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Cooperative Extension Service

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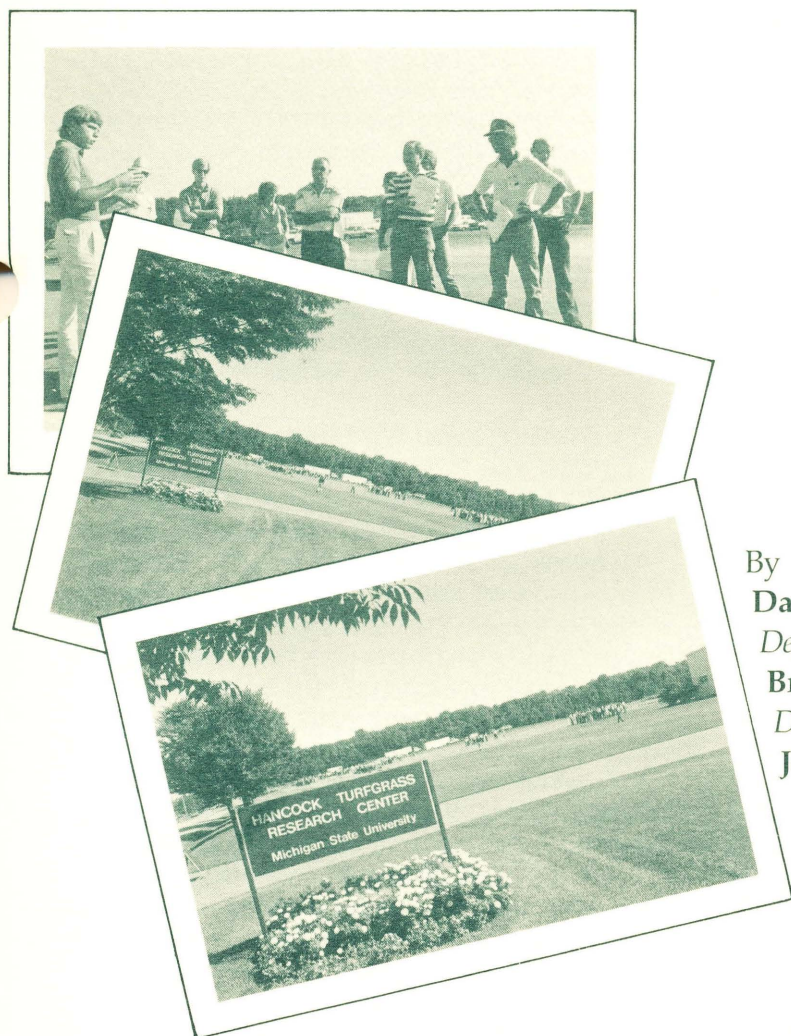
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Insect, Weed and Disease Management on Commercial Turfgrass

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TURFGRASS PEST MANAGEMENT

Maintaining high quality turfgrass for golf courses, lawns or recreational areas requires coupling sound pest management with proper turfgrass maintenance practices.

The first step in preventing weed, insect or disease problems is to grow dense, healthy turfgrass. Proper irrigation, fertilization and mowing will result in dense turf that is relatively free of pest problems. This is true for two reasons: weeds have difficulty becoming established in dense turfgrass stands, and vigorous turfgrass swards can tolerate insect and disease injury by quickly regenerating damaged plants. For instance, turfgrass temporarily thinned in patches by a sudden Japanese beetle invasion can quickly recover once the insects complete their life cycle and stop feeding. Vigorous turf can withstand feeding injury from two or three times the number of beetle larvae that would seriously injure weak or thin turf.

Though a good maintenance program helps reduce pest problems, it will not completely eliminate insects, weeds and diseases. These pests are always present at some level. The insect, disease or weed population that is considered tolerable depends entirely on the turf owner or user. In most cases, turf managers routinely apply herbicides but apply insecticides and fungicides only if they are needed. Decisions to apply turfgrass pesticides should be made only after identifying the pest problem and assessing its potential impact. This publication provides a current list of insecticides, fungicides and herbicides recommended for management of the most common insect, disease and weed pests in Michigan.

An important consideration in choosing a pesticide for a particular pest problem is the impact that pesticide will have on the environment. Some questions to ask about

a pesticide application (other than its efficacy) are:

- Is it harmful to beneficial insects or fungi?
- Is it hazardous to applicators if improperly handled?
- Is it harmful to wildlife?
- Can it directly injure turfgrass under certain conditions?
- What is the potential for runoff to streams and ponds?
- What is the potential for groundwater contamination?
- What is your liability status as an applicator?

All the pesticides recommended in this publication have been legally approved by the Environmental Protection Agency. However, some level of impact in one or more of the categories listed is likely. Applicators should strive to minimize these potential impacts wherever possible. If several pesticides are available, choose one that is relatively safe and has the least expected impact on the environment. One way to do this is to avoid unnecessary pesticide applications. Another is to stay within the labeled application rates.

Pest Control

Despite your efforts to grow healthy plants, insect populations sometimes reach threatening levels that must be controlled with microbial or conventional pesticides.

Pest Identification

If you detect a pest before it can spread or build large populations, control measures generally give satisfactory results. Therefore, the first step in a sound

management program is to identify the problem. Examine turfgrass regularly for stress or signs of pest activity. If you suspect insects or diseases are causing damage, remove a turf sample and send it to the Plant Insect and Disease Diagnostic Laboratory, 41 Plant Biology Building, Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824.

Pesticide Formulations

Insecticides, fungicides and herbicides are available in several formulations: dusts, wettable powders, liquid concentrates, granules, oil emulsions, aerosol sprays, baits and fumigants. Each formulation is best suited for a particular job, so carefully read the label instructions of each product, even if it is a different formulation of a familiar chemical.

LIQUID CONCENTRATES

A liquid concentrate is a high concentration of a pure pesticide chemical dissolved in a solvent. Concentrates are sold in strengths of about 18 to 75 percent. Other materials are added to the concentrate to make the insecticide mix with water. Because they are concentrated, small amounts of the product mixed with water will make an effective spray.

Liquid concentrates may cause plant injury under certain weather conditions because of the solvents they contain. Liquid concentrates are usually best suited to use on landscape plants.

WETTABLE POWDERS

Wettable powders are usually made by impregnating an inert powder with an insecticide and then mixing it in water. When the water evaporates after application, most of the insecticide is left as a residue. Sprays made with wettable powders must be agitated constantly to prevent separation and settling. The powder residue is unsightly. Wettable powders are sold in strengths of 15 to 80 percent. Because they do not contain solvents, wettable powders are

recommended for use on plants that may be injured by solvents.

GRANULES

Granules commonly contain from 1 to 20 percent insecticide impregnated into highly absorptive materials, such as clays, bentonites and diatomaceous earth particles ranging in size from 30 to 60 mesh. Because granules are heavy, using them minimizes drift problems and prevents undue loss of insecticide and undesirable contamination of adjacent areas. Granules are used mainly for soil treatment, not foliar treatment.

SELECTING PESTICIDES

Always thoroughly read the label and the supplemental labeling material for any pesticide that you may consider using. Understand the label instructions and limitations. Make certain your operation will be able to use the pesticide only for the purposes listed and in the manner directed on the label. Select only those pesticides that are labeled for the pest you wish to control and the plant you wish to treat. To do otherwise will cost you, in terms of effective and economical product performance, and may lead to an unacceptable risk to humans, the plant and the surrounding environment.

PESTICIDE EMERGENCY PREPAREDNESS

When you purchase a pesticide, ask the chemical dealer for a complete specimen label of the product. This label and labeling information packet is an exact duplicate of the label information affixed to and/or that must accompany the pesticide container. Use the specimen label material as a reference during any pesticide emergency. Bring the specimen label material along with any person who has been poisoned and needs medical attention.

Follow closely all the warning statements outlined in the "precautionary statements" section of a pesticide label. Be certain you have on hand and use all protective clothing and equipment specified by the label. Make certain that all persons involved in the application operation know




and can carry out the "statement of practical treatment" given on the front panel of all pesticide labels.

TRANSPORTING PESTICIDES

Have your driver deliver chemicals directly to your pesticide storage facility. Transporting pesticides, especially large quantities, can involve a high degree of assumed liability by the applicator. Department of Transportation shipping rules must also be followed when transporting large quantities of pesticides, including proper placarding of the vehicle, liability insurance, special handling requirements, etc.

STORING PESTICIDES



Store pesticides where they will be protected from temperature extremes, high humidity and direct sunlight. The storage facility should be heated, dry and well ventilated. It should be designed for easy handling of pesticide spills and made of materials that will not adsorb any pesticide material that leaks out of a container. Store only in original containers.

Do not store any feed, seed, food or fertilizer with pesticides. Do not store any protective clothing or equipment in the pesticide storage facility. Try to store herbicides separately from insecticides and fungicides -- volatile materials in herbicides will cross-contaminate other materials.

Keep the facility locked when not in use to prevent animals, children and irresponsible adults from entering and becoming poisoned. Post the facility as "pesticide storage facility" to warn others that the area is off-limits. Make a habit of storing pesticides only during the growing season. Also, always read and follow the storage and disposal section of all pesticide labels.

HANDLING AND MIXING PESTICIDES



Always wear protective clothing and equipment when handling, mixing and applying pesticides, and when cleaning application equipment. Protective equipment includes full coverage clothing, chemical-resistant gloves and boots, eye

protection, hard hat and an MSHA/NIOSH-approved respirator with a chemical adsorbent material appropriate for the pesticide you are using.

Mix pesticides below eye level and with your back to the wind. Avoid excessive splashing and sloshing. If you spill pesticides on yourself, wash immediately with large amounts of water and change your clothing. Resume the spray job after cleaning up any accidents. Try to use closed handling/mixing systems whenever possible.

Mix only that amount required to treat the area to be sprayed according to label directions. Avoid mixing excessive amounts -- leftover pesticide is a hazardous waste that is difficult and expensive to discard. Keep unauthorized persons out of the area in which you handle pesticides.

APPLYING PESTICIDES

Before any application, check the equipment thoroughly for sound operation and accurate calibration. Poor maintenance and improper calibration will lead to excessive residues on the crop and can potentially harm humans, animals, plants and the environment. Inspect the application equipment during operation to prevent unintentional release of chemicals. If the equipment needs repair, stop the application operation and fix the problem before completing the job. Spray only the label-directed rate to the target area.

Do not spray when the wind is greater than 5 miles per hour and/or environmental conditions (e.g., inversions) are conducive to pesticide drift away from the target area. Make every effort to avoid pesticide drift.

Warn all unauthorized persons to leave the target area during pesticide application. Warn occupants of properties adjacent to the target area when the pesticide label specifies such precautions.

Application Tips

- Do not apply liquid concentrates at temperatures above 85 degrees F. Do not apply any spray at temperatures

above 90 degrees F. Wettable powder formulations are less likely to cause injury.

- Do not apply dinitro compounds if temperatures are above 90 degrees F or if high temperatures are expected.
- Use only the specified amount of any pesticide.
- Continuous spray tank agitation is required when using wettable powders, granules, emulsions or oils.
- Always clean application equipment thoroughly after each use to ensure uniform application.
- Do not use the same application equipment for insecticides and herbicides.

HANDLING AND DISPOSING OF PESTICIDE

All pesticide containers are considered hazardous waste unless they are triple rinsed and the rinsate is used as additional dilution in the spray mixture. After triple rinsing all empty pesticide containers, perforate both ends so that the container cannot be reused.

All metal and plastic triple-rinsed containers should be offered for recycling. If this option is not available, dispose of them in a state-licensed sanitary landfill. Dispose of all paper containers in a sanitary landfill or a municipal waste incinerator. Do not bury or burn any pesticide containers on personal property. Do not reuse any empty pesticide containers for any purpose.

CLEANING PESTICIDE APPLICATION EQUIPMENT

Follow all label directions for cleaning application equipment. If the label does not give such instructions, triple rinse the entire inside of the application equipment, spraying the rinsate on a labeled site at labeled rates. Wash the outside of the equipment in the target area.

After rinsing with fresh water, clean the spray system with an appropriate cleaning

solution. Do not spray any crop or plant. Dispose of the cleaning solution as you would any municipal waste. Follow the equipment manufacturer's guidelines for routine and year-end cleaning and maintenance.

UNUSED AND UNWANTED PESTICIDES

Unused and unwanted pesticides are considered hazardous waste under both federal and state regulations. Purchase the exact amount of pesticides you will use during the growing season to avoid the stringent disposal requirements of hazardous pesticide waste. Take extreme care during calibration and application operations so that there are no leftovers at the end of a job. Use any pesticide containing rinsates and unused pesticides exactly according to label use directions. If you have leftover pesticides, contact the Michigan Department of Natural Resources Hazardous Waste Division for disposal instructions.

RE-ENTERING TREATED AREAS

Read and follow the label instructions on re-entry for each pesticide you use. Workers or property owners should not work in any treated area until the re-entry period has passed. Any person who has to enter a treated area before the elapse of the re-entry period must wear protective clothing.

PROTECT HONEY BEES

Honey bees and many native bees are important to agriculture because they pollinate numerous fruit, seed and vegetable crops. Cucumbers, melons and other similar crops, for instance, require visits from pollinating insects to produce a crop. Because of the importance of bees, pesticides must be used in such a way as to avoid poisoning them.

Following the guidelines below will minimize the killing of bees when controlling undesirable insects and diseases.

1. Do not apply poisonous sprays when bees are visiting plants in bloom. When there is little difference in effectiveness

between two insecticides, use the one that is less injurious to bees.

2. Avoid leaving puddles when the spray rig is emptied or cleaned. Large numbers of bees will often visit such poisonous puddles.
3. Spray during the evening to reduce damage to bees in flight.
4. Avoid spray or dust drift to blooming crops or weeds in nearby fields.
5. Know the location of nearby hives.
6. Notify the beekeeper if his/her bees are in danger.

FORMULATIONS OF PESTICIDES IN THIS BULLETIN

All formulations of each recommended pesticide are listed in this column. The abbreviations for formulations are:

EC -- Emulsifiable concentrate as lb active ingredient per gal of solution.

E -- Emulsifiable concentrate as lb active ingredient per gal of solution.

%EC -- Emulsifiable concentrate as a percent of active ingredient.

DG -- Dispersable granule.

WDG -- Water dispersable granule.

WP -- Wettable powder as a percent of active ingredient.

SP -- Soluble powder as a percent of active ingredient.

%SL -- Suspension of fine powder in aqueous liquid as a percent of active ingredient.

SL -- Suspension of fine powder in aqueous liquid as lb active ingredient per gal.

EL -- Emulsifiable liquid as a percent of active ingredient.

G -- Granules as a percent of active ingredient.

F -- Flowable as lb active ingredient per gal.

%F -- Flowable as a percent of active ingredient.

SIGNAL WORDS

The signal word that appears on the EPA-approved pesticide label is listed for each recommended product. The table below explains how signal words are chosen for each pesticide. For example, all pesticides that meet any of the hazard indicator criteria (oral LD₅₀, etc.), for a Class I toxicity category are assigned "Danger" as the signal word. A pesticide may be more dangerous when ingested than when skin contact is made, or the reverse may be true. In any case, the pesticide will be assigned to the most toxic category rating determined for any of the hazard indicators. Most of the toxicity categories in the table are defined in terms of LD₅₀. This is the dosage of pesticide necessary to kill 50 percent of the test animals. LD₅₀ figures are always calculated as mg of pesticide per kg of test animal body weight. For example, 50 mg/kg (danger category) means that 1/10 oz ingested would be lethal to a person weighing 150 lb.

SARA TITLE III EMERGENCY PLANNING AND COMMUNITY RIGHT-TO-KNOW ACT

The Emergency Planning and Community Right-to-Know law under SARA Title III requires farmers to notify their State Emergency Response Commission (SERC) if they store extremely hazardous materials. Farmers should check with their state Department of Natural Resources or Cooperative Extension Service to receive a list of EPA-established "extremely hazardous substances" and their reportable quantities.

This list is available in Extension bulletin E-2173, "SARA TITLE III: The Farmer's Responsibility under the Emergency Planning and Community Right-to-Know Law." The SERC may then notify the Local Emergency Planning Committee (LEPC) (or you may have to notify them if the SERC does not), which may request maps of your storage facility and detailed lists of materials you store.

This law also requires that, in the event of a spill, the SERC, LEPC and National Response Commission be notified. The reportable

quantities for spills are much less than for storage and can be obtained from the above sources.

Signal Word and Toxicity Categories (I-IV)

Hazard indicators	Danger I	Warning II	Caution III	Caution IV
Oral LD ₅₀	Up to and including 50 mg/kg	From 50 thru 500 mg/kg	From 500 thru 5,000 mg/kg	Greater than 5,000 mg/kg
Inhalation LD ₅₀	Up to and including .2 mg/liter	From .2 thru 2 mg/liter	From 2.0 thru 20 mg/liter	Greater than 20 mg/liter
Dermal LD ₅₀	Up to and including 200 mg/kg	From 200 thru 2,000 mg/kg	From 2,000 thru 20,000 mg/kg	Greater than 20,000 mg/kg
Eye effects	Corrosive; corneal opacity not reversible within 7 days	Corneal opacity reversible within 7 days; irritation persisting for 7 days	No corneal opacity; irritation reversible within 7 days	No irritation
Skin effects	Corrosive	Severe irritation at 72 hours	Moderate irritation at 72 hours	Mild or slight irritation at 72 hours

When using toxic pesticides in an urban environment, take special precautions. Allow no one in the treated area until spray has completely dried on the plants. Attempt to use Class III and IV pesticides whenever a choice is available.

TURFGRASS INSECT MANAGEMENT

Identification of turfgrass insect pests is the first and most critical step in proper insect management on home lawns, recreational turf, golf courses and sod farms. Visiting problem sites with someone experienced in diagnosing insect problems is the best way to learn. Attending turf tours and educational programs is another way. An excellent reference book that contains 63 pages of color plates is **Turfgrass Insects of the United States and Canada**, by H. Tashiro, Cornell University Press, 1987. Turf experts must become familiar with adult and larval stages of the most important insect pests. Understanding the life cycle of each pest is helpful in diagnosing problems. You need to know what time of year to look for insect pests and the damage they inflict on turfgrass. Abbreviated life cycle and damage information is presented in this bulletin for the most important turf insect pests found in Michigan. For more detailed information, see **Turfgrass Insects of the United States and Canada**.

Management Strategies

After a problem has been correctly identified, an assortment of management strategies should be considered. You can prevent most turf insect problems by using good cultural practices. Home lawns receiving regular irrigation rarely have insect problems. With adequate water and fertilizer, grass plants quickly overcome insect injury. An evenly scattered 10 percent loss of grass plants due to billbug injury will be easily filled in by actively growing, well maintained grass plants. However, a poorly managed lawn may experience an overall thinning effect due to a scattered 10 percent plant loss.

Occasionally, even well managed lawns become infested with annual grubs, webworms or other insect pests to an extent that damage becomes obvious. When turfgrass insect injury is severe, even when the grass is being maintained at the

highest level practical for the situation, an insecticide application should be considered.

It is not beneficial to apply an insecticide to sub-threshold populations of turf pests.

Unnecessary insecticide applications may create several problems, including sometimes even pest problems. Pesticides may destroy beneficial insect predators, such as big-eyed bugs, which prey on chinch bugs. The result is a secondary resurgence of chinch bugs. Also, insecticide applications are potentially harmful to applicators, wildlife and residents if they are not properly applied. If they are correctly applied and the grass is watered after application and then allowed to dry before people or pets walk on it, the insecticides will not be harmful. Finally, we need to become increasingly aware of the potential problems associated with pesticide runoff into storm sewers or streams, as well as movement deep into sandy soils that may contaminate groundwater. For safety and conservation purposes, it is wise to apply insecticides only when they are necessary and then use the safest insecticides that are still effective. You can evaluate the safety factor by considering the signal word on the pesticide label. "Caution" pesticides have the lowest mammalian toxicity and are therefore the safest to use in urban areas. Promote the concept of minimum pesticide impact to conserve natural enemies and reduce risks associated with pesticide application.

Minimum Pesticide Impact

Minimum impact starts with proper cultural practices that reduce the need for insecticide applications. Other ways to reduce impact are to reduce the amount of pesticide applied by treating only heavily infested areas, and to use the lowest effective application rate. Perhaps the greatest potential for reducing pesticide impact is to use biocontrol products,

microbial pesticides, short-residual products, and low-toxicity products wherever possible. Some of these products and their recommended uses are described in Table 1.

When insect-parasitic nematodes become available at competitive prices, it will be

possible to manage most insect pest problems using nematodes or Dipel. One disadvantage of the nematode products is that they require moist soil to be effective.

Table 1. Insecticide products that are relatively safe to use and have minimal environmental impact.

Product	Expected availability	Target insect pest	Impact on insect predators	Impact on aquatic wildlife	Mammalian/human toxicity	Comments
Dipel 2 L	Now	Sod webworm, cutworms, armyworms, caterpillars	None	None	None	
Nematodes	1989-1991	Almost all soil insects and webworms, cutworms	Attack some soil insect predators	None	None	Require moist conditions
Milky spore disease	Now	Japanese beetle, European chafer	None	None	Low	Cost per acre is high
Mavrik	Now	Chinch bugs, others	Toxic to surface predators but short residual activity period.	No runoff expected. Do not allow drift into ponds or streams because of toxicity to fish.	Low	
Sevin	Now	Grubs, webworms, cutworms, billbug larvae, chinch bug	Toxic to predators	Low	Least toxic of available soil insecticides	Toxic to bees

TURFGRASS INSECT PEST INFORMATION

CHINCH BUGS

When to look for damage	June to September. Damage may be difficult to distinguish from drought stress unless irrigation or rain stimulates recovery of surrounding grass.
Preferred turfgrass hosts	Fine fescue.
Damage	Large patches of dry, dead grass in sunny areas of lawn.
Where to look for insect	Examine thatch around base of clumps of grass in sunny areas of lawn.
Resistant cultivars	In home lawns, fescue grasses are more frequently infested than bluegrass. No resistant cultivars are available.
Cultural practices	Irrigated lawns appear to have fewer problems with chinch bugs. Lawns with little or no thatch are less likely to have chinch bugs.
Biological control	Many predators of chinch bugs have been observed. Predators are susceptible to insecticides. Also, a fungal pathogen of chinch bugs, <i>Beauveria</i> sp., is an important natural control.
Threshold	Consider insecticide treatment if chinch bugs are easily found before Aug. 15.

BLUEGRASS BILLBUG

When to look for damage	During July and early August.
Preferred turfgrass hosts	Billbugs prefer Kentucky bluegrass, but they occasionally damage fescue and other grasses.
Damage	General thinning of bluegrass lawns in July or small, dead patches of grass. Small patches may coalesce to form larger patches of dead grass. Pull up injured grass by the blades and examine base for chewing and yellow, sawdustlike frass.
Where to look for insect	Large larvae can be found in soil feeding on grass roots in July and early August.
Resistant cultivars	Bluegrass lawns are most susceptible. The varieties Merion and Nugget seem to be very susceptible. Perennial ryegrass cultivars 'Pennant' and 'Repel' are resistant.
Cultural practices	Adequate irrigation and fertility programs will prevent billbug injury in most cases.
Biological control	Research is needed in this area.
Threshold	Billbug damage is usually observed after it is too late for insecticide treatment. Write down location of all lawns where more than 10% of the grass crowns were chewed by billbug larvae, and apply an insecticide for adults the following May.

JAPANESE BEETLE AND EUROPEAN CHAFER

When to look for damage	In May to June or, more commonly, in August to September. Occasionally old damage is apparent during drought stress in July.
Preferred turfgrass hosts	Young larvae require fibrous roots for normal development. Cultivar of grass is not very important.
Damage	Patches of dead grass with entire root system chewed off. Grass can be lifted like a carpet.
Where to look for insect	Small larvae can be found feeding on grass roots in August. Larger larvae present in root zone in September and late April to June.
Resistant cultivars	None have been identified.
Cultural practices	Irrigation and fertilization help turfgrass compensate for root pruning. Well maintained grass can tolerate 20 grubs per square foot.
Biological control	Milky spore disease -- only for control of Japanese beetle, not very effective against other grubs. Do not use with insecticides. Best on low-value lawns. A nematode pathogen of grubs may be available by 1990.
Threshold	Consider insecticide treatment if you find more than 20 grubs per sq ft in irrigated turfgrass or 5 to 10 grubs per sq ft in non-irrigated turfgrass.

SOD WEBWORM

When to look for damage	First generation damage in June to early July. Second generation damage visible during August and September.
Preferred turfgrass hosts	Most grasses are susceptible, but bluegrass and bentgrass are preferred.
Damage	Look for small brown patches of closely clipped grass. Check thatch in these areas for chunky, green frass and silken tubes.
Where to look for insect	Observe lawns at dusk for small snout moths hovering over grass. Larvae can be found tunneling in the thatch.
Resistant cultivars	Kentucky bluegrass: none released. Perennial ryegrass: endophyte-induced resistance in 'Pennant' and 'Repel'.
Cultural practices	Irrigation helps grass recover from injury.
Biological control	Dipel is effective against sod webworm.
Threshold	Not known.

JUNE BEETLE GRUBS (*Phyllophaga* spp).

When to look for damage	Anytime from May to September when plants are under drought stress.
Preferred turfgrass hosts	Little is known about preferred host plants.
Damage	Patches of dead grass with the root system consumed by larvae in the soil. Grass can easily be pulled up because of the lack of roots. Similar to Japanese beetle injury.
Where to look for insect	These insects have a 2- or 3-year life cycle. Various life stages of the larvae can be found in the root zone from April to September.
Biological control	A bacterium similar to the milky spore bacterium causes a disease of <i>Ataenius</i> larvae. However, milky spore disease products are not effective against June beetle grubs.
Threshold	Consider insecticide treatment if you find more than 3 to 5 grubs per sq ft on non-irrigated turf. These grubs are very difficult to control because they are large and tend to reside deep in the soil. Use the same insecticides recommended for Japanese beetle and European chafer.

BLACK TURFGRASS ATAENIUS

Damage	Similar to damage by other white grubs: grass may die during periods of stress because of severe root-pruning by the larvae.
Biological control	A bacterium similar to the milky spore bacterium causes a natural disease of <i>Ataenius</i> larvae. However, milky spore disease products are not effective against <i>Ataenius</i> larvae.
When to look for damage	First generation: June to mid-July. Second generation: late August to September.
Preferred turfgrass host plants	Large numbers of <i>Ataenius</i> larvae are found mostly on golf courses and less commonly in home lawns.
Where to find larvae	Larvae can be found in the root zone and thatch from June to mid-July and again from late August through September.
Threshold	The number of larvae necessary to cause damage depends on management practices. In general, 30 to 40 per sq ft cause little damage, while 200 to 300 per sq ft may be damaging. Consider insecticide treatment if you find more than 50 grubs per sq ft in golf course fairways or greens.

CUTWORMS

When to look for damage	Cutworms may be found feeding on turfgrass from May to September.
Preferred turfgrass hosts	Adult moths seem to prefer laying eggs in dense grass with high organic matter.
Damage	Cutworms are primarily a problem on golf course greens. Look for small patches of closely clipped grass on greens.
Where to find larvae	The larvae hide deep in thatch during the day and come out to feed at night. Cutworm larvae like to hide in aeration holes. Also, check for them on fairways using a drench of liquid detergent at a concentration of 20 ml detergent per 2 gal water. This forces them to the surface where they are easily observed.
Biological control	Dipel is effective against small cutworms.
Threshold	Consider insecticide treatment when damage is first observed on greens.

Insecticide Recommendations

Insect	Insecticide	Amount per		Signal word	Timing and remarks
		1,000 sq ft	acre		
Annual grubs (European chafer, Japanese beetle)	*Triumph 4 E	1.5 oz	2.0 qt	Warning	Apply insecticide if enough grubs are present to cause damage (> 20 per sq ft for high maintenance turf, and > 10 per sq ft for low maintenance turf). Apply insecticide in 4 gal water per 1,000 sq ft. Use 1/2 inch of irrigation to soak insecticide into soil.
	Oftanol 5 G	0.9 oz	40 lb	Caution	
	Oftanol 2 I	3.0 oz	4.0 qt	Warning	
	Proxol 80 SP	3.7 oz	10.2 lb	Warning	
	Dylox 80 SP	3.7 oz	10.2 lb	Danger	
	Dylox 5 G	3.8 lb	163 lb	Danger	
	Mocap 10 G	2.3 lb	100 lb	Caution	
	Turcam 76 WP	2.0 oz	5.6 lb	Warning	
	*Diazinon AG 500	4.6 oz	6.0 qt	Warning	
	*Diazinon 4 E	4.0 oz	5.5 qt	Warning	
	*Diazinon 5 G	3.0 lb	109 lb	Warning	
	Sevin 4 SL	6 oz	8 qt	Caution	
	Sevin 80 S	4 oz	10.8 lb	Caution	
Ants	Diazinon 4 E	4 oz	5.5 qt	Warning	Ants from underground nests usually reappear 2 to 3 weeks after treatment. Repeat as needed.
	Dursban 4 EC	.75 oz	1.0 qt	Warning	
	Dursban 50 WP	.75 oz	2.0 lb	Warning	
	Turcam 76 WP	1.0 oz	5.6 lb	Warning	
	Mavrik 2F	0.2 oz	8.0 oz	Caution	
Black Turfgrass Ataenius (Adult beetles only)	Dursban 4 E	1.5 oz	2.0 qt	Warning	BTA adults fly from May to early June and again in July and August. Spray for first generation adults May 15-30.
Black Turfgrass Ataenius (Larvae)	Oftanol 5 G	0.9 lb	40 lb	Warning	Treat for larvae when more than 30 per sq ft are found in late June or early July. A second application may be needed for the second generation of BTA grubs in August. Sprayable insecticides listed for BTA larvae are also effective against BTA adults.
	Oftanol 2 I	3.0 oz	4.0 qt	Warning	
	Proxol 80 SP	3.7 oz	10.2 lb	Danger	
	Dylox 80 SP	3.7 oz	10.2 lb	Danger	
	Mocap 5 G	2.3 lb	100 lb	Warning	
	Turcam 76 WP	2.0 oz	5.6 lb	Warning	

*Do not use diazinon on golf courses or sod farms. Do not use Triumph on golf course fairways or sod farms. Triumph may be used on tees and greens in Michigan.

Insecticide Recommendations, continued

Insect	Insecticide	Amount per		Signal word	Timing and remarks
		1,000 sq ft	acre		
Bluegrass billbug (Adults)	*Triumph 4 E	1.5 oz	2.0 qt	Warning	Heavily infested turfgrass can be treated from May 10 to May 30 in central Michigan to control adult weevils.
	Dursban 4 E	0.75 oz	1.0 qt	Warning	
	* Diazinon AG 500	4.6 oz	6.0 qt	Warning	
	Oftanol 2 I	3.0 oz	4.0 qt	Warning	
Bluegrass billbug (Larvae)	Diazinon AG 500	4.6 oz	6.0 qt	Warning	Apply insecticides for control of larvae in late June. Billbug damage is best observed in late July.
	Sevin 4 SL	6.0 oz	8.0 qt	Caution	
	Sevin 80 SP	4.0 oz	10.8 lb	Caution	
	Oftanol 2 I	3.0 oz	4.0 qt	Warning	
	Oftanol 5 G	0.9 lb	40 lb	Warning	
	Turcam 76 WP	2.0 oz	5.6 lb	Warning	
	Proxol 80 SP	3.7 oz	10.2 lb	Danger	
	Dylox 80 SP	3.7 oz	10.2 lb	Danger	
	Mocap 5 G	2.3 lb	100 lb	Warning	
	* Triumph 4 E	1.5 oz	2.0 qt	Warning	
Chinch bug	Mavrik 2 F	0.2 oz	8.0 oz	Caution	Apply insecticide to heavily infested turf in late April for control of overwintering adults, or in late June to July for control of actively feeding bugs. Only one generation per year occurs throughout most of Michigan.
	Dursban 4 E	0.75 oz	1.0 qt	Warning	
	Dursban 50 WP	0.75 oz	2.0 lb	Warning	
	* Diazinon 4 E	3.0 oz	4.1 qt	Warning	
	Turcam 76 WP	1.0 oz	2.8 lb	Warning	
	Oftanol 2 I	2.0 oz	2.7 qt	Warning	
	Sevin 4 SL	6.0 oz	8.0 qt	Caution	
	Sevin 80 SP	4.0 oz	10.9 lb	Caution	
	* Triumph 4 E	1.5 oz	2.0 qt	Warning	

*Do not use diazinon on golf courses or sod farms. Do not use Triumph on golf course fairways or sod farms. Triumph can be used on greens and tees in Michigan.

Insecticide Recommendations, continued

Insect	Insecticide	Amount per		Signal word	Timing and remarks
		1,000 sq ft	acre		
Cutworms	Dylox 80 SP	3.0 oz	8.5 lb	Danger	Apply insecticide to golf course greens, including a 15-ft swath surrounding greens where cutworms are first observed. Repeat as necessary. Watch for damage from early June through August.
	Proxol 80 SP	3.0 oz	8.5 lb	Danger	
	Dursban 4 E	.75 oz	1.0 qt	Warning	
	Dursban 50 WP	.75 oz	2.0 lb	Warning	
	Dipel 2X	.37 oz	1.0 lb	Caution	
	Mavrik 2 F	0.2 oz	8.0 oz	Caution	
	Sevin 4 SL	6.0 oz	8.0 qt	Caution	
	Sevin 80 SP	4.0 oz	10.9 lb	Caution	
	Orthene 75 SP	1.0 oz	3.0 lb	Caution	
Greenbug	Orthene tree and ornamental spray 75 SP	0.5 oz	1.3 lb	Caution	Apply when greenbug damage is first observed.
	Orthene systemic insect control 9.4 % EC	9.0 oz	12.3 qt	Caution	
Phyllophaga grubs (May or June beetle)	*1 Triumph 4 E	1.5 oz	2.0 qt	Warning	Phyllophaga grubs are larger than annual grubs (up to 2 inches long), require three years to complete their life cycle and may feed deeper in the soil. Because of their size and feeding behavior, <u>Phyllophaga</u> grubs are difficult to control with insecticides.
	Oftanol 5 G	0.9 oz	40 lb	Caution	
	Oftanol 2 I	3.0 oz	4.0 qt	Warning	
	Proxol 80 SP	3.7 oz	10.2 lb	Danger	
	Dylox 80 SP	3.7 oz	10.2 lb	Danger	
	Dylox 5 G	3.8 lb	163 lb	Caution	
	Turcam 76 WP	2.0 oz	5.6 lb	Warning	
	*1 Diazinon AG 500	4.6 oz	6.0 qt	Warning	
	*1 Diazinon 4 E	4.0 oz	5.5 qt	Warning	
	*1 Diazinon 5 G	3.0 lb	109 lb	Caution	
	Sevin 4 SL	6 oz	8 qt	Caution	
	Sevin 80 S	4 oz	10.8 lb	Caution	

*1Triumph and diazinon are not to be used on golf courses or sod farms.

Insecticide Recommendations, continued

Insect	Insecticide	Amount per		Signal word	Timing and remarks
		1,000 sq ft	acre		
Sod webworm	Dylox 80 SP	3.0 oz	8.5 lb	Danger	Apply insecticide to golf course greens including a 15-ft swath surrounding greens where sod webworms are first observed. Repeat as necessary. Watch for damage from early June through August.
	Proxol 80 SP	3.0 oz	8.5 lb	Danger	
	Dursban 4 E	.75 oz	1.0 qt	Warning	
	Dursban 50 WP	.75 oz	2.0 lb	Warning	
	Dipel 2x	.37 oz	1.0 lb	Caution	
	Mavrik 2 F	0.2 oz	8.0 oz	Caution	
	Sevin 4 SL	6.0 oz	8.0 qt	Caution	
	Sevin 80 SP	4.0 oz	10.9 lb	Caution	
	Orthene 75 SP	1.0 oz	3.0 lb	Caution	

TURFGRASS WEED CONTROL

The most important step in controlling weeds in turf is to have a dense, vigorous turf. It is difficult for weeds to become established in a properly maintained turf. To maintain a healthy turf requires proper fertilization, timely irrigation and proper mowing. Mowing height is also important -- as the mowing height is raised, the amount of light reaching the soil surface decreases. Many weed species need light to germinate, so a tall, dense turf will help prevent weed seeds from germinating. Thus, proper cultural practices are the first step in a turf weed control program. Herbicide applications are needed to maintain a weed-free turf, however.

Weed problems can be broken down into the categories of broadleaves and grasses. Grasses can be further divided into annual and perennial grasses. Annual grasses are controlled with preemergence (before germination) herbicide applications. Annual grasses can also be controlled postemergence (after germination) but usually with more difficulty. Perennial grasses can be controlled preemergence, but once established, perennial grasses are most difficult to control. Perennial grasses are often turfgrasses out of place, such as creeping bentgrass or tall fescue in a Kentucky bluegrass lawn.

Broadleaf weeds can be either annual, biennial or perennial. No effective preemergence broadleaf herbicide is currently on the market, so weeds are generally controlled postemergence, though some preemergence grass herbicides also control a limited spectrum of broadleaf weeds. A preemergence grass herbicide can therefore also serve as a preemergence broadleaf herbicide.

When trying to control weeds in turf, first identify the weed pests and then pick a suitable control. Consult this handbook or the manufacturer's pesticide label for weeds controlled.

Principles of Broadleaf Weed Control

An effective broadleaf herbicide application program should attempt to control weeds with applications in the fall as the primary vehicle to control broadleaf weeds, applications in the spring to control germinating summer annuals, and summer applications (late June, July and August) as a last resort to control escapees from previous applications. Fall is the best time to control perennial broadleaf weeds and germinating winter annuals and biennials. As a rule of thumb, the younger a plant is, the easier it is to control. Winter annuals are easily controlled with fall herbicide applications. Established perennials are also effectively controlled in the fall because they are actively growing and storing food reserves in their roots, and this increases the movement of herbicide into the roots. Also, non-target injury from volatility and/or spray drift is unlikely because ornamental and vegetable plants are hardening off for the winter. Non-target injury is most likely in the spring when plants are beginning new growth, which is extremely sensitive to most broadleaf herbicides.

Spring applications of broadleaf herbicides are sometimes necessary to control summer annuals and spring-germinating perennials. However, you can achieve control of many of these weeds by selecting a preemergence annual grass herbicide. Products such as DCPA (Dacthal®), pendimethalin (PreM® and Weedgrass Control®) and benefin plus trifluralin (Team®) will provide preemergence control of oxalis and spurge as well as other broadleaf weeds. The spectrum of weeds controlled is not as well documented as it is for the postemergence broadleaf herbicides. Spring is a good time to control weeds, though it's not as good as fall. In the spring, weeds are beginning active growth, though many perennial plants are utilizing reserves

stored in the roots for new top growth and very little food is being translocated to the roots. Herbicide applications at this time may not give acceptable control because the herbicide kills the plant foliage but does not move to the roots, so the plant can regenerate a new shoot system from its root reserves. Therefore, spring applications may not give the expected results, depending on the stage of growth of the broadleaf weeds.

Summer is the most difficult time to control broadleaf weeds. During dry spells, it is often difficult to get as much as 10 percent weed control. When plants are drought stressed, they respond by slowing or stopping growth and modifying their leaves to reduce transpiration. The primary method to reduce transpiration is to increase the waxy coating on the surface of the leaves. The additional wax makes it more difficult for the herbicide solution to stay on the plant foliage and for the herbicide to penetrate the epicuticular wax and enter the plant.

Ester-formulated herbicides are recommended for controlling weeds in summer because the esters are better able to penetrate the waxy surface of the leaves. Spot treating weeds is recommended in the summer to reduce the overall herbicide load applied to the turf and thus reduce the potential for volatility injury to non-target plants.

Difficult to Control Weeds in Turf

The standard broadleaf herbicide in the turf industry is 2,4-D, a broad-spectrum herbicide that is the main ingredient in many of the packaged broadleaf herbicide mixtures currently available. These products provide excellent control of most common turf weeds when applications are properly timed. However, for a handful of broadleaf weeds, different herbicides are needed to get adequate control. These weeds and suggested controls are found in Table X.

Table X. Difficult to Control Broadleaf Weeds

Weed Problem	Herbicide*	Comments
Wild violets (<i>Viola</i> spp.)	Turflon Turflon D Turflon II Buctril Weedone DPC Super Trimec	Very difficult to control; usually requires follow-up application 1 to 4 weeks after first application.
Creeping speedwell (<i>Veronica filliformis</i>)	Dacthal 75 WP Dacthal 6F Turflon D Buctril Super Trimec Weedone DPC	Dacthal is an effective control, as are other products listed. There are 12 other speedwell species and difficulty of control varies. These are beginning to become serious turf weed pests.
Ground ivy (<i>Glechoma hederacea</i>)	Turflon D Super Trimec Weedone DPC	Very difficult to control in summer.
Spurge (<i>Euphorbia supina</i>)	Same as above plus Dacthal, PreM, Team	Can control with spring or preemergence applications of herbicides.
Oxalis (<i>Oxalis stricta</i>)	Same as above	Can control with spring or preemergence application of herbicides.
Prostrate knotweed (<i>Polygonum aviculare</i>)	Same as ground ivy	Difficult to control in summer.

Herbicide Recommendations

Weed problem	Herbicide common name, trade name and formulation	Manufacturer's recommended rate (lb ai/A)	Comments
Annual grasses Crabgrass Foxtails Barnyardgrass			
Goosegrass Preemergence control - new seeding	Siduron - Tupersan 50 W	2-6	Safe on most cool-season turfgrass species; does not give season-long control; reapplication may be necessary. Always apply 1/2 inch of irrigation as soon as possible after application.
Preemergence control - established turf	Benefin - Balan 2.5 G Benefin + Trifluralin (2/1) - Team 2 G Bensulide - Betasan 4 E - Betasan 3.6 G - Betasan, Lescosan, + Presan 7 G + 12.5 G - Betamec 4 L - PreSan 4 E DCPA - Dacthal 75 WP - Dacthal 6 F Oxadiazon - Ronstar 2 G Pendimethalin - Lesco Pre M 60 DG - Weedgrass Control 60 WDG - Turf Weedgrass Control 1.7 G Siduron - Tupersan 50 WP	1.5 - 2 1.5 - 2 7.5 - 10 10.5 2 - 4 1.5 - 3.3 1 - 3 1.5 8 - 12	

Herbicide Recommendations, continued

Weed Problem	Herbicide Common Name, trade name and formulation	Manufacturer's recommended rate (lb ai/A)	Comments
Crabgrass Postemergence - established turf	<p>AMA - Super Methar (Cleary's)</p> <p>CMA - Super Dal-E-Rad Calar 1 lb/gal (Vichem)</p> <p>DSMA - Methar 30 (Cleary's) - DSMA liquid (Riverdale) - Weed-E-Rad 360 (Vichem) - DSMA liquid (Drexel)</p> <p>MSMA - MSMA 4 Plus (Drexel) - Daconate 6 (Fermenta) - Lesco MSMA 6.6</p> <p>Fenoxaprop ethyl - Acclaim1 EC</p>	<p>2 gal</p> <p>2 - 2.5</p> <p>1.8 gal 3.6 lb</p> <p>2.0</p> <p>See label</p>	<p>Methanearsonate products require two applications 10 to 14 days apart for effective control. May cause temporary turf browning.</p> <p>Can injure Kentucky bluegrass.</p>
Annual bluegrass Preemergence - established turf	<p>Same herbicides as listed for preemergence crabgrass control in established turf, except siduron.</p> <p>Ethofumesate - Prograss 1.5 EC</p>	0.75/app.	Preemergence control variable; must have late summer application, Aug. 15-Sept. 1, to assure control of fall-germinating annual bluegrass.
Postemergence - established turf	<p>Ethofumesate - Prograss 1.5 EC</p> <p>Paclobutrazol - Scott's TGR <u>Poa annua</u> control .42 G</p>	<p>0.75/app.</p> <p>0.5</p>	Will discolor turf for 3 to 6 weeks after application.
Yellow nutsedge Postemergence	<p>CMA, DSMA, MSMA - See postemergence control of crabgrass</p> <p>Bentazon - Basagran 4 SL</p>	1	Less risk of turf injury with this product.

Tolerance of established cool-season turfgrass to postemergence broadleaf herbicides

Herbicide	Kentucky bluegrass	Perennial ryegrass	Tall fescue	Fine fescue	Creeping bentgrass
2,4-D	T	T	T	MR	MR
2,4-DP	T	T	T	T	MR
MCP	T	T	T	T	T
Dicamba	T	T	T	T	MR
Triclopyr	T	T	T	MR	MR
Bromoxynil	T	T	T	T	T

T = Tolerant.

MR = Marginally tolerant; herbicide may cause injury under certain conditions.

Tolerance of established cool-season turfgrasses to annual grass control herbicides

Herbicide	Kentucky bluegrass	Perennial ryegrass	Tall fescue	Fine fescue	Creeping bentgrass
Benefin	T	T	T	T	NL
Benefin + trifluralin	T	T	T	T	NL
Bensulide	T	T	T	T	T
DCPA	T	T	T	MR	MR*
Oxadiazon	T	T	T	NL	NL
Pendimethalin	T	T	T	T	NL
Siduron	T	T	T	T	T*
AMA, CMA, MSMA	MR	MR	T	MR	MR
Bentazon	T	T	T	T	T
Fenoxaprop	MR	T	T	T	NL
Ethofumesate	MR	T	MR	MR	MR

T = Tolerant when used according to label directions.

MR = Marginally tolerant; herbicide may cause injury under certain conditions.

NL = Not labeled for use on this species.

* = Not recommended for putting greens or bentgrass at putting green height.

Commonly used broadleaf herbicides in turfgrass

2,4-D Amine

Riverdale Turf Weedestroy D (Riverdale)
Decamine 4 D (Fermenta)
Amine 2,4-D (Gordons)
Formula 40 (Vertac)
Lesco A-4D (Lesco)

2,4-D Ester

Esteron 99 (Vertac)

Mecoprop or MCPP

Mecomec 2.5 and 4 (Gordons)
Lesco Pex (Lesco)
Riverdale Weedestroy MCPP (Riverdale)
Cleary's MCPP (Cleary Chemical)

Dicamba

Banvel (Sandoz)

Bromoxynil

Buctril (Rhone Poulenc)

Chlorfluenol

Breakthru (Andersons)

2,4-D + mecoprop (MCPP)

Chipco Turf Kleen (1:1) (Rhone Poulenc)
2 plus 2 (1:1) (Fermenta)
Lescopar (1:2) (Lesco)
MCPP-2,4-D (1:2) (Cleary Chemical)

2,4-D + dicamba

Phenaban 801 (8:1) (Gordons)
Eight-one selective herbicide (8:1) (Lesco)
Riverdale 81 selective weed killer (8:1) (Riverdale)
Riverdale 101 weed killer (10:1) (Riverdale)

2,4-D + mecoprop + dicamba (amine formulations)

Three-way selective herbicide (1.0.5:0.09) (Lesco)
Trimec (1:0.5:0.1) (Gordons)
Trimec Bentgrass Formula (0.3:1.0.13) (Gordons)
Trexsan (1.0:0.53:0.13) (Mallinckrodt)
Trexsan Bent (0.3:1.0:0.13) (Mallinckrodt)

2,4-D + 2,4-DP

Weedone DPC (1:1) (ester formulation) (Rhone Poulenc)
Weedone DPC Amine (1:1) (amine formulation) (Rhone Poulenc)
Turf D + DP (1:1) (ester formulation) (Riverdale)

2,4-D + 2,4-DP + MCPP

Weedestroy Triamine (1:1:1) (Riverdale)
Weedestroy Triester (0.7:1.0:0.7) (Riverdale)

MCPA + mecoprop + dichlorprop

Riverdale Weedestroy Triamine II (1:1:1) (Riverdale)

MCPA + MCPP + dicamba

Trimec Encore (1:0.46:0.1) (amine) (Gordons)

2,4-D + 2,4-DP + dicamba

Super Trimec (1:1:0.25) (ester) (Gordons)

TURFGRASS DISEASE MANAGEMENT

The term "management" is used in preference to "control", because "control" implies finality and often leads to people's drawing the wrong conclusions. When people think in terms of control, they are often under the misconception that the treatment they are applying will eradicate the disease and that it will disappear and not return. Most diseases appear year after year, however, and sometimes several times during the year. Strategies need to be developed to manage these diseases on a continuing basis. These strategies should include an integrated approach that incorporates any cultural or biological means of managing the disease and applies fungicides only when necessary.

Turfgrass disease management begins with selecting the correct species or cultivars. The improved types of Kentucky bluegrass are the best cultivars for high maintenance lawns. They have resistance to most major diseases, especially melting-out. Resistance to stripe smut can be obtained by planting a blend of three or more of these improved Kentucky bluegrass cultivars. Necrotic ring spot may be a problem on the improved Kentucky bluegrasses, but this disease can be managed fairly well by cultural and biological means. The perennial ryegrasses

currently available have too many diseases to be recommended at this time. They also grow too poorly for most home lawn situations.

Good cultural practices that encourage biological management are important in maintaining a healthy lawn. These include coring, fertilizing and irrigating for the improved Kentucky bluegrass cultivars used on home lawns. Coring should be done once a year, with the soil from the cores reincorporated to help modify the thatch. Early spring or fall is the ideal time for coring. Four to 5 pounds of actual nitrogen per 1,000 sq ft should be applied throughout the growing season. Have soil test done before initiating a fertility program to determine the levels of phosphorus and potassium in the soil. Application of P plus K can then be made more accurately. Irrigate lightly and frequently where necrotic ring spot is a problem. Daily irrigation of approximately 1/10 inch per day is most effective in maintaining high populations of beneficial microorganisms that will help manage necrotic ring spot.

Guide for the control of turfgrass diseases

Disease	Susceptible turfgrass	Cultural	Chemical
Algae	All turfgrasses	Reduce shade. Avoid excessive watering. Improve soil drainage.	Mancozeb (FORE, FORMEC 80, Lesco 4)
Anthracnose (<u>Colletotrichum graminicola</u>)	Bluegrasses Bentgrasses Fescues (red, tall)	Fertilize and irrigate to maintain vigor.	Triadimefon (Bayleton, Proturf Fungicide 7), thiophanate-M (Fungo 50), thiophanate-E (Cleary's 3336), benomyl (Tersan 1991)
Dollar spot (<u>Lanzia</u> and <u>Moellerodiscus</u> spp.)	Bentgrasses Bluegrasses Ryegrasses Fescues	Maintain adequate levels of nitrogen. Remove dew.	Chlorothalonil (Daconil 2787), propaconazol (Banner), anilazine (Dymec, Dyrene), fenarimol (Rubigan), iprodione (Chipco 26019, Proturf Fungicide VI), triadimefon (Bayleton, Proturf Fungicide VII), vinclozolin (Vorlan)
Fairy rings (Basidiomycete - soil fungi)	All turfgrasses	Remove infested sod and soil; replace with clean soil, and reseed or sod. Improve water penetration with aerification or wetting agents.	Methyl bromide or formaldehyde fumigation will eradicate fungus but also kill turf. (<u>Must be licensed to apply.</u>)
Fusarium patch (pink snow mold) (<u>Fusarium nivale</u>)	Bluegrasses Bentgrasses Fescues Ryegrasses	Avoid fall nitrogen applications. Rake leaves and cut short. Control drifting snow; may occur without snow cover.	Triadimefon (Bayleton), benomyl (Tersan 1991), fenarimol (Rubigan), iprodione (Chipco 26019, Proturf Fungicide VI), mancozeb (FORE, FORMEC 80, Lesco 4), mercury chloride (Calo-chlor, Calo-gran), pentachloronitrobenzene (Proturf FFII), thiram (Tersan 75, Thiramad, Spotrete), thiophanate-M (Fungo, Spot Kleen, Topmec), vinclozolin (Vorlan)

Guide for the control of turfgrass diseases, continued

Disease	Susceptible turfgrass	Cultural and biological	Chemical
Helminthosporium leaf spot (<u>Bipolaris sorokiniana</u>)	Bluegrasses Ryegrasses Fine fescue Bentgrasses	Remove clippings. Raise cutting height. Provide adequate levels of nitrogen.	Iprodione (Chipco 26019, Proturf Fungicide VI), chlorothalonil (Daconil 2787), anilazine (Dymec, Dyrene), mancozeb (FORE, FORMEC 80, Lesco 4), vinclozolin (Vorlan)
Melting-out (<u>Drechslera poae</u>)	Kentucky bluegrass	Same as above	Same as above
Necrotic ring spot (<u>Leptosphaeria korrae</u>)	Kentucky bluegrass	Provide adequate nitrogen. Provide light daily irrigation. Lawn Restore	Fenarimol (Rubigan), iprodione (Chipco 26019), Propaconazol (Banner)
Pink patch (<u>Limonomyces roseipellis</u> , <u>L. culmeginus</u>)	Red fescue Ryegrasses (perennial)	Provide adequate levels of nitrogen.	Triadimefon (Bayleton), propaconazol (Banner)
Powdery mildew (<u>Erysiphe graminis</u>)	Bluegrasses Fescues	Reduce shade. Increase air circulation by removing surrounding vegetation.	Triadimefon (Bayleton), fenarimol (Rubigan)
Pythium blight (<u>Pythium aphanidermatum</u>)	Bluegrasses Ryegrasses Fescues	Improve soil drainage. Increase air circulation by removing surrounding vegetation.	Chloroneb (Terramec SP, Proturf Fungicide II), ethazole (Korban, Terrazol), propamocarb (Banol), metalaxyl (Subdue, Proturf Pythium Control), fosetyl-Al (Aliette)
Red leaf spot (<u>Drechslera erythrospila</u>)	Bentgrasses	Fertilize to maintain vigor.	Iprodione (Proturf Fungicide VI), anilazine (Dymec, Dyrene), chlorothalonil (Daconil 2787)
Red thread (<u>Laetisaria fuciformis</u>)	Fescues Ryegrasses Bluegrasses	Remove clippings. Fertilize to maintain vigor.	Iprodione (Proturf Fungicide VI), anilazine (Dymec, Dyrene), chlorothalonil (Daconil 2787)

Guide for the control of turfgrass diseases, continued

Disease	Susceptible turfgrass	Cultural	Chemical
Brown patch (<u>Rhizoctonia solani</u>)	Bentgrasses Bluegrasses Fescues Ryegrasses	Reduce nitrogen levels. Increase air circulation by removing surrounding vegetation.	Anilazine (Dymec, Dyrene), chlorothalonil (Daconil 2787), mancozeb (FORE, FORMEC 80, Lesco 4, Manzate 200)
Rust (<u>Puccinia</u> spp.)	Bluegrasses Ryegrasses	Provide adequate levels of nitrogen. Mow frequently.	Mancozeb (FORE, FORMEC 80, Lesco 4, Manzate 200), chlorothalonil (Daconil 2787), triadimefon (Bayleton, Proturf Fungicide)
Slime molds (<u>Myxomycete</u> spp.)	All turfgrasses	Remove mechanically by mowing or raking.	
Stripe smut (<u>Ustilago striiformis</u>)	Bluegrasses Bentgrasses	Reduce nitrogen. Irrigate to prevent dormancy.	Triadimefon (Bayleton), fenarimol (Rubigan).
Summer patch (<u>Magnaporthe poae</u>)	Bluegrasses	Apply light, frequent watering during dry periods to reduce heat stress. Do not water heavily or deeply. Provide adequate nitrogen.	1. Fenarimol (Rubigan), triadimefon (Bayleton), Propaconazol (Banner) before symptoms are evident; 2. benomyl (Tersan 1991), thiophanate-M (Fungo 50), thiophanate-E (Cleary 3336) after symptoms are evident.
Typhula blight (<u>Typhula incarnata</u> , <u>Typhula ishkariensis</u>)	Bentgrasses Bluegrasses Fescues Ryegrasses	Avoid early fall nitrogen applications. Rake leaves and cut short. Control drifting snow.	Pentachloro = nitrobenzene (PCNB) (Proturf FFII), mercury chlorides (Calo-chlor, Calo-gran)*, phenyl mercury (PMAS)
Take-all patch (<u>Gaeumannomyces graminis</u>)	Bentgrasses	Avoid drought stress.	Fenarimol (Rubigan), propaconazol (Banner)

*Restricted use pesticides.

Some products containing combinations of fungicides for turf disease development

Brand name	Producer	Active ingredients
Proturf Broad Spectrum Fungicide	O.M. Scott & Sons Co.	Phenylmercuric acetate Thiram
Proturf 23-3-3 Fertilizer Plus Fungicide III	O.M. Scott & Sons Co.	Thiophanate-methyl Iprodione
Proturf Fluid Fungicide	O.M. Scott & Sons Co.	Thiophanate-methyl Iprodione
Duosan	Sierra Chemical Co.	Mancozeb Thiophanate-methyl
Snow Mold Turf Fungicide	Lesco, Inc.	Cadmium chloride Thiram
Bromosan-F	W.A. Cleary Corp.	Thiram Thiophanate-ethyl



PESTICIDE EMERGENCY INFORMATION

(Please post in an appropriate place)

For any type of emergency involving a pesticide, the following Emergency Information Centers should be contacted immediately for assistance.

Current as of May, 1989



HUMAN PESTICIDE POISONING

Eastern Half of Michigan

within the Detroit city proper:

***(313) 745-5711**

within the 313 area code:

***1-800-462-6642**

Poison Control Center

Children's Hospital of Michigan
3901 Beaubien
Detroit, MI 48201

Western Half of Michigan

within the Grand Rapids city proper:

***(616) 774-7854**

Statewide

***1-800-632-2727**

Blodgett Regional Poison Center

Blodgett Memorial Medical Center
1840 Wealthy, S.E.
Grand Rapids, MI 49506

Upper Peninsula of Michigan

within the Marquette city proper:

***(906) 225-3497**

Upper Peninsula only:

***1-800-562-9781**

U.P. Poison Control Center

Marquette General Hospital
420 West Magnetic Street
Marquette, MI 49855



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SPECIAL PESTICIDE EMERGENCIES

Animal Poisoning

Your personal veterinarian:

and/or

Animal Health Diagnostic Laboratory, Michigan State University:
(517) 353-1683

Pesticide Fire

Local fire department:

and

Fire Marshal Division, Michigan State Police:
(517) 322-1924

Traffic Accident

Local police department or sheriff's department:

and

Operations Division, Michigan State Police:
***(517) 337-6102**

Environmental Pollution

Pollution Emergency Alerting System (PEAS), Michigan Department of Natural Resources:

***1-800-292-4706**

(Toll free for environmental emergencies)

Michigan Department of Natural Resources, Waste Management Division:

(517) 373-2730

For information on pesticide disposal and local pick-up days:

Pesticides & Plant Pest Management Division, Michigan Department of Agriculture:

(517) 373-1087

*** Telephone Number Operated 24 Hours**