Movement of Fertilizer Nutrients And Pesticides from Turfgrass Sites

Justification: Turf (home lawns, parks, golf courses, schools) is primarily maintained in or near areas of high population where the need for efficient, safe and effective management is important. Therefore, ecologically sound management practices are crucial in urban-suburban ecosystems. Improper use of nutrients and pesticides in these ecosystems may result in a lowering of water quality. Much of the Upper Midwest depends upon ground water for domestic and commercial water supplies. This water is often found in shallow aquifers which are subject to contamination through inappropriate land uses. The use of high rates of fertilizers (particularly nitrogen sources) is often cited as being incompatible with sound ground water management strategies.

Surface waters are being considered for their magnitude and quantity as alternative water resources. Collection and storage of stormwater runoff has been attempted on a limited scale in some metropolitan areas. However, urban and suburban environments contain a high percentage of runoff surfaces which have been associated with the movement of undesirable materials that decrease water quality. A parallel concern has also been expressed relative to the quality of water emanating from turf areas that have received fertilizer and pesticide applications.

The placement of chemicals on turf differs from the methods commonly employed on cultivated croplands, where chemicals are sometimes mixed with the soil. Surface applications to turf reduce the potential for soil absorption or deactivation and increase the potential of runoff losses. In addition, many fertilizers used on turf contain a high percentage of the nitrogen in a soluble form in order to provide a rapid color and growth response. The potential exists for nutrients (particularly nitrogen) and some pesticides to percolate rapidly through sandier, textured soils underlying turf in many locations. Heavier textured soils with poor structure (due to construction activity) are abundant under other turf areas. These sites have a significant potential for runoff and the concomitant movement of soluble nitrogen fertilizer sources and more soluble pesticides. Contamination of surface and groundwater resources via movement of nitrogen fertilizers applied to turf areas is widely believed to be a serious problem in much of the United States. The magnitude of the problem must be documented to provide the basis for the implementation of sound fertilizer management practices.

* * * *

Related Previous and Current Research: Recently, research has been conducted to further understand the fate of nutrients and pesticides applied to turfgrass. Possible fates include: turfgrass phytomass, dissolution, soil and organic matter attenuation, thatch, gaseous loss by volatilization, denitrification and biological degradation.

The amount of nitrogen (N) found in the phytomass has been studied, but only to a limited degree. Snow (1976) estimated that between 50 to 75 percent of the amount of N applied was accountable in the turfgrass plant (including clippings). Similarly, Starr and DeRoo (1981) found that approximately one third of the applied fertilizer N was recovered in the clippings. In their research, they also found that, when ammonium sulfate was used as a fertilizer N source, 14 to 20 percent of the N was in soil organic matter and roots and up to 26 percent could be recovered from the thatch.

The form and frequency of N applications and irrigation management have been shown to impact the nitrate concentration of soil solution which ultimately effects leachability (Brown et al., 1982; Rieke and Ellis, 1974). Because of this potential for N movement, it is not surprising that fertilization of turfgrass has been implicated as a cause for elevated nitrate levels in groundwater (Flipse and Bonner, 1985).

Snow (1976) indicated that an appreciable amount of N that was not tied up in the plant could be leached; however, others (Snyder et al., 1981; Starr and DeRoo, 1981) do not substantiate these results. Watschke and Mumma (1989) reported that the use of spray – applied, soluble N sources on sloped turf plots (heavily watered) rarely caused nitrate N levels above federal drinking water standards in either runoff or leachate. In Snyder et. al. (1981) and Starr and DeRoo's (1981) research, a more comprehensive N fate was delineated than in the research reported by Snow (1976). They measured nitrate and N^{15} concentration in groundwater and found that N not accountable above the root zone, was not accountable below the root zone either. They concluded, that under certain conditions, fairly substantial amounts of N can be lost through volatilization and/or denitrification.

Fertilizer applications on home lawns can occur as often as four or five times throughout the growing season. Although properly-timed applications of fertilizer can improve overall nutrient utilization, it also increases the potential for waterborne losses of N from the site.

Applications of pesticides to non-golf turf areas is largely herbicidal as far as chemical type is concerned with insecticides applied to a lesser degree. Commercial applicators apply pesticides almost exclusively through liquid applications. Most homeowners, however, apply pesticides as granules because they are more apt to have a spreader than a sprayer.

Research at Penn State University (Watschke and Mumma, 1989) and Rhode Island (Gold et al., 1988) has shown that the movement of more soluble herbicides, 2,4-D, 2,4-DP, and dicamba in runoff and percolating does occur when heavy watering is used soon after herbicide applications. Although detectable herbicide has been found, the concentrations to date have been low (almost always below public drinking water standards).

(Continued on Page 17)

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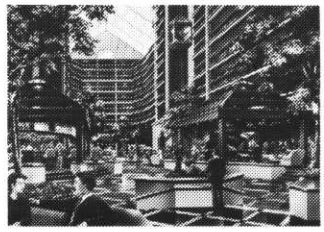

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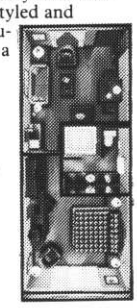

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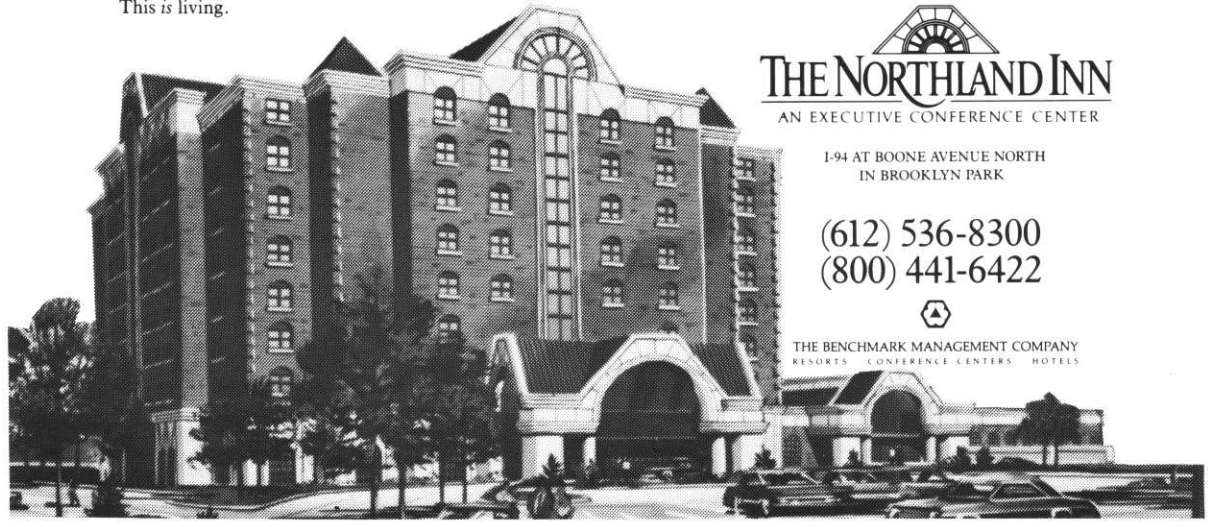

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Remember Safety When Handling Pesticides—From Beginning To End

By Teri L. Linder
GCSAA Communications Specialist

Increased public awareness of the environment has meant new and complex responsibilities for today's professional golf course superintendent—and federal, state and local governments have stepped up their scrutiny of rules and regulations controlling pesticide usage. During its first year of publication, *Briefing* has addressed many of these laws and their impact on maintenance practices. Always paramount in this coverage, however, has been the recognition that the health and safety of golf courses should remain primary concerns for every superintendent.

In addressing those concerns, and in looking back over the first year of *Briefing*, here are some basic thoughts to keep in mind when handling pesticides:

When using pesticides as a part of your overall maintenance program, remember that safety and regulatory compliance go hand-in-hand. Make sure that everyone involved in your operation is aware of the safety considerations of each task he or she performs. Integrate these considerations into your hazard communications training program.

Scrutinize the packaging of pesticides you purchase and properly document each delivery. Look for water-soluble packaging, which means fewer containers for disposal. Consider higher-percent active ingredients materials and mini-bulk containers to reduce the amount of material needed and the number of times it is handled. When you receive pesticides from your distributor, make sure that an up-to-date material safety data sheet [MSDS] is provided for each product. Some superintendents now specify on their purchase orders that delivery will be refused unless the product is accompanied by an MSDS.

ALWAYS read the label. Pesticide labels contain vital information that educates you and your employees on handling, application and disposal of the product. NEVER allow a product to remain in your facility without a label—if a box or carton must be split up, be sure to re-label any container that will store excess product.

Store your pesticides safely. The Environmental Protection Agency has proposed new rules governing the storage of hazardous substances, including turf chemicals. These rules include requirements that pesticides be stored in a building that is securely locked, has an impervious floor, is properly ventilated and is in compliance with local fire codes. As a groundwater protection measure, make sure that all drains located within storage facilities can be quickly and easily plugged in the event of a spill or fire. Remember to separate turf chemicals by type [insecticide, herbicide, fungicide, etc.] to prevent accidental misuse or contamination. Make sure that you check often for any signs of container corrosion or leaks. Finally, post the telephone numbers of your local fire department, state environmental agency and spill response team in a conspicuous place within your storage facility and make sure your employees are trained in proper spill procedures.

Exercise extreme caution when mixing and loading turf chemicals. Federal and state regulations require, at a minimum, that either a certified applicator handle or apply restricted-use pesticides or that a certified applicator directly supervise a non-certified worker. GCSAA strongly recommends that only properly trained pesticide applicators be allowed to handle and apply pesticides. Certified applicators, because of the education they receive, are knowledgeable about label requirements and are trained to safeguard against pesticide misuse, accidents and injuries. NEVER mix turf chemicals near a well and make sure that any drains in proximity to the mixing or loading area are in proper working order and flow into a catch basin. Personnel involved in the mixing and loading operation should be properly clothed and equipped with appropriate safety gear.

NEVER dispose of pesticides or pesticide waste down a drain, sink or sewer, or into a well, lake, pond or lagoon. Protection of groundwater and surface water is a primary concern in using pesticides. When possible, recycle pesticide wastes. If possible, field-apply diluted pesticide rinsate to reduce stored hazardous waste. Properly dispose of unusable products right away—don't procrastinate. Triple-rinse or pressure-rinse containers as soon as they are empty. Do not reuse a pesticide container unless it is specifically designed for that purpose.

Basic concepts in pesticide safety are often easy to forget. It's even easier to take for granted that all of your employees have the same knowledge base as you. A primer such as this is an excellent tool to use with both new employees and experienced workers who need a quick "refresher" to bring home key points. Take a few moments to review these simple reminders with your staff—it can help ensure the safety of your employees, your golfers, your community and your environment.

—Reprinted from Briefing a GCSAA publication

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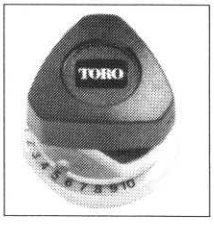

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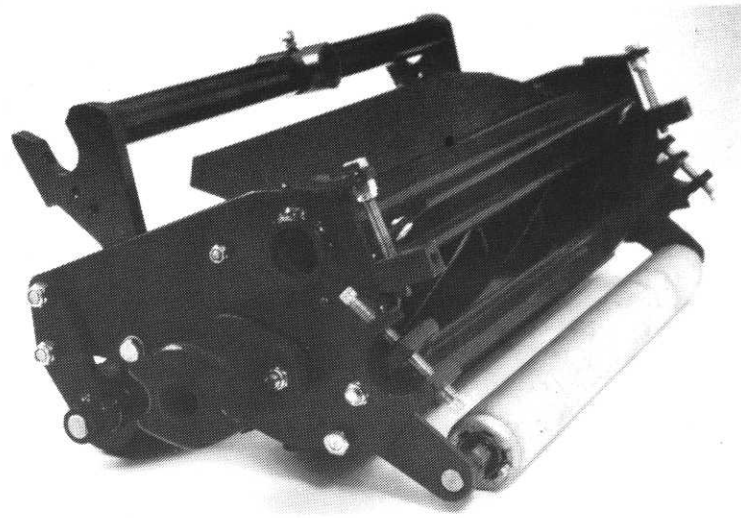

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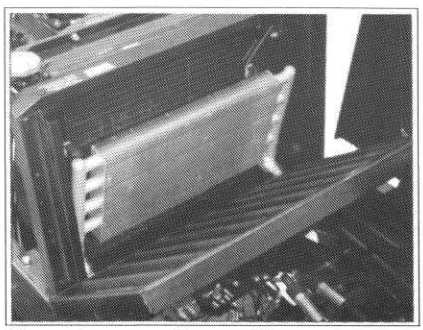

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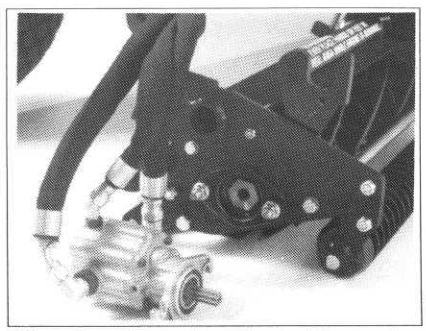

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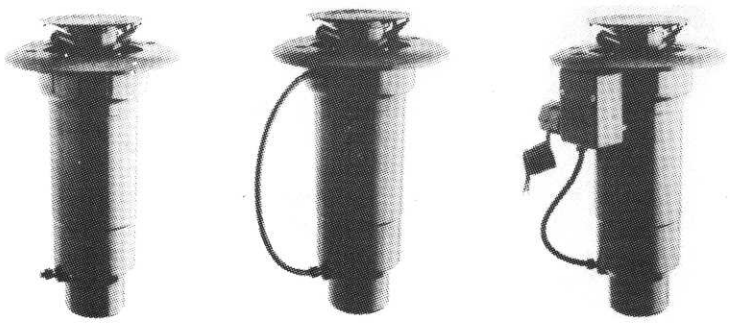

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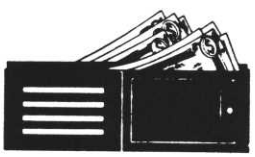

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Movement of Fertilizer Nutrients and Pesticides

(Continued from Page 11)

The dislodgeable residues of some herbicides have been shown to be quite low, particularly for granular formulations or for liquids that have dried (Thompson et al., 1984). As a consequence, the use of granular formulations by commercial applicators has begun to increase. Although granular formulations may not be readily dislodged (less than 1% after 3 days) using a cheese-cloth wipe as in Thompson's research, little is known concerning the runoff potential of granular formulations of broadleaf herbicides. Since application of granular forms of pesticides appears to pose less exposure risk and since they are less conspicuous in urban-suburban settings, it is very likely that the use of granular formulations of pesticides by commercial applicators will dramatically increase each year. Therefore, the effect that granular forms of fertilizers and pesticides applied to turf have on the quality of runoff and percolating water requires documentation as soon as possible.

Objective: To compare the nutrient and pesticide content in runoff and percolating water from turfgrass treated with granular and liquid materials.

Procedure: At the bottom of each of nine sloping plots, the rate of surface runoff and total volume will be determined, and subsamples will be taken for nutrient and pesticide analyses. The collection system is automated to facilitate documentation of peak flow and other hydrological aspects which must be integrated with the water quality data. An automatic irrigation system has been installed so that each runoff site can be individually irrigated to a maximum simulated rainfall of 14.4 cm per hour. When naturally occurring precipitation events result in runoff, the rate and volume will be determined and subsamples will be taken for analyses. The rate of runoff will be continuously monitored during the course of any precipitation event, natural or simulated. Should rainfall be insufficient to cause runoff, the irrigation system will be used to create runoff situations. Pan lysimeters positioned below the root zone (15 cm) will also be sampled following natural or simulated rainfall events, and these samples will be analyzed the same as for those collected during runoff.

As 3 x 3 x 3 factorial design will be used with turfgrass cover type (sodded versus seeded by two methods), fertilizer, pesticides, and date of application as factors. The fertilizer treatment (rate of nitrogen equivalent to 50 kg N/ha applied May, July, and September) will utilize a complete fertilizer (16-8-8) applied in the granular and liquid form using identical nitrogen sources. Irrigation will be applied in sufficient quantity to produce runoff 24 hours after application. Runoff will be continuously subsampled (at 16 ml/min) from the weirs for as long as runoff occurs. The lysimeters will be pumped out four hours after the irrigation has been completed. Nutrient content of the water samples will be determined by standard colorimetric procedures. The zero fertilizer treatment will be fertilized following the irrigation to runoff event to maintain similar turf quality and similar nutrient background levels during the duration of the study. Water samples will be collected for all natural events that produce runoff or leachate. Irrigation to produce runoff will be applied prior to the second and third fertilizer treatments. Turf will be rated for quality throughout the study. For each application timing, granular and liquid broadleaf weed control applications will be made to coincide with the granular and liquid fertilizer applications. Herbicides 2,4-D and dicamba will be used at recommended rates. At the September timing, liquid and granular isazophos will be applied. These fertilizer and pesticide treatment programs will continue over a two-year period. The soil type on the site is a Hagerstown silt loam with a known mechanical and chemical analyzer. Plot slope varies from 9 to 14 percent. Turf quality will be rated on a bi-monthly basis throughout the growing season during both years.

The sensors in a complete weather station on site are also connected to the data logging system, and each runoff plot has a thermocouple buried at 4 cm in the soil. The thermocouples are also connected to the data logger to provide a constant monitor of soil temperature in each plot.

Analytical Procedures

Water samples from runoff or percolated water will be collected to a volume of one liter when possible. Samples will be immediately frozen at the water quality research center. Later, the samples will be transported to the Pennsylvania State University Pesticide Research Laboratory prior to analyses. All analytical work on the water samples will be conducted at the pesticide lab. This laboratory is nationally recognized for its quality and is frequently utilized by industry and governmental agencies for analytical research. Water samples from untreated control areas will be spiked with each pesticide used in the pest management program by personnel from the analytical laboratories. All samples will be logged in and placed in freezers prior to analysis. Freezer control spikes will be prepared at this time. After the samples are thawed, appropriate aliquots will be removed for analysis.

The analytical procedure for dicamba (an herbicide) is illustrated below and is typical of analytical procedures used for other pesticides used in this research.

The samples will be analyzed for dicamba (2-methoxy-3,6-dichlorobenzoic acid, Velsicol Chem. Co. Method Am-0751 and AM-0752). Dicamba and desmethyl dicamba (3,6-dichlorosalicylic acid) will be extracted from aqueous samples with an ion-exchange column. Elution of the column with 0.1 N HCl in methanol and subsequent methylation of the sample with diazomethane provides the methyl ester of dicamba. Following concentration of the solvent to a given volume, aliquots (10 or 25 ml) will be analyzed by gas chromatography or high-pressure liquid chromatography for the methyl ester of dicamba. Aqueous samples spiked with dicamba will be analyzed in the same manner and consist of the recovery checks. Quantification of compounds will be performed by comparison with standard curves obtained from electronic integration and data reduction from standard samples. The analytical procedure proposed above will analyze for dicamba and its desmethyl degradation product together. An alternative procedure requiring diazobutylation will permit the analysis of dicamba and 3,6-dichlorosalicylic acid separately.

Research Timetable: The duration of the project will be one calendar year (April 1, 1990, to March 31, 1991). From May through October, application of treatments, rating of turf for quality, collection of water samples and nutrient analyses will be the primary focus on the research. From November, 1990, to April,

(Continued on Page 23)

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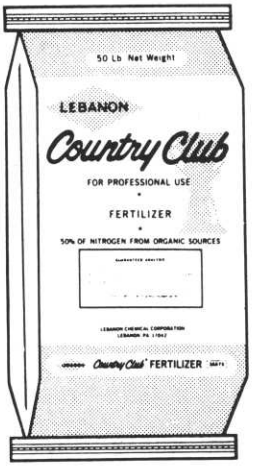

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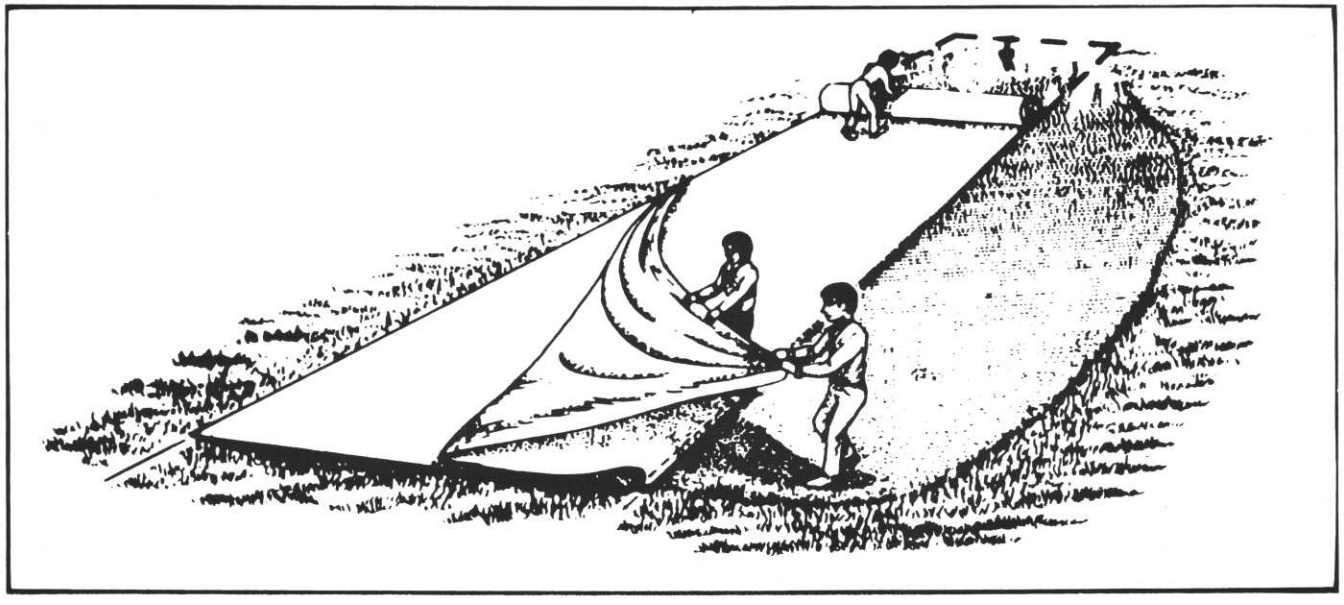

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(Continued from Page 10)

injury when stressed than when there is sufficient water in the plant. This is especially true for pests, such as midge, which require that contact pesticides be sprayed directly into the new shoot areas which contain succulent plant tissue. This new growth is much more susceptible to spray injury than older mature tissue.

Damaged shoot tips or flower buds should be removed to help eliminate the maggots before they complete their life cycle and drop to the ground. However, careful, regular observation is essential for this practice to be helpful. In the case of rose midge, a more preventive approach with a systemic insecticide combined with early removal of infected tissue will usually provide satisfactory control.

Life cycle information adapted from "Insects That Feed on Trees and Shrubs" by Warren T. Johnson and Howard H. Lyon.]

* * * *

The Minnesota Extension Service *has recently published a booklet, Pesticides: Surface Runoff, Leaching, and Exposure Concerns.*

While the information concerns itself mostly with pesticides applied to bare soil surfaces rather than turfed areas, it is an excellent review of fate of many of the pesticides used in agriculture as well as the turf industry. I would highly recommend the publication as one more piece of information to help you address these kind of pesticide issues.

It is available for $1.00 from:
Minnesota Extension Service
Distribution Center
3 Coffey Hall
University of Minnesota
1420 Eckles Avenue
St. Paul, MN 55108

* * * *

The iris borer is the most destructive pest of Iris. As an adult the iris borer is a drab, colored moth with a wing span of about one inch. However, it is the caterpillar stage that does the injury.

The borer winters in the egg stage on old iris leaves and debris at the base of the iris stalks. After hatching in early spring, the caterpillar crawls up and enters into the leaf tissue. During feeding, the tiny caterpillar works its way down the leaf, causing water-soaked, brown streaks. In late summer it reaches the base of the iris and begins feeding on the rhizome.

It is a small, slender caterpillar at first, but by the time it reaches the rhizome, it has grown to 1-1/2 to 2 inches in length. In addition to the feeding injury, the borer introduces a bacteria into the tissue which causes a soft rot. At the end of the summer the iris borer pupates in the soil at the base of the plants, then emerges as a moth in the fall. The female moth lays eggs which overwinter on the old iris plants and the cycle repeats.

Control is difficult. Sanitation and insecticides are both important in the control of iris borer. Remove old leaves and stalks and dispose of any infested or rotting rhizomes. Cleaning up old iris plants in the fall removes the eggs and minimizes the number of iris borers that will be present next year. One application of an insecticide is necessary in the spring.

The timing is very important because the damage is usually not noticed until it is too late for effective control. Dimethoate, the recommended insecticide, should be applied when the iris is four to six inches above the ground. Mix two teaspoons of the 23.4% liquid insecticide per gallon of water [do not mix more insecticide than you plan to use] and spray the iris leaves.

Diamethoate [23.4%]	Water
2 teaspoons	1 gallon
1/2 teaspoon	1 quart

Remaining 1990 MGCSA Meeting Site

Date	Site	Event
October 8	Stillwater C.C.	

How to Care For Birch Trees

By Deborah Brown
Extension Horticulturist
Minnesota Extension Service

Many paperbark birches around the state are looking a bit thin and raggedy. Despite decent rainfall this year, they're still suffering the after effects of the past two summers' drought. Many lost branches to winter kill; others may have been attacked by the bronze birch borer, an insect that moves in when trees are under stress.

Even though birch trees shouldn't be pruned any more than is necessary for health and safety, all dead or dying limbs should be removed or cut back to healthy tissue. August is the best time of year to prune them, regardless of what actually damaged the branches. Wounds will heal rapidly, and the bronze birch borer is no longer active this late in summer.

Pruning paint or wound dressing is not needed. Much research has been conducted over the past ten years, showing that these paints and dressings really don't help the tree—although they may offer some psychological aid to the tree owner. For paperback birch there's another reason not to put anything over the pruning cuts: paint or dressing will contrast with the white bark quite obviously. The wounds will be less visible if left to heal on their own.

If the soil your birch is growing in seems light, sandy or somewhat poor, plan to fertilize it next spring. You might also wish to remove a circle of grass growing right up to the trunk, and replace it with four inches or so of woodchip mulch. This not only helps hold moisture, it keeps the shallow roots cooler in summer. And when we go over a week without rain, by all means, get a soaker hose or sprinklers out under the branches and several feet beyond, to give it a really thorough soaking every 10 to 14 days.

Finally, if all fails and the tree appears doomed, have it taken down. But don't be afraid to plant birch again. River birch, with peeling, cinnamon-colored bark is a tougher tree than the paperback birch. But even the paper birch is worth replanting. It grows fast, and with some additional babying will usually be more than worth the effort.

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METHYLENE UREA	41-0-0 SCOTTS	24.6% WIN

WIN — What is WIN? WIN is the abbreviation for Water Insoluble Nitrogen that will not dissolve in normal temperature water.

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