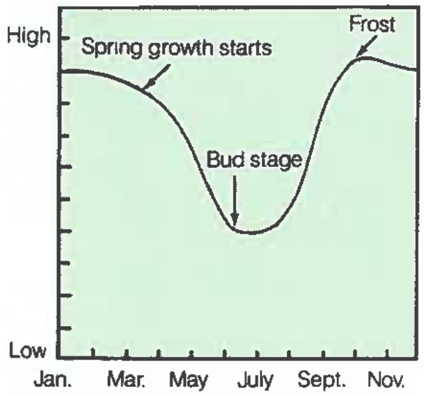
All perennial weeds can be troublesome, however, "deep-rooted" broadleaf perennial weeds such as field bindweed, hemp dogbane, horsenettle, and common milkweed are among the most difficult to control. Like annual and biennial weeds, these perennials reproduce by forming seed. In addition, they spread by rhizomes (underground stems). Between-cropping applications of translocated herbicides during late summer or early fall have proven most effective for controlling these tough weeds than other control programs.

RHIZOMES ARE KEY TO SURVIVAL

Rhizomes are the key to the survival of these perennial broadleaf weeds. Buds or growing points are found all along these underground stems and serve as a storehouse for food reserves (carbohydrates). It is these food reserves that allow these plants to survive winter. In the spring the creeping perennials draw on these food reserves to make new growth. The depletion of food reserves continues until the plants reach full leaf development and flower bud formation in mid- to late summer as shown in the accompanying figure. After flowering, these plants once again move carbohydrates from the leaves into the rhizomes in preparation for winter. Effective control programs involve killing newly germinated seedlings and the buds or growing points found on the rhizomes of established plants.

TRANSLOCATED HERBICIDES

Translocated herbicides are the key to chemical control of "deep-rooted" perennial broadleaf weeds. Translocation refers to the movement of substances from one place to another, such as the movement of herbicides in plants. Herbicide movement in plants may follow the pathway of sugars formed during photosynthesis and/or the pathway of water that is absorbed by the roots. Perennial weed control is most dependent on herbicide movement with the manufactured sugars. These sugars move out of the leaves to areas of rapid growth (growing points). Herbicide translocation to the growing points on the underground stems is most rapid and most effective when large amounts of sugars are being moved to the rhizomes. This usually occurs after full bloom in late summer and fall. Since 2,4-D, dicamba (Banvel), and glyphosate (Roundup) are translocated from the leaves into the underground structures of perennial weeds, these herbicides can be effective against these perennial weeds.



Food reserves of a perennial plant

BETWEEN-CROPPING APPLICATION

Between-cropping applications of herbicides are simply those applications that are made: 1) after harvesting one crop, 2) before killing frost, and 3) before planting the next crop. Situations that meet these requirements include fields where small grains (not seeded to legumes) or certain vegetable crops (peas, early sweet corn, etc.) have recently been harvested and the next crop won't be planted until fall (winter wheat) or the next spring. These between-cropping situations provide the opportunity to use non-selective herbicides such as Roundup or to use high rates of 2,4-D or Banvel that could not be used safely when crops are present.

These herbicides should be applied when the weeds are actively growing and are at or beyond the early bud stage. According to the label, common perennial broadleaf weeds require 2 to 4 quarts per acre of Roundup. The Banvel label allows between-cropping applications of 2 to 4 pints per acre for the control of several perennial broadleaf weeds. Application rates for the various 2,4-D formulations on fallow land generally range from 1 to 3 quarts per acre for perennial broadleaf weeds. In all cases, tillage and other operations should be delayed for 7 or more days following application to allow time for herbicide translocation to the underground buds.

ROTATIONAL CROPS

Since Roundup is inactivated upon contact with the soil, a variety of crops can be planted following the 7-day waiting period. Since Banvel has residual activity in the soil, rotational guidelines must be followed to avoid injuring subsequent corps. Corn and sorghum may be planted in the spring following Banvel applications made the previous fall. Soybean planting should be delayed 30 days per pint of Banvel applied per acre and wheat may be planted in the fall or spring provided the interval between application and planting is 20 days per pint of Banvel applied. These waiting periods should exclude days when the ground is frozen. The waiting interval for planting winter wheat following late summer Banvel applications can be shortened by applying reduced Banvel rates (within the range on the label) in tank mixes with 2,4-D or Roundup.

Between-cropping applications of translocated herbicides provide the best method of controlling "deep-rooted" perennial broadleaf weeds, however, growers must act now to take advantage of existing situations or plan a rotation that will allow such applications next year. ■

AGRICULTURAL METEOROLOGY

Mapping Growing Degree-Days in New York

Steve DeGloria
Soil, Crop and Atmospheric Sciences

A growing degree-day (GDD) is a measure of accumulated heat available to plants, and is most commonly used for estimating the ability of a crop plant to grow, develop, and mature in relation to environmental air temperature on a seasonal or annual basis. Generally, growing degree-days are calculated from average daily temperatures recorded at weather stations distributed throughout a geographic region. Estimates of growing degree-days for land areas located far from a weather station are generated through the interpretation of topographic and climate maps, or through the use of mathematical equations which calculate GDD values from climate data of known points for areas in proximity to sets of known points.

MAPS

Maps are used to visually display ranges of growing degree-days on a regional basis using contours, or isolines, which connect points of equal GDD values. One must then interpolate between these contours lines to estimate the growing degree-day value for a specific geographic location. These maps are commonly used in New York State to determine the suitability of growing certain types of crops or cultivars at various locations. The major limitation of these maps is the inability to control the variability of estimates based on location and topographic relief.

ESTIMATING GDD

A method has been developed for estimating and mapping growing degree-days at regional scale using a regression equation and a geographic information system (GIS). For each of 70 weather stations, growing degree-days (Base 50-86) were computed using 30-year average daily temperatures for a May 15-September 15 growing season. The location of each station is normally recorded in coordinates of latitude and longitude, and elevation is recorded in feet above sea level. The coordinates and elevation values were converted to metric values. The location (in meters north of the equator) and elevation for each station were used as independent variables to develop an equation for predicting growing degree-days.

To estimate growing degree-days for any area in New York State, a computerized database was constructed consisting of elevation data. Values for both elevation and location are stored for every 2.5 acres of land statewide.

The equation was entered into a GIS spatial modeling program to compute the growing degree-day value for each 2.5 acre parcel. The database now forms a contiguous map of growing degree-days for the entire state with spatial resolution of 2.5 acres. From this distribution of GDD values, intervals are selected to generate classes, or ranges, which form map units for display or statistical summary (Table 1). From the database, one can determine the growing degree-days for any location whose map coordinates and elevation are known. These elevation and coordinate values are published on most modern topographic maps.

CURRENT GOALS

Since most geographic variables are spatially autocorrelated, current activity is focused on:

1. developing a more robust estimator using spatial statistics,

2. assessing the accuracy of the statewide growing degree-day maps;

(3) incorporating the predicted growing degree-day values with soil geographic data to map the suitability of landscapes in six northern New York counties for growing selected field crops.

This project is supported by the Northern New York Agricultural Development Program, and is being conducted with assistance from the Northeast Region Climate Center and Soil Information Systems Laboratory.

Contributors to the climate mapping technique include Dan Long, Keith Eggleston, Dave Masonis, Warren Knapp, and Brent Schefter.

For further information, contact Steve DeGloria at CLEARS, 453 Hollister Hall, Cornell University, Ithaca, NY 14853; or, call (607) 255-6328.

GDD Class	% Area
> 1000	1.4
1000 - 1100	1.1
1100 - 1200	2.3
1200 - 1300	5.0
1300 - 1400	6.7
1400 - 1500	9.4
1500 - 1600	10.8
1600 - 1700	11.6
1700 - 1800	10.5
1800 - 1900	12.3
1900 - 2000	12.2
2000 - 2100	5.6
2100 - 2200	2.9
2200 - 2300	2.8
> 2300	5.5

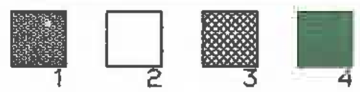
Hydric Soil and Wetlands: A Southern Tier Example

SOIL INTERPRETATION

Bill Waltman
Soil, Crop and Atmospheric Sciences

Perhaps no other environmental issue has reached such a climax of public concern, frustration, and bewilderment than the identification/delineation of wetlands in New York. Wetlands gained both prominence and further protection through the "Swampbuster" provision of the 1985 Food Security Act and the Bush Administration's "no net loss of wetlands" policy. Also, the 1990 Farm Bill contains provisions for a "Wetlands Reserve Program" and has changed the triggering mechanism to Swampbuster, whenever "wetlands are actually drained, filled, leveled, or otherwise altered for crop production." The intention of the Swampbuster provision was to preserve the important values of wetlands, such as wildlife habitat, flood control, groundwater recharge, and erosion control.

Title: Significant Areas of Hydric Soils
Location: New York Soil Resource Information System



1 Areas of Dominantly Hydric Soils
2 Areas of Dominantly Non-Hydric Soils
3 Urban Areas
4 NY Water

Wetlands are defined according to their hydrology, the presence of hydrophytic vegetation, and saturated soils. However, in New York, the major problem and source of inconsistencies in defining/delineating wetlands has been identification of hydric soils. As an example, in Figure 1, the hydric soils are extensive across the glaciated landscapes of the Southern Tier counties. Hydric soils and soils with potential hydric inclusions represent approximately 42% of the landscape, whereas, non-hydric soils represent 55% of the landscapes across Tompkins, Schuyler, Tioga, and Chemung Counties (Table 1). This estimate is conservative since many micro-depressions (wet swales) less than 4 acres in size were not mapped or represented in the detailed soil mapping units.

Table 1. Summary statistics of hydric and potential hydric soils in Tompkins, Schuyler, Tioga, and Chemung Counties.

	% landscape	acres	sq. miles
Areas of Dominantly Hydric Soils	41.53	470,360	735
Areas of Dominantly Non-Hydric Soils	55.30	636,280	979
Urban Areas	1.77	20,045	31
NY Water	1.44	15,814	25
Totals:	100.00	1,132,499	1,770

However, as Table 1 clearly suggests, wetlands are a dominant feature of the landscape in some areas of New York. The consistent and clear identification of hydric soils is imperative to minimize potential conflict between land improvement for production purposes and preservation of wetlands. ◘

Using Sewage Sludge to Reduce Fertilizer Costs

WATER QUALITY

Jack Martin
Soil, Crop and Atmospheric Sciences

In 1989, the New York State Department of Environmental Conservation estimated that 370,000 tons of sewage sludge solids are generated annually at the 497 publicly owned wastewater treatment facilities located in the state. This quantity could double by the year 2000 because of population growth, more stringent wastewater treatment standards, and improved wastewater treatment plant operation. Most of this sludge now is disposed of by either ocean dumping, incineration, or landfilling.

A combination of regulatory and economic factors is forcing many New York State communities to develop new strategies for the disposal of these wastewater treatment residuals. Given the limited number of remaining options, agricultural utilization of sewage sludge as a fertilizer material or soil amendment is increasingly attractive as a disposal strategy for many communities. Thus, many New York State farmers soon may be presented with this option to and will need to make a decision about utilizing sewage sludge on their farms.

Regulations

Agricultural utilization of sewage sludge as a fertilizer material or soil amendment is regulated in New York State by the Department of Environmental Conservation. Such use is considered a waste management activity, and a permit for the operation of a land application facility is required. Permit requirements are outlined in Subpart 360-1 and 360-4 of Title 6 of the NY Code of Rules and Regulations (6 NYCRR Subparts 360-1 and 360-4). As specified in section 360-4.1, application for a land application facilities permit must be made by the landowner or by his delegated representative. Acceptable representatives can be the generator of the sludge, the applicator of the sludge, or the holder of a permit for transporting the sludge to the site.

Risks

Although the principle constituents of sewage sludge are carbon, nitrogen, and phosphorus of agricultural origin, sewage sludge also can contain a variety of organic and inorganic trace constituents from a variety of sources. Some, such as polychlorinated biphenyls (PCBs), cadmium, mercury, and lead, are highly toxic and can be harmful to animals and humans. Others, such as copper, nickel, and zinc, are essential elements for both plants and animals at low concentrations, but are toxic at higher concentrations. The utilization of sewage sludge also results in the risk exposure to pathogenic microorganisms that are indigenous to this material. Utilization of sludge, therefore, entails some degree of risk.

Recognition of the need to manage these risks has produced the rules and regulations cited above. These rules and regulations are more comprehensive and restrictive than the current federal regulations outlined in the Code of Federal Regulations (40 CFR 257). They establish both concentration and cumulative application limits for heavy metals and PCBs, require stabilization and pathogen reduction, and restrict application on land used for production of crops that are directly consumed by humans. Currently, the EPA is in the process of revising federal sludge disposal regulations. Although these revisions have not yet been promulgated, it is anticipated that those regulations applicable to the agricultural utilization of sewage sludge will be more comprehensive and restrictive than either current federal or New York State regulations.

Implications

Sewage sludge, like livestock and poultry manures, can be of measurable value as sources of nitrogen, phosphorus, a variety of micronutrients, and organic matter. Use of sludge, therefore, can reduce fertilizer costs and may, due to the addition of organic matter, increase yields above those obtained using commercial fertilizers.

However, the use of sewage sludge as a fertilizer material also can restrict the future use of land where sludge has been applied. Restrictions include:

- Production of crops intended for direct human consumption, e.g. fruits, vegetables, and edible beans, for at least 18 months after the last application.
- Grazing of dairy cattle for at least 12 months and for at least one month for other domestic animals.
- Also, control of public access by fence or sign for at least 12 months is required.

Summary

A decision about sludge utilization should be based, like any other sound business decision, on a careful analysis of potential benefits versus costs and possible risks. The first step in this analysis should be a determination of crop nutrient needs. If these needs are largely satisfied by purchased fertilizer materials, the possible use of sludge merits further examination due to the production cost reduction that could be realized. On farms where livestock or poultry are produced, it is likely, however, that manurial nitrogen and phosphorus can satisfy crop production needs. Thus, sludge utilization will provide no economic benefit, and may create or exacerbate water quality problems. ■

Nutrient Preservation in Storage of Corn Silage

FORAGE QUALITY

Ron Pitt
Agricultural and Biological Engineering

With corn silage harvest beginning soon, this is a good time to review the important principles of making silage from whole plant corn. While much of this year's corn silage will be stored in bunker silos, a high level of management is needed to preserve the digestible nutrients in silage stored this way.

The basic objectives in making corn silage are to exclude oxygen from the silage mass and to encourage bacterial fermentation which results in a low, stable pH. When oxygen is present, plant enzymes and yeasts, molds, and aerobic bacteria will degrade silage nutrients, causing a reduction in energy content. Anaerobic conditions within the silo are required for lactic acid bacteria to grow and ferment plant sugars to organic acids which reduce the pH. When the silage is fully acidified and is in an anaerobic state, the nutrients will be preserved until the silage is exposed to air during feedout.

Harvesting

Storage management actually starts during the harvesting process. Moisture content is one of the most critical parameters in preserving nutrients. For bunker silos, a moisture content of 65 to 70% is optimum for encouraging anaerobic conditions and lactic fermentation. Above 70% moisture, seepage from the silo is likely to occur, causing a loss of nutrients and a pollution problem. Below 65% moisture, there is more oxygen penetration from the surrounding air and a greater tendency of the silage to heat when exposed to air.

Chop length is an important parameter in harvesting for good nutrient preservation. A theoretical cut length of 1/4 inch will produce small enough particles so that oxygen exclusion in the silo is promoted and most of the grain kernels will be cracked for digestion by the animal. However, if most of the fiber in the diet comes from corn silage, a longer chop length (up to 3/4 inch) may be necessary.

Silo Filling

Rapid and continuous filling of the silo is important to reduce exposure to oxygen before anaerobic conditions are achieved. When delays occur, a layer of yeasts and molds may form at the exposed surface that is visible when the silage is unloaded. Packing the silage during filling is essential for two reasons: to exclude the air mixed in with the silage initially, and to reduce the penetration of oxygen into the stored mass. Both the amount of compaction and the efficiency of packing are important. Using a tractor with single wheels creates a high pressure in the silage that promotes tight packing with less packing time. Packing the silage for a period of 0.1 hours per ton of silage will save about $500 of nutrients for every 100 tons of corn silage dry matter.

Covering the silage has strong benefits for preservation of nutrients, because it reduces oxygen infiltration. In a study by Kansas State researchers, the nutrient losses in the top three feet of silage were reduced dramatically by covering immediately after the silo was filled (see table). When the silage was covered after one week's delay, the loss of nutrients was significantly greater. Plastic sheeting is currently the best option to use as a covering material, but ongoing research is evaluating feedable covering materials which will eliminate the disposal problems associated with plastic.

Silo Unloading

A substantial loss of nutrients can occur when the silage is unloaded. In warm weather, yeast and mold growth on the exposed face is rapid, and deterioration and possible toxin production can cause a drop in animal production. A simple guideline is to remove at least six inches of silage per day from the exposed face, and to use the silage the same day it is removed. To achieve this unloading rate, the silo size must be properly matched to the forage needs of the herd.

Silage management is a year-round activity. By following the proper procedures in harvesting, filling, and unloading the silage now and through next year, the nutrients in this year's corn silage and the monetary investment in those nutrients will be preserved. Such practices are extremely important to the economics of silage production. ◘

Effect of Covering on Losses in Top 3 Feet of Silage

	Digestible Nutrient Losses	Economic Value of Losses
Uncovered	42.2%	$0.71/sq. ft.
Covered after 1 week delay	26.3%	$0.44/sq. ft.
Covered immediately	17.4%	$0.29/sq. ft.

Calendar of Events

August 4-7	46th Annual SWCS Meeting, Lexington, KY
August 6-8	Empire Farm Days, Seneca Falls, NY
August 18-22	American Phytopathological Society Annual Meeting, St. Louis, MO
Oct. 27-Nov. 1	American Society of Agronomy Annual Meeting, Denver, CO
Nov. 6-8	Northeast Div. of American Phytopathological Soc., Syracuse, NY
Nov. 8-9	S&WC Annual Meeting, Empire State Chapter, Canandaigua, NY
Nov. 11-14	53rd Annual NYS Pest Mgmt. Conference, Sheraton Inn, Ithaca, NY

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: Soil, Crop and Atmospheric Sciences, Plant Breeding, Plant Pathology, and Entomology. To subscribe for 1991 send a check for $8.00 along with the form at the right.

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