# IPM for School Lawns

## INTRODUCTION

School 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 moles. As a result, most pesticides used on school grounds are applied to lawns and athletic fields.

Because the bodies of children and youths are often in direct contact with the grass, using pesticides on lawns increasingly raises concerns among parents and health professionals. On the other hand, coaches and school administrators are under pressure to ensure 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 and athletic fields.

The key to lawn IPM is regular scouting. Cultural practices that optimize growth of grasses and minimize conditions favorable to pest insects, weeds, or pathogens are vital to an IPM program. 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 a typical lawn pest, chinch bugs.

## 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 management 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 are needed
- evaluate and fine-tune treatments as the pest management program continues over the seasons

### 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
- 10X 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 (*Turfgrass Insect and Mite Manual*, by Shelton, Heller, and Irish, 1983)
- pheromone traps for cutworms, sod webworms, and other pests

### Background Information 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 in the local area. Learn about their life cycles and how to recognize them. Table 6 on page 77 lists common lawn pests in Pennsylvania along with Web sites that provide more information about each. Additional information can be obtained from the Penn State Cooperative Extension office in your county. It also is 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.

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Most of the information for this chapter was modified from:
*IPM for Schools: A How-to Manual.* United States Environmental Protection Agency. EPA 909-B-97-001. March 1997.
Additional chinch bug information is from: Hoover, G. A. *Chinch bugs*. The Pennsylvania State University. Entomology-Turf-2. 1992.

**TABLE 6.**

## Common Pennsylvania Turf Pests and Web Sites

| Common Name | Scientific Name | Web sites for more information |
|---|---|---|
| **Diagnosing Turfgrass Problems** | | www.agronomy.psu.edu//Extension/Turf/Diagnose.html |
| **Ant, Nuisance** | *Formicidae* spp. | www.ento.psu.edu/extension/factsheets/ants_in_lawns.htm |
| **Black Cutworm** | *Agrotis ipsilon* | ianrwww.unl.edu/ianr/entomol/turfent/documnts/cutworms.htm |
| **Bluegrass Billbug** | *Sphenophorus* spp. | ohioline.osu.edu/hyg-fact/2000/2502.html |
| **Hairy Chinch Bug** | *Blissus leucopterus hirtus* | ohioline.osu.edu/hyg-fact/2000/2027.html |
| **Sod Webworm** | *Crambinae* spp. | ohioline.osu.edu/hyg-fact/2000/2011.html |
| **White Grub in Turfgrass** | Scarabaeidae | ohioline.osu.edu/hyg-fact/2000/2500.html<br>www.ento.psu.edu/extension/factsheets/white_grubs.htm |
| **Asiatic Garden Beetle** | *Maldera castanea* | bugs.osu.edu/~bugdoc/Shetlar/factsheet/turf/Asiaticgardenbeetle.htm |
| **Black Turfgrass Ataenius** | *Ataenius spretulus* | www.agry.purdue.edu/turf/agry210/insects/ataenius.htm |
| **European Chafer** | *Rhizotrogus majalis* | www.uvm.edu/extension/publications/el/el199.htm |
| **Green June Beetle** | *Cotinus nitida* | www.aces.edu/department/extcomm/publications/anr/anr-991/anr-991.htm |
| **Japanese Beetle** | *Popillia japonica* | ohioline.osu.edu/hyg-fact/2000/2001.html |
| **Northern Masked Chafer** | *Cycolcephala* spp. | ohioline.osu.edu/hyg-fact/2000/2505.html |
| **Oriental Beetle** | *Exomala orientalis* | www.leapipm.org/Oriental.htm |
| **May/June Beetle** | *Phillophaga* spp. | iaa.umd.edu/umturf/Insects/May_June_Beetle.html |

### 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, such as bare spots or broken sprinkler heads. 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. Prepare a monitoring form for recording ongoing maintenance activities and information about pests and their management in each section.

You will need to compile an inventory of existing lawn maintenance equipment. In addition to mowers, do you have an aerator, dethatcher, and fertilizer spreader that can handle organic materials? Is there a spring-tooth harrow for removing weeds from infields and running tracks? These are useful tools in nonchemical lawn management. Inspect the condition of the equipment, too. Are mower blades kept sharp? Can mowing height be adjusted easily? Does the equipment have flotation tires to reduce soil compaction? Prepare a list of equipment needs so they can be worked into the budget process.

### 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 users of the lawn must be taken into account when deciding whether or not treatments are warranted, it is a 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 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 for 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. The Transect Method for Monitoring Weeds in a Lawn, discussed on page 79, 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 percent weed growth is tolerable on the back lawn at the elementary school; only 10 percent 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. Soil from the roots is removed, and the number of exposed grubs is counted. Then the grass can be folded back into place, tamped, and watered in. In well-managed lawns, depending on the species, 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. Involving members of the school and community in setting treatment guidelines can minimize confrontations and help develop broad support 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 site conditions replace the lawn?

## MANAGEMENT OPTIONS

When pest numbers threaten to exceed tolerance levels (in other words, when the action level is reached), a wide variety of strategies and tactics is 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 the target of highest pesticide use—is the growth of weeds, such as dandelions (*Taraxacum officinale*) or crabgrass *(Digitaria* spp.). Presence of weeds is a symptom of a lawn undergoing stress or poor management, 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. Relieving the stress can reduce or eliminate the pest problem. For example, the weed yellow nutsedge (*Cyperus esculentus)* often grows in waterlogged soils, so its presence could indicate 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. Brown patch disease, caused by the fungus *Rhizoctonia solani*, suggests excessive fertilization with soluble nitrate or slow-release fertilizers, especially during hot, wet conditions.

## 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 the percentage of weed cover in the total turf area. If time is limited, information recorded from one transect across a representative area of turf (for instance, 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 feet).
   b. Measure the length of the pace of the person doing the transect. To do this, slowly walk a known length (e.g., 20 feet), 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 feet ÷ 10 paces = 2 feet 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 feet ÷ 2 feet 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 ÷ 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-by-3-inch area (this is about the circumference of a softball or the lid to a 1-pound 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 percent or more of the toe area sample is bare soil, check the box marked 'bare.' If less than 25 percent 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, or scalping of the turf due to uneven grade, 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 ID | Yes | No | Bare | Weed ID | Yes | No | Bare | Weed ID |
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| 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 (the 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.*

## Reducing Stress on Lawns

The best way to reduce stress on lawns is to use 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 management. 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. One way to improve poor soils and maintain healthy soils is to ensure that organic matter is routinely replenished by leaving grass clippings to decompose, and fertilizing or topdressing with organic materials such as sludge or composted manure. To prevent buildup of an organic layer, the organic material can be incorporated into the soil using an aerator equipped with hollow tines and a heavy drag mat attached. This operation is best performed during cool, moist seasons when grass is actively growing. On smaller areas, a grass rake can be used to incorporate the materials.

### Planting Appropriate Grass Species

School lawns are subject to high levels of use and wear, and maintenance budgets are usually low, so it is important to select blends of grass species tolerant to such conditions and resistant to local pest problems. The Penn State Cooperative Extension office in your county can recommend grass species suited to local climate and conditions. In Pennsylvania, tall fescue (*Festuca arundinacea*) is recommended for school situations.

### 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 core aeration and amending soils with organic matter.

Core aeration involves removing plugs of grass to improve air exchange and water penetration into the soil. Ideally, heavily used turf should be aerated at least two times per year, although even a single aeration is better than none.

After aeration, and before seeding the desired lawn grass, drag the lawn with a heavy drag mat to break up cores of soil left by the aerator and to fill in holes.

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.

### Increasing the Mowing Height

Most temperate grasses used on school lawns (tall fescues, perennial ryes, bluegrasses, and others) can be mowed at a height of 2½ to 3 inches without sacrificing vigor or function as ball fields or recreational areas. The taller the grass can be kept and the denser the canopy, the greater the interception of available sunlight. Because taller grass shades the soil, 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 semidormant, 14 days or longer may be more appropriate. The right interval between mowings allows grasses to recover from the previous cut.

### 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. On the other hand, chinch bugs require hot dry conditions for optimal survival and reproduction. Irrigation during the spring and early summer may increase the incidence of pathogen spread, especially the lethal fungus, *Beauveria* spp. The adults can withstand water because of the protective hairs on the body but the nymphs readily get wet and can be damaged by large water droplets.

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 best, 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 ensure that it is in good repair and that all areas of the 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 collect 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. Excessive nitrogen applications may result in organic matter production rates that exceed breakdown, encouraging thatch accumulation. Excessive layers of thatch can be removed with dethatching rakes, or with power dethatchers available from equipment rental companies. It is wise to seed the area with desired grasses wherever lawns are thinned by dethatching procedures.

**Fertilizing with Restraint**

Excessive nitrogen fertilizer produces weak grass that is susceptible to disease 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.

Fertilization can be used to directly suppress weeds and lawn pathogens. A study by Ohio State University Extension Service researchers in the 1940s showed that an application of 20 pounds of composted poultry manure per 1,000 square feet 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 percent within one year.

### 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 tactics, 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 are available. Check with the Penn State Cooperative Extension office in your county for information about pesticides appropriate for your pest problems.

## IPM Plan for Hairy Chinch Bugs

Hairy chinch bugs *(Blissus leucopterus hirtus)* are the most important of the “true bugs” (order Hemiptera) that become pests on lawns. Heavily infested areas may contain as many as 200 to 300 chinch bugs per square foot.

### 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 in 30 to 40 days.

Nymphs range from about $^1/_{20}$ inch 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.

### DAMAGE

Chinch bugs suck the juices from grass leaves with 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 and adults concentrated in limited areas and feeding 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 overfertilized, chinch bug populations decrease significantly because the moisture encourages the growth of the lethal fungus, *Beauveria* spp., a pathogen of chinch bugs.

## 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 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-May, before overwintering adults have finished laying their spring eggs. A quick check of the lawn once a month until September should be sufficient in most areas.

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 chinch bugs and their predator, the big-eyed bug, which they superficially resemble.

A second detection method requires a metal container (such as a coffee can) with both ends removed. Insert this can into the ground and fill it three-quarters full with water. Stir the duff at the bottom of the container. Count the number of adults and nymphs floating to the surface over a period of 10 minutes. Repeat this procedure in 3 to 5 locations in the lawn where damage is present, or in adjacent areas.

## 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. Endophytic enhanced grasses may be used to repel insect pests. An endophyte is a fungus that grows inside a plant, and research has shown that turfgrass species containing endophytes have enhanced resistance to surface feeding insects, including chinch bugs, sod webworms and bill bugs. Try perennial ryegrass varieties such as Repell or Score, or a Kentucky bluegrass variety such as Baron.

**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 or too much nitrogen. The discussion of good lawn culture provided at the beginning of this section includes suggestions on overcoming these problems. Proper habitat management will go a long way toward suppressing 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 below. 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 also may 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." (Niemczyk, 1981).

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.

### Soap-and-Flannel-Trap Method for Chinch Bugs

Put 1 fluid ounce of dishwashing soap in a 2-gallon sprinkling can and drench a 2-square-foot area of lawn where you suspect there are chinch bugs. Watch the area for 2 or 3 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.

### Chemical Controls

If nonchemical methods alone prove insufficient to solve the problem, then integrating a pesticide into your management program may be warranted. **Pennsylvania law allows pesticide applications in schools only by certified applicators, registered technicians, or by non-certified applicators or non-registered technicians under the direct supervision of a certified applicator. Notification must be given to all staff and parents or guardians of students who request it 72 hours prior to pesticide use. Warning signs must also be posted in the vicinity 72 hours prior to and for 48 hours after the application. The law also mandates a 7-hour reentry period for common access areas whenever pesticides are applied.**

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

# IPM for Silverfish, Firebrats, and Booklice in Schools

## INTRODUCTION

Silverfish, firebrats, and booklice are discussed together here because they occur in the same or similar habitats. They prefer dark, moist environments with a supply of starchy foods or molds. Although they are all found in similar environments, silverfish and firebrats are not closely related to booklice. These nuisance pests can feed on wallpaper pastes, natural textiles, books, and manuscripts. They also feed on molds growing on various surfaces.

Silverfish, firebrats, and booklice can live both indoors and outdoors. They are frequently introduced into a building with boxes of materials that have been stored in damp basements or attics, but they also can wander in from the outside. Silverfish and firebrats are fast-moving and can travel throughout buildings. Once these insects find a good source of food, however, they stay close to it. In general, they cause little damage, but may cause people to take radical action based on their fear of insects.

## SILVERFISH AND FIREBRATS

### Identification and Biology

Silverfish and firebrats belong to an insect order called Thysanura. Insects in this order characteristically have three long, tail-like appendages about as long as the body. These insects are wingless, with chewing mouth parts, long antennae, and a body covered with scales. The mouthparts of silverfish and firebrats are used for biting off small particles or for scraping at surfaces. The most common species inhabiting buildings are in the genera *Lepisma* (silverfish) and *Thermobia* (firebrat). The silverfish (*Lepisma saccharina*) is about 1/2 inch long when fully grown and covered with silvery scales. It is grayish to greenish in color and its body has a flattened-carrot shape. The firebrat (*Thermobia domestica*) has a mottled appearance with patches of white and black, and is shaped like the silverfish.

Silverfish and firebrats eat material high in protein, sugar, or starch, including cereals, moist wheat flour, starch in book bindings, sizing in paper, and paper under which there is glue or paste. These insects often attack wallpaper, eating irregular holes through the paper to get at the paste. Silverfish may bite very small holes in various fabrics, including cotton, linen (they can digest cellulose to some extent), and silk. Firebrats will feed extensively on rayon, whereas silverfish usually damage it only slightly.

#### Characteristics of the silverfish:

- lays eggs in any season, usually in secluded places
- has a 3- to 4-month life cycle from egg to adult
- prefers moist areas (75 to 97 percent humidity) and moderate temperatures (70° to 80°F)
- is active at night or in dark places, and is rarely seen unless disturbed during cleaning
- may be found throughout the building—sometimes in boxes and books, or in glass utensils and sinks they have fallen into
- leaves yellowish stains on fabric
- outdoors, lives in nests of insects, birds (especially pigeons), and mammals, and under the bark of trees

#### Characteristics of the firebrat:

- lays eggs in cracks and crevices
- has a 2- to 4-month life cycle from egg to adult
- prefers moist areas with temperatures above 90°F
- is active at night or in dark places
- found where heat and starches are present (for example, in bakeries); also found in furnace rooms, steam pipe tunnels, and partition walls of water heater rooms

## BOOKLICE (PSOCIDS)

The most common booklouse (*Liposcelis* spp.) is a small, grayish, soft-bodied insect with chewing mouthparts and long antennae. It is flat and superficially resembles the shape of the head louse. The common house-dwelling booklouse is wingless. The size of an adult is approximately 1/25 to 1/12 inch. Because they feed chiefly on mold, booklice cause little direct damage to plants and wood. They are commonly found in confined areas like the bindings of books, where they eat the starch sizing in the bindings and along the edges of pages.

#### Characteristics of the booklouse:

- has a life cycle from egg to adult lasting about 110 days
- prefers warm, moist conditions that are conducive to the growth of mold and mildew and require humidity of at least 60 percent

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Most of the information in this chapter was modified from:

Powell, T.E. *IPM for Silverfish, Firebrats, and Booklice in Schools*. University of Florida School IPM Web site at **schoolipm.ifas.ufl.edu/tp12.htm**. May 1998.
Jacobs, S. B. *Booklice*. The Pennsylvania State University. Entomology-NP-2. 1998.
Jacobs, S. B. *Silverfish*. The Pennsylvania State University. Entomology-SP-3. 1998.