Chapter 10
IPM for School Lawns

Introduction

In schools, lawns often cover several acres, and serve important roles as athletic fields, picnic lunch sites, outdoor classrooms, and general recreational areas for the community at large.

Heavy use of lawns and athletic fields causes stress that predisposes grass to attack by a variety of weeds, pest insects, pathogens, and vertebrates such as gophers and moles. As a result, most pesticides used on school grounds are applied to lawns.

Because the bodies of children and youths are often in direct contact with the grass, use of pesticides on lawns increasingly raises concerns among parents and health professionals. On the other hand, coaches and school administrators are under pressure to insure quality turf for use by students and by community athletic leagues. In addition, the competence of landscape maintenance staff is often judged by the aesthetic appearance of the lawns that surround most schools. These various viewpoints often come into conflict when pests threaten lawns.

The key to lawn IPM is the use of cultural practices that optimize growth of grasses and minimize conditions favorable to pest insects, weeds, or pathogens. The following discussion describes how to implement an IPM approach to lawn care. Since specific methods for managing all possible lawn pests is beyond the scope of this chapter, a general IPM approach is described, followed by complete management programs for two typical lawn pests: chinch bugs and fusarium blight.

Detection and Monitoring

An IPM approach to lawn management begins with a monitoring program. Monitoring entails making regular inspections of the lawn to gather and record site-specific information on which to base pest control decisions. Monitoring enables pest managers to do the following:

- identify the pest(s)
- identify any natural enemies of the pest(s)
- apply preventive methods to reduce the occurrence of pest problems
- determine *if* any treatment is needed
- determine where, when, and what kind of treatments is needed
- evaluate and fine-tune treatments as the pest management program continues over the seasons

Tools used to monitor lawns are listed in Box 10-A.

Developing Background on Local Pests

When beginning a monitoring program, some effort should be made to become familiar with the common pest insects, weeds, and lawn pathogens found in the local area. Learn about their life cycles and how to recognize them. This information can be obtained from the Cooperative Extension Service, located in every county, or from publications listed in the Bibliography at the end of this chapter. It is also important to learn to recognize the natural enemies of common lawn pests, and factor their presence into deciding if treatments are needed and which ones to use.

Gathering Background Data on the Site

The next step in a monitoring program is to map all lawn areas, noting locations of existing pest problems or conditions that can produce pest problems (bare spots, broken sprinkler heads, etc.). Identify the lawn grasses in each area and record the maintenance history of the turf and current horticultural practices. Soil should be tested at representative sites to assess fertility status and requirements. If any pest organisms are present, be sure to get an accurate identification. Many unnecessary pesticide applications can be traced to mistaken identification of pests.

Next, give each major section of lawn an identifying number and prepare a monitoring form for recording ongoing maintenance activities and information about pests and their management in each section of lawn.

You will need to compile an inventory of existing lawn maintenance equipment. In addition to mowers, is there an aerator, de-thatcher, and fertilizer spreader that can handle sludge or other organic materials? Is there a spring-tooth harrow for removing weeds from infields and running tracks? These are useful tools in non-chemical lawn management. Prepare a list of equipment that is needed so it can be worked into the budget

Box 10-A.
Tools Used to Monitor Lawns

The following tools are useful for monitoring lawns. They can be carried in a sturdy bag designed to transport baseball equipment (available at most sporting goods stores). The soil probe with its extension fits snugly in the bottom pocket designed for baseball bats, and everything else fits into an upper zippered area.

- soil probe
- pH meter
- soil thermometer
- 10-power hand lens (magnifying glass)
- watering can and bottle of detergent
- plastic bags for collecting specimens
- clip board and forms for recording data
- a ball of twine or clothesline for taking transects
- a small hand trowel and knife
- camera
- field guides for identifying pests and natural enemies
- pheromone traps for cutworms, sod webworms, etc.

process. Inspect the condition of the equipment. Are mower blades kept sharp? Can mowing height be adjusted easily? Does the equipment have flotation tires to reduce soil compaction?

Developing Pest Tolerance Levels

Most lawns can tolerate some pest presence without compromising appearance or function. The challenge for the pest manager is to determine how much damage is tolerable and when action is needed to keep pest damage within tolerable levels. Since the competing interests in the lawn mentioned earlier must be taken into account when deciding whether or not treatments are warranted, it is good practice to involve representatives of these interest groups in setting pest tolerance levels for lawn areas.

One approach is to work with an IPM advisory committee (discussed in Appendix B) to develop pest tolerance levels for lawns at each school site. Tolerance levels will differ, depending on location and uses of the lawns. For example, tolerance for pest presence on lawns at the front of the school in public view may be lower than tolerance on playing fields behind school buildings. Tolerance levels may also differ depending on the particular pest. For example, tolerance for damage by pest insects or pathogens that can kill large areas of turf, leaving bare soil, may be lower than tolerance for weeds that displace grasses but nevertheless continue to cover soil and serve as a playing surface.

Tolerance levels can be quantified in a number of ways. Box 10-B describes a method for quantifying the amount of weeds growing in a lawn. This permits expression of tolerance levels by percentage of weeds, for example, "up to 25% weed growth is tolerable on the back lawn at the elementary school; only 10% is tolerable on the football field at the high school."

Tolerance for insect damage can be correlated with numbers of insects present and amount of visible damage. For example, white grubs can be monitored by examining several areas of soil underneath the grass. A spade is used to cut three sides of a 1-foot square of grass. The grass is carefully folded back, using the uncut edge as a hinge. Dirt from the roots is removed, and the number of exposed grubs counted. Then the grass can be folded back into place, tamped, and watered in. In well-managed lawns, up to 15 grubs per square foot can be present without causing any appreciable damage to the turf. In stressed or poorly managed lawns, however, 15 grubs per square foot might seriously damage the grass.

By setting tolerance levels, pest managers and groundskeepers can gear their management efforts to keeping pest populations within tolerable levels, and apply treatments only if, when, and where necessary. By involving members of the school and community in setting treatment guidelines, confrontations can be minimized and broad support developed for the IPM program.

Evaluating Pest Management Practices

When actions are taken to reduce pest presence, monitoring data should be used to evaluate the effectiveness of the treatment. Did pest numbers go down sufficiently to prevent intolerable damage? Were treatments cost-effective? Is the problem likely to recur? Can conditions causing chronic pest problems be altered or removed? If not, can other ground covers better suited to conditions at the site replace the lawn?

Box 10-B.
The Transect Method for Monitoring Weeds in a Lawn

1. At the beginning and at the end of the season, establish three parallel transect lines along the length of the field. Use the center of the field and two imaginary lines on either side.

   Note: Three transects will give sufficient data to indicate percentage weed cover in the total turf area. If time is limited, information recorded from one transect across a representative area of turf (e.g., down the center of the field) may give sufficient indication of weed trends for management purposes.

2. Calculate the number of paces you will walk between samples.

   a. Measure the length of one of your transect lines in feet (e.g., 360 ft).

   b. Measure the length of the pace of the person doing the transect. To do this, slowly walk a known length (e.g., 20 ft), count the number of paces it takes to cover this distance (e.g., 10 paces), and divide the distance by the number of paces (20 ft divided by 10 paces = 2 ft per pace) This figure represents the average length of the pace.

   c. Divide the length of the field by the length of the pace (360 ft divided by 2 ft per pace = 180 paces). This establishes the number of paces it takes to walk the transect.

   d. Divide the number of paces by the number of samples to be recorded (a minimum of 20 samples is recommended): 180 paces divided by 20 samples = 9 paces per sample. Thus, in this example, a sample will be taken every 9th pace along the transect.

3. Stretch lines of string along the three transect lines, laying the string directly on the ground.

4. Beginning at one end of the first transect, walk the calculated number of paces (9 paces in the above example), stop and look at a 3 x 3 inch area (this is about the circumference of a softball or the lid to a 1 lb coffee can) immediately in front of your toe.

   If this area contains part or all of a weed, check the 'yes' box on the first line under 'Transect A' on the monitoring form (see Figure). If you know the identity of the weed, write it down.

   If the toe sample area contains grass, check the 'no' box on the monitoring form. If 25% or more of the toe area sample is bare soil, check the box marked 'bare.' If less than 25% is bare, but a weed is present, check 'yes.'

   Continue pacing the transect line and marking the monitoring form. Repeat along the two other transect lines.

5. To calculate the average percentage of weeds, total the number of boxes marked 'yes' in each column and multiply by 100. Divide this number by the total boxes in all columns. The resulting figure represents average percent weed cover in the turf. Do the same calculation with the boxes representing bare ground. This will indicate percent area that will become weedy if not seeded to grass.

6. By collecting data from the transects at the beginning and end of each season, the turf manager can spot emerging problem areas. For example, if several boxes in succession are marked 'yes' indicating weed presence, a closer look at this area on the transect is warranted. Usually such 'clumping' of weed growth indicates exceptionally heavy wear on the turf, although structural problems such as severely compacted soil, a broken irrigation line, inoperative sprinkler head, scalping of the turf due to uneven grade, etc., also may be indicated.

   By monitoring the turf area from season to season, the manager can tell if weed populations are rising, falling, or remaining relatively stable. This information will indicate whether or not current turf management practices are keeping weeds at or below the agreed-upon tolerance level. If weed populations are rising, changes in management practices are indicated.

Weed Monitoring Form for Turf

Location of Turf ____________________ **Date** ________________________
Data collected by ____________________ **Length of pace** ________________
Distance between sampling points on transect
(for example, every nine paces)
Number of transects ________________ **Length of transects** ____________
Sketch of location of transects

	Transect A					Transect B					Transect C			
	Yes	No	Bare	Weed I.D.		Yes	No	Bare	Weed I.D.		Yes	No	Bare	Weed I.D.
1					1					1				
2					2					2				
3					3					3				
4					4					4				
5					5					5				
6					6					6				
7					7					7				
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16					16					16				
17					17					17				
18					18					18				
19					19					19				
20					20					20				

Average % weed growth________________ Average % bare area____________________

Total the number of boxes marked 'Yes' in each column. Multiply this number by 100 and divide by 60 [total number of samples taken]. The result is the average percentage of weeds growing in the turf area. Follow the same procedure to calculate percentage of bare area.

Management Options

When pest numbers threaten to exceed tolerance levels (i.e., the action level is reached), there is a wide variety of strategies and tactics available to solve any lawn pest problem. The first approach is to address conditions causing stress to lawns.

Stress and Pests

The pest problem of greatest concern on school lawns—and target of highest pesticide use—is growth of weeds, such as dandelions *(Taraxacum officinale)* or crabgrass *(Digitaria* spp.). Presence of weeds is a symptom of a lawn undergoing stress—a common occurrence on school lawns and athletic fields. Lawn stress can contribute to the development of insect and disease problems as well.

Sources of stress include levels of use unsuited to the grass species that has been planted, compacted soils, improper mowing heights, too much or too little irrigation or fertilization, accumulation of thatch, and uneven grading.

Knowing the identity of the pest and something about its biology often reveals the specific source of stress. By relieving the stress, the pest problem can be reduced or eliminated. For example, the weed yellow nutsedge *(Cyperus esculentus)* grows best in waterlogged soils—indicating a faulty or broken irrigation valve or a low spot in the lawn. The presence of chinch bug *(Blissus* spp.) damage, on the other hand, indicates drought stress, while brown patch disease, caused by the fungus Rhizoctonia solani, suggests excessive fertilization with soluble nitrate fertilizers.

Reducing Stress on Lawns

The best method for reducing stress on lawns is to employ good horticultural practices during lawn installation and maintenance. Even where budgets are limited, key sources of stress can be avoided or diminished by minor changes in maintenance practices, such as raising the mowing height or changing fertilizer formulations. The following lawn care suggestions will help keep pest problems to a minimum.

Maintaining Healthy Soil

The most vigorous lawn growth occurs in loose, loamy soils teeming with beneficial microorganisms, insects, worms, and other organisms. These organisms play critical roles in transforming thatch and grass clippings into humus. Humus slowly releases nutrients and buffers grass roots from extremes of drought or other stresses. Soil organisms also play an important role in biological pest control. For example, certain beneficial microorganisms protect lawn roots from attack by soil pathogens or insects such as white grubs.

The presence of humus in the soil is key to a healthy soil ecosystem. The best way to improve poor soils and maintain healthy soils is to insure that organic matter is routinely replenished by leaving grass clippings to decompose, and fertilizing or topdressing with organic materials such as sludge, composted manure, etc.

Planting Appropriate Grass Species

School lawns are subject to high levels of use and wear, and maintenance budgets are usually low. Thus, select blends of grass species tolerant to such conditions and resistant to local pest problems. Check with the Cooperative Extension Service closest to your school for recommendations suited to local climate and conditions. In temperate areas of the country, a seed mix favored by many schools is 80% fine bladed tall fescue *(Festuca arundinacea)* and 20% perennial ryegrass *(Lolium perenne)*. This mix is highly tolerant of drought, wear, and low fertility. Depending on the varieties of tall fescue or perennial ryegrass selected, the mix is also resistant to certain pest species.

'Mustang' tall fescue is resistant to the turf diseases brown patch and melting out. Many tall fescue grasses also release chemicals into the soil that prevent competition from lawn weeds such as crabgrass and purslane. In southern and western states where sub-tropical grasses are grown, centipedegrass and 'Floratam' St. Augustinegrass are resistant to chinch bugs.

Reducing Soil Compaction

When lawns are heavily used, or simply mowed on a regular basis, the soil eventually becomes compacted, and the pore spaces that allow water and air to pass through the soil become compressed, creating adverse conditions for root growth. Compaction can be reduced through aeration, topdressing, and rotation of mowing patterns.

Aeration involves removing plugs of grass to improve air exchange and water penetration into the soil. Ideally, heavily used turf should be aerated two to four times per year, although even a single aeration is better than none. Since aerating can provide a seedbed for problem weeds, you should time aeration operations to avoid periods when heavy seeders such as crabgrass are germinating or setting seed.

Follow aeration with a topdressing of composted sludge along with seeds of the desired lawn grass. Drag the lawn with a piece of cyclone fencing to break up cores of soil left by the aerator and to fill in holes with the topdressing material.

Mowers and other maintenance equipment compact the soil. By rotating the point of mower entry onto the lawn from week to week, compaction at entry points can be minimized.

Raising the Mowing Height

Most temperate grasses used on school lawns (tall fescues, perennial ryes, bluegrasses, etc.) can be mowed at a height of 2 1/2 to 3 inches without sacrificing vigor or function as ball fields or recreational areas. Similarly, subtropical grasses such as St. Augustinegrass or centipedegrass can be mowed at 1 to 1 1/2 inches. The taller the grass can be kept and the denser the canopy, the greater the interception of available sunlight. By keeping the soil shaded, weed seeds are less likely to germinate.

Adjust mowing frequency to changes in the growing season. Weekly intervals may be appropriate when grasses are growing vigorously, but when grasses are semi-dormant, 14 or 21 days may be more appropriate. The right interval between mowings allows grasses to recover from the previous cut and enter the second growth phase when new blades, called tillers, are produced from the growing points. "Tillering" keeps lawns growing in a tight, dense manner that discourages weeds.

Careful Irrigation

Too much or too little water stimulates pest problems. For example, many lawn diseases result from excessive irrigation. Development of a disease can often be arrested by letting the lawn dry out, then keeping irrigation to a minimum.

The length of time needed to adequately water lawns is determined by the time it takes to wet it to the depth of the root system. Most lawn grass roots extend 4 to 6 inches in the soil, but because grasses and soil conditions differ, irrigation schedules must be tailored to individual lawns and adjusted for seasonal changes. Infrequent, deep irrigation is preferred since frequent, shallow watering promotes shallow rooting. Use a soil probe or a pointed tool such as a screwdriver to determine when soil is wet 4 to 6 inches below the soil. This will indicate how long to leave sprinklers on at each irrigation.

Irrigation equipment should be checked to insure that it is in good repair and that all areas of lawn receive adequate coverage. Low spots should be leveled or drained to avoid waterlogged soils that favor weeds and pathogens.

Keeping Thatch to a Minimum

Thatch is the accumulation of dead but undecomposed roots and stems that collects in a layer at the soil surface. If the thatch becomes excessively deep—greater than 3/4 inch—water and nutrients do not penetrate the soil adequately. When water puddles on thatch, it enhances the habitat for disease organisms. Regular aeration keeps thatch at an acceptable level, and the use of organic fertilizers such as composted sewage sludge promotes thatch decomposition. Synthetic chemical fertilizers, on the other hand, actually enhance thatch development. Excessive layers of thatch can also be removed with de-thatching rakes, or with power de-thatchers available from equipment rental companies.

It is wise to seed the area with desired grasses wherever lawns are thinned by de-thatching procedures. The seeds can be mixed into the topdressing (soil amendments or organic fertilizer) that is customarily applied to thinned lawns. The grass seedlings usually out-compete weeds that attempt to occupy the openings.

Fertilizing with Restraint

Excessive nitrogen fertilizer produces weak grass blades with thin cell walls that are susceptible to pest attack. A soil test should be obtained before planning annual fertilization programs. Only the levels of nutrients needed should be applied. Split applications (one in spring, one in fall) should be used, rather than a heavy single application in the spring. Use slow-release fertilizer to prolong the availability of nutrients throughout the growing season. When feasible, organic fertilizers such as sludge or compost are preferable because they provide organic matter to support soil microorganisms and improve soil health.

Fertilization can be used to directly suppress weeds and lawn pathogens. A study by Ohio Extension Service researchers in the 1940s showed that an application of 20 lbs. of composted poultry manure per 1000 ft^2 of lawn in late fall and early spring stimulated early spring growth of lawn grasses, enabling them to crowd out crabgrass. In this study, crabgrass was reduced by up to 75% within one year.

A recent study by Cornell University researchers *(Hummel and Thurn 1992)* showed that monthly applications of Sustane®, a composted turkey litter (NPK 5-2-0), at a rate of 1 pound of actual nitrogen per 1000 sq. ft., suppressed pink and gray snow mold *(Microdochium* spp. and *Typhula incarnata*, respectively), summer patch *(Magneporthe poae)*, dollar spot *(Lanzia spp.)*, and brown patch *(Rhizoctonia solani)*.

Direct Pest Suppression

When the horticultural methods listed above are not sufficient to solve the pest problem, direct suppression methods including physical, biological, and chemical controls can be integrated into the program.

Physical controls include using a flamer to spot-treat weeds, or using a bamboo pole to flick off dew from grass blades in the early morning to deny nourishment to lawn pathogens. Biological controls include applying microscopic insect-attacking nematodes to kill soil-dwelling white grubs, or topdressing lawns with microbially enhanced soil amendments to kill lawn pathogens. Chemical controls include insecticidal oils, insecticidal and herbicidal soaps, botanical insecticides such as neem oil, and pyrethrin.

Chinch Bugs

Chinch bugs *(Blissus* spp.) are the most important of the "true bugs" (order Hemiptera) that become pests on lawns. Several species of chinch bug are serious pests of a variety of lawn grasses. The southern chinch bug *(B. insularis)*, prevalent in the warm climates of the southeast, south, and parts of the west, feeds primarily on St. Augustinegrass, but it also feeds on bermudagrass and zoysiagrass. The hairy chinch bug *(B. hirtus)*, a pest in the northeast, particularly from New Jersey to Ohio, feeds on bentgrasses, bluegrass, and red fescue.

Identification and Biology

Adult chinch bugs overwinter in dry grass and other debris that offers them protection. In spring or early summer, depending on temperature and moisture, overwintering females lay from 200 to 300 eggs on leaves of grass, or push them into soft soil and other protected places. Young nymphs (the immature stages) emerging from the eggs are bright red with a distinct white band across the back. The red changes to orange, orange-brown, and then to black as the nymph goes through five growth stages.

Nymphs range from about 1/20-inch long soon after hatching to nearly the size of the 1/4-inch long adult. The nymphs mature into adults, which are black with a white spot on the back between the wing pads. The adult stage of the southern chinch bug can live 70 days or more; hairy chinch bug adults live only 8 to 10 days. Adult southern chinch bugs tend to move by walking, whereas hairy chinch bug adults fly. In the spring, adults can be seen flying to new areas.

The development time of eggs, nymphs, and adults is directly dependent upon temperature, and thus varies from one part of the country to another. Development of one generation, from egg to adult, can take six weeks at 83°F and 17 weeks at 70°F. Chinch bugs produce up to seven generations per year in southern Florida, but only three to four generations in northern Florida, two generations in Ohio, and one in New Jersey.

Damage

Chinch bugs suck the juices from grass leaves through their needle-like mouthparts. They also inject a toxic saliva into the plant that disrupts the plant's water-conducting system, causing it to wilt and die. Most damage is caused by nymphs that concentrate in limited areas together with the adults and feed on the same plants until all the available juice has been extracted from the grass. This feeding pattern results in circular patches of damaged grass that turn yellow and then brown as they die. In the yellow stage, the grass superficially resembles grass that is drought-stressed. As it dies, the chinch bugs work outward from the center of the infestation, destroying a larger area as they advance.

Populations of chinch bugs increase under hot, dry conditions. In wet, cool years, or when lawns are kept properly irrigated and not over-fertilized, the chinch bug populations decrease significantly.

Detection and Monitoring

Lawns can be protected from damage by chinch bugs through regular monitoring. The objective is to detect pests while their populations are still small and determine whether their natural controls—such as adverse weather, other insects, and diseases—will keep the population low enough to prevent damage.

Any lawn can tolerate a low population of chinch bugs and most other pests without sustaining significant

Box 10-C. How To Count Chinch Bugs

Flotation Method

If you see damage that you suspect has been caused by chinch bugs but you cannot see the bugs themselves, try the flotation method. Cut the ends off a 2-lb. coffee can, then push one end of the can a few inches into the sod. If this is difficult, use a knife to cut the ground around the perimeter of the can. Fill the can with water; if it recedes, fill it again. If chinch bugs are present, they will float to the surface in 5 to 10 minutes.

If you are monitoring before you have seen any sign of chinch bug damage, the flotation method should be used in four or five random locations around the lawn. If damage has already occurred and you are trying to diagnose the cause, place the can at the edge of the damaged area to detect nymphs that have moved to the perimeter of the damage to feed on fresh grass.

Soap-and-Flannel-Trap Method

Put 1 fluid oz. of dishwashing soap in a 2-gal. sprinkling can and drench a 2 ft^2 area of lawn where you suspect there are chinch bugs. Watch the area for two or three minutes. Larger areas can be covered by putting the detergent in a hose attachment designed to hold pesticides for spraying the lawn. If chinch bugs are present, they will crawl to the surface of the grass.

Next, lay a piece of white cloth, such as an old bedsheet or a piece of white flannel, over the area treated with the soapy water. Wait 15 to 20 minutes, then look under the cloth to see if chinch bugs have crawled onto it as they attempt to escape the soap. Their feet tend to get caught in the flannel's nap. Pick up the cloth and either vacuum it or rinse it off in a bucket of soapy water to remove the bugs. The vacuum bag should be disposed of so that the bugs will not return to the lawn.

This method can also be used to monitor for other insects such as lawn caterpillars, mole crickets, and beneficial insects that feed above the soil, but it will not bring soil-inhabiting grubs or pillbugs to the surface.

damage. If the monitoring techniques described below indicate that there are fewer than 10 to 15 chinch bugs per square foot, generally no action is needed.

It is a good idea to begin monitoring as early as mid-April in south Florida, mid-May in Ohio, and early June in New Jersey, before overwintering adults have finished laying their spring eggs. A quick check of the lawn once a month during September should be sufficient in most areas.

Chinch bugs produce an offensive odor that advertises their presence, especially when populations are high or when they are crushed by foot traffic. Since nymphs tend to congregate in groups, it is important to check several areas of the lawn. Infestations often begin on the edges of lawns, particularly in sunny, dry spots, so check these areas carefully. Spread the grass apart with your hands and search the soil surface for reddish nymphs or black adults. Chinch bugs may also be seen on the tips of grass blades, where they climb during the day. Be certain to distinguish between the pest chinch bugs and their predators, the big-eyed bugs, which they superficially resemble. Box 10-C describes two methods of counting chinch bugs.

Management Options

Physical Controls

Chinch Bug-Resistant Grass Cultivars

If chinch bugs are a chronic problem, it may be advisable to replace existing grass with a type that is resistant to chinch bugs. In southern states, centipedegrass or the St. Augustinegrass variety 'Floratam,' are not attacked by chinch bugs. In other parts of the country, try perennial ryegrass varieties such as 'Repell,' 'Score,' 'Pennfine,' and 'Manhattan' or Kentucky bluegrass varieties such as 'Baron' and 'Newport.'

Habitat Management

Chinch bugs are attracted to lawns that have an excessive buildup of thatch, are insufficiently irrigated (often due to soil compaction), or have either too little nitrogen or too much in a highly soluble form that forces grass to grow too rapidly. The discussion of good lawn culture provided at the beginning of this chapter includes suggestions on overcoming these problems. Proper habitat management will go a long way toward controlling these bugs.

Manual Removal

Small populations of chinch bugs can be removed from the lawn using the soap solution and white flannel cloth method described in Box 10-C. This is particularly appropriate when damage is just beginning to appear, since at this stage chinch bug nymphs are still congregated in specific locations and can be collected efficiently. Small vacuums may also be helpful.

Biological Controls

One of the primary tactics for the biological control of chinch bugs is conserving its natural enemies. At least two beneficial organisms often move in to feed on chinch bugs: the big-eyed bug and a tiny wasp. The big-eyed bug (Geocoris spp.) superficially resembles a chinch bug, so pest managers must learn to distinguish between the two. According to Ohio State University turf specialist Harry Niemczyk, "the body of the chinch bug is narrow, the head small, pointed, triangular-shaped, with small eyes, while the body of the big-eyed bug is wider, the head larger, blunt, with two large prominent eyes. Big-eyed bugs run quickly over the turf surface and are much more active insects than the slower-moving chinch bugs."

Although big-eyed bugs cannot be purchased from insectaries at this writing, recent research indicates that members of this genus can be reared easily and inexpensively, so they may become commercially available in the near future.

The tiny wasp Eumicrosoma beneficum can parasitize up to 50% of chinch bug eggs under favorable conditions. It should be noted that common insecticides such as chlorpyrifos and herbicides such as simazine significantly reduce populations of these biological control organisms in lawns, thus triggering repeated pest outbreaks.

Chemical Controls

If non-chemical methods alone prove insufficient to solve the problem, then integrating a pesticide into your management program may be warranted. For information on the hazards of various pesticides and on how to select an appropriate pesticide for your situation, consult Appendix G for a list of resources.

If pesticide use seems necessary to bring a serious chinch bug infestation under control, insecticidal soap or pyrethrin should be considered.

Fusarium Blight

Many schools throughout the U.S. have planted lawns of Kentucky bluegrass, a species that is particularly susceptible to a disease called fusarium blight, caused by the fungus, *Fusarium culmorum.*

Identification and Biology

Infected turf has small, circular, 2-inch spots of dead and dying grass that often enlarge to 24 inches in diameter. Spots begin as dark blue to purple wilted turf and turn straw-colored to light tan when dead. The grass in the center of each spot may remain healthy and become surrounded by a band of dead turf—a symptom called "frog eye." Both the leaf blades and the basal crown may be affected.

Fusarium blight is a warm-weather disease that can occur from late June through early September, depending on the location. It usually appears after a week or two of dry weather following a heavy rain and is associated with shallow-rooted grass, which is highly vulnerable to drought stress. Symptoms often appear first along sidewalks and in poorly drained areas. The disease primarily attacks Kentucky bluegrass when it is kept in a lush, over fertilized state in summer. Kentucky bluegrass varieties 'Park,' 'Campus,' 'Fylking,' and 'Nuggett' are particularly vulnerable. Annual bluegrass and fine-leaf fescues are also affected.

Management Options

Physical Controls

Planting Resistant Grasses

Consider modifying or replacing highly susceptible Kentucky bluegrass lawns with a mix of species such as tall fescues and perennial ryegrasses or, in subtropical climates, bermudagrass or St. Augustinegrass. 'Columbia' is one bluegrass variety that is resistant to fusarium blight.

The increased drought- and heat-tolerance of perennial ryegrass, tall fescue, and other varieties is one of the factors thought to explain the suppression of disease. Simply adding 10 to 15% of these other grasses to a Kentucky bluegrass lawn can greatly reduce the incidence of fusarium blight. The County Cooperative Extension Service can provide information on cultivars that grow well in your area.

Fertility Management

Kentucky bluegrass naturally slows its growth during warm summer months because it does not tolerate high temperatures well. It is important not to over fertilize. Excessive nitrogen produces lush, soft growth more vulnerable to attack by the disease. A moderate but balanced fertilizing program should be maintained so that the lawn can produce growth to cover damage. Slow-release fertilizers, especially composted sludge or manure, is desirable. The highly soluble fast-release nitrogen fertilizers should be avoided.

Aeration

Fusarium blight is exacerbated by compacted soils, excessive thatch, and soil layering, all of which inhibit the percolation (seeping) of water into the soil.

Diseased turf should be aerated with a coring tool (see the discussion at the beginning of the chapter under Reducing Soil Compaction) to reduce compaction and thatch and increase infiltration and soil air movement. Coring also helps integrate the dissimilar soil layers that occur when imported topsoil or sod is used to establish the lawn. When one soil type is laid on top of another, water tends to collect at the boundary, moving laterally rather than vertically. Grass roots tend to stop growing when they reach this boundary, and can die in the excessively wet soil. By coring into the layered soil and incorporating compost, both water and roots are encouraged to move more deeply into the soil, producing more vigorous growth.

Water Management

Supplemental irrigation will help drought-stressed grasses outgrow fusarium blight. It may be necessary to irrigate daily at the hottest times of the day until the grass resumes vigorous growth. Thatch management and removal of infested grass blades after mowing are also effective controls.

Biological Controls

Because fusarium blight primarily attacks roots, the more you can do to increase the number of beneficial microbes in the soil that are antagonistic to the pathogens, the fewer problems you will have.

Studies (Vargas et al. 1989) have shown that a number of products on the market can do just that and thus can help a lawn recover from the necrotic ring spots associated with fusarium blight. Researchers tested these products on lawns with ring spots and found that after 3 years all treated lawns had recovered 100% whereas the number of ring spots on untreated lawns had increased by 300%. The products tested were the following:

- Soil Aid®—contains an enzymatic wetting agent that helps to flush substances that are toxic to beneficial soil microbes out of the soil and the thatch
- Green Magic®—contains a variety of soil nutrients, beneficial microbes, and various plant extracts
- Strengthen & Renew®—contains the same kinds of ingredients as Green Magic
- Lawn Restore®—a fertilizer that consists of bone meal, feather meal, soybean meal, and other protein sources supplemented with beneficial microbes.

All the products were applied twice in the summer and once in the fall at a rate of 1-lb per 100 square feet. Soil Aid was used along with either Green Magic or Strengthen & Renew. Lawn Restore was used alone.

The researchers stress the importance of frequent treatment when using biological approaches to managing lawn diseases, “These products are not like fungicides that can be applied one time, halting the spread of the fungus and allowing the grass to recover. In order to be effective, such products must be applied on a regular basis, either monthly or bi-monthly throughout the growing season to change the biological makeup of the thatch and soil environment.”

Chemical Controls

If non-chemical methods alone prove insufficient to solve the problem, then integrating a pesticide into your management program may be warranted. For information on the hazards of various pesticides and on how to select an appropriate pesticide for your situation, consult Appendix G for a list of resources.

The Cooperative Extension Service should be consulted for information on fungicides registered for use against this pathogen.

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