Outdoor Integrated Pest Management for Maine Schools

10 Things Every School Should Know About Pests & Pesticides

- Children are more **susceptible to harmful effects of pesticide exposure due to their small body size and immature** immune, liver, and neurological systems.
- People with asthma and other respiratory conditions may have severe reactions to pesticide exposure.
- Pesticides that are commonly used in schools include insecticides, herbicides, fungicides, rodenticides, and disinfectants or sanitzers.
- Anyone using pesticides (except disinfectants and hornet/wasp spray) at a school in Maine must have a commercial pesticide applicator's license. Several Maine schools have been fined for unlicensed use of pesticides.
- The State of Maine requires outdoor pesticide applicators to post treated areas to "reasonably ensure that persons entering such areas will see the notice."
- It is a violation of Federal law to use a pesticide in a manner inconsistent with its labeling.
- Many pests can be controlled without pesticide use or with minimal pesticide use.
- There are many informational resources available to help manage pests in the most practical manner. Schools can start by contacting the Maine Scool IPM Progam, http://www.thinkfirstspraylast.org/schoolipm, 207-287-2731.
- New State and Federal regulations may affect pesticide use in schools. For current regulations and questions about pesticides in schools, contact the Maine Board of Pesticides Control, 207-287-287-2731, www.thinkfirstspraylast.org.
- The Cooperative Extension Insect Pest and Plant Disease Diagnostic Laboratory offers free identification and management recommendations, 207-581-3880, www.umext.maine.edu/topics/pest.htm. Contact your County Extension Office for addtional resources (see inside back cover).

About This Manual

WHO—This manual was prepared by the Maine Department of Agriculture, and the University of Maine Cooperative Extension under a federal grant provided by the United States Environmental Protection Agency. The grant established Maine's School Integrated Pest Management Program coordinated by the Maine Department of Agriculture, Food and Rural Resources.

Outdoor Integrated Pest Management for Maine Schools was reviewed by a committee that included concerned parents, state and academic professionals, school employees, school administrators, and commercial pest managers.

WHAT—In this manual we introduce Integrated Pest Management (IPM), an effective and environmentally sensitive approach to pest management that relies on a combination of common sense practices. IPM uses comprehensive information about pest life cycles, their interactions with the environment, and an understanding of all available control methods to manage pest damage by the most economical and least hazardous means.

WHY—IPM offers practical, affordable, long-term solutions for managing school grounds in ways that ensure a safe and healthy learning environment. This manual provides information that can be used to incorporate IPM into current facilities management practices. Our goal is to help schools manage outdoor pests through more structured pest monitoring, adopting practical communication and performance guidelines, writing well constructed pest management contracts, and using low-risk pest management methods. For more information contact the Maine School IPM Program 207-287-2731.

How To Use This Manual

This manual deals with outdoor pests on school grounds. For information about managing indoor pests, contact the Maine School IPM Program, 207-287-2731.

1. Read chapters 1 to 3

The first two chapters are of particular interest to school board members, administrators, principals, facility managers, and parents as they establish school IPM policies. Topics include:

- the general concepts of IPM,
- pesticide risk,
- school pest management policies,
- working with pest management contractors, and
- designing and conducting your own IPM program.

Chapter three is written primarily for school pest managers involved in day-to-day pest management activities. It offers a more detailed discussion of an IPM concepts, including:

- monitoring,
- record keeping,
- determining action thresholds,
- selecting pest control methods, and
- evaluating program performance.

The remainder of the manual introduces landscape and turf management, and pests that are commonly encountered. The appendices discuss State and Federal pesticide regulations and licensing requirements for individuals making applications on school grounds.

2. Determine pest management needs

Survey the school grounds noting pest damage and conditions that favor pests. Examine current pest management practices and weigh their effectiveness in terms of cost, risk, and benefit.

Larger school units, and schools familiar with IPM, should establish an IPM committee.	>	Smaller school programs should assign IPM responsibilities to individuals.

3. Write an IPM Plan based on your needs

Review the IPM practices presented in this manual to learn about specific control methods. Discuss them with your IPM committee, pest control professional, administration, staff, and parents. Decide on a few appropriate practices and design a pilot program to fit your situation. Gradually incorporate IPM into current maintenance practices.

Larger school units can develop a comprehensive program to replace traditional methods.	>	Smaller school programs should focus on short term pest management goals.

Pest Management Challenges in the School Environment

School is a challenging place for a pest management program. Significant pest problems can unexpectedly develop in many areas and pesticides often seem to be the best solution, perhaps the only one. Yet, nationwide, parents and other citizens have voiced legitimate concerns about the risks of pesticide use in schools. Integrated Pest Management (IPM) is a decision making process that addresses both sides of this issue. IPM's focus on pest prevention and least-toxic methods is practical to apply and cost-effective to operate.

Schools are complex systems including different physical spaces, indoors and out. Most school buildings are unintentionally built with inconspicuous entry points and shelter for insects, rodents, and other unwelcome wildlife. Inappropriate landscape design and plant selection often encourage pests. Diminishing budgets and deferred maintenance compound the problems. Pesticides offer a quick and effective means of dealing with many pest problems but schools should carefully consider their use.

In Maine, as elsewhere, schools need to balance the known health risks of uncontrolled pest infestations, the safety of school children, and the use of pesticides. We know that pests can be a serious threat to the school community. We also know that children are more vulnerable to pesticide exposure than adults. It is necessary to sensitively address the concerns of parents and others who understand the benefits of a pest-free school and safe playing fields, but want this achieved with a minimum of toxic materials.

IPM combines practical pest management strategies to prevent or control pests in ways that reduce risks to health and the environment. School IPM takes a broad-minded view of pest problems, gathering everyone involved to design flexible, site-specific pest management plans. IPM does not reject technology, nor does it blindly embrace new technology. IPM does promote a deeper awareness of natural systems, an understanding of pest life cycles, and how cultural modifications, mechanical controls, and beneficial organisms affect pest populations. IPM does not rule out pesticide use, but requires thoughtful consideration, an increased awareness of the world around us, and the importance of environmental preservation. School is the perfect place for this lesson.

Contents

Contents

Acknowledgments

In addition to references listed after each chapter, the committee would like to acknowledge use of the following resources:

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SAD—School Administrative District
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CHAPTER 1

INTEGRATED PEST MANAGEMENT FOR MAINE SCHOOLS

Conventional pest control can be quick and effective but relies heavily on chemical methods that usually provide only short term results. Conventional control may use pesticides as soon as pests appear or as regular maintenance applications whether pests are present or not. This approach ignores the underlying causes of pest problems by depending solely on pesticides to overwhelm and eradicate pests. Chemical methods also pose a hazard to the environment and especially to children.

In contrast, Integrated Pest Management (IPM) is an environmentally sensitive and effective approach that combines specific information about a pest with a number of control methods to reduce pest damage by the most economical means, and with the least possible hazard to people, property, and the environment.

Maine schools are ready to take advantage of IPM. Many school employees actively make pest management decisions and many schools contract professional applicators. Schools also have a strong foundation in sanitation and maintenance practices that prevent pest problems. This foundation can be strengthened by learning about and practicing IPM.

Elements of Integrated Pest Management

Monitoring

IPM uses direct observation and inspection to locate and identify pest problems. By monitoring on a regular basis, pests are detected early enough to begin nonchemical treatments and avoid a severe infestation that can only be controlled with pesticides.

Action thresholds

The action threshold is a specific number of pests or quantity of pest damage that requires some form of control, not necessarily chemical, to avoid illness, injury, or damage to school grounds. Below the threshold, no direct action is required. Thresholds vary depending on the situation and the pests involved.

Record keeping and evaluation

Accurate records track the key pests found on school property and measure the effectiveness of management activities. Records form the basis for evaluating the IPM program, making improvements, and deciding how to distribute resources sensibly.

Natural controls

IPM emphasizes natural controls by protecting the predators, parasites, and diseases of pests. These beneficial organisms help prevent pest outbreaks.

Nonchemical controls

Nonchemical controls promote plant health and make the environment unfavorable to pests. A combination of cultural, physical, and biological methods often achieves satisfactory pest control without chemicals.

Low-risk pesticide applications

Pesticides may be required in certain situations but are applied as a last resort, never on a fixed schedule. Whenever possible, IPM uses pesticides that affect only specific pests, are less toxic to beneficial organisms, and present low risk to humans. Application methods are chosen to minimize exposure to humans and other nontarget organisms.

Why we should use IPM in schools

Unique characteristics of children

In January 1993, the National Research Council, a committee of the National Academy of Sciences, released a five-year study, *Pesticides in the Diets of Infants and Children*. The report documented that infants and children face relatively higher risks from pesticides than adults exposed at the same levels. This is due to a number of physiological factors. Children have rapidly developing nervous systems making them particularly vulnerable to environmental toxins. For their size, children eat more food, drink more water, and breathe more air than adults. When they are exposed to pesticide residues, they get larger doses. The report also points out that children can be exposed to pesticides applied in homes, schools, parks, and other environments, as well as pesticide contaminants in foods.

This study adds a degree of uncertainty to the research EPA uses to register pesticides. The traditional methods of toxicological risk assessment may not adequately protect infants and children. EPA is currently reviewing all pesticide tolerances with children in mind.

Overuse

Pesticide overuse causes unnecessary exposure to school children. This may not result in acute poisoning but continued exposure to low amounts of pesticides increases the risk of adverse developmental affects.

Overuse is also an immediate threat to the naturally occurring beneficial organisms that can control pest outbreaks. When beneficial populations are destroyed, pest populations often rebound first; even insects that are not ordinarily pests become troublesome.

IPM for every school

Not all IPM methods are practical or appropriate for every school. Choose those that will be most effective for your program. The important thing is to:

- **end routine pesticide applications;**
- **create an IPM policy;**
- **identify the available resources;**
- **set up a pilot program; and**
- **keep it simple, gradually increase your practice of IPM.**

Education

Schools adopting IPM can set an important example by teaching students, staff, and parents the benefits of IPM. Education promotes IPM in homes and fosters a community awareness of our environment.

Economics

IPM has the potential to save money while delivering excellent pest control. By emphasizing sanitation and maintenance, IPM not only improves the condition of school grounds and facilities but prevents or reduces pest problems. Established school IPM programs consistently demonstrate that IPM costs less than conventional practices and reduces the potential for illness, injury, or environmental damage.

IPM is a winning proposition for Maine schools

- **Effectively and safely manage risks**
- **Improve facility safety**
- **Save money**
- **Incorporate into regular maintenance and custodial practices**
- **Improve community relations**

The decision-making process

The United States Environmental Protection Agency (EPA) is responsible for regulating pesticides in the United States. Before a pesticide product can be legally applied, EPA requires a significant amount of research to identify the risks surrounding its use. Restrictions are then imposed to improve product safety. However, it is impossible to identify all conceivable risks of pesticide applications.

In Maine, as elsewhere, schools need to balance pest control needs, liability issues, health risks, and the potential damage of uncontrolled pest infestations. IPM incorporates pesticide use, but only as a last resort. If nonchemical controls fail, pesticides may be the only effective treatment option, and, in some situations, specific controls are necessary—wasp colonies threatening children who are sensitive to stings, weedy athletic fields that increase sports injuries, or the presence of rats and ticks that carry human disease.

However, the mere presence of a pest does not necessarily indicate a problem. After an IPM program detects a pest population, but before a potentially disruptive control method is used, the following questions are considered:

Is action necessary?

If an organism can be tolerated without causing injury is it really a pest? Is action needed at all? If the presence of nonthreatening organisms upsets certain individuals, perhaps education about ecology can replace pesticide treatments. In other cases, the presence of a single organism may be intolerable.

Example: Box-elder bugs are brightly colored and cluster under shrubs, on the shady side of tree trunks. They often enter buildings through open doors or torn window screens. The sight of them can frighten people, or raise fears that they will damage plants. In fact, these insects are harmless. They feed on the seeds of box-elders and silver maples and never harm humans—they rarely even harm trees. Concern about their presence is generally unwarranted.

Example: Large rodent droppings and grease trails suggest rats are in a crawl space under the eaves. Treatment is usually required even if only one rat is observed. Rats cause serious bites; they gnaw on electric wires causing fires; leave fleas which can transmit disease; and there is never just one rat—if you see one, there are more.

Where should treatments take place?

Before using any method of control, consider the pest in its ecological setting; learn its biology and apply treatments where they have the greatest effect.

Example: Mosquitoes are commonly managed by area-wide insecticide fogging. These applications kill adult mosquitoes but are effective for only a short while. Mosquito IPM targets the immature stages before they become biting adults. Mosquito larvae develop as "wrigglers" in the still water trapped by clogged gutters and drains, stagnant ponds, old tires, low-spots in playing fields, etc. By treating these sites with a low-risk pesticide or by eliminating them altogether, mosquitoes are managed with minimal environmental impact. In Maine, using pesticides in water may require a state permit; call the Board of Pesticides Control at 207-287-2731 for more information.

The school ecosystem combines many, overlapping subsystems, each affecting the other and all potentially influenced by pest management activities. If you look at your system and see only the pest, you may miss something important—a broader view is essential.

Example: The school is having trouble with carpenter ants despite repeated pesticide treatments. Monitoring records show the ants prefer specific areas allowing the replacement of perimeter sprays with spot

What is a pest?

A pest is a plant, animal, or microorganism that has a negative effect on humans. This is a very subjective concept that varies with each individual's point of view. In general, pests are unwanted or undesirable because they:

- **reduce the availability, quality, or value of human resources such as food, feed, water, or space;**
- **injure humans, animals, crops, structures, and possessions;**
- **spread or cause disease;**
- **interfere with our activities by causing annoyance, discomfort, or inconvenience.**

Many organisms may become pests, certain organisms are often pests, but none are inherently pests.

treatments. A broader view finds the real problem—several tree limbs overhanging and touching the roof, providing access for foraging ants. The solution is pruning, not spraying. An even broader view focuses on several dead and rotting tree stumps near the school, that provide ideal habitat for carpenter ant colonies. Removing dead wood and managing a buffer zone gives continued control and saves money in the long run.

When should action take place?

There is often an optimal time in a pest's life cycle to apply control; a time when the pest is particularly susceptible. Identifying this point requires monitoring, accurate pest identification, and understanding pest biology. Properly timed treatments are lasting and effective, and least hazardous to natural controls, humans, and the environment. Improperly timed treatments may actually increase pest problems.

Example: Bacillus thuringiensis *is a naturally occurring bacteria developed as a commercial insecticide known as Bt. One strain of Bt affects only caterpillars, but this material must be applied to leaves when caterpillars are small and actively feeding. Bt is ineffective if treatment is delayed until the caterpillars are too large.*

Example: Developing an IPM program requires coordination with the overall budget of the school district. Improving rodent and fly management may require changes in handling kitchen garbage, relocating a dumpster, more frequent cleaning, and improved plumbing or drainage. These methods are cost effective and provide long-term control only if the changes are made well before the problems might occur.

Which methods should be used?

Control treatments may have ecological consequences that are difficult to predict. Consider all possible pest management options before taking action. Integrate a combination of techniques in a compatible manner to ensure that one technique does not conflict with another. Especially consider how control methods will affect beneficial organisms.

Example: The spider mite is a common ornamental pest often controlled by naturally occurring predatory mites. We may never see the spider mites at all until we make a pesticide application to control some other pest that we can see. For a number of reasons, pesticides are more harmful to predatory mites than to spider mites. A poor pesticide choice may control the other pest problem but will kill most of the predatory mites as well. The few spider mites present are only slightly affected and, freed from their natural enemies and competitors, they quickly multiply and devastate the plant.

In addition to avoiding pesticides that are toxic to beneficial organisms, combine as many nonchemical methods of control as possible.

Example: To control aphids, examine the foliage, stems, and new growth of plants to detect early infestations; plant flowers that shelter parasitic wasps; purchase and release natural control organisms; keep ants away from plantings; plant hedges and windbreaks; manage adjacent weeds; reduce fertilizer rates to moderate shoot growth; use slow-release nitrogen fertilizer; replace susceptible plants with resistant plants; and promote plant health by mulching, irrigating, or relocating. Use low-risk pesticides such as insecticidal soap as a last resort.

Organizing and implementing school IPM

Making the right decisions about school pest management requires administrative structure as well as fieldwork. The process of organizing and implementing school IPM generally involves the following steps. See Chapters 2 and 3 for discussion.

Organization:

- **Learning about IPM**
- **Involving school administration**
- **Budgeting for IPM costs**
- **Forming an IPM committee**
- **Writing an IPM policy statement**
- **Developing communication links**
- **Assigning duties**
- **Selecting a school IPM coordinator**
- **Establishing a pilot program**
- **Developing a site plan**

Implementation:

- **Monitoring**
- **Record keeping**
- **Evaluating the program**
- **Determining action thresholds**
- **Selecting pest control methods**

Integrated Pest Management

After World War II, the enormous exploitation of synthetic pesticides led many to believe that modern society would totally eradicate insect pests. However, scientists soon discovered that certain insects had developed resistance to insecticides—an adaptation of a pest population allowing it to resist the toxic effects of pesticides. In other cases insect populations that were not ordinarily pests surged to damaging levels because the insecticide treatments wiped out the native predators and parasites that had kept them in control. IPM grew in the 1950s and 60s from academic research that focused on these issues as well as on minimizing the impact of insecticides in the environment.

In 1971, the first federal IPM programs for insect pests were demonstrated in field crops. By encouraging and enhancing natural control and using insecticides only when pest populations reached action thresholds, IPM produced quality crops with fewer costs than conventional methods. Since then, IPM programs have been developed for weeds, plant diseases and vertebrate pests, and moved from agricultural crops into urban settings. The general concept of IPM now refers to a system-wide approach that integrates a variety of management tools including biological, cultural, genetic, physical, and chemical methods.

Government policy

For more than 20 years, the Federal government has been funding multi-agency research, training, and implementation programs that attracts broad interest in IPM. Following a 1979 report by the Council on Environmental Quality, IPM was adopted as a standard for all federally managed property including 70 million acres of forests and parks. Reductions in pesticide use of up to 70% were reported within five years. In 1993, the *National IPM Initiative* announced a commitment to increase IPM in U. S. crops and included an educational outreach program to hasten broad acceptance of proven IPM strategies on farms, forests, homes, parks, industrial or public buildings, and range lands.

In 1996, Congress unanimously passed the *Food Quality Protection Act* (FQPA). This law, 70 pages in length, combines the intent of several regulatory acts and represents a national commitment to the health of all Americans, particularly children. FQPA mandates a single, health-based standard for all pesticides on foods, providing special protection for infants and children. It expedites approval of low-risk pesticides, requires the reevaluation of all existing pesticide registrations, and supports the adoption of IPM:

> The Secretary of Agriculture, in cooperation with the Administrator [of EPA], shall implement research, demonstration, and education programs to support adoption of Integrated Pest Management. Integrated Pest Management is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools in a way that minimizes economic, health, and environmental risks. The Secretary of Agriculture and the Administrator shall make information on Integrated Pest Management widely available to pesticide users, including Federal agencies. Federal agencies shall use Integrated Pest Management techniques in carrying out pest management activities and shall promote Integrated Pest Management through procurement and regulatory policies, and other activities.

The state of Maine has also passed an initiative that concerns IPM—the *1997 Act to Minimize Reliance on Pesticides*:

> It is the policy of the State to work to find ways to use the minimum amount of pesticides needed to effectively control targeted pests in all areas of application. The agencies of the State involved in the regulation or use of pesticides shall promote the principles and the implementation of integrated pest management and other science-based technology to minimize reliance on pesticides while recognizing that outbreaks of disease, insects and other pests will necessitate fluctuations in pesticide use. These agencies, in cooperation with private interest groups, shall work to educate pesticide users and the general public in the proper use of pesticides and to determine other actions needed to accomplish the state policy.

School IPM programs

After the publication of *Pesticides in the Diets of Infants and Children*, pesticide use in schools attracted the attention of state legislatures. A number of states have now passed school pest management laws. Many of these mandate the use of IPM or encourage voluntary participation. More states now require some type of notification before applying pesticides on school properties. Schools in many states, including Maine, must post signs when applying certain pesticides. Maine encourages voluntary participation in school IPM but requires licensing before an individual can apply pesticides on school grounds. New regulations may affect pesticide use in Maine schools, contact the Maine School IPM Program for updates, 207-287-2731.

At the Federal level, the *School Environment Protection Act* (SEPA) was recently introduced before congress. This bill supports safer pest management practices, low risk materials, notification of pesticide use, a National School IPM Advisory Board, and a provision allowing for the emergency use of pesticides when the immediate health and safety of children are being threatened.

A Federal IPM Plan

The following standards are among those mandated in 1989 by the U. S. General Services Administration, National Capital Region:

- **All on-site pest control contractor personnel must be certified pesticide applicators. Persons "working under the supervision" of a certified applicator do not meet this standard. Pesticides should never be applied by government employees.**
- **Pesticide application should be according to need, when pests are actually present, rather than by schedule. Pesticides should be used only if adequate control cannot be achieved with nonchemical methods.**
- **Pesticide use should always consist of the least hazardous material, most precise application technique, and minimum quantity of material necessary to achieve control.**
- **The contractor should provide labels and material safety data sheets for every pesticide used on the premises to the contracting officer or representative.**
- **Pesticides should not be stored on the premises.**
- **Traps, sanitation, and exclusion techniques should be emphasized for rodent control.**
- **Exclusion techniques should be emphasized for bird control.**

To locate IPM resources that are available to Maine schools, contact the Maine School IPM Program at the Maine Department of Agriculture, Food & Rural Resources, 28 State House Station Augusta, ME 04333-0028. Phone 207-287-2731, Fax 207-287-7548.

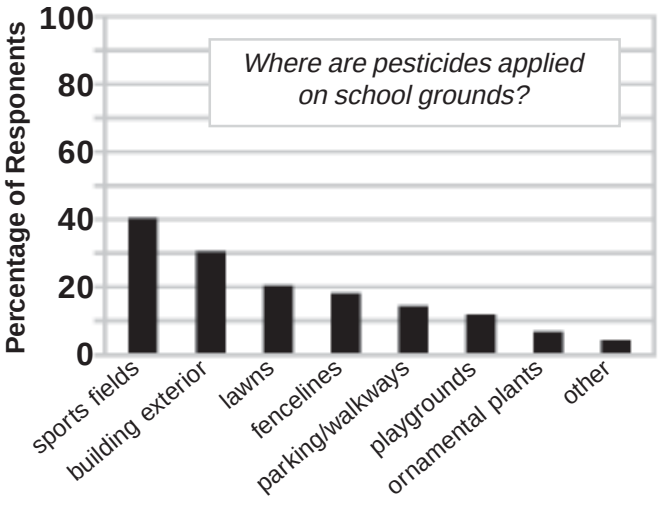
The Maine school IPM survey

The Maine School Integrated Pest Management Program recently published *What's 'Bugging' Our Schools? Pest Concerns and Pesticide Use in Maine Public Schools.* This survey included 262 respondents representing 148 Maine school districts.

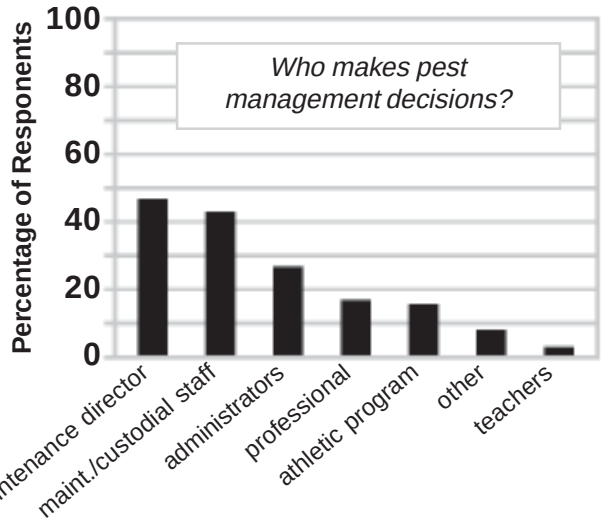
The study revealed that 42% of the responding schools use pesticides even though most are unfamiliar with state pesticide regulations. In general, school staff and administration are not aware that pesticides may only be applied by persons with a commercial applicator license. IPM is used by 18%, 54% of the respondents said they do not use IPM, 18% said they did not know.

The charts presented here represent only a small portion of the data. The full report is available at the Maine School IPM website http://www.state.me.us/agriculture/pesticides/schoolipm/schoolipm.htm

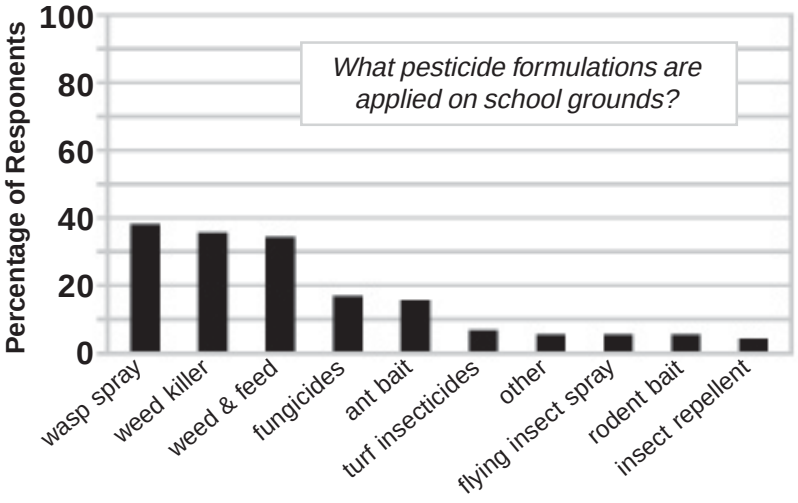
Sports fields receive more pesticide applications than other areas of the school grounds.



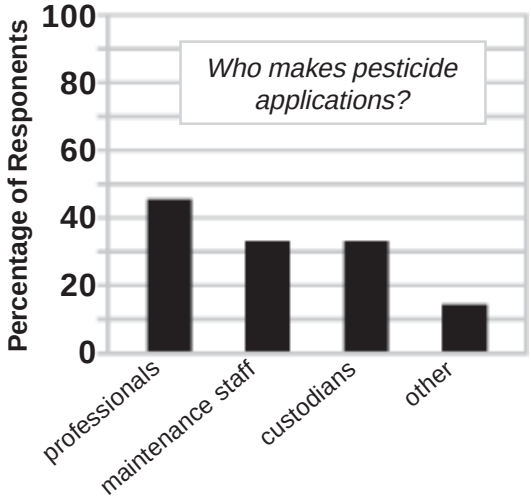
School employees are actively involved in pest management decisions.



In this survey, herbicides and wasp sprays made up the majority of pesticides applied on school grounds.



Nearly half of the respondents hired pesticide professionals.



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Illinois

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Massachusetts

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Maine

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Maryland

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IPM standards for schools

The IPM Institute of North America has developed a set of IPM Standards that can help you learn about all of the IPM options available for school IPM, and provide an opportunity to grade your school's performance in managing pests and minimizing risks. Schools will also find these Standards useful in developing and maintaining an IPM program.

Use the Standards to score your school. Where does your school place along the continuum from low to high-level IPM? What additional IPM practices can you implement to improve performance over the next year? The next three years?

IPM certification for schools

By meeting certain minimum requirements, your school can become certified by the IPM Institute. Certification establishes your school's achievement on a national scale.

To become fully certified by the IPM Institute, your school must:

1. Implement all practices in the IPM Standards labeled "Priority".
2. Implement sufficient additional IPM practices to earn a minimum 70% score.
3. Use only pest controls meeting the definitions for Reduced-Risk or Least-Risk.
4. Contact an approved verifier for inspection.
5. Complete an application and pay the appropriate fee.

To maintain certified status with the IPM Institute, your school must be re-inspected every three years. A list of approved verifiers and an application is available from the IPM Institute, 608-232-1528, http://www.ipminstitute.org.

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CHAPTER 2

ORGANIZING A SCHOOL IPM PROGRAM

Learn about IPM

The concept of IPM should be widely understood by the school community. IPM programs are more information-intensive than treatment-intensive; they involve more training than conventional control. Provide the opportunity to learn by gathering educational materials. The Maine School IPM Program, 207-287-2731, is the primary resource for the state. The University of Florida School IPM web site maintains a national clearing house for school IPM materials at http://schoolipm.ifas.ufl.edu. Other resources include pest control professionals, the University of Maine Cooperative Extension (see office listing on inside back cover), the IPM Institute (http://www.ipminstitute.org), and other schools with active IPM programs.

Involve school administration

Local school boards and administrators are responsible for the health and safety of their school communites. Students and staff spend a significant part of each day on school property and should not be stung, bitten, or otherwise harmed by pests; neither should they be exposed to pesticides. IPM addresses these concerns but needs administrative leadership and support.

Budget for IPM

Budgeting for IPM is not the same as budgeting for conventional pest control services. IPM may require an initial increase in time and money, but in the long run, the program should pay for itself. For example, improving maintenance of an athletic field may cost more for a few years but might save expensive field renovation costs in future years. Take the time to educate your school board and gain support for IPM.

Start simple and avoid budget issues by doing small things like keeping mower blades sharp, using soil tests, switching to slow release fertilizers, and writing IPM into pest control contracts.

The costs for school IPM generally fall into the following categories:

- Contracts for pest control services;
- IPM training;
- Licensing staff to apply pesticides, if necessary;

Learn about IPM
Involve school board & administration
Budget for IPM costs
Form an IPM Committee
Write an IPM Policy Statement
Develop communication links
Assign duties
Select a school IPM Coordinator
Establish a pilot program

- Pesticide purchases;
- Specific IPM projects: monitoring, equipment purchases, unusual pest problems, new construction or repair, improving waste management, landscaping, etc.; and
- Administrative costs related to committees and management meetings, contract procedures, record keeping, liability insurance, and communications.

Form an IPM committee

The IPM Committee may serve an entire school district or a single school. Form a committee that represents the entire school community: volunteers, PTA members, school administrators, facilities directors, custodial and grounds keeping staff, school nurses, athletic program staff, food service staff, pest

Form an IPM committee that represents the entire school community.

control professionals, parents, and teachers. The responsibilities of the IPM Committee may include:

- Developing school IPM policy; write a policy statement;
- Developing site plans for various locations;
- Evaluating progress of the program;
- Facilitating communication;
- Approving contract specifications;
- Providing notification to parents as required;
- Managing IPM educational and training programs;
- Resolving pesticide issues and pest concerns; and
- Working with public relations personnel and local news media.

Write an IPM policy statement

The policy statement emphasizes the importance of IPM and the school's commitment to effective and environmentally sensitive pest control. It includes the reasons for adopting an IPM program, the objectives of the program, and guidelines for pest management issues and decision-making. Each school needs to develop its own policy. The example on the following page is more than many schools need.

Develop communication links and assign duties

Involve the school community in the day-to-day IPM program as early as possible so they understand and support the program during start-up. Keep the community informed about the program, including current events, expected results, and future plans. Promote communication among program participants by assigning clear roles and responsibilities. Specific duties of committee members should include:

- Day-to-day operation of the IPM Program;
- Ensuring that pesticide applications and re-entry intervals do not conflict with school or community activities;
- Maintaining a prioritized list of structural and landscape requirements;
- Working with administrators when contracting for pest control services;
- Gathering pest management and IPM resources;
- Training in-house IPM personnel;
- Keeping monitoring records, pest complaints, and a log of pesticide applications, including contractor services; and
- Keeping copies of pesticide labels, Material Safety Data Sheets (MSDS), the IPM Policy Statement, and IPM site plans.

Participation and communication are the keys to success.

School board and administrators

Administrators and school boards set the tone for the IPM program. Administrators should have a general understanding of the state laws pertaining to IPM and pesticide application in schools. The most important responsibilities of the administrative staff are: general program support, helping to form an IPM Committee, designating an IPM Coordinator, developing pest management policy, and providing adequate funding.

The School IPM Coordinator

The IPM Coordinator is a school employee who coordinates IPM activities and responsibilities within the school unit. They might be a school principal, custodian, district maintenance director, food service director, athletic director, nurse, or a teacher. The Coordinator should be able to communicate effectively with all IPM committee members, administrators, maintenance and custodial staff, community members, and professional pest management contractors. The Coordinator should also understand and be able to communicate State and Federal regulations governing pesticide use.

The Coordinator may be responsible for most of the day to day operation of the IPM program, or they may simply coordinate others who share those responsibilities. However, it is essential that the Coordinator ensures that all necessary information is communicated and that all necessary activities are completed in a timely manner—do not let the IPM program fail because no one takes responsibility.

Facilities and grounds keeping staff

These people need to recognize conditions that lead to pest problems and take corrective action within the framework of the IPM plan. It is important that they are adequately trained. They should also maintain copies of Material Safety Data Sheets (MSDS) for any chemical used on school grounds.

A Model Policy Statement

Pests can pose significant problems to people, property, and the environment. Pesticides pose similar risks. Children spend a great deal of time in schools and face greater potential for health effects resulting from pest and pesticide exposure. By reducing reliance on pesticides and incorporating low-risk control options, IPM reduces both pests and pesticide risks. It is therefore the policy of this school to incorporate Integrated Pest Management (IPM) procedures for controlling pests.

Integrated pest management procedures. IPM incorporates the most practical and least hazardous combination of cultural, physical, biological, and/or chemical controls to prevent unacceptable levels of pest activity and damage. The school will develop a site plan for each locality on school property that may experience pest problems. These plans will incorporate IPM and specific management tactics.

The full range of management options, including no action at all, will be considered. The choice of using a pesticide is based on a review of all other available options and a determination that these options are not acceptable or are not feasible. Nonchemical pest management methods are used whenever possible. Direct action will be used only when specific pest thresholds are reached. When it is determined that a pesticide must be used, the least hazardous material and method of application will be chosen. Pesticide applications will be timed to minimize their impact on school grounds. All pesticides will be handled according to state and federal law.

Pest management objectives

- Maintain a safe and sustainable school environment.
- Protect human health by suppressing pests that threaten public health and safety.
- Reduce the exposure of humans—particularly children—to pesticides.
- Reduce or prevent pest damage to school properties.
- Reduce environmental pollution.
- Reduce the costs of pest management.
- Prevent pests from spreading beyond school property.
- Enhance the quality of life for students, staff, and others using school property.

IPM Coordinator. The school will appoint a staff memeber to be the IPM Coordinator with the following duties:

- Coordinating the IPM activities and individual responsibilities.
- Recording all pest sightings by school staff and students.
- Recording all pesticide use.
- Coordinating management activites with pest control contractors, or licensed staff.
- Approving appropriate pesticide applications—methods, materials, timing, and location.
- Assuring that all of the pest control contractor's recommendations on maintenance and sanitation are carried out.
- Posting and notification of pesticide application.
- Evaluating the school's progress with the IPM plan.
- Ensuring that pesticides are only used by licensed applicators.

Education. The school community will be educated about potential pest problems and IPM methods used to achieve the pest management objectives.

Record keeping. Pest sighting data sheets and pest control records will be kept current and accessible to verify the need for treatments and track the effectiveness of management activities. Pesticide records shall be maintained on site and meet the requirements of the Maine Board of Pesticides Control.

Notification/posting. A notice will be provided to school staff, students, and parents at the beginning of each school year briefly explaining the school's pesticide use policy. The notice will indicate that pesticides may be used both indoors and outdoors, as needed with the exception of emergencies. The school will provide notification of pesticide applications at least 48 hours before pesticides are applied.

Pesticide purchase and storage. Pesticide purchases will be limited to the amount authorized by the School IPM Committee for use during the year. Pesticides will be stored in an appropriate, secure site that is not accessible to students or unauthorized personnel and will be disposed of in accordance with label directions and state regulations.

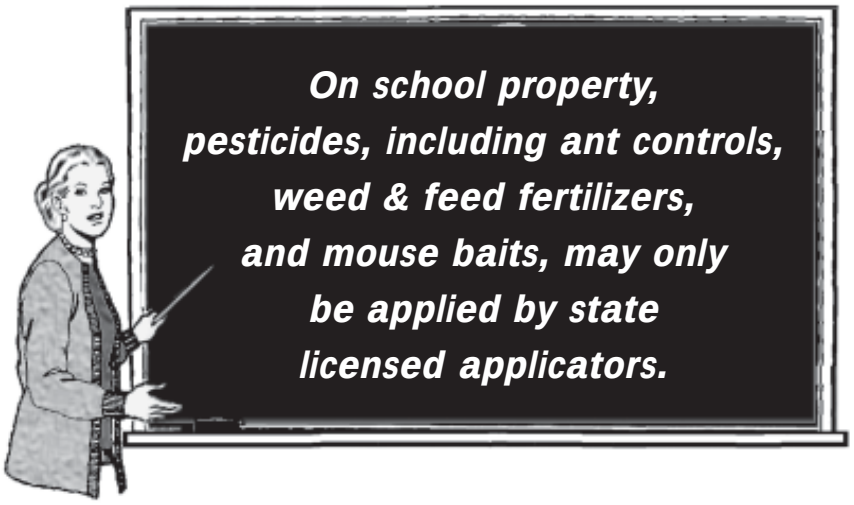
Pesticide applicators. Any person applying pesticides on school grounds will be trained in the principles and practices of IPM and licensed by the state to apply pesticides. Applicators must follow state regulations and label precautions and must comply with the School IPM Policy and pest management site plans.

Kitchen staff

Waste management and sanitation are among the most critical areas for pest management. It is essential that kitchen staff understand the importance of good sanitation and proper waste management and play an active role in the IPM program.

School nurse

The school nurse should keep the MSDS for any chemical used on school property and be aware of any children with asthma or chemical sensitivities. The nurse may also help coordinate notification of pesticide applications at the school.



Students and staff

The most important pest management responsibility of students and staff is sanitation. Pest prevention and reduction is directly related to food and food containers that are discarded or left on playgrounds, common areas, and athletic fields. Students and staff can also provide important information by promptly reporting the presence of pests.

Parents

Parents are often the major factor in starting a school IPM program. Visible interest and concern by parents serves as a stimulus to the school to do its best to provide safe, effective pest control.

Equipment and sanitation vendors and contractors

While it is in the interest of vendors and contractors to foster good customer relations, the only mechanism to enforce proper practice is specific contract language. Contracts should specify regular maintenance service, cleaning during service visits, and the immediate correction of problems.

Pest control professionals

Pest control firms work with the IPM Coordinator and the IPM Committee to provide professional services. Site plans for various locations are developed jointly and written into contracts. Pest management contracts should clearly establish what and how services will be provided. In advance of any pesticide treatments, applicators should report to the IPM Committee or IPM Coordinator the justification for treatment (action threshold, failure of nonchemical control, etc.)

Establish a pilot IPM program

Schools that are new to IPM should not change everything at once. The IPM Committee needs to sit down with pest management professionals, maintenance directors and staff, and the IPM Coordinator to evaluate current pest management activities. Design a pilot program for a specific area. Begin with a simple program while maintaining current practices elsewhere. A single pest at a single location may be chosen. Plan for specific, short-term goals that will introduce IPM to the school community. Remember, IPM is a long-term process; to see success may take an entire season. When the pilot program is working well, develop a plan for another site and expand the program.

The site plan

To begin the pilot program, write a specific site plan for the pilot program detailing the exact procedures to follow including:

- Educational activities to involve the school community;
- The means for monitoring pest populations and record keeping;
- The physical, mechanical, and cultural controls used to inhibit pests;
- Action thresholds—the conditions requiring pesticide application;
- A list of approved pesticide products—to be used only as a last resort; and
- Management restrictions, special safety precautions, and other constraints.

Sample Site Plan for a School Lawn

This plan is specific for highly visible lawns surrounding school buildings, primarily in the front of the building, easily viewed by visitors, students, and passers-by, and not ordinarily used as playground areas. Quality turf is expected to maintain a school's image, which may affect both public perception and student conduct.

Mowing

Turf will be mowed at least weekly when actively growing. During hot, dry summer periods, mowing frequency may be reduced. Mower blades will be kept sharp. Clippings remain in place and decompose in the turf. Never will more than one-third of the grass height be removed at any one mowing.

Irrigating

Irrigation is not usually required. It is acceptable to allow the grass to brown and become dormant during the summer. Foot traffic will not be allowed on dormant grass.

Fertilizing

Soil will be tested every 3 years for pH, phosphorus, and potassium levels. Recommended materials will be applied as soon as practical. Apply 2 to 3 pounds of nitrogen per 1000 ft^2 annually. Fine fescue lawns will receive 1 to 2 pounds of nitrogen per 1000 ft^2 annually. Fertilizers with approximately 30-50% slowly available nitrogen and at least a 2:1 ratio of nitrogen to potassium will be used. No more than 1 lb nitrogen per 1000 ft^2 of a rapidly available nitrogen source will be applied at any one time. If a 100% slow release fertilizer is used, then the total application may be as high as 2 lb nitrogen per 1000 ft^2.

Topdressing

This site will usually not require topdressing, although ruts or rodent holes will be promptly filled with soil.

Aerating

High traffic areas that become badly compacted will be aerated but no more than once a year.

Pest management

Chemical controls may be applied after nonchemical methods fail but only when pests reach action thresholds and only with the consent of the School IPM Committee. If children regularly gather at the site, chemical pesticides will not be used. Organophosphate insecticides and restricted-use pesticides will not be used on this site.

The IPM Coordinator will plan a monitoring and record keeping system to inspect the lawn every two weeks for weeds, diseases, and insect pests and to evaluate the effectiveness of cultural controls.

Weed management. Weeds will be controlled by hand-pulling and frequent mowing. Herbicides will be used only as a last resort and never when children are present.

Disease management. A mixture of turfgrass species will be planted, including at least three cultivars for each species to establish a wide range of disease tolerance.

Insect management. The action thresholds for this site will be set quite a bit higher than athletic fields. Insecticides should rarely be required. If white grubs reach action thresholds, apply nematodes (*Heterorhabditis bacteriophora* or *Steinernema glaseri)* in August and increase irrigation. If the grubs persist, halofenozide or imidacloprid will be applied in late July of the following year.

Vertebrate management. Rodent burrows will be filled with suitable soil and overseeded or sodded. If rats are present, bait boxes will be installed and serviced weekly. Moles will be managed with harpoon traps.

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CHAPTER 3

IPM ON SCHOOL GROUNDS

Monitoring
Record keeping
Evaluating the program
Determining action thresholds
Selecting pest control methods

Begin fieldwork after the administrative details of school IPM are established, the duties are assigned, and a pilot program is approved. This part of IPM involves several coordinated activities.

Monitoring and record keeping

Monitoring involves inspecting the school grounds on a regular basis for pests, damage caused by the pest, or conditions that favor pests. The same method of monitoring should be used at regular intervals.

Record your observations with a method that is easy enough to be practical and accurate enough to be meaningful. The idea is to use time wisely and gather enough information to make intelligent pest management decisions. Monitoring records might include any of the following items:

- Who is doing the monitoring, date and time.
- Where? A map is useful;
- The general condition of school grounds and plants—their vigor and appearance;
- The specific pest species and their abundance (send samples to Cooperative Extension for positive identification);
- The types of beneficial species and abundance;
- Stage of the pest—immature, adult, seedling, etc.;
- Plant damage—symptoms, location, and quantity;
- Human impacts—foot traffic compacting the soil, physical damage to plants, plants in inappropriate sites, etc.;
- A map that locates all trapping devices, and bait stations in or around the school grounds; and
- Pest reports from students and staff.

In addition to monitoring records, keep a log of management activities—pruning, fertilizing, mulching, traps, pesticide applications, etc. Keep the log available to answer questions about pesticide applications or medical concerns, and for program evaluation. Maintain these records for at least three years:

- Pesticide application date, time, and location;
- Target pest, application method, and the extent of the application;
- Product name, quantity used;
- Wind speed, air temperature, and sky conditions; and
- Follow-up monitoring results.

Evaluating the program

Evaluate the program every year. By comparing management methods and results, action thresholds can be fine-tuned, problem sites can be identified, and nonchemical controls can be developed to discourage pests. Accurate record keeping should allow a school to answer the following questions:

- Were there significant pest problems?
- What damage was observed? What damage was considered tolerable or intolerable?
- Was the pest population held below the action threshold? Does the threshold need adjustment?
- Did the control methods work quickly enough to prevent pest damage?
- Was control really necessary or would the problem have diminished by itself?
- Were beneficial organisms affected? Did this lead to other problems?
- Did any other side effects or unanticipated consequences occur?
- Should another type of treatment be used?
- How can pest control methods be improved?
- Were the necessary components of the program developed and successfully integrated?
- Was the IPM Plan followed?
- Is more information needed to make proper decisions?
- Can monitoring or record keeping be improved?
- Were the right people involved?
- What were the total costs of the treatment including management costs, repair costs, costs due to risks, side effects or unexpected consequences.
- Is the site worth maintaining? Can the site be changed to eliminate or reduce the problem for the same cost as continuing maintenance?

Determining action thresholds

Unnecessary pesticide applications are often the result of unrealistically low tolerance for pests. There is little leeway in the tolerance for health-threatening pests, but many organisms that might be troublesome are tolerable at low levels; they become pests only if their population increases. The cost and risk of taking extreme action because of a few potential pests outweigh any benefits. We can avoid unnecessary treatments by changing the way we view pests and pest damage and by understanding the kinds of damage that are truly serious and those that are not.

IPM uses action thresholds to identify the point at which direct management activities are taken to avoid unacceptable economic, aesthetic, or medical injury.

Economic injury includes repair costs for pest damage to structures, playing fields, lawns, ornamentals, etc.

Aesthetic injury is a measure of annoyance or embarrassment from the visibility of a pest or damage to plants that may reduce aesthetic appeal but not necessarily plant health. This is a very subjective measure; the tolerance for weeds might be much higher in a large school playground than in a small front lawn at the school's main entrance. Considering the health concerns to children surrounding pesticide use, schools may want to rule out any use of pesticides for purely aesthetic reasons.

Medical injury stems from illness or injury to humans, pets, or wildlife that is caused or transmitted by pests such as rodents, ticks, stinging insects, weeds, and poison ivy.

Pest patterns emerge quickly when monitoring data are plotted on graph paper or with computer software.

Selecting pest control methods

The best way to achieve long-term, environmentally sensitive pest control is to use a combination of different methods. Living systems are so complex that a single tactic will rarely work for long. If monitoring indicates control is needed, use the following criteria to choose methods with the school community in mind:

- Least hazardous to human health;
- Least toxic to nontarget organisms;
- Most likely to be permanent and long-lasting;
- Easiest to perform safely and effectively;
- Most cost-effective;
- High benefit, low risk; and
- Appropriate to the site and maintenance system.

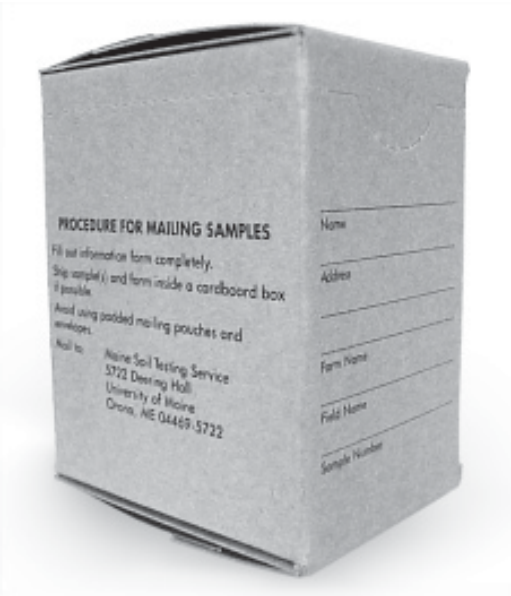
Cultural controls

Cultural controls are practices that discourage pests, prevent plant problems, and improve plant health. Many of these practices are routinely used.

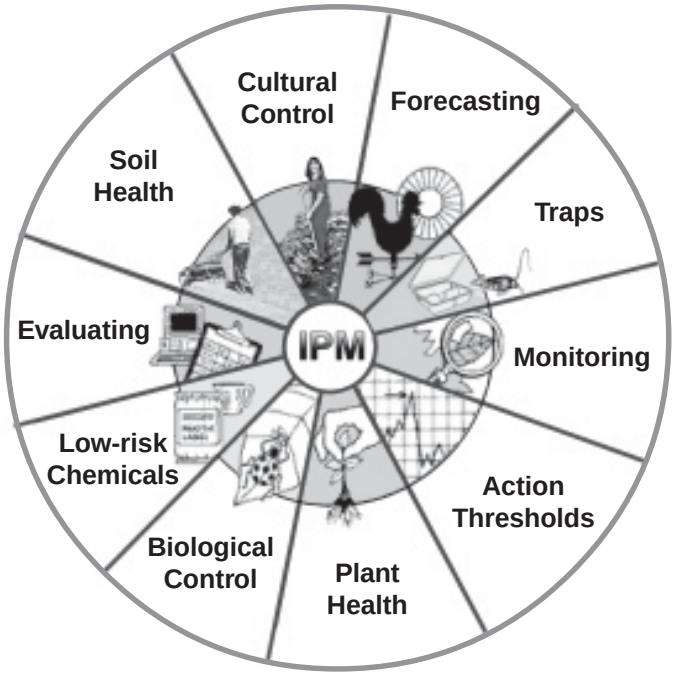
Sanitation. Sanitation can reduce or eliminate food for pests such as rodents, ants, flies, and yellow jackets.

Horticultural techniques. Many of the problems encountered in school landscapes begin with improper care, neglect, or poorly placed plants. The proper planting techniques, irrigating, soil testing, fertilizing, pruning, and mowing will encourage vigorous, thriving plants with fewer pest problems.

Design/redesign of landscape plantings. Effective pest management begins with proper landscape design. School groundskeepers must learn and understand the requirements of different plants.



Deliver soil samples to your County Extension Office.



Any method that discourages pests, can be incorporated into IPM. Use as many low impact methods as possible, in as many ways as practical.

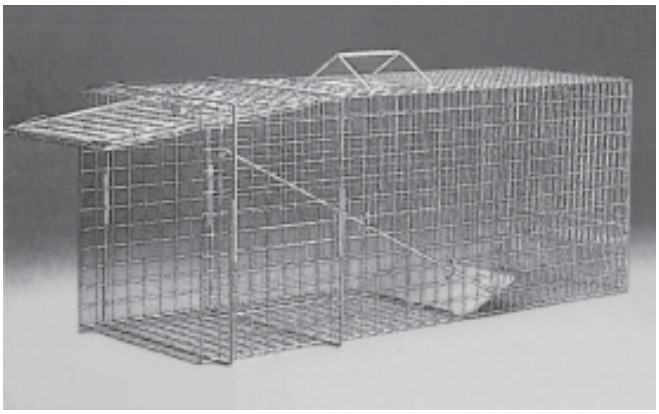
Physical controls

Physical control includes the manipulation of water, humidity, and temperature; the use of sound, electric shock, and light; as well as mechanical methods, such as traps, hand destruction, and exclusion devices. Physical controls kill pests, disrupt their life cycles, or make the environment unfavorable.

Habitat modification. To survive, pests need food, water, shelter, and the proper environment. If these necessities are reduced, the environment supports fewer pests. For example, removing dense vegetation near buildings decreases rodent habitat; eliminating standing water reduces mosquito breeding sites; removing secondary plant hosts controls certain fungal diseases.

Barriers. Barriers are used to exclude pests—window screens keep out flying and crawling insects; sticky barriers exclude ants from trees; landscape fabric and mulch control weeds.

Heat, cold, electric current. Commercial heat treatments can kill wood-destroying pests. A propane torch can kill weeds sprouting through cracks in pavement.



A box trap provides mechanical control for small vertebrate pests.

Removing pests by hand. In some situations, removing pests by hand may be the safest and most economical strategy. For example, weeds can be pulled by hand or hoed; tent caterpillars can be clipped out of trees; gypsy moth egg masses can be collected and destroyed. This method should not be used with poisonous species such as brown tailed moth or poison ivy.

Trapping. Many traps are available including snap traps for mice and rats, electric light traps, flypaper and other sticky traps, cone traps for yellow jackets, harpoon traps for moles, and box traps for skunks and raccoons.

Traps play an important role in nonchemical pest control, however there is a risk of injury to children if they find them. By involving students in the IPM program, they will have more of a stake in guarding against misuse and vandalism.

Biological controls

Biological control uses living organisms that naturally suppress pest populations. These organisms include many species of birds, bats, insects, spiders, nematodes, fungi, bacteria, and viruses. Because they control pests, they are often known as beneficial organisms. Biological controls often target specific pests and, once established, they provide long term, or even permanent control.

A school can artificially increase biological control in an area by purchasing and releasing beneficials. Most of the available beneficial organisms are insect parasites and predators although an increasing number of microorganisms (fungi, bacteria, nematodes and viruses) are available.

Many pesticides are lethal to biological control organisms. Apply pesticides with their survival in mind.

- Treat pests only at action thresholds.
- Avoid broadcast pesticide applications.
- Use spot treatments to reduce impact on nontarget organisms.
- Time treatments to be least disruptive to the life cycles of natural enemies.
- Include flowering plants in the landscape to provide pollen and nectar for beneficial insects.
- Select species-specific, low-risk pesticides, such as *Bacillus thuringiensis*, insect growth regulators, and baits formulated to attract only the target pest.

Chemical controls

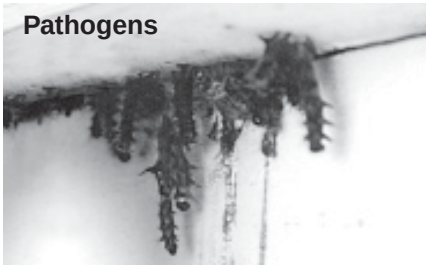
This form of control uses organic or synthetic pesticides to kill, attract, repel, or otherwise control the growth of pests. See Appendix A for pesticide use guidelines and a discussion of the pesticide label.

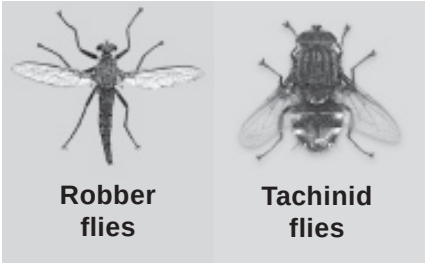
When considering a pesticide application, it is important to consult the product label and Material Safety Data Sheet (MSDS). These are available from pesticide suppliers and contain information on potential hazards and safety precautions.

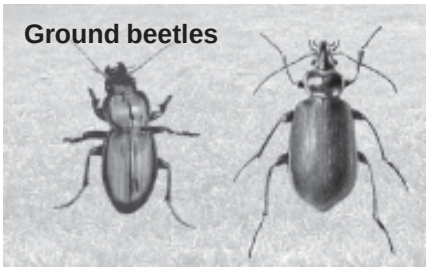
- What is the acute (immediate) and chronic (long-term) toxicity of the pesticide? Acute toxicity is measured by the LD50, which is the dose of the pesticide required to kill 50% of a group of test animals (measured in milligrams of pesticide per kilogram of body weight of the test animal). The higher the LD50 value, the more poison it takes to kill the test animals. In other words, high LD50 equals low acute toxicity. Chronic toxicity refers to potential health effects from repeated exposure to low doses of the pesticide. Chronic effects can be

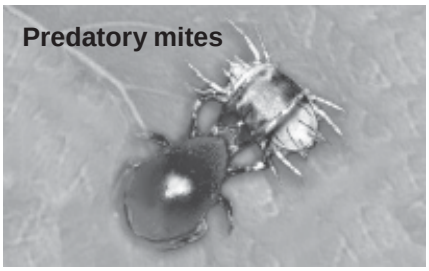
Lady beetles are familiar beneficial insects. They feed almost exclusively on soft-bodied insects and insect eggs.

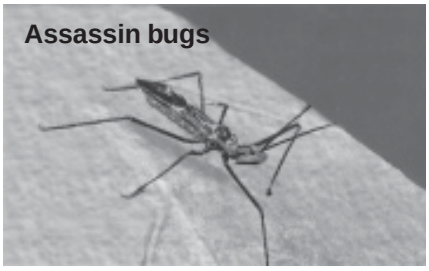
Beneficial Organisms

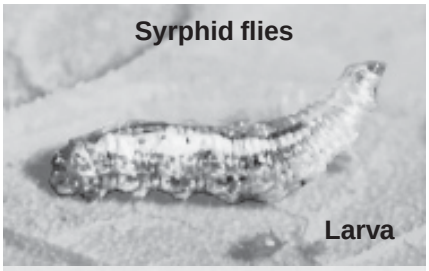


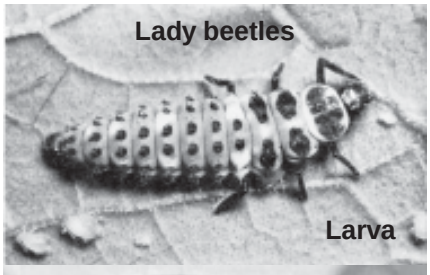


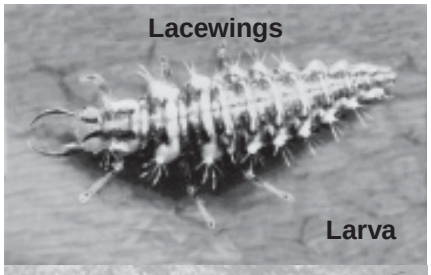












carcinogenic (cancer-causing), mutagenic (causing genetic changes), or teratogenic (causing birth defects).
- Is the pesticide selective for the target species? Does it affect a narrow range of species or is it active against nontarget species?
- How mobile is the pesticide? Is the compound volatile, so that it drifts into the air? Can it move through the soil into the groundwater? Does it run off in rainwater to contaminate lakes and rivers?
- What is the residual life of the pesticide? Is it persistent? How long is it toxic in the environment?
- What are the environmental hazards listed on the label? What are the potential effects on wildlife or beneficial insects?

Low risk pesticides have most or all of the following characteristics:

- They are stable, do not volatilize in the air, and use very small amounts of the active ingredient.
- They can be applied precisely to target the pest while minimizing exposure to people.
- They are formulated as baits, pastes, or gels and present no obvious physical hazard or dust/powder inhalation hazard.
- They biodegrade rapidly.
- Pesticide label precautionary statements do not include "toxic" or "extremely toxic" to bees, birds, fish, or wildlife and do not include specific warnings regarding ground or surface water contamination.
- They are effective against a narrow range of target pests.
- They have low mammalian toxicity via oral, inhalation, or dermal routes, no effects on the eyes, mild or slight effects on skin—EPA toxicity Category IV.

Contracted services

Professional pest managers can provide much of the knowledge and experience needed to establish an IPM program. Professional services also eliminate the need for a school to store pesticides or hire and train personnel. Choose a well-respected contractor with IPM experience. Records on various companies may be found through the local Better Business Bureau or the Board of Pesticides Control.

The contractor should survey the school grounds before submitting a proposal. The proposal should outline a comprehensive program including site plans for all contracted areas; these are developed with the IPM Coordinator and approved by the IPM Committee. Fees under contract should be based on monitoring and preventive activities rather than on the number of pesticide applications. Choose a proposal that is most advantageous to the school, considering the costs, the risks, and the benefits.

Read the label before mixing, applying, storing, or disposing a pesticide.

Pest management resources in Maine

Maine School IPM Program	**287-7616**
Board of Pesticides Control	**287-2731**
Maine Forest Service	**287-2431**
Maine Department of Agriculture	**287-3871**
Inland Fisheries and Wildlife	**287-8000**
UMCE Pest Management Office	**1-800-287-0279**
County Extension Offices	**See inside back cover**

Sample Contract Specifications for Integrated Pest Management in Schools

This guide, provided by the Safer Pest Control Project (www.spcpweb.org), provides a general outline for bid specifications and school pest management contracts. This is a very extensive treatment and many elements will need revision to suit individual schools. An experienced contract officer or legal counsel should review any pest control contract to ensure compliance with pest management policy and state regulations.

1. General

A. Description of program: This specification is part of a comprehensive Integrated Pest Management (IPM) program for the premises listed herein. IPM is a process for achieving long-term, environmentally sensitive pest suppression through the use of a wide variety of technological and management practices. Control strategies in an IPM program include monitoring, physical, cultural, biological, and procedural modifications that reduce the food, water, harborage, and access used by pests. Chemical controls are used only as a last resort after considering non-toxic options.

B. IPM Coordinator: The school district will appoint a school employee as the IPM Coordinator. The IPM Coordinator will act as the manager of the IPM program including overseeing and monitoring contract performance.

C. Contractor service requirements:

i. The Contractor shall furnish all supervision, labor, materials, and equipment necessary to accomplish the surveillance, trapping, pesticide application (when deemed necessary), and pest removal components of the IPM program.

ii. The Contractor shall provide detailed, site-specific recommendations for any structural and procedural modifications needed to aid in pest prevention.

iii. The Contractor shall provide evidence of sufficient expertise in pest control and IPM training and/or IPM experience to carry out these responsibilities. All contractors must be licensed by the Board of Pesticides Control.

iv. All services provided by the contractor will be in compliance will all relevant Federal, State, and local laws.

2. Pests Included and Excluded

The IPM program specified in this contract is intended to manage pest populations in the contracted area including insects, plant diseases, rodents, etc. [modify this point to suit the particular situation].

3. Action Thresholds

Levels of pest populations or site environmental conditions that require remedial action by the Contractor shall be fixed by the Contractor and the IPM Coordinator. Action shall only be taken when a pest population is present and posing a problem and/or risk to school property and/or building inhabitants.

4. Initial Inspections

The Contractor and the IPM Coordinator shall conduct a thorough, initial inspection during the first month of this contract. The purpose of the initial inspection is for the Contractor to evaluate the pest management needs of the property and discuss these with the IPM Coordinator. Access to all areas shall be coordinated with the IPM Coordinator. The inspection shall address:

- Identification of problem areas in and around buildings, on all athletic fields, and playgrounds.
- Identification of structural features or sanitation problems contributing to pest infestations.
- Discussion of the effectiveness of previous control efforts.
- Facilitation of Contractor access to all necessary areas.
- Information about restrictions or special safety precautions, or other constraints that the Contractor should be aware of.

5. Pest Management Plan

Following the initial inspection, the Contractor will develop a detailed Pest Management Plan and Service Schedule for each site. This must be submitted to the IPM Coordinator for approval prior to initiation. The Pest Management Plan shall consist of the following:

A. Service schedule for each building or site: Frequency of inspections, monitoring, and treatment by the Contractor shall depend on the specific pest management needs of the premises and/or grounds. At a minimum, the Contractor shall perform regularly scheduled inspections and monitoring to determine if remedial action is necessary.

B. Monitoring and inspection program: The Contractor shall outline a monitoring and inspection program that includes proposed methods of surveillance and that will identify infested areas and allow an objective assessment of site environmental conditions and pest population levels. Monitoring and inspection shall be continued throughout the duration of this contract. Between visits from the Contractor, the IPM Coordinator will ensure that regular monitoring of pest prone areas takes place.

C. Description of site-specific pest control methods: The Contractor shall describe physical, structural, operational, biological, and least-hazardous chemical recommendations and actions to manage pest populations that exceed the established thresholds or other measures aimed at preventing pest infestations. The Contractor shall use nonchemical methods wherever possible.

D. Description of any structural or operational changes that would facilitate the pest management effort: The Contractor shall provide the IPM Coordinator with written recommendations for site-specific solutions for preventing future pest infestations or eliminating observed sources of pest food, water, harborage, and access.

E. Statements of the conditions considered necessary to allow pesticide application: *Pesticide applications shall be by need and not by schedule.* The Contractor must obtain written permission from the IPM Coordinator before using pesticides. [Some schools may wish to list which pesticides require permission and those that do not].

F. Proposed materials and equipment for service: The Contractor shall provide current labels and *Material Safety Data Sheets* (MSDS Sheets) for all pesticides used, and the brand names of rodent bait boxes, pest monitoring devices, pest surveillance and detection equipment, and any other pest control devices or equipment that may be used to provide service.

G. Commercial pesticide applicator licenses: The Contractor shall provide photocopies of the business' Pest Control License and Pesticide Applicator Licenses for every Contractor employee who will be performing on-site service under this contract.

H. Notification and posting: The Contractor shall work with the IPM Coordinator to ensure full compliance with state notification and posting requirements.

6. Record Keeping

The IPM Coordinator shall be responsible for maintaining a pest control logbook or file for each building or site specified in this contract. These records, or a copy of them, shall be kept on site. The Contractor shall be responsible for documenting each visit to the site and all services provided. This file shall include:

A. Pest control plan: A copy of the Contractor's approved Pest Management Plan, including labels and MSDS sheets for all pesticides used and the Contractor's service schedule.

B. Pest sighting reports: Pest monitoring data sheets that record the number and location of pests found by the Contractor's monitoring program and sightings by school occupants.

C. Work request and inspection forms: Work Request and Inspection Forms will be used to advise the Contractor of routine service requests and to document the performance of all work, including emergency work. Upon completion of a service visit to the building or site, the Contractor's employee performing the service shall complete, sign, and date the form, and return it to the logbook.

D. Contractor's service report forms: Customer copies of a Contractor's Service Report Form documenting all information on pesticide applications, including the location of all traps, trapping devices, and bait stations in or around the property.

7. Manner and Time To Conduct Service

A. Time frame of service visits: The Contractor shall not perform routine pest control services during regular school hours. When it is necessary to perform work during school hours, the Contractor shall notify the IPM Coordinator at least one day in advance.

B. Safety and health:
   i. The Contractor shall observe all safety precautions throughout the performance of this contract. All work shall comply with applicable state and municipal safety and health requirements. Where there is a conflict between applicable regulations, the most stringent will apply.
   ii. The Contractor shall assume full responsibility and liability for compliance with all applicable regulations pertaining to the health and safety of personnel during the execution of work.

C. Special entrance: The Contractor must coordinate access to restricted areas with the IPM Coordinator.

D. Uniforms and protective clothing: All Contractor personnel working in or around buildings designated under this contract shall wear distinctive uniform clothing. The Contractor shall determine the need for and provide any personal protective items required for the safe performance of work. Protective clothing, equipment, and devices shall comply with FIFRA and the specific pesticide labels.

E. Vehicles: Vehicles used by the Contractor shall be identified in accordance with state and local regulations.

8. Special Requests and Emergency Service

On occasion the IPM Coordinator may request that the Contractor perform corrective, special, or emergency service(s) that are beyond the routine service requests. The Contractor shall respond to these exceptional circumstances and complete the necessary work within one working day after receipt of the request. In the event that such services cannot be completed within one working day, the Contractor shall immediately notify the IPM Coordinator and indicate an anticipated completion date.

9. Use of Pesticides

The Contractor shall minimize the use of pesticides whenever possible. The Contractor shall not apply any pesticide that has not been included in the Pest Management Plan or approved in writing by the IPM Coordinator. Applications of nonapproved pesticides will be restricted to unique situations where no alternative measures are available and nonchemical options have been exhausted. The pesticides used by the Contractor must be registered with the U.S. EPA, Maine BPC, and used in strict accordance with the manufacturer's label instructions and all applicable Federal, State, and local laws and regulations. The Contractor shall adhere to the following rules for pesticide use:

A. Written permission to use pesticides: The Contractor will not use any pesticide without first obtaining written permission from the IPM Coordinator and after monitoring indicates the presence of pests that exceed action thresholds and nonchemical control methods or actions have not reduced the pest population to below the action threshold. The Contractor shall provide a written request explaining the need to use a pesticide. The request shall identify the target pest, the need for such treatment, the time and specific place of treatment, the pesticide to be used, the method of application, what precautions should be taken to ensure school occupant safety, and the steps taken to ensure the containment of the spray to the site of application. If pesticide use is approved, the Contractor shall employ the least-hazardous material, most precise application technique, and minimum quantity of pesticide necessary to achieve control.

B. Timing of application: The Contractor must time applications of pesticides requiring notification to occur when areas are unoccupied and will remain unoccupied until the reentry period specified by the label.

C. Notification procedures: The IPM Coordinator shall provide the Contractor with information about the district's procedures for notifying parents, guardians, and staff about applicable pesticide applications. The Contractor shall provide the IPM Coordinator with sufficient advance notice of pesticide applications for the district to comply with the notification requirement.

D. Pesticide storage: The Contractor shall not store any pesticide product on the premises listed herein.

10. Structural Modifications and Recommendations

Structural modifications for pest suppression will not necessarily be the responsibility of the Contractor. The Contractor shall be responsible for advising the IPM Coordinator about any structural, sanitary, or procedural modifications that would reduce pest food, water, harborage, or access. The Contractor shall be responsible for adequately suppressing all pests included in this contract regardless of whether or not the suggested modifications are implemented.

11. Controlling Invertebrates, Weeds, and Plant Disease

A. Monitoring: The contractor shall monitor pest populations and control efforts.
B. Emphasis on nonchemical methods: The Contractor shall use nonchemical methods of control whenever possible.
C. Bait formulations: Bait formulations shall be used wherever appropriate. Bait shall be placed in areas inaccessible to children and other building occupants.
D. Records: The locations of all monitoring devices, bait stations, and other control devices shall be recorded in the pest control logbook.

12. Controlling Vertebrate Pests

A. Indoor trapping: As a general rule, vertebrate control shall be accomplished with trapping devices only. All such devices shall be concealed out of the general view and in areas inaccessible to children and in protected areas not affected by routine cleaning and other operations. The Contractor or school employee authorized by the IPM Coordinator must check trapping devices regularly. The Contractor or school personnel shall properly dispose of vertebrates killed or trapped within 24 hours.
B. Rodenticides: Rodenticides will be placed in EPA-registered tamper-resistant bait boxes. Frequency of bait box servicing shall depend upon the level of rodent infestation. All bait boxes shall be labeled and dated at the time of installation and each servicing. All bait boxes shall be maintained in accordance with EPA and Maine BPC regulations, with an emphasis on the safety of nontarget organisms.
C. Records: The locations of all traps, trapping devices, and bait boxes shall be recorded in the pest control logbook.

13. Quality Control Programs

The Contractor shall establish a complete quality control program to assure the requirements of the contract are provided as specified. The program shall include at least the following items:

A. Inspection system: The Contractor's quality control inspection system shall cover all the services stated in this contract to detect and correct deficiencies in the quality of services before the level of performance becomes unacceptable and/or the IPM Coordinator identifies the deficiencies.
B. Checklist: A quality control checklist shall be used in evaluating contract performance during regularly scheduled and unscheduled inspections
C. File: A quality control file shall contain a record of all inspections conducted by the Contractor and any corrective actions taken. The file shall be made available to the IPM Coordinator upon request.
D. Inspector(s): The Contractor shall state the name(s) of the individual(s) responsible for performing the quality control inspections.

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University of Maine Cooperative Extension, Pest Management Office, 491 College Ave., Orono, ME 04473. 207-581-3880, toll free (in Maine) 800-287-0279. http://www.umext.maine.edu/topics/pest.htm

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CHAPTER 4

LANDSCAPE MANAGEMENT

School grounds can support a complex biological community. The landscape is actually sustained by the complexity—a living web of checks and balances that offers fewer opportunities for pests. Because of this wide diversity, most school landscapes experience fewer pest problems than turfgrass. Landscape problems usually involve compacted soil, drought stress, over-watering, frost damage or other physical factors. Landscape IPM focuses on understanding the nature of the school landscape, plant health, soil health, and sustainability.

The landscape ecosystem

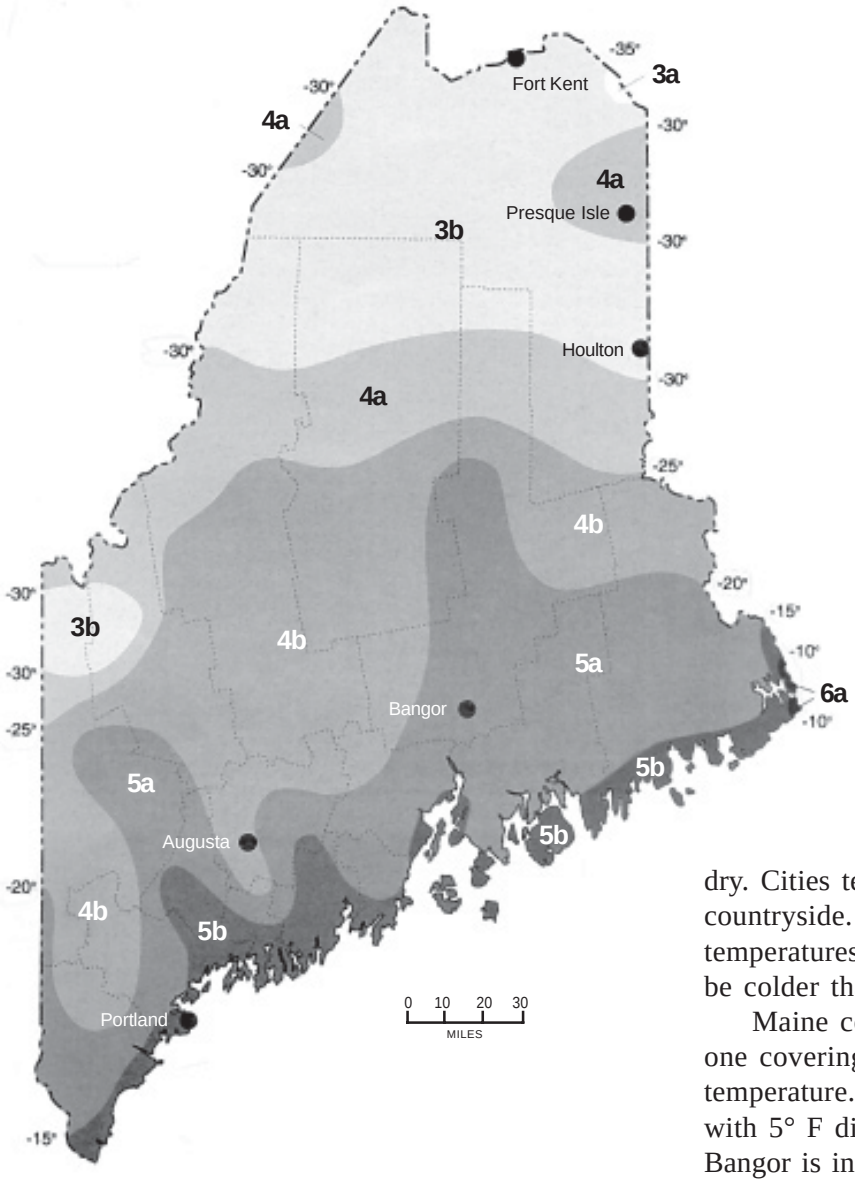
The school landscape is an ecosystem—a tightly knit relationship among plants, animals, water, soil, sunlight, weather, etc. You must understand these relationships to apply effective pest management activities that promote plant health.

- What is your climate?
- What are the maximum and minimum temperatures?
- Do microclimates affect plant growth?
- What is the speed and direction of prevailing winds?
- What are your seasonal patterns of precipitation?
- Are plants getting too little or too much water?
- Where are the sunny and shady parts of the school grounds? (These change over time as plants grow and die.)
- What are the characteristics of the soil in each part of the landscape?
- What are the drainage patterns?
- Are root systems damaged by excavation or soil compaction?
- What is the history of each area?
- Was an area ever covered with asphalt or concrete?
- Did a road or path go through the site?
- Do vehicles park on turf?
- What plants and animals, domestic and wild, impact the landscape?
- How do human activities affect the landscape?
- Do children injure plants when they play?
- Does grass grow so close to the trunks of trees that mowers regularly damage the bark?
- Does winter maintenance add salt to the soil?
- Is air pollution a problem in your area?

Know your plants

Before you can properly care for a landscape plant, you must know what type of plant it is and the growing conditions it requires. Make a map of the grounds—locate and identify the species of every significant tree, shrub, and ornamental plant. Research each one; look them up in gardening books; talk to nursery personnel and horticulturists; talk to your County Extension Office. You should be able to answer the following questions:

- What kind of soil does the plant prefer?
- How much water does it need?
- How much heat or cold can it tolerate?
- Does it prefer shade or sun?
- Will this plant thrive in its setting?
- When should it be fertilized?
- How should it be pruned?
- What are its most common pest problems?
- Is it susceptible to soil compaction, air pollution, salt damage, or other environmental problems?



Average Annual Minimum Temperature

Zone 3a	-35° to -40°F
Zone 3b	-30° to -35°F
Zone 4a	-25° to -30°F
Zone 4b	-20° to -25°F
Zone 5a	-15° to -20°F
Zone 5b	-10° to -15°F
Zone 6a	-5° to -10°F

Plant hardiness zones

Low temperature is a critical environmental limit in the life of plants. Some plants, such as annual flowers and vegetables, survive cold weather as seeds; all vegetative parts die with the frost. A cold winter may kill the seeds as well. Perennial plants may survive many winters but there is a minimum temperature at which they will die. These threshold temperatures determine a plant's winter hardiness.

The map shows the plant hardiness zones of Maine based on the average minimum temperatures for years 1974 to 1986. Temperature data are limited across the state giving us only a general picture—the mountainous areas of Maine are certainly colder than the map indicates. Local variations called microclimates are not included. A low, wet location, for example, may be quite a bit colder than a neighboring area that is higher and dry. Cities tend to be warmer than nearby countryside. Large bodies of water make local temperatures less extreme. High elevations tend to be colder than lower elevations.

Maine contains four zones, 3 through 6, each one covering 10 degrees of average minimum temperature. Each zone is subdivided into a and b, with 5° F difference between each. For example, Bangor is in zone 5a (-15° to -20° F); Portland is in zone 5b (-10° to -15° F). This information is useful when choosing landscape plants, but there is a difference between surviving and thriving. A plant exposed to the lowest temperatures it can tolerate may survive the winter but may lose so much vigor that it never grows well.

Plant catalogs and reference books often use hardiness zones to indicate if a plant is likely to survive in a location. For example, Eastern White Pine is rated hardy to zone 3, and should grow in any part of Maine. Japanese maple, on the other hand, is hardy to zone 5 or 6 and would show great adaptability only along the coast.

Remember the map is based on *average* minimum winter temperatures; some winters are colder than average. Plants that are barely hardy in a particular zone may succumb in an extremely cold winter. Landscapers should consider selecting plants rated a zone colder than their location.

Know your soil

A routine soil test is a quick and inexpensive way to check the level of nutrients that are available for plant growth. Soil tests save money and prevent water pollution by indicating:

- The soil pH;
- Levels of potassium (K), phosphorus (P), calcium (Ca), magnesium (Mg);
- Level of organic matter;
- The presence of lead contamination;
- How much lime and fertilizer (organic or chemical) to add; and
- Management tips for growing healthy plants.

Test your soil at least once every three years. Test more often in problem areas, or where abundant nutrients have been added. Record test results to track changes. Note that there are no reliable tests for measuring nitrogen levels in soil. Test results come with recommendations for the next growing season, so sample the soil in early spring, after the frost is out of the soil, or in the fall, before the ground freezes (wait several weeks after your last fertilizer application before sampling). Fall sampling will give the same test results as spring sampling. A soil test usually takes two to three weeks to complete. For more information see the Maine Soil Testing Service web page http://anlab.umesci.maine.edu/.

Taking a good soil sample

1. Get a Maine Soil Testing Service container from your County Extension Office or from the Maine Soil Testing Lab, 207-581-3591. Some garden centers may carry them as well.
2. Using a clean tool, take several samples from different spots to fully represent the sample site. Sample in the root zone (usually 6-8 inches for gardens and 3-4 inches for turf).
3. Combine all samples in a clean container, mix thoroughly and fill the sample box.
4. Label the container with your name, address and sample identification.
5. Fill out the information form, available online: http://anlab.umesci.maine.edu/forms/forms.htm. Keep a copy for your records.
6. Deliver to your County Extension office or mail to the Soil Testing Lab. A standard soil test costs $10.

Maine's native landscape

Nearly 1500 species of plants make up Maine's unique environment. They form the historical basis of our landscape, provide food and habitat for animals, and serve as natural sources of food, fiber and other products. Native plants can be naturally resistant to local insects and diseases, but only if they are located in their preferred environment. A fabulous forest shrub can have serious difficulties when planted between a playground and a sidewalk. To maintain our landscape:

- Avoid disturbing natural areas.
- Purchase only propagated native plants, not those dug from the wild.
- Do not purchase or plant invasive species, such as purple loosestrife and Japanese barberry.
- Learn to identify and control invasive plants. Take samples for identification to a local nursery or garden center, or to your County Extension Office.

A sustainable landscape will feature native plants but many nursery plants are also appropriate. Avoid invasive plants. These are aggressive, usually non-native plants that can spread rapidly and replace native species. They can alter the structure and function of habitats making them less suitable to native plants and animals.

Non-native plants considered most invasive in Maine

Purple loosestrife
(Lythrum salicaria)
Japanese barberry
(Berberis thunbergii)
Oriental bittersweet
(Celastrus orbiculatus)
Japanese knotweed
(Fallopia japonica)
Smooth and common buckthorn
(Frangula alnus and Rhamnus cathartica)
Non-native honeysuckles
(Lonicera spp.)
Garlic mustard
(Alliaria petiolata)
Multiflora rose
(Rosa multiflora)
Small-flowered tickle-grass
(Deschampsia cespitosa ssp. parviflora)

For information about invasive weeds in Maine: http://www.state.me.us/doc/nrimc/mnap/programs/invasives.html

Sustainable plants

These plants are native to Maine and are sustainable in the landscape—they are noninvasive and require fewer pesticides, less water, and reduced maintenance. They appear in both of the following publications:

Sustainable Trees and Shrubs. University of Rhode Island. http://www.uri.edu/research/sustland/

Native Plant Recommendations for Maine. http://www.umext.maine.edu/onlinepubs/htmpubs/2502.htm

American Cranberrybush - *Viburnum trilobum*
zone 3-8 8-12 ft tall x equal width
Adaptable to soil conditions, easy to grow, full sun/part shade.

American Hornbeam - *Carpinus caroliniana*
zone 3-9 20-30 ft tall x equal spread
Moist, acid soils, tolerates drier sites, partial/deep shade. Smooth gray, beech-like bark, useful as an understory tree.

Arrowwood - *Viburnum dentatum*
zone 2-8 6-8 ft tall x 15 ft wide
Adaptable to various soil conditions, sun/part shade. Forms large clumps. Viburnum leaf beetle may be a problem in some areas.

Bayberry - *Myrica pensylvanica*
zone 3-6 5-12 ft tall x variable width
Does extremely well in poor sandy soils, may be adaptable to heavy soils, full sun/light shade.

Beach Plum - *Prunus maritima*
zone 3-6 6 ft tall x equal spread
Adaptable to most soil conditions except wet, drought tolerant once established, full sun, salt tolerant. White flowers in May followed by purple fruit in late summer. Relatively pest free but subject to tent caterpillar, brown tail moth, plum pox, and eriophyid mites. Good for naturalizing in coastal plantings.

Bearberry - *Arctostaphylos uva-ursi*
zone 2-5 1/2 -1 ft tall x 2-4 ft wide
Does best in poor, dry, sandy soils, difficult to transplant, full sun, acidic conditions. Should be grown as a container plant.

Bush Cinquefoil - *Potentilla fruticosa*
zone 2-7 1-4 ft tall x 2-4 ft wide
Moist, well drained soils but is very adaptable, will do well under dry conditions, full sun/light shade, likes neutral to alkaline conditions. Extremely cold hardy. Long bloom period. Many improved cultivars available.

Chokeberry
Red - *Aronia arbutifolia*
Black - *Aronia melanocarpa*
zone 4-9 6-10 ft tall x 3-5 ft wide
Adaptable to various soils, tolerates both wet and dry soils, sunlight to shade but best fruit production in full sun. Good for massing or naturalizing. White flower clusters in spring, red berries that persist into winter. Black chokeberry is a smaller shrub with black fruit.

Common Witchhazel - *Hamamelis virginiana*
zone 6-8 20 ft tall x 15 ft wide
Generally prefers moist, acid soils high in organic matter, sun/part shade. Blooms in the fall.

Gray Dogwood - *Cornus racemosa*
zone 4-8 10-15 ft tall x very wide
Adaptable to wet or dry soils, full sun/light shade. Spreads rapidly by root suckers; siting important to avoid maintenance problems. Best for naturalized areas. Most drought tolerant of the native shrub dogwoods.

Highbush Blueberry - *Vaccinium corymbosum*
zone 3-8 6-12 ft tall x 8-12 ft wide
Native to swamps but does well in dry, acid, poor, and sandy soils, in full sun/partial shade. Mulch.

Ironwood / Hop Hornbeam - *Ostrya virginiana*
zone 3-9 25-40 ft tall x 20-30 ft wide
Prefers moist, slightly acid, well drained soils. Tolerates dry conditions once established. Full sun/part shade. One of the most drought tolerant and salt resistant small trees.

Red Maple - *Acer rubrum*
zone 3-9 40-60 ft tall x equal spread
Tolerates most soils but prefers moist, acid conditions, excellent for wet conditions. An important tree for urban landscapes; in full sun it will develop clear red fall foliage; many excellent cultivars available.

Red Oak - *Quercus rubra*
zone 4-8 60-75 ft tall x 75 ft wide
Moist, acid soils, full sun. Intolerant of high pH, tolerates urban conditions. Easily transplanted.

Serviceberry
Allegheny - *Amelanchier laevis*
Downy - *Amelanchier arborea*
Shadblow - *Amelanchier canadensis*
zone 4-9 variable width
Moist, acid soils, good for wet and/or naturalized areas, sun/shade. Newer cultivars are reported to be less subject to pest and disease pressure. Generally multi-stemmed with white flowers in early spring followed by purple-black berries in summer. Good fall foliage.

Sweet Fern - *Comptonia peregrina*
zone 2-7 2 ft tall x 4-6 ft wide
Well adapted to poor, dry, infertile soils, full sun/light shade. Difficult to transplant, best when container grown. Somewhat invasive although slow growing. Good for naturalizing or on embankments.

Black Tupelo - *Nyssa sylvatica*
zone 3-9 30-50 ft tall x 20-30 ft wide
Moist, well drained soils, tolerates wet soils, will also grow on upland areas. Full sun/light shade. Difficult to transplant, should be grown as a container plant. Excellent fall foliage.

White Oak - *Quercus alba*
zone 3-9 50-80 ft tall x equal spread
Adaptable to soil types, prefers moist, acid conditions, full sun. Dark blue-green lobed leaves, fall color not dependable; burgundy in good years. White oaks are more likely to die from gypsy moth attack than other oak species.

Native groundcovers

Bearberry, *Arctostaphylos uva-ursi* - a very durable, evergreen groundcover that grows in dry, sandy, or acidic soils forming dense, spreading mats. Individual plants are 6-12 inches tall and 15 inches in diameter. Bearberry is slow growing and may be hard to establish. It requires full sun to very light shade, rarely needs pruning, and never needs fertilization.

Bunchberry, *Cornus canadensis* - a deciduous groundcover needs moist, acidic soil, high in organic matter. It spreads slowly but is excellent under evergreens, shrubs, and woodland areas. Plants are 4-6 inches tall ending in a cluster of 4-6 leaves. Bunchberry needs partial or full shade, frequent watering, and acidic mulching until it is well established.

Checkerberry, *Gaultheria procumbens* - a low, evergreen groundcover that creeps underground to form mats. It does best in moist, organic, acidic soils with good drainage. Plants are 6 inches tall. Checkerberry needs light to full shade. It will not tolerate drought and does not adapt well to marginal sites.

Creeping juniper, *Juniperus horizontalis* - a slow growing, prostrate, evergreen shrub. It tolerates very hot, poor, dry soils, full sun, and exposed sites, although it does best in partial sun with moist, well-drained soils. The branches are very long and flexible forming large mats. Mature plants are 1-2 feet tall and 4-8 feet wide. Creeping juniper transplants easily, and adapts to a wide range of soil pH. They have few disease or pest problems, although spider mites may be troublesome in some areas.

Lowbush blueberry, *Vaccinium angustifolium* - a deciduous, twiggy shrub that forms dense colonies in woods or in sunny fields. It has a moderate growth rate and prefers partial shade or partial sun, and moist to wet soil. It tolerates full sun and dry, sandy soils. Plants are 1-2 feet tall spreading to 2 feet. Blueberry makes a good groundcover in acid soils (ideal pH is 4.5 to 5.5). Acidic mulch may be required.

Partridgeberry, *Mitchella repens* - a slow growing, evergreen groundcover that grows in deep shade. It requires moist, acidic soil but will tolerate dry shade if the soil is rich. Plants are 2-3 inches tall and spreads 2-3 feet. Partridgeberry is not particularly easy to grow; acid mulch is usually necessary.

Managing landscape pests

Landscape IPM relies heavily on natural processes, cultural practices, and regular monitoring to maintain plant health. A healthy landscape can out-compete most weeds, survive most insect attacks, and fend off most diseases.

- Use proper planting techniques.
- Know the care that each plant requires.
- Match the plant to the site—some plants cannot grow in full sun, others are adapted to salty, compacted, or poorly drained soil.
- Use pest and disease resistant landscape plants.
- Avoid plants that drop numerous seeds or fruit that may attract insects, rodents, and undesirable birds.
- Build organic matter in the soil. This loosens soil, increases the amount of pore space, and allows the soil to hold more nutrients and water.
- Mulch landscape plantings, but no more than 3 inches deep and not up against trunks or stems.
- Use landscape fabric covered with mulch for long-term weed control in flower and shrub beds.
- Keep vegetation, shrubs, and bark mulch at least one foot from building exteriors; keep tree limbs at least 6 feet away.
- Diversify landscape plantings—when large areas are planted with a single type of plant, a pest population can explode and devastate an area.
- Include flowering plants that attract and provide nectar and pollen for beneficial insects.
- Hand weeding is preferable to using herbicides for controlling occasional weeds.
- Educate students to respect the landscape; the more that students can be involved in the planting and care of various portions of the school yard, the less they will damage these areas.
- Use biological control to target specific pests.
- Use chemical control judiciously, in the least-toxic formulations, and as a last resort. Spot-treat to minimize the amount of active ingredient used. Remember that a commercial applicator's license is required for all pesticide applications on school property, including weed killers.

The right plant in the right place experiences fewer problems and needs less input than a poorly located planting.

Landscape monitoring

Landscapes are dynamic; monitor them regularly to keep up with changes. Make a map of the grounds noting locations of existing pest problems or conditions that can produce pest problems. Divide the landscape into management units and visit them every two weeks during the season. Identify the plants in each area, record the maintenance history of each site, and the current horticultural practices. Pay attention to plants that are growing in poor conditions or are under stress and more likely to suffer from insects and disease. Note developing pest problems and signs of plant stress—yellow or wilted leaves, dead twigs, etc.

You should be familiar with the kinds of damage symptoms caused by common pests but, with so many potential problems, it may be impossible to identify all of the pests that you encounter. For pest identification and treatment recommendations contact your County Extension Office or the Pest Management Office.

Identifying pests

The University of Maine Cooperative Extension Insect and Plant Disease Diagnostic Laboratory identifies insects and plant diseases for Maine citizens as a free service. Specimens can be mailed or dropped off at the clinic, or left with your County Extension Office. For more information call the Diagnostic Clinic, 1-800-287-0279, or visit the website http://pmo.umext.maine.edu/ipddl/ipddl.htm

Rating scales

Rating scales are useful for identifying pest problems. When properly used, they make monitoring faster, easier, and help standardize observations. Once a problem is identified, monitoring should become more precise and should relate to specific management practices for the pest. The rating scales below categorize pest abundance and plant damage and are used to complete the *Landscape Monitoring* sheet on the next page.

Rating Pest Abundance and/or Damage

Rating	Indicators
Few	Pests or damaged plants occasionally found, but only after much searching.
Common	Pests or damaged plants easily found during typical searching.
Abundant	Pests or damaged plants found in large number—obvious without searching.
Innumerable	Pests or damaged plants *extremely* numerous—obvious without searching

Rating Plant Condition

Rating	Leaf color[1]	Amount of growth[2]	Damaged parts[3]	Pest problems[4]
Excellent	Good	Adequate	None to few	None visible
Good	Good	Slightly reduced	Few to common	A few minor pests
Fair	Poor	Much reduced	Common to abundant	Either major *or* minor pests occur frequently
Poor	Poor	Severely reduced	Innumerable	Major and minor pests extremely numerous

[1]**Leaf Color:** Note that some healthy plants do not have bright green leaves. Leaves can be purple, yellow, or mottled. "Good" leaf color depends on the kind of plant.

[2]**Amount of Growth:** This refers to the length of new growth for the season, as well as the number of new leaves, and the size of the leaves, flowers, or fruit.

[3]**Damaged Parts:** Look at the whole plant. Are there leaves with holes, spots, or discolorations? Are they wilted, curled, or dead? Are there dead twigs or branches? Where are they located? Is the damage only on old leaves?

[4]**Pest Problems:** A major pest problem seriously affects or injures plants and requires intervention. Make sure what you are counting is truly a pest.

Landscape Monitoring

Name: _____ Date: _____

Location:

Ornamental beds _____ Fence lines _____

Sport turf _____ Paved areas _____

Ornamental turf _____ Trees _____

Playground _____ Other _____

Type of Plant	Plant Condition[1]				Pests?[2]	Pest Abundance[1] and/or Damage				Natural Enemies?	Management Activites	Comments
	Excellent	Fair	Good	Poor		Few	Common	Abundant	Innumerable			

[1]For rating scales, see charts on previous page.
[2]Identify the pest here or take a sample to your County Extension Office.

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CHAPTER 5

TURFGRASS MANAGEMENT

Healthy turfgrass brings many benefits to school grounds. It provides a safe surface for sports fields and playgrounds, and lends aesthetic appeal to the landscape. Thick grass prevents soil erosion, moderates temperatures, filters contaminants from rainwater, and absorbs many type of airborne pollutants. The extensive root system improves soil by adding organic material, and efficiently breaking down pesticides and other environmental chemicals. Grass also converts carbon dioxide to oxygen, a process that helps clean the air. Finally, vigorous turf stands resist and withstand pest attack, and require fewer pesticide applications.

Turfgrass IPM

Turfgrass IPM maintains turf by using cultural practices that keep turf healthy, monitoring for pests before they become a problem, and choosing pest management methods that are effective and environmentally sound. The entire program is evaluated every year and fine-tuned to each particular location.

Benefits of healthy turfgrass

- **Each 25 square feet of turfgrass produces enough oxygen for one person for one day.**
- **Turf cover reduces rain water runoff and soil erosion.**
- **A thick, healthy lawn allows 15 times less runoff than poor quality turf.**
- **Turf builds soil through decomposition of organic matter.**
- **Turf absorbs greenhouse gases, such as carbon dioxide.**
- **Turf traps pollen and dust for breakdown by soil microbes.**
- **Turf reduces noise, glare and heat.**

Monitoring

Turfgrass IPM begins with monitoring—regularly scheduled inspections to detect pests, plant damage, and other problems. Record all observations for future reference. Monitoring allows pest managers to:

- Identify pests;
- Identify natural enemies of the pest(s);
- Determine where, when, and what kind of treatments is needed;
- Timely apply preventive methods to reduce pest problems; and
- Evaluate and fine-tune the management program.

To begin monitoring, divide all turfgrass areas into management units; these usually correspond to treatment or use areas. Maps of the management units are useful for noting the locations of existing pest problems or conditions that can produce pest problems (bare spots, broken sprinkler heads, etc.) Design a monitoring form to record your observations (see next page). Inspect each unit every 2 weeks. Areas with active pest problems may need more attention. Identify the turf grasses in each area, record the maintenance history of the turf, and current horticultural practices. If any pests are present, be sure to get an accurate identification. Common turfgrass pests do not distribute themselves evenly. To catch them before they become a problem, it is important to monitor the entire site in a consistent, uniform pattern. Sampling in a zigzag pattern or pacing transects (see Chapter 8) is usually accurate and efficient.

Turf Monitoring

Name:		Date:
Turf species, variety, mix?	Specific location of injured turf:	
Soil type, pH, fertility:	Compaction:	Soil moisture (to depth of 4-6”):
Level of maintenance or turf visibility:	Level of wear:	Sunlight exposure (amount and intensity):
Fertilization (type, rate, frequency):	Mowing height/frequency:	Irrigation (amount and frequency):
Herbicide applications (what, rate, when):	Unusual chemical exposure (road salt, automotive, etc.)	Action level:
Injury pattern:	Circles or blotches? Spots?	Streaks or rows? Overall, uniform injury?
Presence of weeds?		% in sample area
Evidence of disease pathogens or fruiting bodies?	Where and what form?	
Presence of insects or frass?	on blades? in thatch? by roots?	What species?
Sampling technique(s)?		Average number of insects found per sample?

Turf monitors should become familiar with the common pest insects, weeds, and lawn pathogens, as well as natural enemies of common lawn pests, found in the local area. Learn about their life cycles and how to recognize them. Contact your County Extension Office for more information.

Determining action thresholds

Action thresholds are flexible guidelines usually defined as the level of pest density or damage that can be tolerated before taking action. They vary with the location, the turf use, and the pest. Most turf can tolerate some pest presence without compromising appearance or function. The challenge is to determine how much damage is tolerable and when action is needed to prevent unacceptable pest damage. Pest tolerances should be defined for each turf area on school grounds.

Evaluating the program

After taking action to reduce pest presence, use the monitoring data to evaluate the effectiveness of the treatment.

- Did pest numbers go down sufficiently to prevent intolerable damage?
- Do action thresholds need to be adjusted?
- Were treatments cost effective?
- Is the problem likely to recur?
- Can conditions that cause chronic pest problems be altered or removed?
- If not, can turf be replaced with another ground cover better suited to conditions at the site?

Turfgrasses

All perennial turfgrasses reproduce from seed. Once established, certain species can also spread vegetatively. New shoots can grow either from the base of the plant or from the nodes of modified stems. Modified stems growing underground are known as rhizomes; modified stems growing along the surface of the ground are known as stolons.

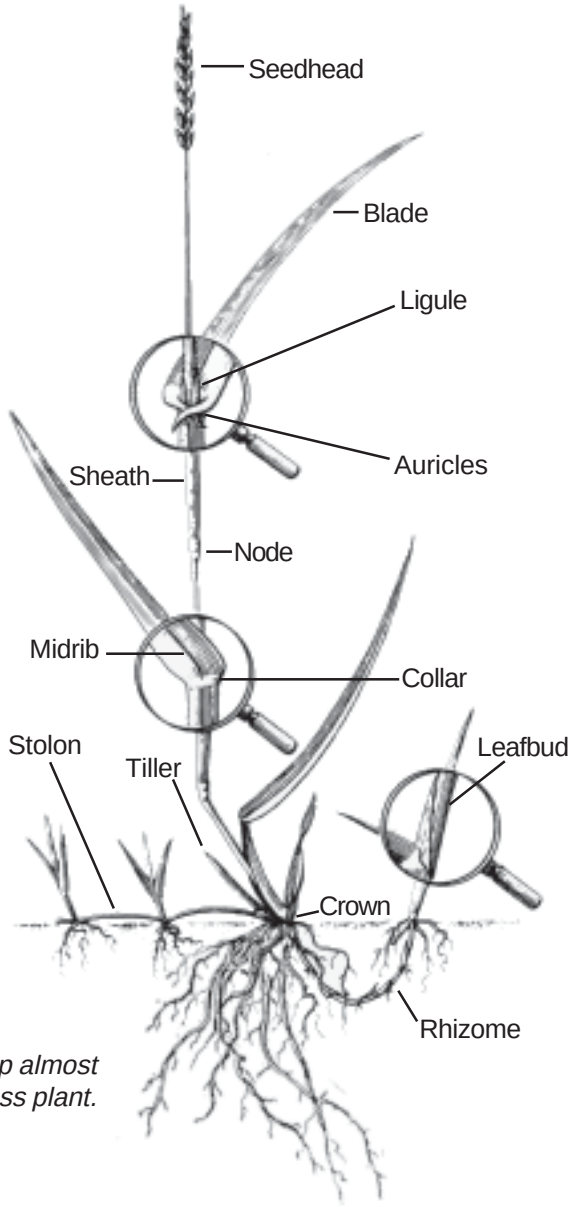
The leaves of grass plants develop from a node, or thickened joint, along the stem. The leaves curl around the stem in a sheath before unfurling into a long, narrow blade that has parallel, lengthwise veins. When turfgrass is clipped close, the plants adapt to low growth by forming nodes that crowd together along the shortened stem. The leaves arising from these nodes give grass a short, dense growth habit.

Selecting turfgrass

Choose a seed mix suited to your conditions—soil characteristics, light, use, and desired level of maintenance. In Maine, a mixture of cool-season grasses is recommended (see *Seed Mixtures*, page 42).

Kentucky bluegrass is the most commonly used turfgrass for lawns and athletic fields in Maine. It is adaptable to a range of environments, mowing heights, and traffic level. It is pest resistant and spreads by rhizomes, allowing it to re-colonize bare or thin areas. The rhizomes produce thatch and bluegrass turf may require aeration.

While Kentucky bluegrasses are generally considered moderate to high maintenance turfgrasses, several cultivars provide acceptable quality turf in low traffic areas with little fertilization or irrigation, and high mowing height.



Roots may make up almost half of the entire grass plant.

Perennial ryegrass rapidly germinates from seed and is often used for overseeding thin or bare areas and athletic fields. It is not as cold tolerant as Kentucky bluegrass, but its wear tolerance is better. Perennial ryegrass is susceptible to pythium blight, crown rust and other diseases.

Fine fescues (red, hard, and Chewings) as a group require less mowing, fertilization, and irrigation. They are not traffic tolerant but are shade tolerant and perform well in relatively dry soils. The turf quality of fine fescues is low to moderate but they can be mixed with Kentucky bluegrass to provide a medium quality turf.

Tall fescues are generally used for low quality turf that requires infrequent mowing and little or no fertilizer and irrigation. Tall fescue is shade and traffic tolerant, and will perform acceptably with mowing as infrequently as once every two weeks on high use areas. Newer cultivars require more frequent mowing, fertilizing, and irrigating than older cultivars and are not cold tolerant.

Supina bluegrass is a perennial, stoloniferous bluegrass that performs well in moist environments, and has excellent shade tolerance. Because it spreads by stolons, it rapidly fills in bare areas in high traffic situations, such as athletic fields. It requires high levels of fertilization and irrigation to perform well. The preferred mowing height is lower than other cool season grasses, with best results obtained between $^{3}/_{4}$ and $1^{1}/_{2}$ inches. It makes a good turfgrass for well maintained soccer fields but is quite expensive.

Endophytic grasses support certain microbes growing within them. These microorganisms secrete substances that make grass leaves less susceptible to turf diseases and above-ground insects, including aphids, leafhoppers, chinch bugs, armyworms, webworms, and billbugs. Endophytic grasses also grow more roots making them more drought tolerant and quicker to recover from injury or stress. Endophytic grasses include cultivars of perennial rye, and tall and fine fescues. Useful endophytes have not yet been found in creeping bentgrass or Kentucky bluegrass.

Turfgrass Characteristics

Grass species	Growth habit	Leaf Texture/Color	Preferred Environment	Tolerance
Kentucky bluegrass	Rhizomes	Fine to med. Dark green	Well drained, sunny areas. High nutrient requirements.	• Cold-high • Wear-high • Drought-moderate • Shade-low
Supina bluegrass	Stolons	Fine to med. Light green	Sun to dense shade. High nutrient requirements.	• Cold-high • Heat-low • Drought-low • Wear-very high
Perennial ryegrass	Bunch	Fine to med.	Well drained soils. Moderate fertility.	• Cold-low • Heat-low • Drought-low • Shade-low • Wear-high
Tall fescue	Bunch	Med. to coarse	Well drained soils. Open sunny areas.	• Cold-low • Heat-high • Drought-moderate • Shade-moderate • Wear-high
Fine Fescues: Red fescue Hard fescue Chewings	 Rhizomes Bunch Bunch	 Very fine Med. to dark green	Drier, shaded, less fertile areas.	• Heat-low • Drought-high • Shade-high • Low pH-high • Humidity-low

Selected List of Improved Cultivars

Species	Cultivar
Kentucky Bluegrass	Liberator, Award, Midnight, Nuglade, North Star, Baronie, Odyssey, Kenblue, RamI, Vanesa, Harmony
Perennial Ryegrass	Citation III, Linn, Stardance, Pennfine, Advantage, Palmer III, Secretariet, Brightstar II, Calypso, Premiwer II, Pennant II
Chewings Fescue	Shadow II, Banner III, Brittany, Tiffany, Bridgeport, Warwick, Southport, Jamestown III
Hard Fescue	Discovery, Reliant II, SR 3100, Osprey, Defiant, Nordic
Creeping Red Fescue	Florentine, Shademaster II, Jasper, Falcon, Reliant, Spartan, Waldina
Sheep Fescue	Covar, Quatro, MX-86

For more information see the National Turfgrass Evaluation Program
http://www.ntep.org

Turfgrass Characteristics

Grass Species	Management requirements	Seeding rate lb/1000ft^2	Mowing height	Nitrogen (N) Requirement	Comments
Kentucky Bluegrass	Low-high	1-2 lb/1000 ft^2	Common types 3 - 3$^1/_2$" Elite types 1 - 2$^1/_2$"	2-4 lbs N /1000 ft^2	•Forms good sod. •High accumulation of thatch. •Slow establishment.
Supina Bluegrass	High	1-1$^1/_4$ lb/1000 ft^2	1 - 1$^1/_2$"	4-6 lbs N /1000 ft^2	•Seed is expensive. •Establishes quickly. •Agressive growth habit. •Thatch builds quickly.
Perennial Ryegrass	Medium-high	7-9 lb/1000 ft^2	2 - 3"	2-4 lbs N /1000 ft^2	•Good for overseeding but use no more than 20% ryegrass in seed mix. •Many cultivars w/endophytes. •Low accumulation of thatch.
Tall Fescue	Low-medium	4-5 lb/1000 ft^2	Improved types 2 - 3" Dwarf types 1$^1/_4$ - 3"	2$^1/_2$-3lbs N /1000 ft^2	•Slow to establish. •Low accumulation of thatch.
Fine Fescues:					
Red fescue Hard fescue Chewings	Low-medium	4-5 lb/1000 ft^2	1$^1/_2$" and higher (including no mowing)	1-2lbs N /1000 ft^2	•Slow to establish. •Low accumulation of thatch.

Establishing turfgrass

Turf can be established from seed or sod. Soil preparation is the same for both methods and is the foundation for growing quality turf. The most vigorous turf grows in loose, loamy soils teeming with beneficial microorganisms, insects, worms, and more. These organisms play critical roles in transforming thatch, grass clippings, and other organic matter into humus—a highly decomposed plant and animal matter that makes up good soil. Humus slowly releases nutrients and buffers grass roots from environmental extremes and pest damage.

Preparing the soil

- Test the soil—use a test container from your County Extension office or from the Maine Soil Testing Lab, 207-581-3591.
- If needed, apply lime to adjust pH to 5.5-6.5.
- Apply starter fertilizer at 1 lb phosphorus/1000ft^2.
- Rototill amendments into top 4inches of the soil mix.
- Finish grade.
- Firm soil and finish rake.
- Apply a complete fertilizer at 1 lb nitrogen/1000ft^2.
- Seed or sod.

Sod

- Select top quality sod from a reputable grower.
- If the root mix is sandy material, purchase sod grown on sandy soil; if unavailable, use washed sod.
- Quickly lay sod, roll it, then irrigate with sufficient water to wet the soil beneath.
- Maintain moist soil by irrigating daily, or as needed, for the first 3 weeks.
- Restrict use until sod is well established—a minimum of 4-6 weeks.

Seed

- Use top quality seed from a reputable seed dealer.
- Seed at half rate in one direction and at half rate in a perpendicular direction.
- Seed in August and September or May and June.
- Lightly rake seed into the top 1/8 -1/4 inch of the soil.
- Roll to insure the seed has good soil contact.
- Mulch with straw.
- Irrigate lightly and frequently, maintaining a moist seedbed until seed germinates.
- As the turf develops, increase irrigation amounts and shorten the interval between irrigation.
- Restrict use until turf is well established, usually 2-4 months, except athletic fields, which need a full year to mature before use.

Seed Mixtures for School Grounds

High maintenance athletic fields	80% Kentucky bluegrass (use 2-3 varieties) 20% Perennial Ryegrass (use 2 varieties)
Athletic practice and recreational fields	60% Kentucky bluegrass (use 2 varieties) 20% Red fescue 20% Perennial ryegrass
General lawns	40% Kentucky bluegrass (use 2 varieties) 20% Chewings fescue 20% Hard fescue 20% Perennial ryegrass

Managing turfgrass

Vigorous, well managed turf is able to resist considerable pest pressure. IPM encourages healthy plants by a number of cultural practices including overseeding, top dressing, mowing, fertilizing, irrigating, and managing thatch.

Overseeding

Overseeding helps thicken the turf stand, avoids excessive compaction, minimizes soil erosion, inhibits weeds, and provides stable footing. Overseeding is performed using either broadcast or slit seeding. Slit seeding (sometimes referred to as drilling) places the seed directly in the soil. Usually a single pass is sufficient, but bare areas require overseeding in two to three directions to provide sufficient seed. Broadcast seeding is performed a variety of ways and may be combined with aeration. Spikers, hollow-tine aerifiers, or vertical mowers may also be used to expose soil to aid seedling establishment.

Once an area has been overseeded, apply top dressing (see below) to ensure seed-to-soil contact. An area may also be overseeded shortly before a sporting event—the athletes help push the seed into the soil.

Use Kentucky bluegrass and/or perennial ryegrass for overseeding. Kentucky bluegrass forms rhizomes (modified underground stems), that are important for providing traction and allow the plant to fill in bare areas. Perennial ryegrass germinates quickly (3-5 days) and provides quick cover but does not give the most stable footing and is less winter tolerant. Ryegrass should not comprise more than 20% of a seed mixture or a

predominantly ryegrass turf will result. On the highest quality athletic fields Kentucky bluegrass is preferred for the traction it provides. Use fast growing cultivars of Kentucky bluegrass with good rhizome development for overseeding. Supina bluegrass may also be used. This stoloniferous grass can be mowed shorter than other grasses. It provides dense cover and quickly recuperates from damage, however, supina bluegrass is more easily ripped from the soil and better suited for soccer than football fields.

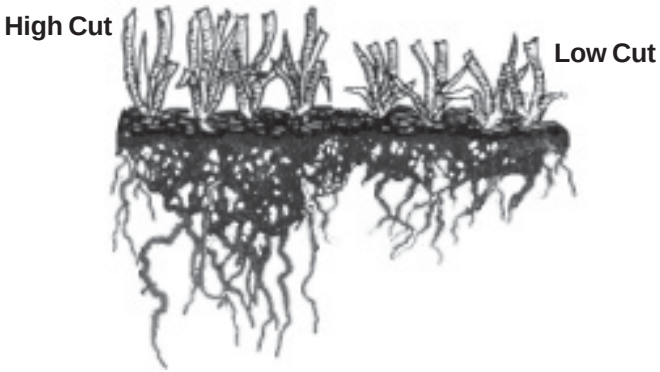
Seeding rates vary with the amount of exposed area and the seed mix. For maintenance overseeding where turf has at least 95% cover, use 1/2 lb/1000ft^2. When more than 25% of the soil in an area is exposed, use 2-3 lb/1000ft^2.

Where soils are deficient in phosphorous, overseeded areas may require a starter fertilizer (1-2-1 ratio of N-P-K) that is high in phosphorus to promote establishment. In general, apply one to two applications of starter fertilizer over a three to eight week period, supplying approximately 3/4-1 lb nitrogen/1000ft^2 each time.

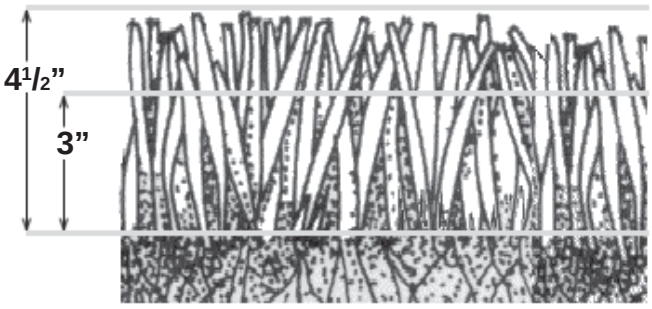
Top dressing

Top dressing is the application of a uniform layer of soil, sand, or compost, 1/16 -1/4-inch deep, that is brushed or dragged into the surface of turf. This increases water and nutrient retention and creates a favorable environment for soil organisms. Decomposition increases, more humus is produced, and thatch thins. Top dressing after overseeding encourages germination.

Athletic fields require top dressing to maintain a uniform surface for safety and playability, and to improve drainage. Lower quality turf generally does not require top dressing, although an occasional rut or rodent hole may need to be filled in with soil.



The effect of mowing height on root growth. A lower cut produces shorter roots and higher maintenance.



No more than one-third of the leaf tissue should be removed in a single one mowing. If the grass height is 4 1/2 inches, it should be mown no shorter than 3 inches.

Mowing

Good mowing practices are essential to good turf management. Keep mower blades sharp to provide a clean cut. Clean cuts heal faster and minimize disease while maintaining stress tolerance. Keep mowers in good repair—leaking oil and grease can damage or kill turf. Minimize soil compaction by rotating the point of mower entry onto the turf from week to week. Mow when the lawn is dry to minimize the chance of spreading diseases.

The One-Third Rule. To sustain a vigorous turf, no more than one-third of the leaf should be cut at any one mowing. Removing the youngest, most photosynthetically active tissue severely stunts the re-growth of the grass. This may seem like a good idea—the grass will not grow back as fast—but a weaker turf allows sunlight to hit the soil; weed seeds germinate and grow. The turf is forced to compete with weeds and becomes more susceptible to pest damage.

Mowing height. Mow high to encourage dense, well rooted turf that will tolerate environmental stress and reduce the need for fertilizer and pesticides. Most turfgrasses used on school lawns can be mowed at a height of 2 1/2-3 inches without sacrificing vigor or function. Taller grass with a denser canopy intercepts more sunlight and keeps the soil shaded so weed seeds are less likely to germinate. Shorter mowings prevent adequate root development. Turf with a poorly developed root system is unable to obtain sufficient water and nutrients from the soil. Raise the mowing height slightly during the summer. The increased leaf surface area buffers the soil from temperature extremes and promotes deep roots.

Clipping return. Dry clippings almost never need to be removed from turf. Clippings do not contribute to thatch. They are approximately 90% water and 10% solids such as cellulose, proteins, and minerals (nitrogen, phosphorus, potassium, calcium, and others) which are recycled by the turf. Indeed, returning clippings to a turf adds approximately 1 lb nitrogen/1000ft^2 back into the system each year and reduces the need for fertilizer. Damp clippings, however, can kill underlying grass and should be removed.

Fertilizing

All grasses require certain nutrients, including nitrogen (N), phosphorus (P), and potassium (K). Fertilizer is added to the soil periodically to increase nutrient levels. Use a fertilizer that supplies at least a 2:1 ratio of nitrogen to potassium. Although phosphorus levels are critical during seed establishment, phosphorus requirements are significantly less than nitrogen or potassium. Little or no phosphorus is usually required unless indicated by a soil test. Other nutrients are rarely limiting. Note that there are no reliable tests for measuring nitrogen levels in soil.

There are two basic forms of nitrogen contained in fertilizer products: quick-release water soluble nitrogen (WSN) and slow-release water insoluble nitrogen (WIN). Many fertilizer products contain a mixture of both types. In general, WIN fertilizers, or mixtures with a high percentage of WIN (50% or more), are preferred for turf.

The timing and rate of fertilizer applications depend on the requirements of the turf species, the proportion of WSN and WIN in the fertilizer, your expectations for turf quality, time limitations, and the use of your turf. A soil test should be the basis for planning fertilization schedules. In high maintenance areas, testing every year will save money on fertilizer, lime, and other soil amendments. Use the lowest product rate possible that will meet your own expectations and produce a healthy turf. Rather than making a single, heavy application, apply half of the rate in the spring and half in the fall. Slow-release fertilizers will prolong the availability of nutrients throughout the growing season; they reduce the risk of water pollution, reduce plant and turf damage, and avoid an undesirable flush of growth. Organic fertilizers, such as compost, are preferable because they provide organic matter to support soil microorganisms and improve soil health.

To help move the fertilizer into the soil and prevent phytotoxicity, fertilize shortly before or during a light rainfall, or irrigate within 24 hours. For a uniform distribution, use a properly calibrated and functioning spreader. A drop spreader or diverter should be used to prevent fertilizer application to nontarget areas such as sidewalks, roads, drains, flower beds, etc. If fertilizer falls onto paved areas, sweep it back into the turf to prevent it from running into storm sewers. When using a drop spreader , insure uniform coverage by making two half-rate applications at perpendicular directions. A broadcast spreader (sometimes called a rotary or centrifugal spreader) may be used to fertilize large areas.

Avoid the use of weed-and-feed products; these contain herbicides. It is a violation of Maine law to apply these products on school grounds except by a commercially licensed pesticide applicator.

Corn gluten, a by-product of cornstarch production, is 10% nitrogen by weight, in a slow

Testing your soil

A routine soil test is a quick and inexpensive way to check soil pH and the levels of essential soil nutrients.

- **Get a Maine Soil Testing Service container and information form from your County Extension Office or from the Maine Soil Testing Lab 207-581-3591.**
- **Use a clean tool to gather the soil.**
- **Sample at the rooting zone (usually 6-8 inches for gardens and 3-4 inches for turf).**
- **Take several samples in different spots to fully represent the location.**
- **Use a clean container to combine the soil—mix thoroughly.**
- **Fill the sample container and label it with your name, address and sample identification.**
- **Fill out the information form as completely as possible.**
- **Remove the top sheet of the form; keep this copy for your records.**
- **Mail sample containers, information form, and check or money order to the Maine Soil Testing Lab or take them to your local County Extension Office.**

Conventional Nitrogen Sources

Quick release water soluble nitrogen—WSN	Slow release water insoluble nitrogen—WIN
Urea, Ammonium sulfate [$(NH_4)_2SO_4$]	Sulfur coated urea (SCU)
Ammonium nitrate [NH_4NO_3]	Isobutylenediurea (IBDU)
Ammonium phosphate [$(NH_4)_xH_yPO_4$]	Ureaformaldehyde, methylene urea, Milorganite™
Potassium nitrate [KNO_3]	Corn gluten meal
Calcium nitrate [$Ca(NO_3)_2$]	Dried manure, compost

Nitrogen Requirements and Application Timing

Field type Usage level	Total nitrogen lb/1000 ft²/yr	Typical application times for central Maine (adjust as necessary for your location)
Low to Medium Use	1 - 2	mid May, early September
High Use	3 - 5	mid May, mid June, mid August, September, October

release form, and also contains naturally occurring substances which inhibit the growth of seedling roots. As a 10-0-0 fertilizer it can add nitrogen to the soil and inhibit weed germination at the same time. Since corn gluten kills only the roots of sprouting seeds, it can be used around established turf. Corn gluten lasts 5-6 weeks; the application rate is 20 lb/1000ft^2.

Irrigating

Water deeply but infrequently to encourage a deep root system that efficiently taps the soil. All areas of lawn should receive adequate coverage and low spots should be leveled or drained to avoid waterlogged soils. One inch of water should wet the soil to a depth of 4-6 inches, but because grasses and soil conditions differ, irrigation schedules must be tailored to individual lawns and adjusted for seasonal changes.

Water turf just before it begins to wilt. Learn to recognize the signs leading to this state, including a bluish-green or purplish color to the grass, rolling or folding blades of grass, footprints that remain on the lawn for several minutes after passage, or soil that appears dry four inches below the surface.

Water while turf is still wet with dew—early in the morning before the sun gets too high. This minimizes plant stress, limits evaporation, and reduces the spread of disease. Lawns may also be watered at night except during long periods of hot, humid weather. High humidity and excessive watering encourages fungal diseases. Over-watering reduces root growth, so lawns become lush, weak, and are unable to tolerate wear. This may be a problem with automatic irrigation systems and small, tightly planted courtyards that offer little air circulation.

How frequently you water depends on the soil and weather conditions, species of grass and the health of plants. Fine fescues are highly drought resistant; tall fescue and Kentucky bluegrass are moderately so; perennial ryegrass has low drought tolerance.

Aerating

Aerating involves removing plugs of grass or poking holes into turf to improve air exchange and water penetration. This promotes turf growth, reduces weed invasion, manages thatch buildup, and relieves compaction. Soil compacts when lawns are heavily used, or even mown on a regular basis. The pore spaces that allow water and air to pass through the soil compress, creating adverse conditions for root growth. Top dressing, and rotating mowing patterns will also help relieve soil compaction.

Practice fields and lawns should be aerated at least once a year in the spring or fall. Heavily used turf may require aeration up to four times a year. On high use, high maintenance fields, aerate using

a core cultivator. Hollow-tine, vertical drive units with tine spacing on 4 inch centers, capable of penetrating to a 4inch depth, are best. The soil must be moist enough to allow good penetration but not so moist that machinery will rut or compact the soil. Make several passes across the field in different directions. Pulverize and distribute the cores over the field with a mat to incorporate the soil into the thatch layer. Time aeration operations to avoid periods when weeds are producing seed.

Managing thatch

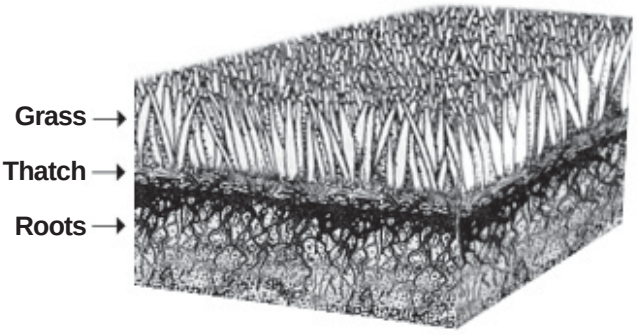
Thatch is a layer of undecomposed or partially decomposed plant material above the soil surface. Thatch creates resiliency enabling the turf to absorb shock and minimize sport injuries. However, water can puddle on thatch layers greater than 3/4-inch and increase disease problems. As thatch builds, fertilizer and pesticide applications become less effective and stress tolerance is reduced. Soil conditions that promote shallow rooting, such as compaction, improper pH, and poor drainage, will result in excessive thatch accumulation. Organic fertilizers, such as compost, promote thatch decomposition. Synthetic chemical fertilizers, on the other hand, actually enhance thatch development.

Regular aeration prevents thatch buildup and will, over time, reduce thatch to acceptable levels. Excessive layers of thatch can be removed with dethatching rakes, or with power dethatchers. Seed all areas that become thinned by dethatching procedures.

Managing athletic fields

Stressed plants, damaged turf, and pests are present in every athletic field. Weeds rapidly germinate on bare soil following sporting events and heavily trafficked turf leads to insect and disease problems. Consequently, athletic fields usually require more management activities than any other location on school grounds, but plant health rather than pest control is the focus of athletic field management. Field performance and safety are directly related to root development.

During the off-season, athletic fields recover and are prepared for the next season. Off-season maintenance includes higher mowing heights, aerating, top dressing, overseeding and fertilizing. Condition off-season fields to promote deep rooted, healthy plants.



A thick layer of thatch restricts water and air movement into the soil, and may encourage disease and insect pests.

In-season maintenance faces traffic and turf damage. Typically, the field is mown at a lower height that increases plant stress from traffic, heat, diseases, or insects. During the season, monitor regularly, overseed, fertilize, and irrigate to maintain a healthy field that resists pest damage. Pesticide exposure to students is minimized by restricting treatments to the off-season or during open weeks of the playing season.

Mowing heights for in-season turf should be reduced gradually. Several weeks of 1/4-1/2 inch reductions do not generally compromise plant health. Once the desired height is reached, increase mowing frequency to three times per week to condition plants to spread laterally. Clippings should be returned to the field as a source of nutrients; they should be removed only when they lie wet or clumpy on the surface.

In athletic fields, soil compaction and weed growth are unavoidable. Aeration, or some other form of tilling, is the only way to relieve soil compaction. If turf loses its competitive advantage to weeds, herbicide applications or other control methods may be required to maintain a safe playing surface.

Athletic fields receive more pesticide applications than any other area on school grounds.

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Chapter 6

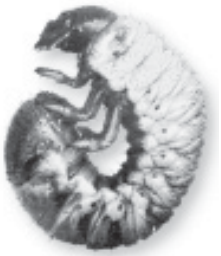
Insect Pests of Turfgrass

Injured turfgrass might be wilted and water-starved, lesions may appear on the leaves, or the blades may be clipped off entirely. These symptoms *may* indicate the work of insects but accurate pest identification is essential to a management program. This chapter discusses two important insect pests of turfgrass, white grubs and chinch bugs. Other potential pests include billbugs, sod webworms, hyperodes weevils, and cutworms.

White grubs
Japanese beetles
May/June beetles
European chafer
Hairy chinch bug

White grubs

White grubs are the C-shaped larvae of a large group of beetles known as scarabs. They develop in the soil feeding on grass roots. White grubs in turf share similar life cycles. In the summer, adults emerge from the soil and feed on foliage and/or flowers before mating and depositing their eggs in turf. The eggs hatch in August and larvae feed on grass roots until October. As soil temperatures cool, the grubs move deeper into the soil to overwinter. The following April or May, they return to the surface and begin feeding again.



White grub

Japanese beetle

May/June beetle

European chafer

Many scarabs may attack turfgrasses and cause considerable damage. There are three important species in Maine: the Japanese beetle, May or June beetle, and the European chafer.

Japanese beetle

The Japanese beetle was introduced into southern Maine during the early 1960s. They are now established south of Millinocket; heavy populations are common south of Waterville. Adults are dark, metallic green beetles about 1/2-inch long. Adults are voracious plant feeders and may become serious ornamental pests. They prefer maple, birch, mountain ash, linden, grape, blueberry, and members of the rose family including flowers and fruit trees such as apple, cherry, peach, and plum.

May or June beetle

May/June beetles are native and found throughout Maine. They are shiny, robust, reddish-brown beetles nearly 1 inch long. Adults emerge in May or June and are active at night. They are highly attracted to lights, frequently fly into windows and screen doors, especially during hours of peak activity— 7:00 to 9:00pm. Egg laying may be concentrated near exterior lighting. May/June beetles have a three-year life cycle. The grubs are most damaging in their second year when they feed heavily from May through September.

European chafer

The European chafer is a recently introduced turf pest. It is expanding its range inland, but is now found mostly in southern coastal areas of Maine. The adult is light-brown and 5/8-inch long. European chafers tend to remain in the root zone later in the fall and return to the root zone earlier in spring than other white grubs.

Adults emerge from the soil in June and July. At dusk they congregate in conspicuous mating flights, usually at a tall object on the skyline, such as a tree 20-30 feet high. Swarms may number in the thousands and may look and sound like a swarm of bees. Larval damage is later concentrated in the turf around these swarms.

Damage

White grubs eat organic matter including the roots of plants. Heavily infested turf appears to be drought stressed—off color, gray-green, and wilting rapidly in the hot sun. Fine and tall fescues are not as severely attacked as Kentucky bluegrass and perennial ryegrass. Continued feeding kills turf in large irregular patches. The tunneling of the larvae causes the turf to feel spongy under foot; it can often be rolled back like a loose carpet. Sometimes animals, such as crows, skunks, or raccoons, feed on white grubs, causing considerable damage as they dig.

Managing white grubs

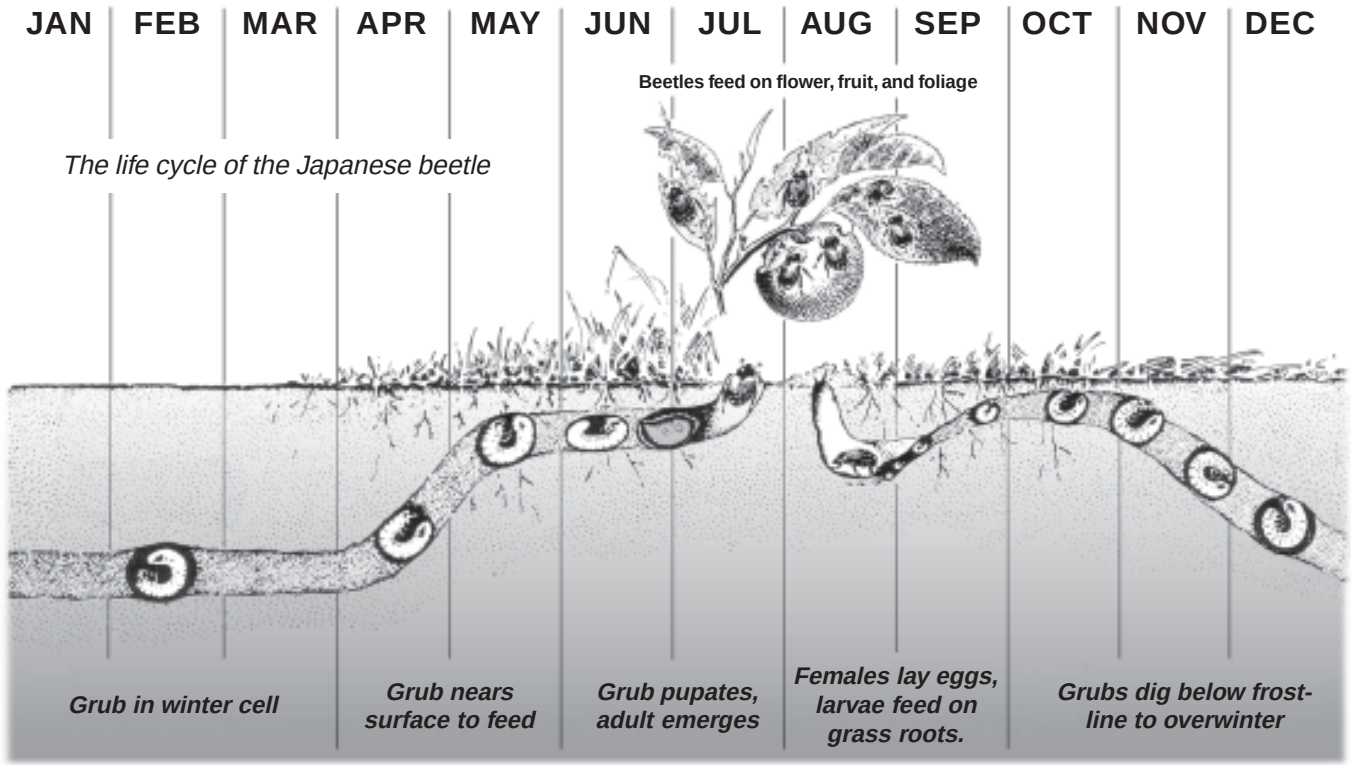
Monitoring

Monitoring for white grubs involves sampling several locations across an area of turf. It is important to use a uniform method to accurately assess the population. A zigzag pattern taking samples at 10-20 foot intervals works well. Begin sampling in August when grubs are easily seen and actively feeding, but before signs of injury are visible.

White grubs are distributed in patches; dense populations build where the eggs are laid, but they are absent over large areas of turf. Be sure to sample in the most likely turfgrass habitats. Japanese beetles and European chafers prefer grass in sunny areas, and high quality turf near the adult's favorite food plants. May/June beetles often lay large numbers of eggs under or near exterior lights.

Take square foot samples by cutting through the turf and thatch on three sides of a square. Peel back the turf and inspect the thatch and upper 2-3 inches of soil. To find the grubs, shake and break the sample, and probe through the soil and roots with a pocket knife or screwdriver. Count the number and species of grubs found at each sampling site and record these on a map of the area. Replace the sod after sampling and irrigate thoroughly. A quicker method is to use a standard 4-inch golf course cup cutter. This cuts a round core of about $^{1}/_{10}$ square foot. Multiply the average grubs per core by 10 to get the approximate number of grubs per square foot.

If white grubs are not detected but damage is present, examine the turf for other causes of injury such as disease, excessive thatch, moisture stress, heat damage, or other insect pests.



Monitor for white grubs by cutting through a foot square section of turf and rolling it back.

Action thresholds

Japanese beetle and European chafer. Irrigated turf has a tremendous ability to recover from injury. Even so, irrigated turf with more than 20 grubs per square foot will likely suffer from water stress. In un-watered turf, 5-10 grubs per square foot may result in brown patches.

May/June beetle. Large grubs and can cause more damage. Turf injury is likely if more than 10 grubs per square foot are found on irrigated turf, or if more than 3-5 per square foot are found on low maintenance turf.

Landscape modifications

Certain species of scarab adults prefer specific host plants. Where Japanese beetles are common, do not plant roses, grapes, or lindens around high maintenance turf areas. May/June beetles prefer oaks.

Water management

White grubs usually need moist soil for egg hatch. The young larvae are also very susceptible to dry conditions. In areas where turf can stand some moisture stress, do not water in July and early-August when white grub eggs and young larvae are present. Use water management cautiously; dry soil will accentuate any existing white grub damage.

Traps

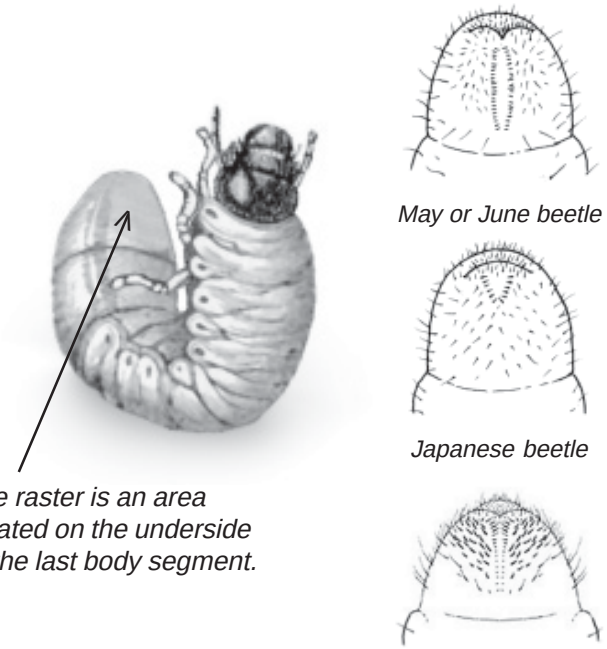
Adult Japanese beetles are highly attracted to traps baited with floral and pheromone lures. The traps are useful for monitoring the presence of adult populations, but they are not useful for controlling turf damage. Traps may have some utility for managing Japanese beetles on ornamentals, although plants in the immediate area can sustain increased damage.

Biological control

Certain nematodes (microscopic wormlike animals that can cause disease in insects) have shown some promise for controlling white grubs in turf. The species *Steinernema carpocapsae* is relatively ineffective; *Steinernema glaseri* works consistently but may be difficult to find; *Heterorhabditis bacteriophora* and *H. heliothidis* provide moderate white grub control. Other species, including *S. riobravis* and *H. megidis*, have provided good white grub control in research trials.

Nematodes are very sensitive to drying and must be used carefully. They should be watered in as soon as they are applied to turf, either by applying them during rain, or by irrigating immediately after application. Do not apply nematodes during the hottest parts of the day. When preparing them for use, keep them cool and out of the sun; store them in a cooler if the day is hot.

The naturally occurring soil fungus *Beauveria bassiana* is commercially available and may be effective against white grubs. *B. bassiana* requires high humidity to infect insects. Research has shown promising results, but only when the fungus is used during a wet summer.



The raster is an area located on the underside of the last body segment.

Identifying white grubs. *Turf infesting scarab grubs can be identified by examining the raster. This is an area on the underside of the last body segment where spines and other features form definite patterns. Magnification with a hand lens is usually required.*

Japanese beetle adults congregate to feed on their preferred host plants—maple, birch, mountain ash, linden, grape, blueberry, and members of the rose family including, roses, raspberries, apple, cherry, peach, and plum.

White grub injury in heavily infested turf appears drought stressed—off color, gray-green, wilting rapidly on a hot day. Continued feeding kills turf in large, irregular patches; weeds germinate in exposed soil.

Chemical control

White grubs are most susceptible to chemical control when they are very small. The degree of control is highly variable from site to site and year to year, but insecticides may provide 50-80% control of white grubs. If irrigation is available, liquid insecticide applications can be effective. Granular insecticides are often more effective where irrigation is not possible.

Apply spot treatments in late August and early September. Early morning or evening is the preferred time for insecticide treatments. If soil moisture is unusually low at the time of application, consider irrigating the area a day or two before the intended application to draw the grubs up into the upper root zone. Irrigating after application washes the treatment into the soil. Check the label for the reentry period and post the area of application. Three weeks after treatment, evaluate the treatment by sampling for grubs where the original samples were taken. Be sure to record the results for future reference. Keep in mind that no insecticide will eliminate an entire grub population, but the numbers can be reduced below the action threshold.

Research indicates that most of the pesticide applied for grub control ends up in the thatch. Irrigating before or after an application does affect this binding. If the thatch layer is an inch thick or more, grubs probably will not contact an effective dose of any applied insecticide.

In Maine schools, pesticides, including ant controls, weed & feed fertilizers, and mouse baits, may only be applied by state licensed applicators.

Irrigating the turf before treatment will draw the grubs into the upper root zone. Irrigating after treatment will wash the material into the soil where grubs are feeding.

Hairy chinch bug

Adult chinch bugs are small black bugs, 3/16-inch long with white wings. The wingless immatures, or nymphs, are smaller than the adults. The youngest nymphs are brick red in color with a white band that crosses on the back; older larvae are mostly black.

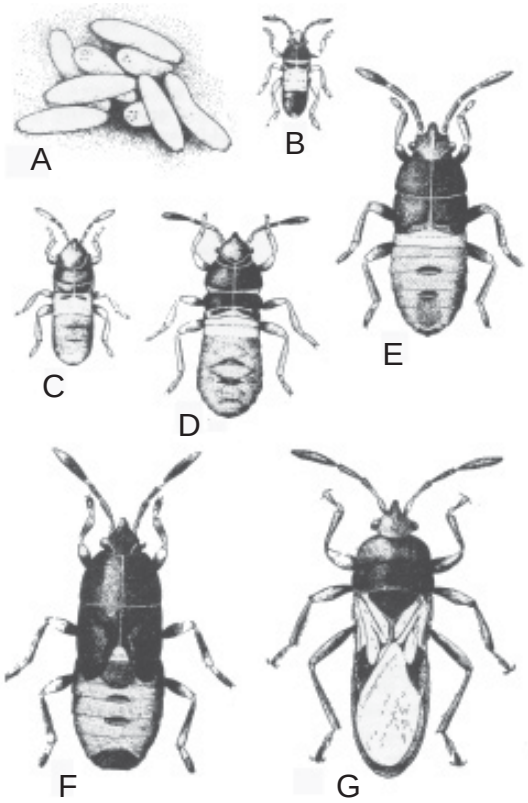
In most of the state there are two generations of chinch bugs per year; northern parts of Maine have only one generation. Adults overwinter in protected areas near lawns, emerge in May, mate, and lay eggs in the leaf sheaths of grass plants. First generation larvae develop in June and July. The second generation of adults is present in July and August. Second generation larvae are in the soil during mid-August.

Damage

Both nymphs and adults suck plant juices through straw-like mouth parts. Their saliva contains substances that are toxic to plants and the puncture wounds often block water movement. Chinch bug injury is characterized by irregularly shaped, yellow patches in turf, 2-3 feet in diameter. These patches often turn brown and die. Clumps of clover and other non-grass weeds may survive in these areas. This injury looks like drought or heat stress, but is not eliminated by applying water. Their damage is most frequently observed in July in central and northern Maine or in mid summer or early fall in southern Maine and is often attributed to some other agent.

Hairy chinch bugs prefer ryegrass and fescues but will attack many other lawn grasses. They also prefer areas with thick thatch. Chinch bugs are most damaging in open, sunny areas, especially sandy areas that drain well. Damage can be serious when warm, dry conditions induce water stress in grass plants.

Inspecting turf for chinch bugs: from a kneeling position examine grass blades in injured turf, beginning with the yellow outer zone of damage. Separate blades and check the stem, crown and thatch area.



Chinch bugs: A, eggs; B-F, the five immature stages, or instars. G, the winged adult. First instar nymphs (B) are also known as red nymphs.

Monitoring using the coffee can method: after removing the bottom of a coffee can, insert it into the turf and fill with water using moderate pressure. Chinch bug nymphs or adults will soon float to the surface.

Managing chinch bugs

Monitoring

Visual inspection. Examine the grass in the marginal areas of injured patches, not in the grass that is already dead. Spread the grass gently with your fingers and look in the thatch, near the soil surface. Chinch bugs are usually very active in the summer, especially on warm, sunny days. Inspect several areas for a total of 2 minutes. Count and record all nymphs, adults, and predatory insects.

Coffee can method. Remove both ends of a large tin can, such as a coffee can. Soften the soil in an injured area with a watering can and insert one end of the can 2-3 inches into the ground. Leave at least 4inches of the can above ground. Fill the can with water from a garden hose with moderate pressure and wait about five minutes. If chinch bugs are present, they will float to the surface of the water. Count and record all nymphs, adults, and predatory insects.

Action thresholds

Visual inspection: 20 adults or larvae after monitoring several areas for a total of two minutes.

Coffee can method: 15 bugs per flooded can. Note that the big-eyed bug, a common natural predator of chinch bugs, may provide significant natural control. If 50% or more of a sample is big-eyed bugs, they may be able to reduce the chinch bug population without treatment.

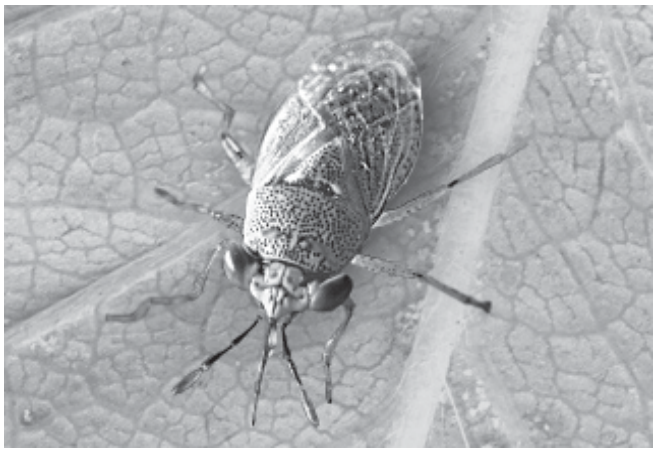
Irrigation

Turf that receives deep, weekly watering throughout the summer is able to tolerate a relatively high population of chinch bugs without injury. The insects may be present, but vigorous turf can outgrow the insect damage.

Biological control

Many lawns have natural populations of predators, such as ground beetles or big eyed bugs, that can keep chinch bug populations from getting out of hand. Insecticide applications can adversely affect these predators, allowing chinch bug populations to develop more rapidly.

Heavy rainfall and cool temperatures during egg hatch will reduce survival of chinch bug nymphs. Much of this mortality is due to a naturally occurring fungus, *Beauveria bassiana*. The fungus is ineffective during hot, dry periods but, when present, may reduce chinch bug populations so much that summer treatments are unnecessary. *B. bassiana* is available in commerical formualtions.



The big-eyed bug, an insect predator, looks similar to the chinch bug but has large, bulging eyes. They often prey in infested areas providing natural chinch bug control.

Thatch management

If a lawn has thick, dense thatch (more than 1 inch) and has a history of chinch bug activity, dethatching should help reduce chinch bug activity for a year or two.

Endophytic grasses

Endophytic grasses have increased drought tolerance and appear to provide substantial resistance to chinch bug feeding. Renovating turf areas with a history of chinch bug activity should include at least some endophytic cultivars.

Chemical control

If chinch bug populations exceed threshold levels, an insecticide application may be necessary. Pesticides are usually applied in early to mid-June, when the chinch bugs are beginning to move to their summer turf sites. If a population is very heavy, a second application should be made after 2-3 weeks.

Ground beetles are beneficial insect predators commonly found in turf.

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University of Maine Cooperative Extension. *Insect and Plant Disease Diagnostic Clinic*, 491 College Ave., Orono, ME 04473. 207-581-3880, toll free (in Maine) 800-287-0279. http://www.umext.maine.edu/topics/pest.htm

CHAPTER 7

Turfgrass Diseases

A disease, simply defined, is a continual disturbance of normal plant function. Noninfectious diseases, those that do not spread between plants, are caused by nonliving agents, such as drought, soil compaction, chemical burn, and nutrient deficiency. These diseases are more often thought of as cultural or environmental damage. Certain fungi, bacteria, viruses, and nematodes cause infectious plant diseases. These disease-causing organisms (or pathogens) multiply and spread from plant to plant.

Plant pathogens

Positive identification of the pathogen is required to diagnose many diseases. For assistance, contact the University of Maine Cooperative Extension. Samples of symptomatic plants may be dropped off at your County Extension Office (see inside back cover) or sent directly to: Plant Disease Diagnostic Lab**,** UMCE Pest Management Office, 491 College Avenue, Orono, Maine 04473-1295.

Fungi

Fungi are the most common plant pathogens. They can produce a variety of symptoms in any part of a plant. Fungi obtain food as parasites of living plants or as saprophytes feeding on decaying organic matter. They spread from healthy to diseased plants by wind, rain or irrigation water, soil, machinery, humans, and animals. Some species enter through wounds while others penetrate healthy tissue directly.

Viruses

Viruses are smaller than bacteria and reproduce only when associated with living tissues; they use the host's DNA to reproduce themselves. Symptoms of viral disease commonly include mosaics or stunts that may not kill the host but frequently reduce vigor and quality. Almost all plants are susceptible to one or more viruses.

Viruses enter healthy plants only through wounds or during pollination. Sucking insects (aphids, leafhoppers, and whiteflies), as well as chewing insects (beetles, grasshoppers) can transport virus-laden sap from one plant to the next. Other viruses spread by nematodes and fungi.

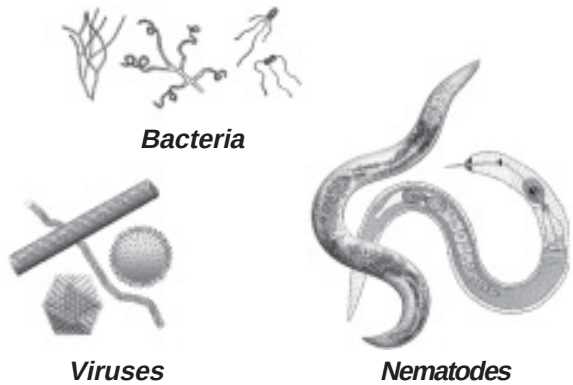
Nematodes

Certain microscopic nematodes can cause plant disease. These tiny, unsegmented, round worms suck the contents of plant cells through hypodermic-like mouths. The most commonly encountered nematodes are root feeders. As they destroy the root system, the plant wilts and declines. Root feeding nematodes may also introduce other pathogens into feeding wounds.

Bacteria

Bacteria are microscopic organisms that rapidly increase in number, especially in wet, humid weather. They cause fewer plant diseases than fungi but can be very destructive.

Bacteria cannot penetrate intact plant surfaces but easily enter natural openings and wounds. Insects may also introduce bacteria through feeding wounds. Foliar diseases caused by bacteria often spread by wind-driven or splashing rain.



Managing infectious disease

Disease management seeks to prevent a disease from occurring and to reduce the effects of disease already present. There are three strategies to protect turf from disease injury—resistance, avoidance, and protection.

Resistance

This strategy focuses on the host plant rather than the pathogen. Turf varieties and cultivars differ in disease susceptibility. Select turfgrass species and varieties that are resistant to disease infection or damage.

Avoidance

Manipulate the landscape environment or microclimate through cultural controls such as tree and shrub pruning, watering habits and mowing height, to avoid conditions that favor disease development.

Protection

Protectants can prevent disease organisms from infecting plant tissue even though they are present. They do not kill pathogens but interfere with their germination and growth. Good record keeping of past infections is important as protectant fungicides must be applied before disease injury is obvious. Most fungicides are protectants.

Fungicides

Where cultural practices are insufficient, contact or penetrant/systemic fungicides will usually reduce fungal disease outbreaks. Fungicides should not be a routine part of lawn and grounds care, but they may be useful during difficult environmental conditions. If turf loss is widespread and severe, overseeding or renovation may be more cost-effective than chemical control.

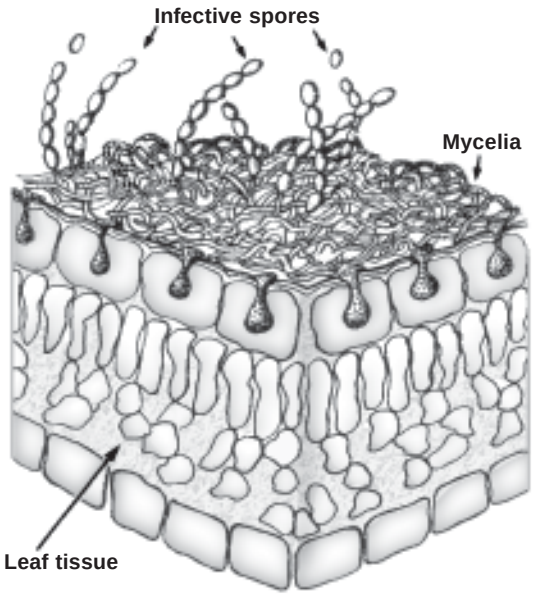
Nontarget effects. Fungicides may be toxic to earthworms and the beneficial microbes that populate healthy soil. These organisms break down thatch and organic matter, and transfer nutrients in the soil.

Plant injury. Fungicides rarely cause plant injury (phytotoxicity) to lawns and grounds. Emulsifiable concentrate formulations may be phytotoxic in hot weather. Penetrant/systemic fungicides may interfere with plant growth at high rates. Application equipment should be properly calibrated to prevent over application.

Biological fungicides. Biological fungicides are beneficial microorganisms (fungi, bacteria, or actinomycetes) that naturally suppress plant diseases. The water extract of compost, known as compost tea, is a homemade example. In contrast to chemical pesticides that attack a single aspect of the disease process, biological fungicides enhance natural disease resistance, increase nutrient uptake, and suppress pathogens through antagonism and competition. Biological fungicides require shorter re-entry intervals, decreased residue worries, and less public concern. There is also less chance of resistance developing in the pathogen population.

Contact and protectant fungicides. Contact, or protectant, fungicides prevent infection by coating the surface of the plant with a material that prevents infective spores from germinating. If fungal growth ever penetrates below the surface and into plant tissues, the fungicide is no longer effective. Rainfall may wash off these materials and rapid plant growth will produce new, unprotected tissue. Frequent and thorough applications are usually necessary to maintain protection.

Penetrant and systemic fungicides. Penetrant and systemic fungicides enter and move within plant tissues including the roots. Some of these fungicides provide curative action by controlling fungi after infection. Even though they may inhibit further growth of the fungus, they do not replace dead plant tissue. Severely diseased plants rarely recover.



Fungal diseases often spread a mat of threadlike mycelia on infected plant tissue. The mycelia penetrate plant cells to absorb nutrients and produce infective spores that are spread by wind and rain.

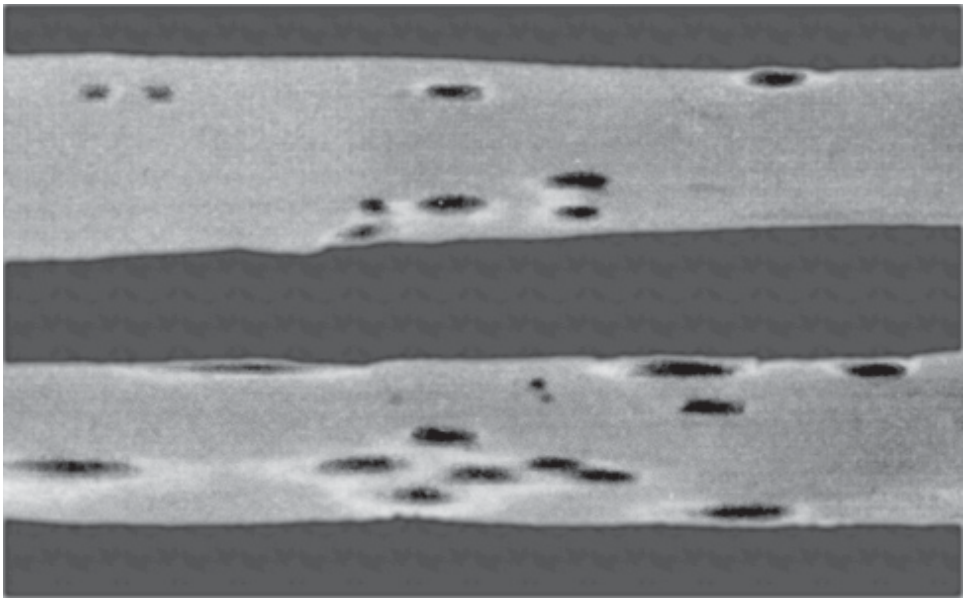
Crown and Root Rot

Description

This disease, formerly classed with "Helminthosporium" diseases, is now known to be caused by fungi in the genera *Bipolaris* or *Drechslera*, especially *Bipolaris sorokiniana* and *Dreschlera dictyoides*. The disease attacks all turfgrasses, especially Kentucky bluegrass. It is most evident during early spring and fall. Stands are thin in scattered areas; dead grass appears brown to red in color; purple or red straw-colored lesions with dark margins appear on leaf blades parallel to the stem, and the crown and roots become discolored.

Management

- Maintain balanced fertility.
- Avoid excess nitrogen, especially in the spring.
- Avoid night watering and thatch buildup.
- Use resistant turfgrass varieties.



Purple or red straw-colored lesions with dark margins appear on leaf blades parallel to the stem.

Fairy Rings

Description

Fairy rings are caused by fungi that live in the soil and break down organic matter. Fairy ring fungi are likely to develop in areas that were previously forested or where stumps or other organic matter is used as fill. The fungus is usually several inches below the ground where it forms a dense layer of mycelial threads that break down organic matter at the leading edge of the ring. Fairy rings develop during the spring and early summer as circles or arcs of dark green, fast growing grass. This lush grass results from the increased amount of nitrogen made available to the grass roots as fungi degrade organic matter. A ring of thin or dead grass may develop outside of the circle. Fairy rings may be a few inches to more than 50 feet in diameter. The rings enlarge from 5-24 inches annually and leave alternate bands of green and discolored grass. Often, after rains or heavy sprinkling, many mushrooms (fruiting bodies) suddenly appear within the circle. Fairy rings are generally of little concern, but they can be a serious problem on athletic fields; these slippery mushrooms can cause serious accidents.

Management

- Fairy ring symptoms may be masked by moderate nitrogen fertilization or an application of iron. Fertilization will also stimulate some fairy ring fungi.
- Core aerate and irrigate during periods of draught.
- Remove buried stumps or wood debris; remove excess thatch.
- Eradicating rings is difficult and expensive. The fairy ring and infested soil must be completely removed and replaced.
- Fumigation, the only chemical control for fairy rings, is especially hazardous and usually not appropriate for school grounds. Fumigation should be used only when absolutely necessary and should be performed by an experienced and certified applicator.

Soil infested with fairy ring fungi sprouts fruiting bodies (mushrooms)at the outer growing edge.

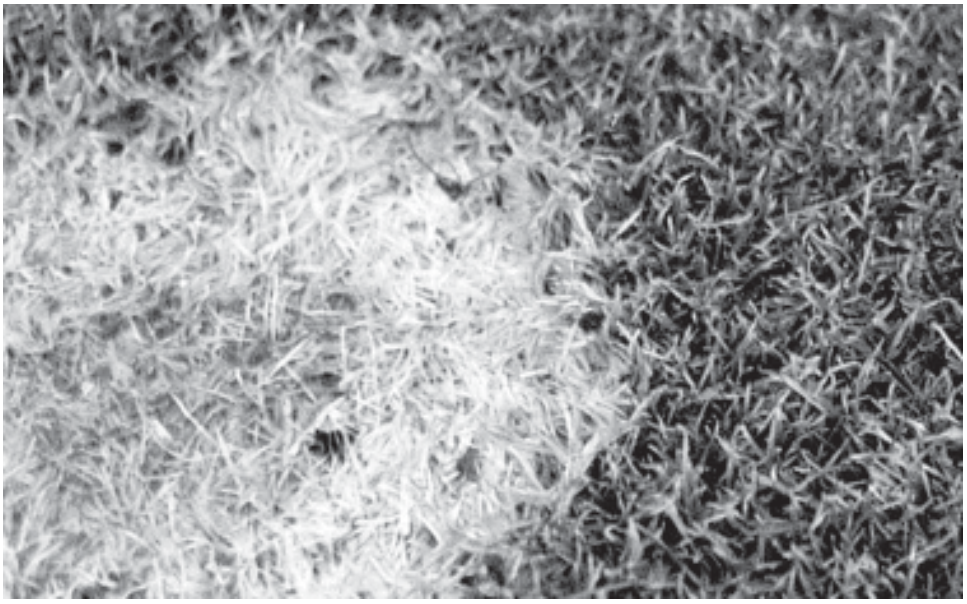
Fusarium Patch (Pink Snow Mold)

Description

Pink snow mold is caused by the fungi *Fusarium nivale* or *Microdochium nivale.* These species flourish at temperatures near freezing. The fungi survive in turf thatch and residue, and when conditions are cool (32° - 45°F) and wet, whitish-gray or reddish-brown spots of bleached, dead grass develop often at the edge of melting snow. The spots are irregular or rounded, two inches to two feet in diameter, and can develop with or without snow cover. Shortly after snow melt, exposure to sunlight causes the fungal strands to turn pink, which can be seen on the edges of the spots. Annual bluegrass, perennial ryegrass and bentgrass are highly susceptible to fusarium patch.

Management

- Avoid heavy applications of water-soluble nitrogen in late fall prior to dormancy.
- Repair injured turf by raking and replacing matted grass.
- Preventive fungicide treatment may be used for valuable, susceptible turf stands.
- Continue mowing until autumn growth ceases.
- Prevent excessive piling of snow on turf. Use snow fence around high value areas.



Fusarium patch appears as pink-bordered patches that fade to tan as they dry.

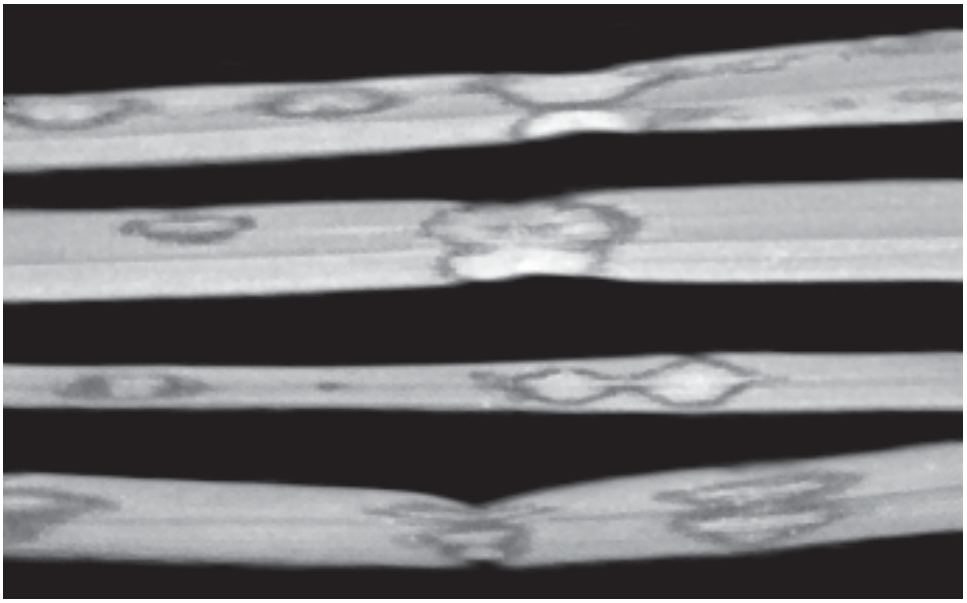
Leafspot and Melting-Out Diseases

Description

Leafspot diseases, formerly called helminthosporium diseases, are caused by a variety of fungi: *Bipolaris*, *Drechslera*, *Exserohilum*. Leafspot diseases can develop during most of the year, but become most active in Maine during the cool, moist weather of spring and fall. The leafspots first appear as small, purple to black lesions on the leaf blades. As more spots develop, they join together to form large, elongated areas of infection. Severely infected blades wither and die. During periods of drought stress, the fungi may spread to and blight the crowns and roots causing gradual thinning and browning (melting-out). Infected areas turn yellow and may turn brown and die. Because dead or badly diseased plants often lose the characteristic symptoms described, drought or insect damage is often blamed as the cause of injury. Leafspot is mainly a problem on creeping bentgrass and fine leaf fescues, while melting-out injures mostly Kentucky bluegrass.

Management

- Use resistant turf varieties when establishing new lawns.
- Diversify monocultures of perennial ryegrass.
- For established turf, reduce leafspot and melting-out by:
  - mowing high height of cut to limit stress;
  - not promoting excessive lush growth by avoiding excess nitrogen applications in the spring;
  - limiting moisture on the foliage by avoiding evening and night watering; and
  - promoting air circulation.
- A number of fungicides are effective when applied during wet weather in the spring and fall, when temperatures are optimum for development. While spray programs are effective, they are time consuming and expensive.



Dark oblong spots, parallel to the blade with bleached centers characterize melting-out disease on bluegrass.

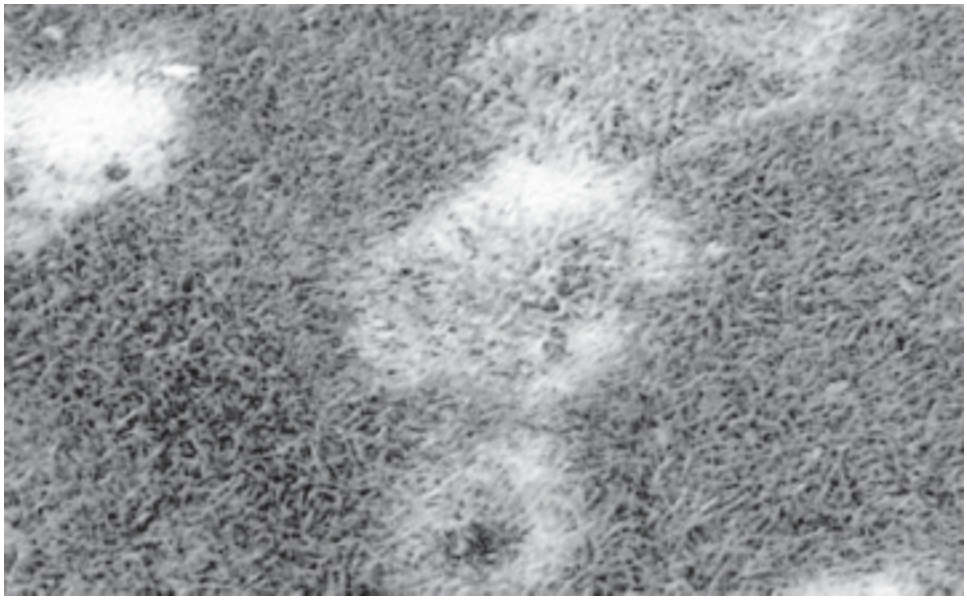
Necrotic Ring Spot

Description

Necrotic ring spot (formerly part of the fusarium blight complex) is caused by the fungus *Leptosphaeria korrae* and is a serious disease of Kentucky bluegrass. Symptoms may appear from spring to autumn but are most pronounced in midsummer. The disease is favored by periods of cool, wet weather followed by periods of heat and drought. Wilted, dying or dead turf in spots 2 to more than 12 inches wide appear first. Patches fade with warmer temperatures but return when turf is heat or drought stressed. The straw-colored or bronzed patches may grow together, forming streaks, crescents, or circles in the turf. Healthy grass is often surrounded by a ring of dead turf creating a characteristic frog-eye pattern. This disease is often associated with turf in hot, compacted areas along driveways or sidewalks. It is most common on turf areas recently established from sod.

Management

- Use resistant Kentucky bluegrass varieties.
- Avoid stressing turf with inadequate nitrogen fertilization, low mowing height, and inappropriate irrigation.
- Since drought stress favors necrotic ring spot, infected areas of high maintenance turf should receive light, daily irrigation during the summer months.
- Keeping thatch at a minimum also helps prevent drought stress and reduce disease severity.
- Fungicides can be used to protect valuable turf at the first sign of symptoms.



Necrotic ring spot forms patches varying from irregular streaks to round. Patches may contain central tufts of healthy turf or weeds.

Pythium Blight

Description

Pythium blight (also known as greasy spot or cottony blight) affects all turfgrasses, although bentgrass, annual bluegrass and ryegrasses are especially susceptible. The disease is caused by more than a dozen different species of soilborne fungi belonging to the genus *Pythium*. It is a high moisture, hot-weather disease that rapidly develops when daytime temperatures are in the 90s and night temperatures stay above 75°F. In Maine, pythium blight appears in poorly drained turf; often in elongated streaks reflecting the presence of wet areas. Round to irregular, water-soaked, greasy, sunken patches up to 12 inches wide are first to develop. In the early morning, when the humidity is high, a fluffy white mold may be seen on the leaves. Diseased areas quickly fade as the grass dies.

Management

- In Maine, pythium can be managed largely by improving soil drainage.
- Avoid over-watering, thick thatch, compaction, and excessive nitrogen fertilization.
- Mow only when turf is dry.

Sunken, water soaked areas indicate pythium blight.

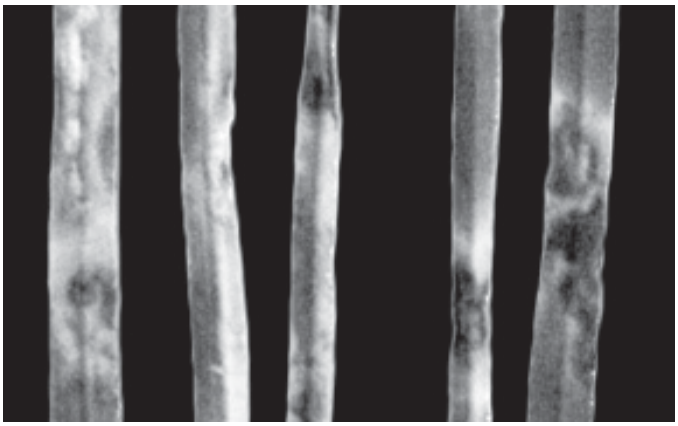
Summer Patch

Description

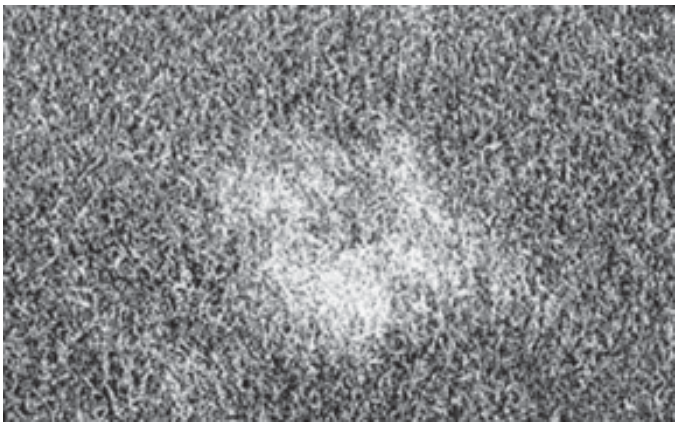
This disease was formerly part of the fusarium blight complex but it is now known to be caused by the soilborne fungus *Magnaporthe poae*. Summer patch is a disease of Kentucky bluegrass and annual bluegrass. Symptoms develop in late June through August and reappear in the same location year after year. Grayish patches of wilted turf, 2-6 inches in diameter, appear first. Large, irregular patches become prominent as wilting leaves turn reddish-brown then tan, and finally light straw color. Blighted areas of turf may form throughout the lawn. These patches may form elongated streaks, crescents or circles 2 feet or more in diameter. Healthy grass may occur within the centers of dead grass, giving a characteristic frog-eye pattern. Summer patch occurs more commonly on older established turf. It develops following the high temperature and heavy rainfall that is common in midsummer. It commonly occurs on slopes with southern exposure.

Management

- Avoid excess nitrogen, especially during summer. Use acidifying nitrogen sources, such as ammonium sulfate, in the fall and a slow release fertilizer in spring.
- Avoid mowing lower than 2½ inches.
- Irrigate to maintain even growth with little turf wilting.
- Avoid frequent, light irrigations. Alternate wetting and drying cycles may increase infection. Water high maintenance turf deeply but infrequently (every 5-7 days).
- On sites prone to summer patch, plant fescue rather than bluegrass.
- Use resistant turfgrass varieties.



Summer patch lesions on bluegrass.



Grayish patches of wilted turf, 2 to 6 inches in diameter, are the first symptoms of summer patch.

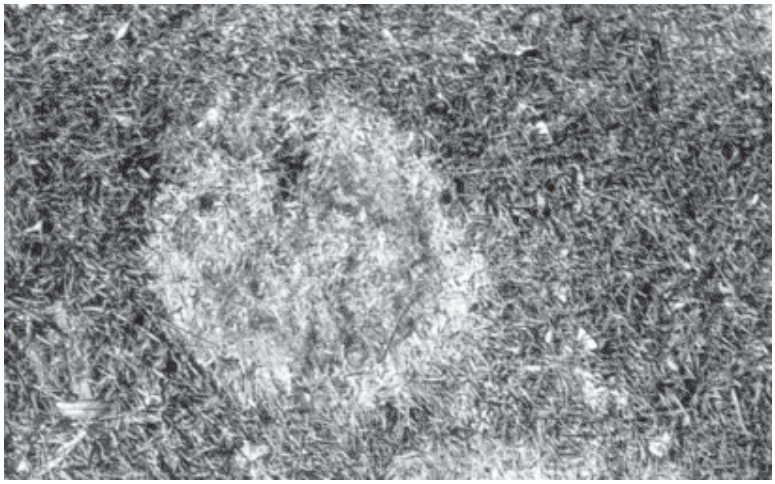
Typhula Blight (Gray Snow Mold)

Description

Typhula blight is an important disease where snow cover remains on the ground for three months or more without melting. The disease is caused by the fungi *Typhula incarnata* and *Typhula ishikariensis*. As the snow melts, circular gray to dark brown spots appear in the turf. The spots range from 3-24 inches, but most are 6-12 inches in diameter. Grayish-white fungal strands can be seen on the spot margins. Typhula blight is most severe when snow falls on unfrozen turf and when turf is lush going into the winter.

Management

- Do not apply nitrogen fertilizers after September.
- Use resistant turfgrass varieties when possible.
- Continue mowing until autumn growth ceases.
- Prevent excessive piling of snow on turf. Use snow fence around high value areas.
- A fungicide treatment may be necessary to protect valuable turf when conditions favor Typhula blight.



Typhula blight.

Under favorable conditions, spots of gray snow mold may coalesce and kill large areas of turf.

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Chapter 8

Weeds

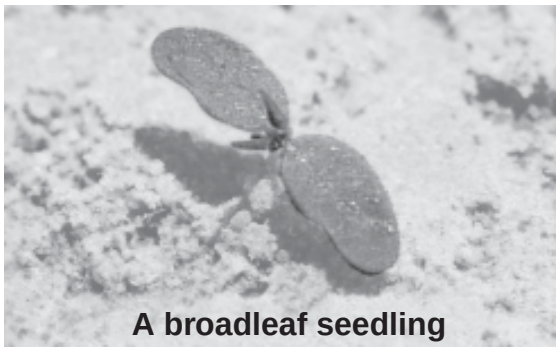
School grounds can be maintained in a way that minimizes weed growth by applying a basic understanding of weed biology. The idea is to remove the conditions that favor weeds and encourage desirable plants to out-compete weeds. Herbicide use can be reduced or, in some areas, eliminated by using sound cultural practices.

Types of weeds

To successfully manage weeds, some information on the various types of weeds and their growth habits is useful. Biological differences divide weeds into two groups: grassy weeds (monocots) and broadleaf weeds (dicots). Monocot seedlings grow a single seed leaf and develop narrow, parallel-veined leaves. Dicots seedlings have two seed leaves and broad net-veined leaves.

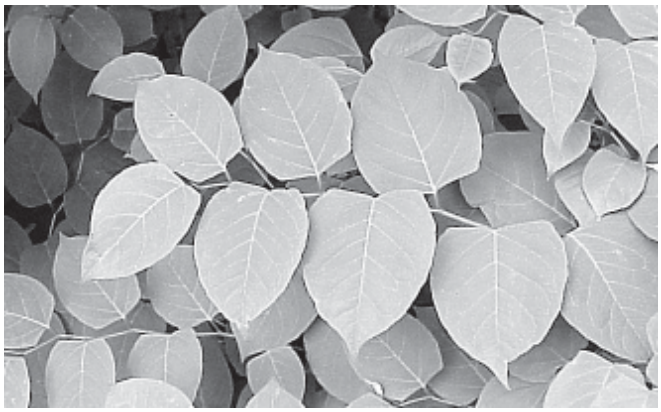
The seasonal abundance of weeds, whether they are monocot or dicot, is related to their specific life cycle. Annuals live a single year and reproduce by seeds. Biennials live two years and reproduce both vegetatively and by seed. Perennials grow during each growing season. The above ground parts may die during the winter or may remain viable but dormant.

A grass seedling



A broadleaf seedling

The grassy plants, also known as monocots, have narrow leaves and parallel leaf veins. The growing points of most of the grassy weeds are at or below ground level, making them difficult to manage.



Broadleaf, or dicot, plants have a network of small leaf veins originating from a main vein that divides the leaf in half. Broadleaf plants usually have above-ground growing points.

Annuals

These are the most common weeds. Annuals have a rapid life cycle that requires a minimum of water and nutrients. They germinate from seed, grow, flower, and set seed in one year or less. Many annual weeds can produce more than 20,000 seeds per plant. However most seeds do not immediately sprout. They fall to the ground and lie buried in soil, waiting for enough moisture and sunlight to germinate. Annuals spread only by seed.

Most annual weeds are known as summer annuals. They germinate in spring, grow to maturity during summer, and die by fall or winter. Examples include prostrate spurge, purslane, crabgrass, and pigweed.

Winter annuals germinate in fall or early winter and overwinter in a vegetative state, without flowering. In spring they flower, produce seeds, and die. Examples include henbit, shepherds purse, annual bluegrass, chickweed.

Summer annual weeds germinate in spring or summer, mature, produce seed, and die in one growing season.

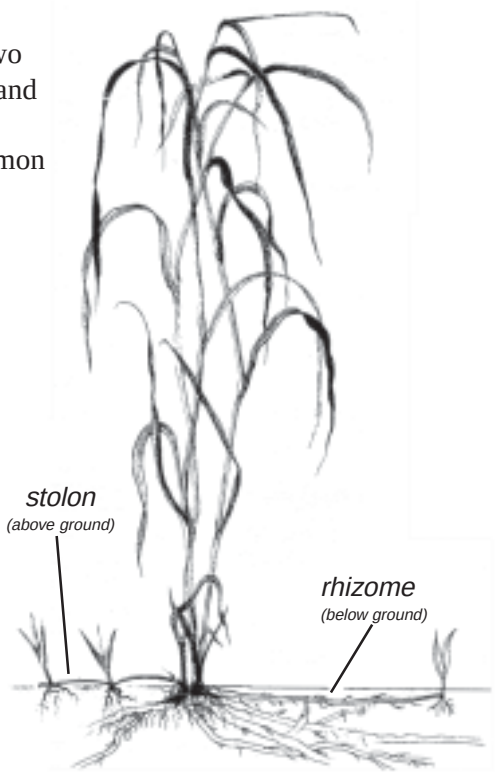
Biennials

Biennials grow during the spring, summer, and fall of their first year, survive the following winter, and flower during the next growing season. Different stages of growth are likely to be present at any time of the year. Biennials may germinate at any time during the growing season. They usually produce a radial cluster (rosette) of leaves lying close to the soil during the first season. In the second year they produce flower stalks using food stored from the first season's growth, then they produce seeds, and die.

Winter annuals germinate in late summer or fall and overwinter. They mature, produce seed, and die the following spring or summer.

Perennials

These weeds live more than two years. Perennials spread by seeds and vegetative means such as bulbs, rhizomes, tubers, or stolons. Common perennials include bindweed, plantain, thistle, dock, dandelion, ground ivy, quackgrass, sorrel, clover, and yarrow.



Perennial weeds spread by seed or by vegetative parts, such as stolons or rhizomes. They live for more than two years.

Biennial weeds grow from seed anytime during the growing season, then flower, mature, and die during their second year.

Managing weeds on school grounds

Monitor weeds throughout the growing season. Less frequent inspections should be made during late fall and early spring to identify sites that may experience weed problems. Weeds are most likely to be found in places where some type of disturbance has taken place, such as areas of soil compaction, bare soil, worn areas on athletic fields, the edging along walkways, or areas with extremes of soil moisture.

Managing weeds in the landscape

Use sound cultural practices, including regular soil testing, proper fertilization, and deep irrigation when needed in order to:

- Minimize the spread of existing weeds;
- Remove conditions that promote weeds, such as bare or disturbed soil, cracks in pavement, etc.; and
- Prevent the growth of new weeds by keeping desirable plants healthy enough to out-compete weeds.

Physical controls. Hand-pulling, cultivation, string trimmers, and mowers can control weeds very effectively. Flamers are used to treat weeds in pavement cracks, under picnic tables and benches, along fence lines, and other difficult areas. This technique uses a small gas or propane torch to sear the tops of young weeds (no later than the 4-5 leaf stage in most weeds). Flaming is most effective when the roots die. Grasses are difficult to kill by flaming because their growing points are low and covered by a protective sheath. Keep the torch about 6 inches above the vegetation and pass it slowly over the plants. Hold the flamer over each plant briefly so that the plant is heated but not actually burned. The leaves may lose their usual green color, but there may not be any evidence of wilting for several to many hours.

Cultivating. Cultivation and hand-removal is cost-effective in small areas and easiest in the spring and fall when soil is moist and weeds are easily removed. Rototill or hand-cultivate the planting beds and irrigate to force weed seeds to germinate. As soon as sprouting weeds form a “green fuzz” on top of the soil, they can be killed by a second shallow cultivation one inch deep. This avoids bringing more weed seeds to the top 2 inches of soil where they can germinate.

There are certain times when cultivation does more harm than good. For example, avoid cultivation when annual weeds have gone to seed, or when perennial weeds are large enough to produce rhizomes or tubers.

Mulching. Mulch blocks the sunlight and limits weed seed germination by covering bare soil. This offers long-term control but can be expensive. Mulches may be compost, wood chips, stones, gravel, black plastic, or landscape fabric. Fabric outperforms black plastic—both exclude light and create a physical barrier to seedlings, but landscape fabric allows air and water to move through the soil and maintains a healthier soil environment. If landscape fabric is used, an inch or two of mulch on top improves the appearance of the area and protects the fabric. New plantings should be mulched immediately but no more than 3-4 inches deep. Do not mulch right up to the trunks or stems of ornamentals; excess mulch can damage plants.

Groundcovers. Certain low growing shrubs and groundcover plants have a rapid, spreading growth habit that can out-compete weeds. Once they are established, they form dense shade near the soil and act like living mulches.

Weeds may colonize the spaces between individual plants during groundcover installation. This can be avoided by planting bare areas with a fast growing annual such as sweet alyssum (*Lobularia maritima*), farewell-to-spring (*Clarkia amoena*), or scarlet flax (*Linum grandiflorum* var. *rubrum*).

Chemical control. If chemical treatments are required, have your pesticide applicator apply herbicides as spot-treatments to the target weeds or use a rope wick applicator to wipe a small amount of herbicide on individual plants. This reduces human exposure and environmental impact.

Broadleaf herbicides should be applied primarily during spring or fall. Annual grassy weeds are best controlled with preemergence herbicides applied in early spring, before weed seeds germinate.

Keep in mind that proper herbicide selection and use can be complicated and must be used in accordance with label directions. Applicators must be licensed by the Board of Pesticides Control to use herbicides on school grounds.

Managing weeds in parking lots, along walkways, under fences, and similar areas

- Proper design and construction reduces the need for weed management For example, placement of concrete or asphalt mow strips under fencing or backstops provides long-term weed management. Most landscape areas can be designed for either long term weed exclusion or mechanical weed management with mowers or string trimmers.

- When fences surround paved playing surfaces, install posts 8-12 inches inside the edge of the pavement, to prevent weed growth along the fence.
- Seal cracks on asphalt surfaces. If weeds are already present, control them with flamers prior to sealing.
- Retrofit existing cyclone fence lines by pouring a 16-inch concrete or asphalt strip to cover the soil under and beside the fence. Retrofits can be done in stages over several years as budgets permit.
- Use landscaping fabric in plant beds and under stone or brick walkways.
- Mulches such as bark or compost inhibit weed growth by blocking sunlight. Apply mulches immediately after the ground is disturbed or plants are installed. Mulches should to be 3-4 inches thick. Reapply mulch periodically.
- Suppress weeds on baseball infields, tracks, and other bare soil areas using periodic shallow cultivation with a tractor mounted rotary harrow, also called a rotary hoe or power rake.
- Use hand weeding, string trimmers and mowers wherever possible.
- Plant groundcovers with rapid, spreading growth habits between shrubs.
- Plant fast growing, annual flowers, such as sweet alyssum, farewell to spring and scarlet flax in bare areas between bedding plants or shrubs.

Managing weeds in turfgrass

Sound cultural control practices and regular mowing are often sufficient to control weeds in turf. Monitor regularly, overseed, fertilize, and irrigate to maintain healthy turf that resists pest damage. There are several factors that contribute to weed problems in turf.

Poor quality seed. Lawn grass seed mixtures may contain types of grasses that are not well adapted to Maine and/or may contain excessive weed seed. Buy certified seed to ensure that you obtain quality seed.

Close mowing. When turf is mown too closely or too frequently, the leaf area is reduced and insufficient for the development of a vigorous root system. See Chapter 5 for mowing height recommendations. The lawn should not be allowed to get taller than 1/3 the desired height before mowing again.

Too little or too much fertilizer and lime. Weeds are favored over turf when fertilizer and lime applications are improperly timed. Except for high use turf, avoid applications during summer. Too little fertilizer or lime results in poor turf vigor, which decreases competition against weeds. Too much nitrogen fertilizer can increase drought and disease injury. Have your soil tested regularly. Consider applying corn gluten meal as a fertilizer—it helps to control seedling weeds in turf.

Improper watering. Frequent and shallow watering usually does more harm than good by increasing chances for disease, restricting the depth of rooting, and encouraging germination of weed seed. When water is needed, apply with a sprinkler and wet the soil to a 4- to 6-inch depth. Never apply water so fast that it puddles or runs off the surface.

Droughty or poorly drained soils. Not all soils are suited to growing a dense turf. In droughty or poorly drained areas, ornamentals or ground covers may be better adapted.

Lack of sunshine. Many turfgrass species will not tolerate shade; even shade grasses grow slowly with insufficient light. If the area receives less than three hours of direct sunlight each day, shade tolerant ground covers should be considered.

Too much traffic. Heavy use of turf or concentrated traffic across one section, particularly when the soil is wet, will compact the soil and weaken turf. Under these conditions, weeds are more competitive.

Insect and disease damage. Decreased vigor and thinning turf occurs where insect pests and/or diseases are left unchecked. Weeds can rapidly invade damaged areas.

Sound cultural control and regular mowing are often sufficient to control weeds in turf.

The transect method for monitoring weeds in turfgrass

A transect is a randomly chosen line crossing the turf. By walking a series of transects, and taking observations at uniformly paced intervals, the average percentage weed growth and bare ground can be accurately measured. Transects save time when monitoring large areas of turf.

Sampling transects early in the season can spot emerging problems. If monitoring detects an increase in weeds, it usually indicates a specific problem—heavy wear on the turf, compacted soil, a broken irrigation line or sprinkler head, or scalping of the turf due to an uneven grade. By monitoring turf areas from year to year, weed populations can be tracked to see if they are rising or falling, and management practices can be adjusted to meet changing needs.

Lay out the transects. In each management unit establish three relatively parallel transect lines. Choose lines that are randomly placed in areas that represent all turf species, habitats, and uses. If time is limited, fewer transects across a representative area may be sufficient for management purposes.

Calculate the sample interval. The entire transect must be divided into evenly spaced sampling sites—areas where you stop and record data. For a large area of turf, such as a football field, a minimum of 20 samples per transect is recommended. To determine the spacing, walk the transect counting the paces it takes. Divide this number by 20 and round to the nearest half. This is the number of paces to take between each sampling site.

Record samples. Beginning at one end of the first transect, walk the calculated number of paces to the first sampling site and stop, without looking down. Now look at a 3-by-3-inch area immediately in front of your toe. This is about the circumference of a softball or the lid to a 1 pound coffee can. If this area contains part or all of a weed, check the 'yes' box on the monitoring form on the first line under Transect A. If you know the identity of the weed, write it down. If the toe sample area contains only grass, check the 'no' box. If 25 percent or more of the area is bare soil, check the box marked 'bare.' If more than 25 percent is bare, but a weed is present, check 'yes.' Continue pacing and recording your observations. Be sure to sample the entire transect.

Calculate percentages. 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 number of sample sites you recorded (the monitoring form on the next page uses 60 samples in 3 transects). The result is the average percent weed cover in the turf. Use the same calculation with the boxes marked 'no' to calculate the percent area that may become weedy if not seeded to grass.

Record the average percentage of weed growth in each management unit several times a year. Note trends in weed growth. Learn to recognize the average percentage of weeds or bare ground that limits turf use and determine what percentage requires action to avoid damage.

Transects save time when monitoring large areas of turf for weeds. Transects are randomly chosen lines crossing the turf. By walking a series of transects and taking observations at uniformly paced intervals, the average percentage weed growth and bare ground can be accurately measured.

Transect Weed Monitoring

Name _____ Date _____

Location of turf _____

Is this turf performing well? Yes _____ No _____ Comments _____

Sketch of the location and the transects:

	Transect A				Transect B				Transect C			
	Yes	No	Bare	Weed ID	Yes	No	Bare	Weed ID	Yes	No	Bare	Weed ID
1	❒	❒	❒	_____	❒	❒	❒	_____	❒	❒	❒	_____
2	❒	❒	❒	_____	❒	❒	❒	_____	❒	❒	❒	_____
3	❒	❒	❒	_____	❒	❒	❒	_____	❒	❒	❒	_____
4	❒	❒	❒	_____	❒	❒	❒	_____	❒	❒	❒	_____
5	❒	❒	❒	_____	❒	❒	❒	_____	❒	❒	❒	_____
6	❒	❒	❒	_____	❒	❒	❒	_____	❒	❒	❒	_____
7	❒	❒	❒	_____	❒	❒	❒	_____	❒	❒	❒	_____
8	❒	❒	❒	_____	❒	❒	❒	_____	❒	❒	❒	_____
9	❒	❒	❒	_____	❒	❒	❒	_____	❒	❒	❒	_____
10	❒	❒	❒	_____	❒	❒	❒	_____	❒	❒	❒	_____
11	❒	❒	❒	_____	❒	❒	❒	_____	❒	❒	❒	_____
12	❒	❒	❒	_____	❒	❒	❒	_____	❒	❒	❒	_____
13	❒	❒	❒	_____	❒	❒	❒	_____	❒	❒	❒	_____
14	❒	❒	❒	_____	❒	❒	❒	_____	❒	❒	❒	_____
15	❒	❒	❒	_____	❒	❒	❒	_____	❒	❒	❒	_____
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17	❒	❒	❒	_____	❒	❒	❒	_____	❒	❒	❒	_____
18	❒	❒	❒	_____	❒	❒	❒	_____	❒	❒	❒	_____
19	❒	❒	❒	_____	❒	❒	❒	_____	❒	❒	❒	_____
20	❒	❒	❒	_____	❒	❒	❒	_____	❒	❒	❒	_____

Sum Yes ___ + **Sum Yes** ___ + **Sum Yes** ___ = _____ (Total Yes) x $^{100}/_{60}$ = _____ **Average % weed growth**

Sum No ___ + **Sum No** ___ + **Sum No** ___ = _____ (Total No) x $^{100}/_{60}$ = _____ **Average % weed free**

Sum Bare ___ + **Sum Bare** ___ + **Sum Bare** ___ = _____ (Total Bare) x $^{100}/_{60}$ = _____ **Average % bare soil**

To calculate average percentages count the number of checked boxes in each column (yes, no, bare). Add like columns together. Average the totals (divide by 60; if less than 60 samples are taken, divide by the smaller number). Convert each average to a percentage (multiply the total by 100).

Poison ivy

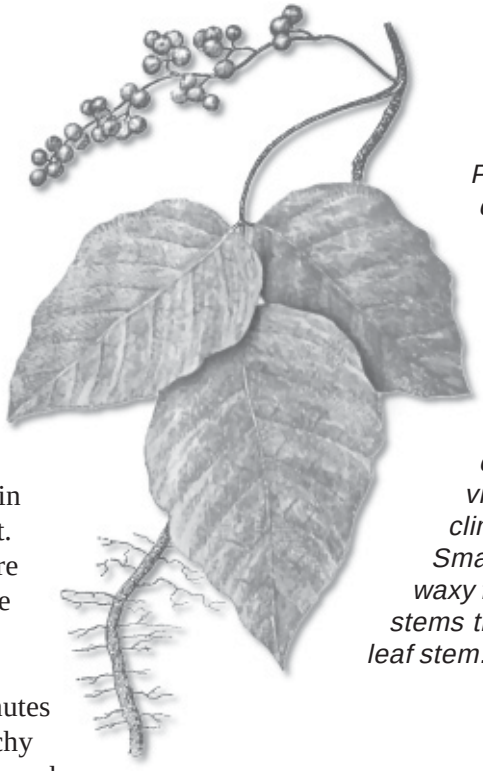
Poison Ivy is a common plant found in woodlands, fields, pastures, and landscapes. It takes on different growth forms depending on its age and growing conditions, but typically grows into a woody vine attached to trees or other objects for support. Shrub forms typically develop when grown in the full sun. Poison ivy quickly grows from seeds that are dispersed by birds and other animals that eat the small fruits. Young plants spread rapidly by rhizomes. It often grows within shrubs and groundcovers, making it difficult to spot.

The entire plant is poisonous; all parts contain an irritating oil—urushiol. This oil is very potent. Dead plants may cause allergic reactions for more than a year. If the plant is burned, urushiol can be carried in the smoke causing severe allergic reactions.

Urushiol attaches to skin cells within 20 minutes of exposure. Untreated skin erupts into a red, itchy rash in 3 out of 4 people within 12-72 hours, although it may take up to two weeks. Some people are more sensitive than others, however, sensitivity can change from time to time. Someone unaffected by poison ivy for years can get a reaction at any time.

The plants are most dangerous in spring and summer when oil content is highest. The oil can remain active for months on objects. It can be picked up on tools, clothing and the fur of pets. Therefore, anything that may be carrying the oil should be carefully washed.

Washing with running water is recommended, but washing with soaps that contain oils, such as complexion soaps, can actually spread the irritating oil—and the rash. Commercial products are available to remove urushiol if applied within 4-8 hours of contact.



Poison ivy has a characteristic 3 leaf appearance although leaves may be in groups of 5, 7, or 9. Leaf margins can be smooth, wavy, lobed, or toothed. Mature poison ivy plants are often thick, woody vines with holdfasts for climbing trees or rocks. Small flowers and white, waxy fruit cluster on slender stems that originate near the leaf stem.

Controlling poison Ivy

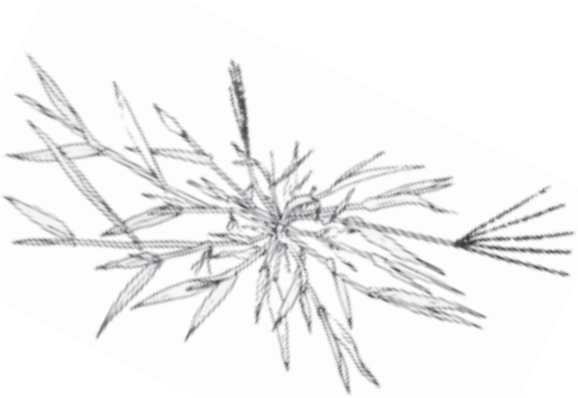
Always wear a long sleeved shirt, long pants, and protective gloves when working around poison ivy. Launder the clothing separately from the family laundry. Heavy growths of poison ivy should never be removed by hand because of the obvious hazard. Do not use propane torches to control poison ivy plants.

Covering new sprouts in spring with black plastic or heavy carpet will eventually smother them, but the covering has to be in place an entire season, perhaps longer. A mulched or cement mow strip may be necessary where poison ivy is a recurring problem along fence lines.

Spot spraying the foliage (by a licensed applicator) with a nonselective herbicide may be necessary. Use care to protect other plants from being harmed by the spray. Herbicides are most effective during active growth—early to mid-summer. The chemicals are most efficiently absorbed and translocated through the plant at these times.

Spreading by rhizomes, young poison ivy plants form a dense groundcover.

Annual grassy weeds



Smooth Crabgrass

Hairy Crabgrass

Barnyard Grass

Annual Bluegrass

Fall Panicum

Perennial grassy weeds

Colonial Bentgrass

Quackgrass

Timothy

Creeping Bentgrass

Roughstalk Bluegrass

Yellow Nutsedge

Orchardgrass

Tall Fescue

Zoysiagrass

Annual broadleaf weeds

Knotweed

Galinsoga

Black Medic

Common Chickweed

Pigweed

Prostrate Spurge

Wild mustard

Shephard's purse

Pineapple Weed

Hop Clover

Henbit

Purslane

Biennial broadleaf weeds

Bull Thistle

Mullein

Wild carrot

Burdock

Spotted knapweed

Perennial broadleaf weeds

Broadleaf Plantain

Bitter Nightshade

Canada Thistle

Wild Strawberry

Bedstraw

Common Speedwell

Cinquefoil

Curly Dock

White Clover

Chicory

Dandelion

Perennial broadleaf weeds

Ground Ivy

Milkweed

Sheep Sorrel

Hawkweed

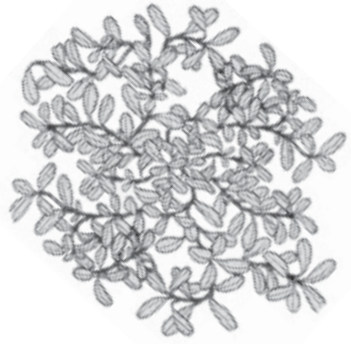
Poison ivy

Narrowleaf Plantain

Heal-all

Wood Sorrel

Thymeleaf Speedwell



Mouse-ear Chickweed

Yarrow

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CHAPTER 9

Spiders

In the U. S., four types of spiders are considered dangerous: the black widow, brown recluse (or violin) spider, the aggressive house (or hobo) spider, and the tarantula. Bites from these spiders can have painful consequences, but they bite only when provoked or under certain circumstances. Poisonous spiders are rarely, if ever, found in Maine.

The general appearance of spiders is familiar to most. They are closely related to insects but spiders have eight legs; insects have only six. Spiders belong to a group of animals known as arachnids, which also includes mites, ticks, and harvestmen (daddy longlegs). Few organisms create as much hysteria as spiders; this fear is largely unwarranted. In fact, spiders are beneficial to humans because they help to control a wide variety of indoor and outdoor pests.

Children may be especially sensitive to spider bites, but many bites blamed on spiders are more likely inflicted by fleas, bedbugs, mosquitoes, ticks, or mites. Most spiders are too small to have a dangerous amount of venom, or a bite that can penetrate skin, or too weak to harm humans.

Managing spiders

Unwanted spiders, and their webs, can usually be removed simply by sweeping or vacuuming. In most cases this is sufficient to control a problem. If more action is necessary, study the situation to locate the spider's source of prey. Are spiders thriving on night-flying insects that are attracted to security lights? Are insects being attracted by poor sanitation habits? Eliminating the food source for the insects will reduce the food source for the spiders. Maintenance to reduce spiders includes:

- Moderating the use of exterior lighting. Replace mercury vapor lights with sodium vapor lights where possible;
- Postioning lights away from buildings rather than moutning them directly on the exterior;
- Vacuuming spider webs, adult spiders, and egg sacs. Empty the bag immediately to prevent the spiders' escape;
- Removing litter and clutter from the sides of buildings, keeping all areas free of unneeded, unwanted items;
- Sealing openings in outdoor structures, playground equipment, bleachers, fencing, outdoor furniture;
- Repairing screens, filling cracks and crevices around windows, doors, and foundations;
- Using weather stripping around windows and doors;
- Eliminating moisture from crawl spaces; and
- Pruning plants 6 feet away from buildings.

Chemical control

Chemical control of spiders is rarely, if ever, needed, often ineffective, and is not recommended.

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University of Maine Cooperative Extension County Offices. See inside back cover.

University of Maine Cooperative Extension. *Insect and Plant Disease Diagnostic Clinic*, 491 College Ave., Orono, ME 04473. 207-581-3880, toll free (in Maine) 1-800-287-0279. http://www.umext.maine.edu/topics/pest.htm

Common Spiders

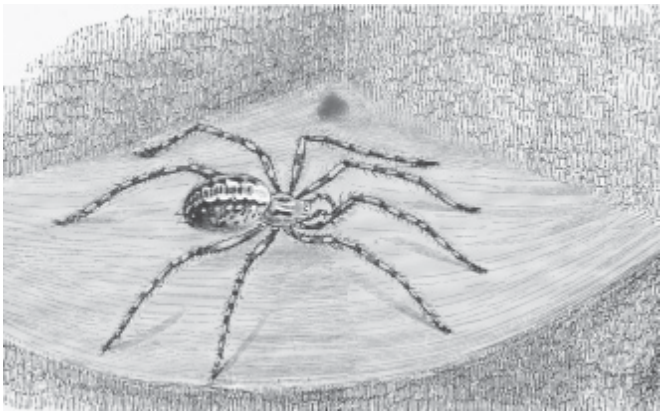
The wolf spiders weave no webs to snare pray. They hunt, day and night, and are often observed running on the ground. Females may carry egg sacs attached to their abdomen.

Orb-web weavers spin a familiar sight. Many are common near exterior lights where they spend their life in a web designed to capture flying insects.

Crab spiders grasp and hold their prey with elongated front legs. Their bodies are somewhat flattened and they often move sideways or backwards, like a crab. Many species that are common on wildflowers prey on flies and bees.

The black and yellow orb-web weaver is a familiar spider of meadows and tall grass. This large spider may weave webs more than two feet in diameter often with zigzag bands at the center. Some bad bites have been reported.

The common house spider weaves an irregular tangle-web. The spiders hang upside-down often with several egg sacs present.



Funnel-web weavers lay a flat sheet of silk with a funnel at one end in which the spider hides. The spider runs out and captures insects that cross the sheet. Hundreds of small webs, wet with the dew, may be seen on turf.

Often found at windows, jumping spiders stalk their prey during the day. Their eyes accurately follow objects up to a foot away. They react rapidly to movement with legs braced to jump.

CHAPTER 10

WASPS AND BEES

Wasps and bees are among the most common insect pests on school grounds and they deserve special attention. As insect predators they help control pests and can be considered beneficial components of our ecosystem. But, because these stinging insects pose an extreme health risk to allergic individuals, schools must take steps to minimize the hazard.

Paper wasps
Bald-faced wasps
Yellow jackets
Honey bees
Bumble bees
Ground nesting bees
Mud daubers

Characteristics of wasps

Wasps are social insects, that is, they live and reproduce in colonies. These insects build nests that are used for a single year. After the first hard frost, they are permanently abandoned. The only individuals remaining are solitary queens that survive the winter in protected spots such as leaf litter, logs, rocks, window frames, or attics. In spring, the queens emerge to start building new nests in which to lay eggs.

Wasps can travel 300-1,000 yards from their nest searching for protein and sugary foods found in nature or human foods and beverages found outdoors. Foraging wasps are attracted to food odors such as barbecues, outdoor food stands, beverages, and dumpsters, and also to scents found in some personal care products such as perfume, soaps, aftershave, suntan lotion and shampoos. They also investigate shiny buckles, jewelry, and colorful clothing, especially bright yellow, light blue, orange, and red. The greatest risk of stings occurs in late summer and fall when colonies are large.

Paper wasps

Paper wasps are long-legged, slender, and narrow-waisted and about 3/4-1 inch long. Their color varies from reddish-orange to dark brown or black. The abdomen (rear body part) has yellowish markings. They build a paper "umbrella" nest suspended by a short stem attached to eaves, window frames, porch ceilings, attic rafters, etc. The nest grows as a circular layer of hexagonal (six-sided) cells known as a comb. Paper wasps build a single comb that is not enclosed.

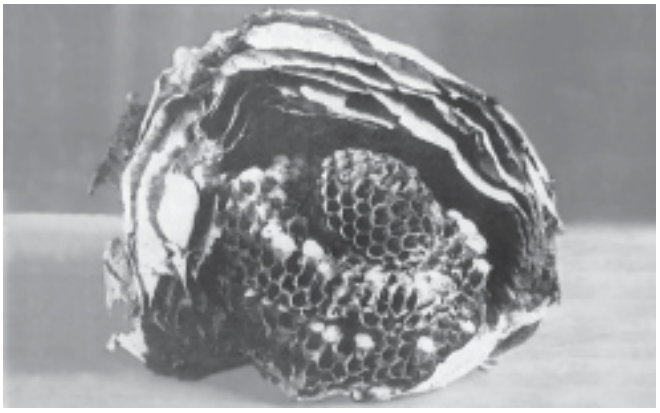
Bald-faced wasps

Bald-faced wasps are up to 3/4-inch long with black and ivory-white markings on the face, thorax (middle body part) and tip of the abdomen. Their nest is basketball sized and pear shaped; made from grayish brown paper. It hangs upside down the entrance near the bottom. Inside the nest is a suspended stack of combs.

Yellow jackets

Yellow jackets are 1/2-3/4 inch long, short and blocky, with alternating black and yellow bands on the abdomen. Nests are enclosed like the bald-faced wasp and built in trees, shrubs, or in more protected locations like attics, hollow walls, sheds, tree cavities, or underground in abandoned animal burrows.

Yellow jacket workers often scavenge for meat or sweets at picnics and other outdoor events.



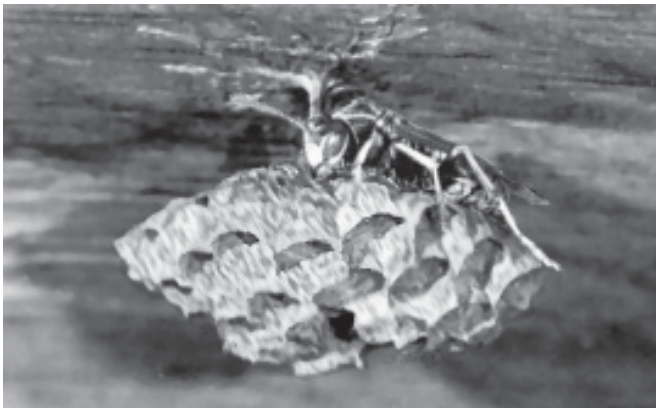
The combs are visible inside this yellow jacket nest. In late summer and fall, colonies may house 1,000-3,000 wasps.

Yellow jacket

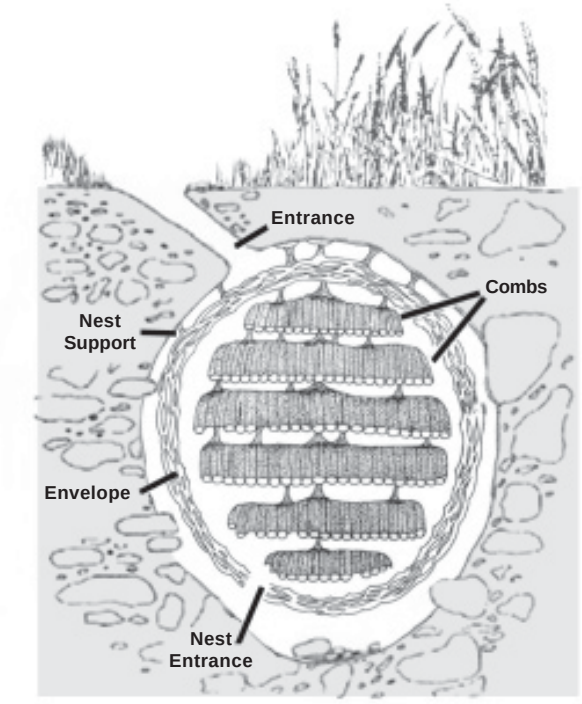
Bald-faced wasp

Bald-faced wasps and yellow jackets protect their nests with an outer paper envelope. Guard wasps are posted at the entrance.

Paper wasp



A paper wasp queen builds a small nest to rear her first brood. Mature colonies may include up to 200 individuals.



Yellow jackets may build nests in underground cavities. The surface entrance is protected by guard wasps that may attack sudden movement near the nest.

Preventing stings

The biggest threat of stings comes when a nest is disturbed. Movement or noises near a nest, such as the noise from a lawn mower, a running child, or stepping over an underground nest can provoke attack by wasps and yellow jackets. Wasps and yellow jackets can sting repeatedly and they signal an alarm to other wasps nearby attracting even more stinging wasps.

Regularly inspect grounds and building exteriors for active nests. Look for wasp activity near garbage bins or outdoor food stands. To find concealed nests, look for many wasps regularly going into and out of an opening in a structure or a hole in the ground.

Make a thorough inspection before moving or starting the engine of equipment that has been unused for some time. Monitor an area before pruning, mowing, or performing other maintenance activities in which nests could be disturbed. Restrict access to areas near active nests by roping them off if necessary until the colony is removed, treated, or killed by frost.

Staff and students should be instructed to avoid nests and to remain calm when stinging insects fly near. If a wasp or bee lands on you, stand still for a while, gently brush them off, slowly raise hands to protect your face, then move slowly away from the wasp and any nearby nest. Never swing or strike at it or run away rapidly. Wasps and bees can fly about 6-7 miles per hour, so humans can outrun them. However, near a large nest, the rapid movement could still attract a dozen stings. Running away from wasps, especially a single foraging wasp is often not a good idea anyway, because of the risk of accidental injury.

If a bee or wasp gets into a moving vehicle, remain calm. They almost never sting when in enclosed spaces—they tend to fly against windows trying to escape. Slowly and safely pull off the road. Open the windows and doors to let the wasp out.

Individual wasps or bees that enter buildings can be crushed with a fly swatter or carefully captured and escorted out.

Managing wasps

There are five important steps to managing these stinging insects.

1. Learn the characteristics of common species.
2. Modify outdoor structures to prevent nest building.
3. Regularly inspect grounds and structures for nests; rope off or destroy those that pose a risk to people.
4. Manage food and waste outdoors. Use traps if necessary to reduce the number of foraging wasps.
5. Teach students and staff how to avoid stings and how to respond when stings occur.

Modify outdoor structures to prevent nest building

- Repair and seal building exteriors.
- By early spring, block or cap openings and cavities that may attract nest building.

Regularly inspect grounds and structures

In late spring, wasps begin building nests. These small nests often go unnoticed until late summer when the colony is large and menacing. Building exteriors, sheds, outdoor equipment, playground structures, fences and outdoor furniture, shrubs, trees, and trails should be inspected for nests before the area is disturbed and before maintenance activities are planned. Look especially for remnants of old nests. Although old nests are not reused, wasps may build a new nest in the same or similar areas.

Rope off or destroy nests that pose a risk

Nests located where people may disturb them should be destroyed or roped off. Be extremely careful when destroying wasp nests, especially large ones. Small paper wasp nests can be vacuumed or knocked down with a broom or other long pole into a doubled set of black plastic bags. Set the bags in the sun to kill the wasps. The safest method is to use a professional.

Manage food and waste outdoors

- Keep refuse in tightly sealed containers with tightly fitting lids. Ideally, trash and recycling cans on school grounds should have spring-loaded doors to restrict wasps.

- Empty trash cans frequently so that accumulated trash does not interfere with tight lid closure.
- Cleaning garbage containers every day may be required at certain times of the year.
- Do not plant fruiting trees and shrubs that attract wasps near school entrances. If these plants are on school grounds, pick the fruit as soon as it ripens and clean up fallen fruit regularly.
- When eating outdoors, keep food covered until eaten, especially ripe fruit and soft drinks.
- Eating outdoors should be restricted if wasps are numerous and active.

Traps

Traps can be useful in small areas; they are less effective in more exposed sites. There are several commercial, non-toxic bait traps for wasp control. For outdoor events, traps should be in place for two or more days before the event. Place traps strategically in the vicinity of heavy wasp activity, but out of the pathway of human traffic. Frozen apple juice concentrate, diluted by half with water, makes a good bait, improving as it ferments. Bait lasts 2-3 days; service traps regularly.

Chemical control

In Maine, there is an exemption to pesticide applicator licensing regulations for emergency control of stinging insects. This means that a pesticide applicator's license is not required to apply ready-to-use insecticides by non-powered equipment, such as an aerosol can of wasp spray, for controlling stinging insects that pose a health threat on school properties.

Always follow product label instructions exactly. Keep copy of the product label and the appropriate MSDS on file in a readily accessible location at the school.

Treat nests after dark; most wasps will be in the nest and stinging is less likely. Use a flashlight with the lens covered in red cellophane; bright light may stimulate the wasps to come out of the nests. If applications must be made during daylight hours, use protective equipment such as gloves, hat, bee veil, coveralls, etc. It is a good idea to have a partner present to assist, but do not treat if any other people are present.

Above-ground nests. For above-ground nests near windows, eaves, in trees, etc., use formulations in pressurized containers that spray a narrow stream 15-20 feet. First, aim the spray into and around the nest's entrance hole, then saturate the outside of the nest. Wasp freeze or wasp stopper compounds, containing highly volatile solvents mixed with pyrethrins, carbamates, or pyrethroids, produce almost instant knockdown of wasps.

Below-ground nests. Puff insecticidal dusts or pour liquid formulations into the nest and immediately cover the entrance with a full shovel of moist soil to prevent escape. For daytime treatments, do not cover the nest entrance—foraging wasps returning to the nest must be able to enter in order to contact the insecticide.

Several trap designs are available for wasps.

Other wasps and bees

Bees and some wasps feed on flower nectar and pollen; they are often found on dandelions and other flowering weeds. Occasional encounters with these insects are common on playgrounds, lawns, and athletic fields. Frequent mowing and weed control will eliminate weed flowers during warm months and help to limit the presence of occasional stinging insects. Ground-nesting bees, honey bees and bumblebees and other occasional wasps and bees should be tolerated unless their nest location presents a hazard. If stinging is a real possibility, control may be justified.

Honeybees

Honeybees are not native to Maine. They are usually kept by beekeepers for honey production, though escaped swarms are sometimes found in the wild. If a honeybee swarm is found on school grounds, call a local beekeeper or the Division of Plant Industry, 207-287-3891 for assistance in removing the swarm.

Honey bee

Bumble bees

Bumble bees are stout-bodied insects with black or gray hairs variously tinged with yellow, orange or red. They are important pollinators of red clover and other flowers. Bumble bees generally nest in open grasslands, abandoned field mice nests, holes in the ground, old stumps, or along foundations.

Bumble bee

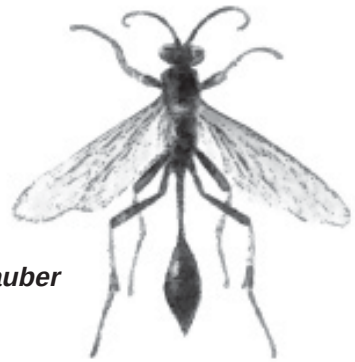
Ground nesting bees

Sweat bees and miner bees nest in the ground digging small, solitary, cylindrical tunnels in loose, shaded soil where vegetation is sparse. Some are gregarious and nest in groups but not true colonies. These bees are not aggressive and rarely sting. If the locations of ground nesting bees poses a stinging risk, spot treat the tunnels after dark with insecticidal dusts, liquids or foams.

Sweat bee

Mud daubers

Mud daubers are thread-waisted wasps about 1 inch long, shiny, slender, and black. They lay their eggs in a series of parallel mud tubes. They may become a nuisance when they construct nests on decks or building exteriors. In spite of their formidable appearance, these solitary wasps are not aggressive and control is usually not required. If necessary, nests can be removed with a putty knife and adults killed with a fly swatter.



Mud dauber

Honeybee swarms

Schools that have swarms on their property can call their County Extension Office or the Division of Plant Industry, 207-287-3891 for assistance. Undisturbed swarms are usually docile and are not defensive since they have no brood or honey to defend. It is common for a swarm to alight for several hours or for one day then fly off to a new nest site. Swarms become increasingly defensive if they have been clustered in an area for several days—they are low on food reserves and may have started a nest.

Bee swarms may either be removed by a beekeeper or exterminated. If a large amount of honey is present in a wall void or attic, exterminating the bees can cause additional problems when the comb melts or sags and honey oozes from walls and ceilings.

If there is a mass stinging incident, people should run for cover indoors or in a car. Call the local fire department; they can exterminate the swarm. If there has been a major accident involving a bee truck, call the state police.

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CHAPTER 11

FLIES AND MOSQUITOES

Garbage and manure breeding flies

House flies, blue and green bottle flies, and flesh flies breed in garbage and/or animal feces and are generally referred to as filth flies. They pass through four distinct stages in their life cycle: egg, larva (maggot), pupa, and adult. These flies can detect odors across long distances. Smells of souring milk from hundreds of containers thrown in dumpsters can attract thousands of flies from the surrounding neighborhood. Sanitation is the key to preventing fly problems.

House flies

House flies are the most common fly in and around schools. The adults are 1/8-1/4 inch long, and dull gray. Females lay eggs in organic material, such as garbage or decaying vegetation that has sufficient food for developing maggots. After emerging as adults, flies range 1-2 miles; some may travel as far as 20 miles. Their behaviors make them annoying—they enter buildings, hover around people, and crawl on food. They also leave fecal spots, or "specks," where they have walked, and may transfer human and animal diseases.

Blow flies—greenbottle and bluebottle flies

These flies are similar in size to house flies, but are metallic blue or green. Adults make a loud, droning buzz. They breed in dead animals, feces and/or garbage. They are stronger fliers than the house fly; flight range is 3-10 miles. If a large number of these flies is found indoors, there is probably a dead animal nearby. Green bottle flies are commonly seen on animal feces outdoors.

House flies
Blow flies
Flesh flies
Mosquitoes

Flesh flies

Flesh flies are 2-3 times larger than house flies (over 1/3-inch long), gray with 3 dark stripes on the body, a gray and black checkerboard pattern on the abdomen, and red eyes. Most species of flesh flies are scavengers and breed in garbage, manure or animal carcasses. A few species are parasites of caterpillars and considered beneficial insects. Flesh flies are common in populated areas but seldom enter buildings in large numbers.

Managing flies

Permanent or long-term control involves locating and eliminating larval breeding sites through improved maintenance and sanitation.

Sanitation and maintenance

- Make sure window and door screens are in good repair.
- Promptly fix drains or electric garbage disposal units that leak, or drains that allow food waste to accumulate under sinks or floors. Leaky drains can attract many species of flies. Remove any food waste that has accumulated under sinks or floors; or in crawl spaces or basements at the site of a broken drain, and then clean the area thoroughly.
- All food waste from the kitchen, cafeteria, and other areas should be separated from other garbage, drained so that it will be as dry as possible, and then stored in sealed plastic bags before disposal.

- Seal containers with small amounts of food waste, such as milk or yogurt cartons, in plastic bags before disposal.
- In food preparation areas, rinse all cans, bottles, and plastic containers before recycling or discarding.
- Inform students, teachers, and staff about the importance of placing garbage inside the proper containers. Garbage should never be left lying on the ground.
- Promptly remove animal waste or dead animals found on school ground.
- To avoid attracting flies into the building, place dumpsters and recycling containers upwind from the outside doors of the school, particularly doors to the kitchen or cafeteria.
- Garbage cans on the school grounds should have removable domed tops with self-closing, spring-loaded swinging doors. Line cans with plastic bags that can be tightly sealed and removed daily.
- Make sure garbage can and dumpster lids close tightly and remain closed when not in use. Repair or replace garbage cans that have holes or lids that do not close tightly.
- Inspect dumpsters and other outdoor trash receptacles daily and remove any wastes lying on the ground.
- Wastes should be collected and moved off-site at least once a week. Since flies breed faster in warm weather, garbage removal twice a week may significantly reduce fly problems.
- Regularly clean garbage cans and dumpsters to prevent the buildup of food waste. If possible, dumpsters should be fitted with drains so that they can be hosed or scrubbed out as needed. Use a high-pressure stream of water or a brush and soapy water. A solution of borax and water will eliminate odors that attract flies. Some pest management companies will power-wash dumpster and dumpster areas as part of their service. You may need to require your sanitation company to clean the dumpster or replace it with a clean one more frequently.
- Flies can develop in soil that was soaked with water used to clean garbage cans and dumpsters. Check these areas regularly. If you see maggots, scrape them up along with the soil and dispose of everything in a tightly sealed plastic bag.

Fly traps

Adult flies can be captured with attractant fly traps or sticky fly tape. Traps can monitor the effectiveness of management programs and give moderate control in small, closed areas where fly populations are low. Attractant traps need to be serviced regularly, and repaired or replaced when damaged. Sticky traps should be hung where people do not inadvertently contact them. For some examples of commercially available fly traps see http://schoolipm.ifas.ufl.edu/tech_np.htm#3.

Chemical control

Except for odor-eliminating chemicals (such as borax) and baits (placed only inside dumpsters), pesticides are not recommended for fly management.

Low concentrations of borax in water can be used to eliminate fly odors. This solution is particularly effective for removing fly specks from walls and eaves, and for rinsing out garbage cans and dumpsters. These solutions should not be used near ponds, streams, lakes, or other bodies of water, and should not be poured onto plants.

Fly traps are available in several designs. Traps need to be serviced regularly, and repaired or replaced when damaged.

Mosquitoes

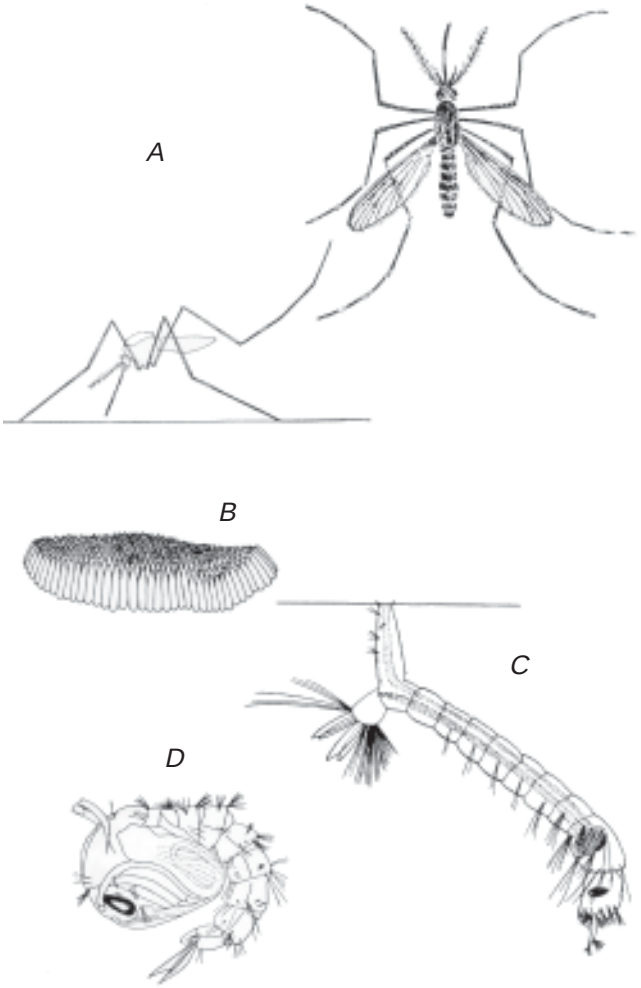
Although there are roughly 40 different species of mosquitoes in Maine, only about half of them are considered biting pests of humans and even fewer are sufficiently abundant to be considered important pests. Female mosquitoes feed on blood to acquire the extra protein they need to produce and lay eggs. In this process they can carry disease organisms and parasites from one animal to another. Most mosquito-borne diseases are not a problem in Maine, however there has been recent concern over Eastern Equine Encephalitis and West Nile Virus.

Habitats and life cycles

All mosquitoes breed in standing water. The majority of biting species live in the temporary spring pools formed by melting snow. Other annoying species live in fresh water swamps, ponds, salt marshes, grassy ditches, culverts, and natural or artificial containers, such as tree holes, hollow stumps, rock holes, tires, swimming pools, cans, etc.

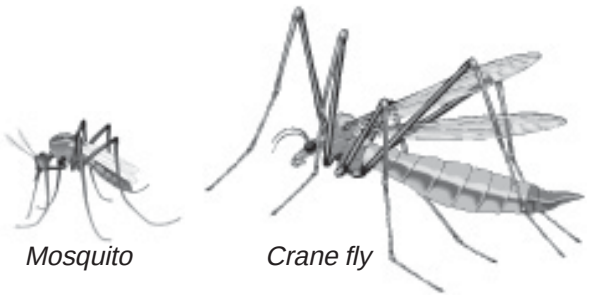
Eggs are deposited by females either individually or in groups on the surface of water or on soil where flooding will produce pools or ponds. In southern Maine, mosquitoes begin hatching in early to late March and continue until late April or early May, each species having a particular temperature range favorable for egg hatch. In central and western Maine, hatching occurs about 2 weeks later. At the Canadian border, mosquito eggs do not hatch until the last week of April. The larvae are called wrigglers because of their thrashing motion in the water. They breathe through a straw-like tube held at the water surface. The length of this life cycle varies, by species, from 4–30 days.

Adults begin emerging in late April. As long as water is available in their habitats, mosquitoes tend to increase in abundance gradually through the summer. Their numbers generally depend on the amount of rainfall. During wet summers, mosquitoes will be abundant; in dry summers, numbers will be low and individuals short-lived. Peak annoyance to humans usually occurs during the month of June.

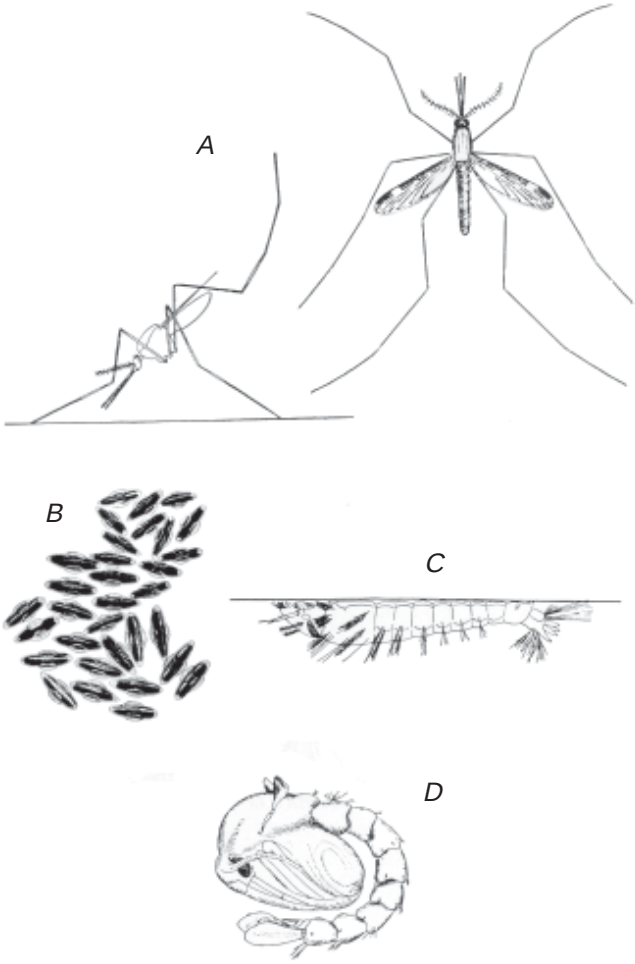


Culex *mosquitoes.* *A, Adult. B, Egg mass. C, Larva. D, Pupa.* Culex mosquitoes *are persistent biters that feed from dusk to dawn. They prefer birds but frequently bite humans. They breed in small pools of stagnant water containing organic debris and usually range no more than 300 feet from that site. The common house mosquito,* Culex pipiens, *is the primary carrier of encephalitis viruses.*

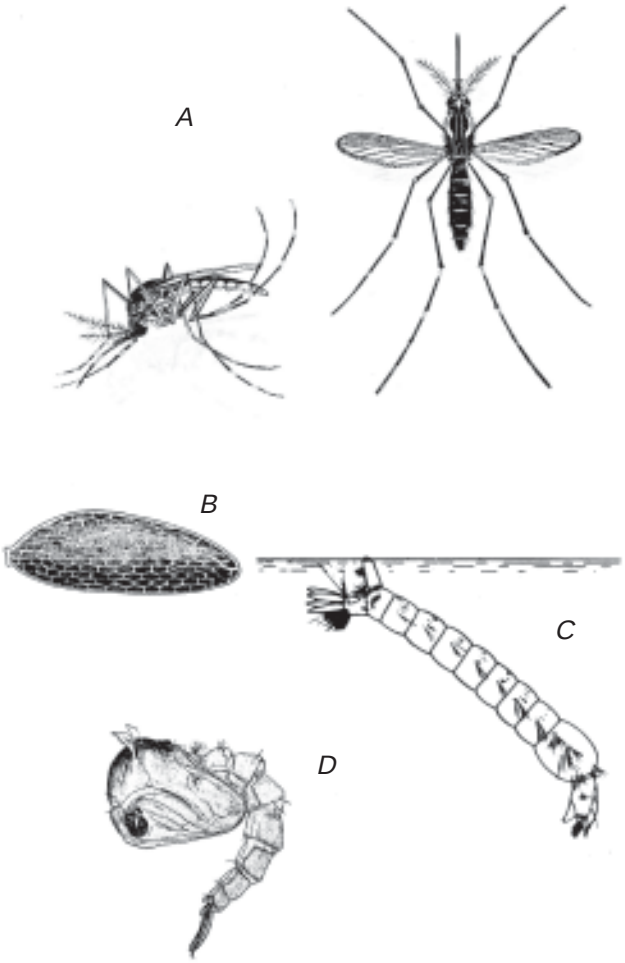
The mosquito is often confused with the harmless crane fly, which is more than twice the size of the mosquito and does not bite. All mosquitoes are less than ½ inch long as adults.



Mosquito *Crane fly*



Anopheles *mosquitoes.* *A, Adult. B, Eggs. C, Larva. D, Pupa. These mosquitoes are associated with permanent fresh water. Eggs are laid on the surface of calm water. The biting female holds her body at a 45° angle. This is the only group of mosquitos that can carry malaria.*



Aedes *mosquitoes.* *A, Adult. B, Egg mass. C, Larva. D, Pupa.* Aedes *mosquitoes are aggressive, painful biters that feed during daylight and prefer humans. They fly several miles from breeding sites (areas that flood) but usually do not enter buildings.* Aedes solicitans*, the salt marsh mosquito, is common along the coast of Maine.*

Managing mosquitoes

Eliminate breeding sites

Locate breeding sites before the adults emerge (late April), drain or remove all stagnant water in unused buckets, pools, old tires, tin cans, and other discarded containers. Be sure gutters and downspouts are cleaned. Keep dumpsters and trash receptacles covered to prevent water accumulation.

Eliminate adult resting sites

Cut back or remove dense brush and other vegetation from around buildings. Keep grassy areas mowed. Promote natural breezes to discourage mosquito occurrence.

Encourage natural predators

Predators such as dragonflies, bats, birds, frogs, and mosquito eating fish provide some natural control of mosquitoes, especially in and around small ponds and salt marsh pools. Both the nymphs and adult dragonflies are natural enemies of mosquitoes.

Avoidance

- Avoid outdoor activity when mosquitoes are most active—at dusk or on cloudy, warm days.
- Avoid areas where mosquitoes tend to concentrate—in tall grass, margins of wooded areas, or in heavily wooded areas in dense vegetation.

- Avoid wearing dark colors. Mosquitoes and other biting flies are attracted to dark greens, browns and black. They are less attracted to light colored clothing, especially whites, and yellows.
- Make sure window and door screens are in good repair.

Repellants

Chemical repellents can be applied to the skin or clothing to repel mosquitoes for 2 hours or more. Since repellents can irritate the eyes or the lips, care should be taken in their application. Be sure to read the instructions to make sure the repellent will not harm clothing or plastic items. Do not over-use repellents on young children, particularly those containing DEET.

Questionable control methods

"Bug zappers" are commonly sold for mosquito control. Using an electrified grid and an ultraviolet light, they attract and kill any insect entering the trap. Unfortunately, the lights are not especially attractive to female mosquitoes; they are more attracted to host odor. These devices generally kill more beneficial insects than pests. Light traps and carbon dioxide traps used by mosquito control programs are for monitoring purposes and are not effective in reducing mosquito numbers.

There have been several ultrasonic "mosquito repellers" on the market. The sound emitted by these devices is supposed to confuse mosquitoes and prevent biting. Tests under carefully controlled conditions have shown that these devices are totally useless for repelling mosquitoes.

Chemical control

There are several chemicals and formulations specialized for mosquito control. Chemical control is only a temporary solution to mosquito problems. If the school landscape supports mosquito habitat, chemicals must be used each year to control mosquito populations. Overuse of chemical pesticides can adversely affect nontarget organisms and can lead to pesticide resistant mosquito populations that are more difficult to control.

If there are extensive mosquito breeding areas on school property, consider having a licensed operator apply a carefully chosen insecticide to the breeding areas to kill mosquito larvae. This method eliminates mosquitoes before they disperse and gives more effective, longer lasting control than applications that target adult mosquitoes. The population should be monitored to determine proper treatment timing. Larviciding should be used when mosquito egg hatch is complete but before the larvae transform into pupae. Larvicides will not affect eggs or pupae.

Use the least toxic materials to minimize contamination of aquatic environments and adverse effects to other organisms in the area. Note that any treatment of the surface waters of Maine requires a special permit issued by the Department of Environmental Protection.

Insecticide applications that target adults are the least effective and most expensive method of mosquito control and are not recommended for controlling mosquitoes on school grounds. This method will rapidly reduce mosquitoes in a local area, but the effect does not last long and applications must be repeated several times to keep mosquito populations low.

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CHAPTER 12

ANTS

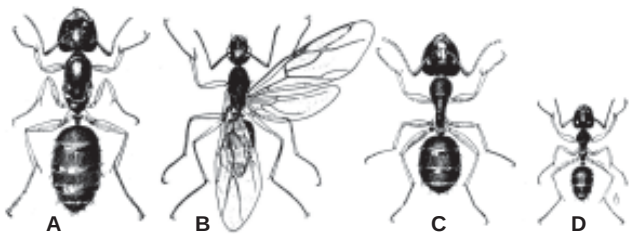
Ants may be a nuisance, at times, but they are beneficial as well. Many ants are predators and help regulate insect populations. They aerate the soil and recycle organic matter. Ants even pollinate plants in some areas.

Ants are social insects living in colonies that are divided into three castes. The workers are sterile, wingless females who may number in the thousands. Queens lay the eggs; there may be a single queen in a colony or several. Males are winged ants that swarm with queens.

Individual queens begin colonies at suitable sites. The nests can be found almost anywhere and the colony may move to more favorable locations when necessary. When a colony is large enough, winged males and females are produced and released in a swarm that often involves hundreds of extremely active ants. Newly mated queens establish more colonies.

Carpenter ant

Carpenter ants are predators and scavengers that prefer to nest in wet or rotting wood. They do not eat wood, but remove quantities of it as they expand their nest. The queens and major workers are the largest ants found in Maine. Winged queens measure 3/4-inch, wingless queens are 5/8-inch; winged males are slightly smaller. The workers come in two sizes—large major workers 1/2-inch long and small minor workers 1/4-inch long. The workers may have some brown on them; queens are entirely black. Foraging workers can stray far from their nest in search of food. Carpenter ants may cause structural damage as they excavate wood and other soft materials (such as foam insulation board) to make nests.



Carpenter ants: A, queen (winged when young), B, male, C, major worker, D, minor worker.

Cornfield ant

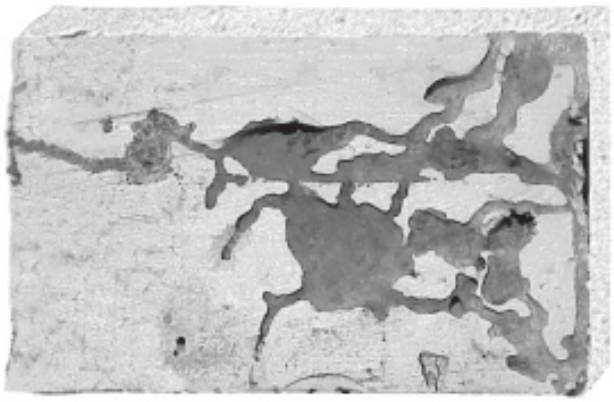
Cornfield ants feed on flower nectar, insects—dead or alive, and honeydew secreted from aphids. These ants often collect and transport aphids. Nests are commonly found in fields, lawns, between bricks in walkways, beneath rocks, in pavement cracks, etc. Workers are about 1/10-1/4 inch long, light to dark brown, soft-bodied, and robust. When crushed, they emit a strong odor of formic acid. Numerous mounds can be common in turf where they ruin the surfaces of lawns, dull mower blades, and may suffocate the underlying turf.

Pavement ant

Pavement ants may forage in buildings throughout the year, feeding on grease, meat, live and dead insects, honeydew, roots of plants and planted seeds. These are very common ants usually found outdoors under stones, in pavement cracks, under slab foundations, along the curb edges and in crevices of masonry and woodwork. Workers are sluggish, between 1/12-1/4 inch long. They are hairy, light to dark brown or blackish, with pale legs and antennae. The head and thorax are furrowed with parallel grooves running top to bottom. In winter, nests are often moved indoors near a heat source.

Lawn ant

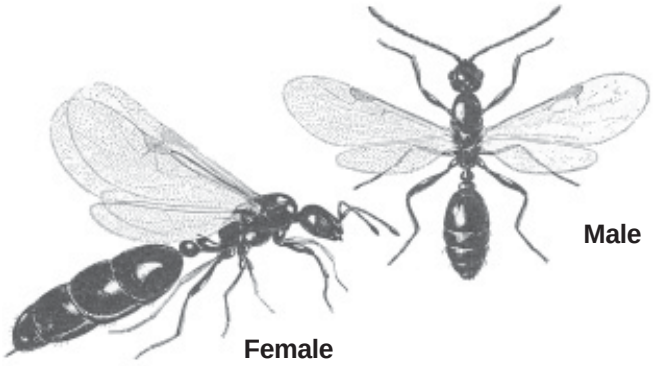
Lawn ants are general scavengers. They may also tend aphids and collect nectar when available. They nest under walks or stones, in turf, and on trees. In well-drained, clay or gravelly soil they make the well-known small ant hills with a central entrance. Workers are about 1/4-inch long, yellowish, and occur in turf. The abdomen is light tan with brown bands. The head, thorax and legs are slightly darker.



Carpenter ants prefer to burrow in wet or rotting wood but they may use existing hollow spaces, such as the gap between a building foundation and styrofoam insulation.

Allegheny mound ant

Allegheny mound ants are uncommon in Maine, living in just a few isolated localities. They normally attend honeydew-secreting insects on plants and prey on other insects. They occasionally enter buildings. Nests are large, conical mounds, sometimes measuring three feet high by six feet in diameter. Workers are about 1/4-inch long with a blackish-brown abdomen and legs, while the head and thorax are rust red. These ants have a painful bite. The bitten area is smeared with formic acid, which greatly increases the irritation. Allegheny mound ants may girdle and kill small trees near their nests.



Ants are usually wingless but swarms of winged males and females are produced periodically. Ants mate in flight. The males die within a few days. Females shed their wings and begin a new colony.

Little black ant

Little black ants feed on sweets, meats, vegetables, honeydew, and insects. They nest in woodwork, masonry, soil, and rotted wood. Nests in the ground have very small craters of fine soil surrounding the entrance. Workers are slow moving, about 1/8-inch long, slender, shiny black or sometimes dark brown.

European red ant

The European red ant is found in isolated areas including Mount Desert Island and Cape Elizabeth. They do not general enter buildings but prefer moist soil in meadows, lawns, and gardens where they build wide, shallow nests. Workers are about 1/4-inch long, yellow to yellowish brown. This species can be aggressive and can inflict a painful sting that may cause allergic reactions.

Many species of ants tend aphids and other insects that secrete honeydew.

Managing outdoor ants

The most direct form of ant control is to locate the nest and destroy the colony. But ant management is rarely that simple. Often the nest cannot be found, or it may be inaccessible, or there may be multiple nests involved. In most cases, long-term management requires improved sanitation, structural repairs, and habitat modification, and often more direct control tactics, such as insecticide baits, crack and crevice treatments.

Habitat modification

- Check any areas where there might be a water leak, or moist or rotting wood in decks, sheds, firewood, logs, stumps, etc. Make repairs where needed.
- Carry a caulking gun when making inspections, and seal as many cracks as time allows.
- Trim branches that overhang or touch school buildings to exclude ants.
- Keep plants at least 3 feet from buildings.
- Alter landscape and ornamental plantings to minimize aphids and other honeydew-producing insects that attract ants.
- Use weather-stripping around doors and windows where ants may enter.

Sanitation

- A sudden ant infestation may indicate a change in handling food, or food waste, that increases food sources for ants.
- Clean up food and drink spills promptly.
- Place garbage in sealed plastic bags, then place the bags into a pest proof dumpster or other storage receptacle.
- Empty garbage cans and dumpsters regularly and keep them as clean as possible.
- Clean recyclables before placing them in bins.
- Ants walk over many different kinds of surfaces and sometimes feed on dead animals and insects. They can carry disease causing organisms, although this is unusual. Assume that ant-infested food is contaminated and throw it away.

Chemical control

Integrating pesticides into your management program may be necessary to gain control of ant problems. Pesticides, including ant cups or baits may be applied in schools only by licensed applicators. Discuss chemical control methods with your licensed pesticide applicator.

Diatomaceous earth and silica aerogel. These are insecticidal dusts. Diatomaceous earth is made from certain fossilized sea organisms; silica gel is produced from sand. Both kill insects by desiccation—they abrade the wax and oil on the insect's outer covering leading to dehydration and death. Because these materials are very fine dusts, they travel freely through the air and can be irritating to the eyes and lungs. Applicators should use a dust mask and goggles. No other people should be present during application.

Diatomaceous earth and silica aerogel are especially useful in wall voids and similarly closed spaces. These dusts can be blown into closed areas during construction and remodeling. In finished buildings, they can be applied inside the walls through carefully drilled holes. These dusts also are useful in crack and crevice treatments.

Insect growth regulators (IGRs). These insecticides are available in bait form for some ant species. Insect growth regulators inhibit normal development of insects. They are slow-acting because they stop the next generation from developing rather than killing the current generation.

Drenches. A soil drench can be effective for ground nesting ants that dig deep nests. An insecticide dilution can be applied directly onto a mound or nest so that the entire nest is soaked.

Ant baits. Baits greatly reduce the amount of pesticide that must be used to kill ants. Fast-acting baits quickly kill foraging workers but are less effective than slower acting baits. Slow-acting baits allow foraging ants to return to the nest and feed the bait to other members of the colony, resulting in colony death. Even if the queen is not killed, baits will usually stop an ant invasion. If a colony has been starved by effective sanitation measures, baits will be more readily accepted. Correct identification of the pest ant is necessary to select the right bait. Some baits use a sweet attractant, others use a protein or an oil.

- After setting out bait, observe to see if the target ant is taking the bait.
- Ant colonies have changing nutritional requirements that can pose problems in baiting. A colony that accepts a protein bait one week may be more interested in a sugar bait the next.
- The nesting and foraging environment can also affect bait acceptance. Ants nesting and foraging in dry areas will be more interested in baits with

a high water content than will ants nesting in moist environments.

- When there are several competing ant species in one area, nontarget ants may accept the bait more readily than the pest ant and, in some cases, prevent the pest ant from getting to the bait.
- Do not spray pesticides when using baits. Bait stations contaminated with pesticide are repellent to ants, and sprays disperse the ant infestation, making it more difficult to place baits effectively.
- Some baits come packaged in plastic disc "bait stations" that come with double-sided tape so that they can be attached to various surfaces out of view. It is important to remove bait stations when they are no longer needed.
- Place bait stations along foraging trails, but do not disturb ant trails between the nest and the bait. Killing the ants or disturbing the trails prevents the ants from taking the bait back to the colony to kill nest mates.
- Some baits are formulated as granules or gels that can be injected into wall voids through small holes. Gel baits also can be placed near ant trails in inconspicuous places where they will not be disturbed.
- Baits should be placed out of sight and reach of children.
- Do not use baits as preventive treatments.

Biting and stinging ants

Certain ant nests present a personal hazard on school grounds. The Allegheny mound ant has a particularly painful bite. The European red ant can actually sting when disturbed.

For ant nests found on school grounds where school staff and children are at risk from bites or stings, the following method can be used.

- Mix a solution of soapy water (3-4 tablespoons of liquid dish soap/gallon water) in 5-gallon plastic buckets.
- Standing a foot away from the nest (wear long pants or coveralls and tuck pant legs into socks to avoid ant bites), slowly pour soapy water into the nest. Have a partner poke holes in the nest with a stick and continue pouring the solution until no more live ants are seen.
- Excavate the nest with a shovel and pour more soapy water into depression

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Chapter 13

Vertebrate Pests

Vertebrates, animals with backbones, may become serious pests on school grounds. Uncontrolled populations can destroy stored goods, contaminate food, dig up ornamental plantings, or damage turfgrass. They may also spread a number of diseases.

Rats and mice

The most persistent rodent pests in schools are the house mouse, roof rat, and Norway rat. White-footed and deer mice may also be troublesome. Rats and mice damage stored items and consume or contaminate food. They are also reservoirs of disease—rat bite fever, leptospirosis, murine typhus, rickettsial pox, plague, trichinosis, typhoid, dysentery, salmonellosis, tapeworms, lymphocytic choriomeningitis, and hantavirus.

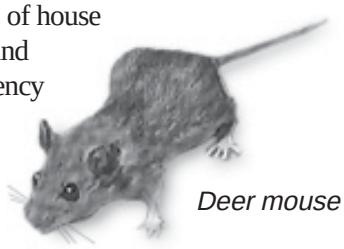
House mouse

House mouse

The house mouse is the most common rodent found in schools. They are inquisitive, good climbers, and actively explore anything new. House mice are gray-brown with a lighter belly and small, black eyes. House mice feed primarily on seeds, grain products, and dried foods. They are nocturnal and secretive and tend to nibble on many small meals each night. They have a small home range, usually staying within 10-30 feet of their nest. Nests usually are built in structural voids, undisturbed storage or debris, or in outdoor burrows. The presence of mice is usually indicated by actual sightings, damage caused by gnawing into food containers, or the presence of droppings.

White-footed and deer mice

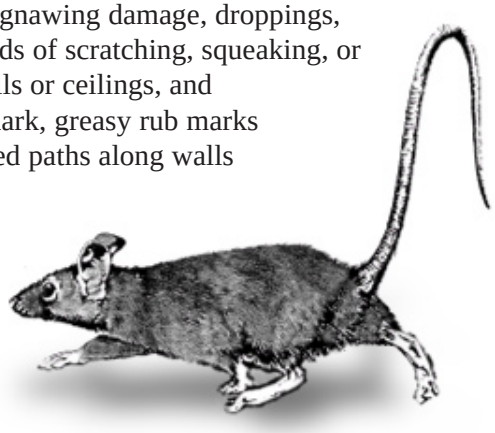
White-footed and deer mice have white feet, usually white undersides, and brownish upper surfaces. They have larger eyes and ears than house mice and most people find them more "attractive." These mice are seed eaters. They also consume fruits, insects, fungi, and possibly some green vegetation. They are uncommon in urban or suburban areas unless there is considerable open space nearby. They are mostly nocturnal with a home range of 1/3 to 4 acres. The signs they leave are similar to those of house mice, although white-footed and deer mice have a greater tendency to cache food supplies. They also lack the characteristic mousy odor of house mice. They will enter structures where they can cause considerable damage to materials that they use for nest building. White-footed mice may harbor hantavirus.



Deer mouse

Roof rat

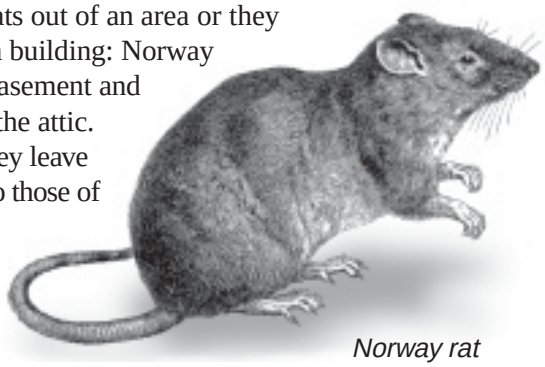
The roof rat, or black rat, is an excellent climber. They like to travel off the ground and enter buildings from nearby trees or along power lines. Roof rats prefer fruit, but will eat any type of food. They have a large home range and may travel more than 50 yards to reach food or water. They often nest in attics, wall voids, and hollow trees. The presence of roof rats is determined by gnawing damage, droppings, sightings, sounds of scratching, squeaking, or gnawing in walls or ceilings, and characteristic dark, greasy rub marks along frequented paths along walls and rafters.



Roof rat

Norway rats

Norway rats are strong burrowers, good climbers, and excellent swimmers. They are more common in sewers and buildings than the roof rat. They strongly prefer meat and fish, but will do well on any type of human or pet food. Their home range may be more than 50 yards in radius. These rats usually dig burrows along building foundations and under debris piles. The Norway rat is very aggressive and may drive roof rats out of an area or they may share a building: Norway rats in the basement and roof rats in the attic. The signs they leave are similar to those of roof rats.



Norway rat

Rodent facts and figures

- **A mouse produces between 40 to 100 droppings per day.**
- **A rat produces between 20 to 50 droppings and ½ ounce of urine per day.**
- **Rats and mice spend about ½ hour each day gnawing on objects.**
- **Diseases spread by rodents have killed more than 10 million people over the last 100 years, but this number is declining dramatically due to advances in sanitation, antibiotics and rodent pest management.**
- **Rats can climb vertical pipes up to 4 inches in diameter.**
- **Rats can jump 3 feet straight up or 4 feet straight out, they can drop from 50 feet without being killed.**
- **Rats can burrow 4 feet deep and emerge from floor drains, water traps or toilets.**

Managing rodents

Most rodent problems can be prevented with landscape maintenance, good sanitation, and rodent proofing.

Sanitation

- Inspect the school grounds for food sources. Remove edible plants, fallen fruit and nuts, and animal feces.
- Keep lids on trash cans and close dumpsters at night. Cover the drainage holes in dumpsters with wire mesh to keep rodents out.
- Remove debris, lumber piles, firewood, trash, and discarded items to reduce shelter for rodents.
- Trim all vegetation at least 3 feet from all buildings to decrease cover for rodent runways and prevent hidden access to buildings.
- Break up long stretches of dense vegetation or tall ground cover that allow rodents to travel long distances under cover.

Rodent proofing

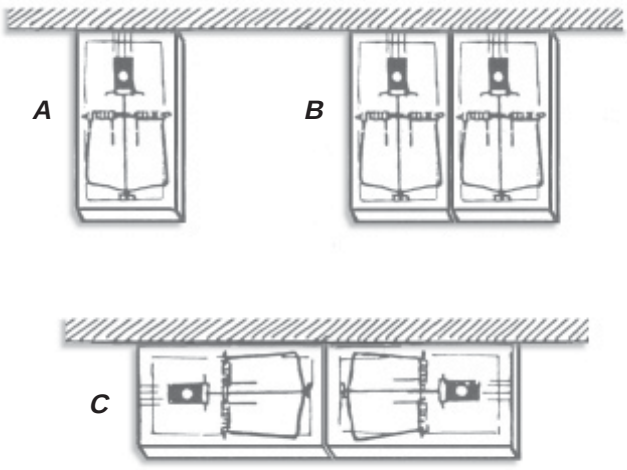
Also called exclusion, rodent proofing involves tightening a structure so that rodents cannot get in. A young rat can squeeze through an opening as small as $^1/_2$-inch. Any opening that a pencil can fit through will admit a mouse. Inspect and seal doors, door sweeps, weather-stripping, cracks, gaps, and other openings where rodents may enter a building.

Traps

Trapping is preferable to using rodenticides for controlling rodents on school grounds. Traps can be used in situations where poisonous baits are not allowed; they also avoid the odor problem of rodents dying in inaccessible places. School staff do not need a license to use mechanical traps for rodent control.

Rodents often run along edges, and they routinely follow the same runways. Identifty runways by sprinkling a fine layer of flour or baby powder in suspected areas to observe tracks. Place traps along walls and runways, 6-10 feet apart, especially where objects such as a box or appliance will guide them into the trap. Roof rats and Norway rats usually fear new items in their environment; they avoid them for several days. Keep all rat traps in place for at least 1 week before moving them.

Traps used for rodent monitoring or management should be checked daily. Traps or other surfaces contaminated with rodent urine or feces should be properly disinfected or disposed of.



Place snap traps in secure areas, along a wall or rodent runway. A, trap triggers should face a wall. B, two traps next to each other increses the chance of success. C, two traps may also be placed inline, the triggers to the outside.

Baits. The bait depends on the rodent. House mice prefer peanut butter, gum drops stuck to the trigger, or rolled oats or bird seed sprinkled on the trap. When food is abundant, nesting material, such as a cotton ball tied to the trigger, can be effective. Roof rats prefer peanut butter, pieces of fruit, or shelled nuts. For Norway rats, use raw or cooked meat, fish (sardines are excellent), or peanut butter.

Snap Traps. Both the classic rodent wooden trap and the newer metal clothespin design kill trapped animals quickly. Snap traps should be placed in locked rooms or other areas not accessible to children or in locked, tamper-resistant containers securely attached to a surface so that the container cannot be picked up or moved.

Live traps. Several types of live traps are available. Some catch a single rodent, others reset themselves to capture several. Check live traps regularly to prevent the captured rodents from starving or dying of thirst and creating an odor problem. These traps may be expensive and the live animals must be dealt with. Rodents should not be released to the wild.

Glue boards are most effective against juvenile mice in dry, dust free areas. Although rat-sized glue boards are available, captured rats can often pull themselves free. Use a tack, a small nail, wire, or double-sided tape to fix glue boards to ledges, pipes, or rafters. Do not set them near open flames or above carpet. These traps should not be set where children or domestic animals will come into contact with them. Although they are not hazardous to children, an encounter with a glue board can create a frustrating mess. Clean hands with room-temperature cooking oil. Clean hard surfaces with paint thinner or mineral spirits.

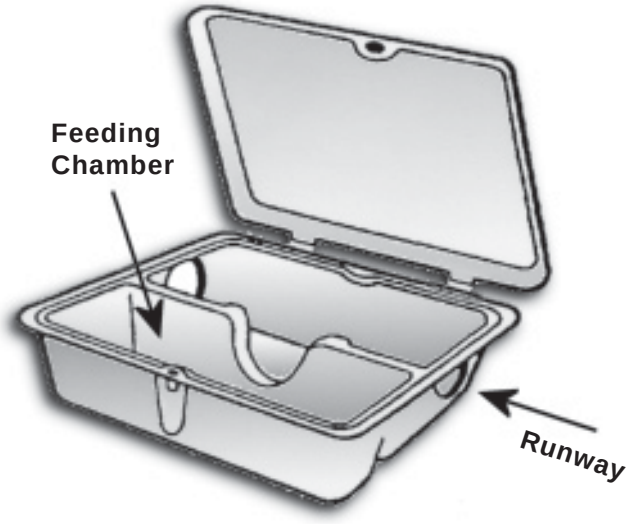
Ultrasound Devices

Ultrasonic devices create a loud noise, above the range of human hearing that is unpleasant to rodents. Rats and mice quickly adapt to the sound by avoiding it. Because the extremely high notes are easily reflected, any object in the area can create a sound shadow. Rodents shift their activity to these low noise shadows. Although the expense of the devices may not be justified, this behavioral change can be used to guide rodents into traps that are purposefully set in low noise locations.

Chemical control

In situations where trapping alone cannot resolve rodent problems, anticoagulant baits are usually effective. Because rodenticides may be highly toxic to humans, they should only be used in secure locations and contained in tamper-resistant bait boxes. As with all pesticides, it is a violation of Maine law for unlicensed persons to use rodent poisons in schools. Be sure your pest control professional follows these guidelines for using rodent poisons:

- Use rodent bait stations that are locked and firmly anchored.
- Place bait stations in areas inaccessible to children.
- Place rodenticides in the baffle-protected feeding chamber of the box. Never place bait in the runway.
- Bait stations should be monitored and serviced regularly, and removed promptly when rodents are no longer using them.
- Have your licensed applicator provide a map showing locations of all traps and dates of service.



Place rodenticides in the baffle-protected feeding chamber of the box. Never place bait in the runway.

HANTAVIRUS

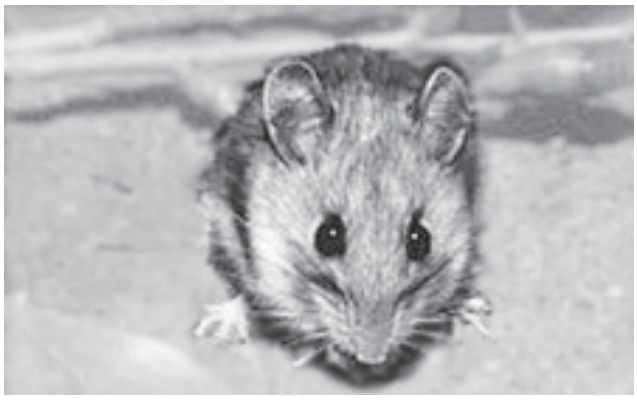
Hantavirus pulmonary syndrome (HPS), first recognized in 1993 from the southwestern United States, has now been reported throughout North and South America. The disease is caused by several types of hantaviruses that are carried by rodents and occasionally transmitted to humans. HPS is fairly uncommon; the chances of becoming infected are low. However, HPS is potentially deadly. Of 289 cases, 38% resulted in death. Immediate intensive care is essential once symptoms appear. There have been no cases reported from Maine.

In New England, the white-footed mouse can harbor the virus. The mice are unaffected by the disease but maintain it within their population by biting and grooming. These rodents shed the virus in their urine, droppings and saliva. The virus is mainly transmitted to people when they breathe in air contaminated with recently shed virus particles. This may happen if droppings and nesting materials are accidentally stirred up. Entering tightly closed areas that are infested with mice increases risk. The virus is not transmitted from person to person in the same way as other infections, such as the common cold. It appears that HPS cannot be transmitted by insects, dogs, cats, farm animals, Guinea pigs, hamsters, or gerbils.

Symptoms of Hantavirus pulmonary syndrome

Symptoms do not appear for 1-3 weeks; they may be occasionally absent for up to 6 weeks. There are no known differences in susceptibility due to age or sex. Pneumonia is the most frequent misdiagnosis of HPS. The symptoms of HPS are nonspecific, but there are some characteristic patterns.

- Early symptoms experienced by all: fever, fatigue, muscle aches.
- Early symptoms experienced in about half of all cases: headaches, dizziness, chills, and abdominal problems.
- Late symptoms experienced by all: coughing, shortness of breath.
- Symptoms uncommon in all cases: earaches, rashes, and sore throat.



In New England, the white-footed mouse can harbor hantavirus.Two cases have been reported, one in Vermont and one in Rhode Island.

There is no specific antidote or vaccine for HPS. Care consists of early and aggressive symptomatic treatment. For more information contact Maine Department of Human Services, Division of Disease Control 207-287-5301.

Prevention

Sanitation and rodent proofing are the best ways to eliminate mice and minimize the chances of contracting hantavirus.

- Seal all openings in building exteriors that are over 1/4-inch in size. Pay particular attention to areas where utility lines or pipes enter a building.
- Use rodent proof containers for trash.
- Remove trash, brush, and debris from school grounds.
- If rodents are a continuous problem, consider using rodenticides in bait boxes.
- Because the virus probably remains viable for only 3-4 days in feces and urine, wait at least that long before cleaning an area formerly infested with white-footed mice.
- Wear rubber gloves when handling mice or their nest materials.
- Clean up urine and feces by spraying with a disinfectant solution and then wipe up. Do not sweep or vacuum if at all possible; stirring up dust increases the levels of airborne virus.
- If dusty areas must be entered, wear a respirator or dust mask with a HEPA filter to remove viruses.

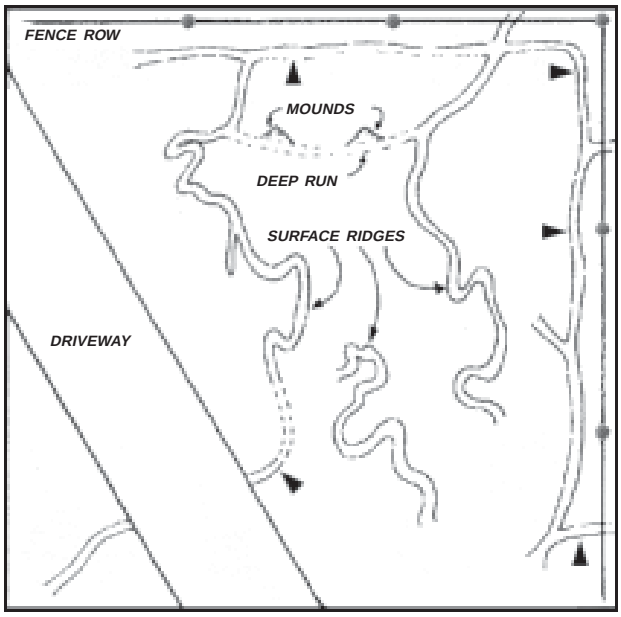
Moles

Moles are solitary predators. They live in secluded underground burrows, coming to the surface rarely, often only by accident. Their front feet are greatly enlarged for tunneling through the soil. Moles make their dens under buildings, sidewalks, or large trees. Deep runways, 3-12 inches below the surface, connect the den to shallow tunnels in the hunting ground. The deep runways are often marked by mole hills.

Moles are about 7 inches long with a short tail. They lack external ears and have very tiny eyes.

Damage

Moles "swim" through soil in search of their food—primarily earthworms, beetle grubs, ants, and other soil animals. As they travel near the surface, they create upheaved ridges. These surface runs may be used daily, may be revisited at irregular intervals, or may be used only once and then abandoned. They prefer to hunt in soil that is shaded, cool, moist, and populated by worms and grubs. This preference accounts for the mole's attraction to lawns and flower beds. Their burrowing habits disfigure turf and destroy flower beds. Their mounds provide a medium for germinating weeds.



A network of mole runways in a yard. The arrows indicate good locations to set traps. Avoid the twisting surface ridges and do not place traps on top of mounds.

Moles push up volcano-shaped hills of soil, 2-24 inches tall. Mole hills do not reflect population size. One acre of land usually supports no more than 2-3 moles.

Managing moles

Electronic devices

Many ultrasonic and vibration producing devices are available to repel moles. These devices have little value in a management program.

White grub control

Controlling white grubs may not solve a mole problem. Grubs make up only a portion of the mole's diet which also includes earthworms and other soil animals. Moles are often present in grub-free lawns.

Trapping

Trapping is the most reliable method of mole control but it requires patience, practice, and persistence. Moles have an uncanny ability to detect and spring improperly set traps. Place traps carefully; keep trying until experience leads to success. The harpoon trap is probably the easiest trap for the novice to use, and is readily available from most hardware and garden shops.

Generally, trapping is most effective during the spring and fall, when mole activity is at a peak. Begin trapping as soon as mole activity is noticed. Observe the damage to get an idea of how the mole is traveling; try to locate well-used runways. Place 3-5 traps along main runways, active surface tunnels, or where runways enter the damaged area.

To distinguish active runways, look for tunnels that follow a fairly straight course for some distance, or appear to connect two mounds or two runway systems, or follow fencerows, wooded edges, concrete paths or other manmade borders. Poke small holes into suspect runways at several locations throughout the system. Mark these holes with a stick or flag and monitor them daily. Active tunnels will be repaired within a day or two. Runways unrepaired for more than 2 days are not worth trapping.

Raccoons

Raccoons are very adaptable and thrive in many habitats, including urban areas. Raccoons are night hunters. They usually leave their den soon after dusk and are active until morning. They are not fussy about their choice of food. They eat meat, fruits, acorns, vegetables and seeds. They also eat dead animals that they encounter. Individual raccoons have a home range of 1-3 square miles and are somewhat territorial, especially the males. In the wild, they usually den in a hollow tree. In urban areas, raccoons live in rock and debris piles, attics, crawl spaces beneath buildings, culverts, and sewer drains.

Adult raccoons are about 2-3 feet long (including their 10-inch tail) and weigh 10-30 pounds, or more.

Damage

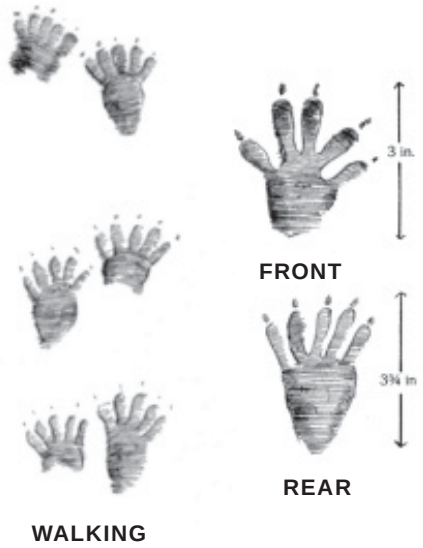
Raccoons raid bird feeders and pet food bowls and get into garbage cans that are not secured. Raccoons can be a considerable nuisance when they roll up freshly laid sod in search of earthworms and grubs. They may return repeatedly and damage extensive areas of sod on successive nights. Raccoons may be infected with rabies.

Managing raccoons

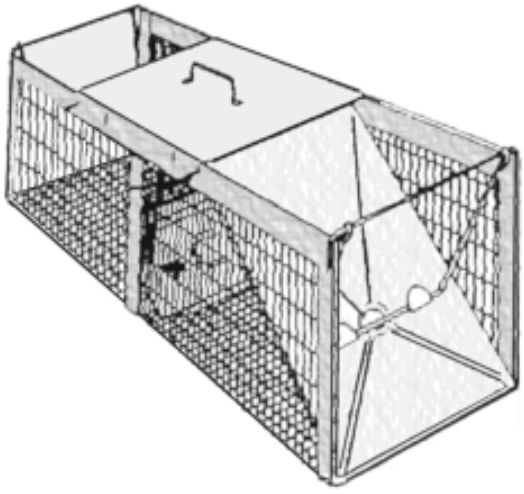
Repellents of any kind, including blood meal, dog feces, moth-balls and dirty laundry, will not work. Scare devices are also ineffective. The use of poisons is not legal without a permit and is not recommended for raccoons. Check with the Board of Pesticides Control before using any lethal control method.

The best strategy is to prevent their access to food wherever possible. Regularly remove trash and debris from school grounds. If raccoons are raiding garbage cans, keep them in a secure area or use bins with latching lids.

For persistent problems, raccoons may be trapped and removed. Check your local ordinances before attempting to solve an animal problem with live traps. For more information call Inland Fisheries and Wildlife, the Warden Service, or your local Animal Control Officer.



Five long rear toes and a "hand-like" front print are characteristic of raccoon tracks. Except in soft mud or sand, the "heel" of the hind foot seldom shows.



A cage-type trap, although bulky and expensive, is often the best choice for removing raccoons or skunks from school property.

The striped skunk is the only skunk that is commonly found in New England. Adults are 2- 2½ feet long and weigh 6-8 pounds.

Skunks

Skunks hunt at night. During the day they usually sleep in dens dug under logs, wood piles, or buildings. They feed on various plants and animals, but prefer insects, such as crickets, grasshoppers, and beetles.

Damage

Skunks often tear up and destroy turf during their search for white grubs and other insect larvae. This grubbing activity is most common in the spring and fall when larvae are found near the soil surface. Digging normally creates 3-4 inch, cone-shaped holes or patches of overturned sod. Skunks may be infected with rabies.

Managing skunks

Eliminate potential den sites and food sources to reduce skunk populations. Remove rock piles, wood piles, or other debris that might provide a den. Exclude skunks from under buildings by sealing all holes with fine wire mesh. At building foundations, bend out the bottom of the mesh 6 inches at a 90-degree angle and bury it 6 inches deep to prevent skunks from digging beneath.

If white grub populations exceed 10-20 per square foot, a soil insecticide applied by a licensed applicator may be effective in reducing skunk damage to turf.

Live trapping

Check your local ordinances before attempting to live traps skunks. For more information call Inland Fisheries and Wildlife, the Warden Service, or your local Animal Control Officer. The use of poisons is not legal without a permit and is not recommended. Check with the Board of Pesticides Control before using any lethal control method.

Animal control contacts

For animal control assistance:
Maine Inland Fisheries and WIldlife
http://www.state.me.us/ifw/index.html

Central Office	207-287-8000
Enfield	207-732-4132
Jonesboro	207-434-5927
Strong	207-778-3324

Warden Service (weekdays):

Division Hdq.	207-941-4440
Gray	207-657-2345
Sidney	207-547-5300
Bangor	207-941-4440
Greenville	207-695-3756
Ashland	207-435-3231

Animal Control Officer:
Call your town office or police department to contact your local animal control officer.

Domestic animal questions:
State Veterinarian, Maine Department of Agriculture
207-287-3701

Bat-proofing questions:
BPC, Maine Department of Agriculture
207-287-2731

Skunk tracks. Both the hind and forefeet have five toes; although the fifth toe may not be obvious. Claw marks are usually visible, the heels of the forefeet are usually not.

RABIES

Rabies is a viral disease of the central nervous system (brain and spinal cord) that is almost always fatal. Rabies in humans is very rare in the United States, but rabies in animals, especially wildlife, is increasingly common in Maine.

How is rabies spread?

The rabies virus lives in the saliva, brain, and spinal cord of animals and is spread when they bite or scratch. The virus can also be spread if a rabid animal's saliva or nerve tissue touches broken skin or a mucous membrane in the mouth, nose, or eye. The human incubation period varies depending on the type of exposure.

What kinds of animals spread rabies?

The rabies virus can infect any mammal but infection is most common among skunks and raccoons; bats, foxes, and woodchucks are occasionally infected. Rabies is very rare among rodents (squirrels, rats, mice, and chipmunks). Thanks to vaccines, rabies is extremely rare among pets and farm animals.

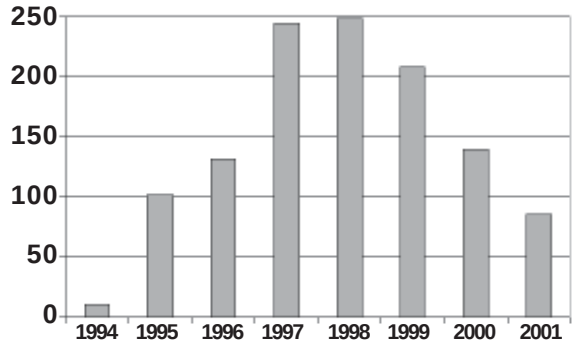
How common is rabies in Maine?

Since its reintroduction in 1994, rabies has increased dramatically in Maine. Rabies has been found in all 16 counties but most cases are concentrated in central, eastern and southern Maine.

How can you tell if an animal is rabid?

Rabid animals usually behave abnormally, but signs vary. Some animals may appear shy and fearful, others become aggressive, some may simply stumble as though drunk or lame. Suspect animals that have exposed either a human or domestic animal should be tested by the Health and Environmental Testing Laboratory in Augusta.

Confirmed cases of animal rabies in Maine



What to do if a bat is found inside a building

- **Do not attempt to handle or capture it. Instead, evacuate the room, then contact your local Animal Control Officer or the Maine Department of Inland Fisheries and Wildlife for help.**
- **Contact the Health and Environmental Testing office for advice on having the bat tested for rabies, even if there has been no known contact with the bat.**
- **If bitten or scratched, call your doctor or the Maine Health and Environmental Testing Laboratory, 207-297-2727.**

How can you prevent rabies?

- Children and staff should be instructed to avoid contact with wild animals, dead or alive, especially bats, skunks, fox, and raccoons that wander onto school grounds.
- Report any animal, wild, farm, or domestic, that behaves oddly to your local Animal Control Officer (ACO).
- Discourage wild animals from "sharing your lunch." Fasten trash can lids tightly. Garbage attracts animals, including skunks and raccoons, who are looking for an easy meal.
- It is against the law to keep wild animals as pets, including skunks, raccoons, and bats. Hybrids (offspring of wild animals bred with domesticated cats or dogs) are considered wild animals.
- Bats found indoors, alive or dead, should be tested for rabies—even if there was no known contact with the bat.
- Do not handle sick or injured wild animals, including baby animals. Call the police, ACO, or State Game Warden. If you must handle a dead animal, use heavy gloves, sticks, or other tools to avoid direct contact with saliva, brain tissue, or neural fluid.
- Do not allow domestic or stray dogs or cats to roam on school property. Call an ACO for help in removing unattended domestic animals from school properties.

What to do if someone may be exposed to rabies at school

The most dangerous type of exposure is a bite or scratch from an infected animal that penetrates the skin. If you think you have been exposed to a rabid animal, follow these steps:

1. Immediately wash the wound with soap and water for at least 10 minutes.
2. Call your doctor or health care professional as soon as you finish washing. He or she will help you decide if you need to be treated for rabies. Follow instructions exactly.
3. Contact your town office or local law enforcement agency. They can refer you to the local Animal Control Officer. The officer will need your help in locating the animal that has bitten or scratched you. Dogs and cats are quarantined for observation. Wild animals are euthanized and sent to the State Health and Environmental Laboratory in Augusta for testing.

Human and animal exposure questions:
Health and Environmental Testing Laboratory 207-287-2727

For consultation involving human exposure
Epidemiology Program 207-287-5301

Emergency consultation
Bureau of Health, Disease Control 1-800-821-5821

References / Resources

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Stier, *et al.* 2000. *Wisconsin's School Integrated Pest Management Manual*. University of Wisconsin, Madison, WI. http://ipcm.wisc.edu/programs/school/intro.htm

University of Maine Cooperative Extension County Offices. See inside back cover.

Appendix A

Pesticides

The purpose of this appendix is to familiarize school pest managers with pesticides, so that reasonable and informed decisions may be made by schools, in consultation with their licensed, professional applicators.

The Federal Insecticide Fungicide and Rodenticide Act (FIFRA) defines a pesticide as:

- Any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any pest.
- Any substance or mixture of substances intended to be used as a plant regulator, defoliant, or desiccant.
- Any nitrogen stabilizer.

The U.S. Environmental Protection Agency (EPA) administers FIFRA at the Federal level. In Maine, FIFRA, as well as state pesticide regulations, are administered by the Board of Pesticides Control (BPC), part of the Maine Department of Agriculture.

Many kinds of pesticides are currently available, including insecticides, herbicides, fungicides, rodenticides, wood preservatives, and disinfectants. Choose a product registered by the EPA and the state of Maine that includes the appropriate site and pest on the label. The product should be the least toxic available with low potential for exposure and a history of effectiveness. Use pesticides that degrade rapidly and affect a narrow range of target pests. Pesticides should be used only after a pest is properly identified and monitoring determines that the population has reached the action threshold. According to Maine law, pesticides on school property may be applied only by licensed applicators.

Pesticide label information

The pesticide label provides a good deal of information regarding the proper use, storage, and disposal of the product. Misusing a product can cause poisonings or other adverse effects and carry legal penalties. It is against the law to use a pesticide in a way that is inconsistent with the label—the label is the law. The following statements are taken from the *NO PEST* insecticides label on the next page.

Pesticide use guidelines

- **READ THE PESTICIDE LABEL. Follow all label instructions.**
- **Choose a pesticide that is labeled for the specific site, intended for the pest you are trying to control, and as specific to the target pest as possible.**
- **Use all safety equipment and clothing required by the label (gloves, goggles, respirator, hat, etc).**
- **Verify that the person doing the application is certified and licensed by the Maine Board of Pesticides Control.**
- **Make sure application equipment is properly calibrated and appropriate for the job.**
- **Use spot treatments—apply pesticides only where needed.**
- **Limit the use of sprays, foggers, or volatile formulations; use bait and granular application when possible.**
- **Unless it is an emergency situation, pesticide should *not* be applied when children are at school.**
- **Notify students, staff, and interested parents of upcoming pesticide applications. Pay particular attention to those individuals at higher risk.**
- **Post all areas to be treated or that have been treated. Note any reentry intervals listed on the label, and be aware that some residues can remain long after application.**
- **Monitor the pest population after the application to see if the treatment was effective—record the results.**
- **Be prepared for all emergencies—compile a list of whom to call for help and the kinds of first aid to be administered before help arrives. Place the list in an accessible area near a phone.**
- **Keep records of all applications, copies of labels and the MSDS for all pesticides in an easily accessed location.**
- **Dispose of pesticides properly. Do not pour pesticides down the drain, into the toilet, into the gutter, or into storm drains! If you are unsure about how to dispose of a pesticide, call the manufacturer or the Board of Pesticides Control, 207-287-2731.**

CHEMCO
REG. U.S. PAT. & TM OFF.

NO PEST INSECTICIDE

Restricted use pesticide. For retail sale to and use only by Certified Applicators, or persons under their direct supervision, and only for those uses covered by the Certified Applicator's certification.

ACTIVE INGREDIENT:	**BY WEIGHT**
deltathion (1,2 phospho-(5)-4 chioromethane).....	50%
INERT INGREDIENTS:.....	50%
TOTAL	100%

EPA Reg. No. 999 000 EPA Est. No. 000

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION - Harmful if inhaled. Avoid breathing vapor or spray mist. Contact with product may result in transient tingling and reddening of the skin. Remove contaminated clothing and wash before reuse.

STATEMENT OF PRACTICAL TREATMENT

If Swallowed: Do not induce vomiting. Contains aromatic petroleum solvent. Call a physician or poison control center immediately. **If In Eyes:** Flush with plenty of water for at least 15 minutes. Get medical attention. **If on Skin:** Wash with plenty of soap and water. Get medical attention if irritation persists. **If Inhaled:** Remove to fresh air immediately. Get medical attention

PERSONAL PROTECTIVE EQUIPMENT

Wear long sleeved clothing, full length trousers, eye protection, and protective gloves when handling.

Discard clothing and other absorbent materials that have been drenched or heavily contaminated with this product's concentrate. Do not reuse them. Follow manufacturer's instructions for cleaning/maintaining PPE. Keep and wash PPE separately from other laundry.

ENVIRONMENTAL HAZARDS

This pesticide is toxic to birds and extremely toxic to fish. Do not apply directly to water. Do not contaminate water by cleaning of equipment or disposal of waste. This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Avoid use when bees are actively foraging.

"No Pest" is a pesticide that can move (seep or travel) through soil and can contaminate groundwater that may be used as drinking water. "No Pest" has been found in groundwater as a result of agricultural use. Users are advised not to apply "No Pest" where the water table (groundwater) is close to the surface and where the soils are very permeable (i.e., well drained soils such as loamy sands). Your local agricultural agencies can provide further information on the type of soil in your area and the location of groundwater.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

For any requirements specific to your State or Tribe, consult the agency responsible for pesticide regulation. Do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application.

REENTRY STATEMENTS

Do not apply this product in such a manner as to directly or through drift expose workers or other persons. The area being treated must be vacated by unprotected persons.

Do not enter treated areas without protective clothing for 24 hours.

Written or oral warnings must be given to workers who are expected to be in a treated area or in an area about to be treated with this product. When oral warnings are given, warnings shall be given in a language customarily understood by workers. Oral warnings must be given if there is reason to believe that written warnings cannot be understood by workers. Written warnings must include the following information: "WARNING! Area treated with "No Pest' Insecticide on (date of application). Do not enter without appropriate protective clothing until sprays have dried. If accidental exposure occurs, follow the instructions below." (Written warnings must include the STATEMENT OF PRACTICAL TREATMENT given at the beginning of this label.)

STORAGE AND DISPOSAL

PROHIBITIONS: Do not contaminate water, food or feed by storage or disposal. Open dumping is prohibited. Do not reuse empty container.

STORAGE: Store in original container only. Keep container closed when not in use. Store "No Pest" in a well ventilated clean dry area out of reach of children and animals. Do not store in areas where temperature averages 115°F (46°C) or greater.

PESTICIDE DISPOSAL: Pesticide wastes are toxic. Improper disposal of excess pesticide, spray mixture or rinsate is a violation of federal law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency.

CONTAINER DISPOSAL: Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by other procedures approved by state and local authorities.

KEEP OUT OF REACH OF CHILDREN

CAUTION

Use classification

EPA categorizes every use of every pesticide as either general- or restricted-use. A pesticide, or some of its uses, are restricted if it has the potential to harm humans or the environment. Before purchasing or using a restricted use pesticide, an applicator must be certified by the state of Maine and licensed to make applications to a specific commodity. *There are very few situations where restricted-use pesticides should be used in or around schools.*

Use Classification Statement—*No Pest*

Restricted use pesticide. For retail sale to and use only by Certified Applicators, or persons under their direct supervision, and only for those uses covered by the Certified Applicator's certification.

The active ingredient

The active ingredient statement specifies the percentages of active components found in the product. Sometimes the information is technical, for example, the chemical name of the active ingredient in *No Pest* is (1,2 phospho-(5)-4 chioromethane). The common name for this active ingredient is deltathion. EPA's Label Improvement Program is working to make the active ingredient statement more understandable to the public.

Active Ingredient Statement—*No Pest*

ACTIVE INGREDIENT:	**BY WEIGHT**
deltathion (1,2 phospho-(5)-4 chioromethane)	50%
INERT INGREDIENTS:	50%
TOTAL	100%
EPA Reg. No. 999 000	EPA Est. No. 000

The EPA registration number

An EPA registration number (for example, *No Pest*, EPA Reg. No. 999 000) indicates that the pesticide label has been approved by EPA. This number is a unique identifier used for accessing pesticide databases including those used by poison centers.

Signal word

EPA uses the acute toxicity of a pesticide (short term exposure and skin and eye corrosiveness) to determine the signal word to place on the pesticide label: CAUTION, WARNING, DANGER, or DANGER/POISON. See the Toxicity Classification Appendix A.

The effects on fish or wildlife as well as long term exposure (chronic toxicity) are not included in the signal word. Thus, a pesticide with a CAUTION label could still be toxic to fish or cause cancer in lab animals. The signal word refers to the product as it is formulated, *not* just the active ingredient. A highly toxic active ingredient may display CAUTION on the label if it is greatly diluted—most rodenticides fall into this category. Conversely a product with low acute toxicity may be formulated with a solvent that increases toxicity and gives the formulation a DANGER label—certain pyrethroids fall into this category. *Read the label!*

Precautionary statements

Label information directly associated with the toxicity and other hazards of the product is found in various precautionary statements, including:

- Hazards to humans and domestic animals;
- Statement of practical treatment;
- Environmental hazards; and
- Physical or chemical hazards.

Signal Word and Precautionary Statement—*No Pest*

CAUTION - Harmful if inhaled. Avoid breathing vapor or spray mist. Contact with product may result in transient tingling and reddening of the skin. Remove contaminated clothing and wash before reuse.

Statement of Practical Treatment

This section describes first aid procedures for accidental exposures. All DANGER labels, and some WARNING and CAUTION labels, contain a note to physicians describing the appropriate medical procedures for poisoning emergencies and may identify an antidote. A copy of the label should always be available for emergencies.

Statement of Practical Treatment—*No Pest*

If Swallowed: Do not induce vomiting. Contains xylene range aromatic hydrocarbons. Call a physician or poison control center immediately. **If In Eyes:** Flush with plenty of water for at least 15 minutes. Get medical attention. **If on Skin:** Wash with plenty of soap and water. Get medical attention if irritation persists. **If Inhaled:** Remove to fresh air immediately. Get medical attention.

Personal Protective Equipment (PPE)

The minimum Personal Protective Equipment (PPE) required for handling a pesticide may be listed as a general reference to clothing, hats, etc., or specific equipment such as the type of respirator or gloves. The requirements may vary for different activities; for example, more protection may be needed when mixing a pesticide than is needed when you are applying it.

Personal Protective Equipment—*No Pest*

Wear long sleeved clothing, full length trousers, eye protection, and protective gloves when handling.

Discard clothing and other absorbent materials that have been drenched or heavily contaminated with this product's concentrate. Do not reuse them. Follow manufacturer's instructions for cleaning/maintaining PPE. Keep and wash PPE separately from other laundry.

Some labels do not mention PPE. To determine common-sense precautions for these materials, consider the signal word, and all precautionary statements. For example, *Avoid skin contact* indicates the need for gloves, long sleeves, long-legged pants, and goggles.

Follow all PPE requirements on the label. It is illegal to wear less protection than the label requires. However, the absence of a statement, or the mention of only a single piece of equipment, does not rule out the exercise of more precaution or the common-sense use of additional protection whenever possible.

Environmental hazards statement

The following advisory statement must appear in the environmental hazard statement of any product intended for outdoor, terrestrial applications:

Environmental Hazards Statement—*No Pest*

For terrestrial uses, do not apply directly to water, or to areas where surface water is present, or to intertidal areas below the mean high water mark. Do not contaminate water by the cleaning of equipment or disposal of wastes.

If a pesticide is hazardous to wildlife or the environment, statements are required describing the nature of the hazard and the appropriate precautions to avoid accident, injury, or damage.

Directions for use

The Directions for Use give explicit application information:

- The pests that the product will control;
- The crop, animal, or site the product is intended to protect;
- The proper equipment to use;
- Mixing instructions;
- How much to use and how often to apply;
- Compatibility with other products;
- Phytotoxicity and other possible injury; and
- Where and when the material should be applied.

On every label, directly under Directions for Use, is the following statement:

Misuse Statement—*No Pest*

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

Reentry statement

The label may specify a restricted-entry interval (REI, also known as a reentry interval), during which no one is allowed in the treatment area without taking the precautions specified on the label. The label may also require you to post warning signs at entrances to the treated area during the REI.

The reentry statement may be printed in a box under the heading *Reentry* or *Agricultural Use Requirements* or under a more general title such as *Important*, or *Note*, or *General Information*. The reentry interval for *No Pest* is 24 hours.

If no reentry statement appears on the label and none has been set by the state, anyone without the proper PPE must wait at least until sprays have dried or dusts have settled before reentering without protective equipment—the minimum legal reentry interval.

Reentry Statement—*No Pest*

Do not apply this product in such a manner as to directly or through drift expose workers or other persons. The area being treated must be vacated by unprotected persons.

Do not enter treated areas without protective clothing for 24 hours.

Storage and disposal

All labels contain general instructions to properly store and dispose of the pesticide and its container. Because state and local laws vary considerably, specific instructions are usually not included.

Storage and Disposal Statement—*No Pest*

PROHIBITIONS: Do not contaminate water, food or feed by storage or disposal. Open dumping is prohibited. Do not reuse empty container.
STORAGE: Store in original container only. Keep container closed when not in use. Store "No Pest" in a well ventilated clean dry area out of reach of children and animals.....
PESTICIDE DISPOSAL: Pesticide wastes are toxic. Improper disposal of excess pesticide, spray mixture or rinsate is a violation of federal law. ....
CONTAINER DISPOSAL: Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by other procedures approved by state and local authorities.

Acute toxicity

The hazard, or risk, of a toxic chemical is based on two things—the chemical's ability to harm and the amount of contact with it:

Risk = Toxicity x Exposure.

Acutely toxic effects—the immediate injuries from a single pesticide exposure, by any route of entry—are measured in test animals through the four routes of entry. Lethal doses are calculated statistically and expressed as an LD50 (lethal-dose-fifty) or an LC50 (lethal-concentration-fifty). The LD50 value is the amount or concentration of an active ingredient required to kill 50 percent of a test animal population.

LD50s are expressed by the ratio of the milligrams of active ingredient required for each kilogram of animal weight—or milligrams per kilogram (mg/kg). A gram is a small weight in human terms—the weight of a paper clip. A milligram is one thousandth of a gram; a very small amount—the weight of a grain of salt. A kilogram is 1,000 grams, or about 2.2 pounds.

The LD50 and LC50 values are useful in comparing the acute toxicity of different active ingredients, and different formulations that use the same active ingredient. A low LD50 (less than 50 mg/kg) indicates a highly toxic pesticide; only a small amount is required to kill 50 percent of a test population. Pesticides with high LD50 values (greater than 5,000 mg/kg) are considered the least acutely toxic to humans when used according to the label directions.

The proportion mg/kg, or one thousandth of a gram to one thousand grams, is one to one million. This provides another way of expressing toxic doses: parts per million (ppm). One part per million means that every million parts of a solution or mixture will have just one part of the active ingredient. The measures mg/kg and ppm are interchangeable. Other units used for environmental and residue measurements include parts per billion (ppb), and parts per trillion (ppt). These vanishingly small amounts are significant at times—ppb of certain chemicals can be hazardous.

1 part per million (ppm)

= 1 milligram per kilogram
= 1 ounce of salt in 62,500 pounds of sugar
= 1 inch in 16 miles
= 1 minute in 2 years

1 part per billion (ppb)

= 1 square foot in 36 square miles
= 1 inch in 16,000 miles
= 1 second in 32 years

1 part per trillion (ppt)

= 1 pinch of salt in 10,000 tons of potato chips
= 1 inch in 16,000,000 miles
= 1 second in 32,000 years

Poison symptoms

Topical effects from pesticide poisoning are a result of either a chemical irritant (active or inert ingredient), or an allergic response by the victim. Dermatitis, or inflammation of the skin, is the most commonly reported topical effect associated with pesticide exposure. Symptoms of dermatitis range

Pesticide Toxicity Classifications

Measure of Toxicity	Category I Highly Toxic	Category II Moderately Toxic	Category III Slightly Toxic	Category IV Relatively Nontoxic
Signal Word(s)/ Symbol	DANGER or DANGER/POISON w/ skull & crossbones	WARNING	CAUTION	CAUTION
Oral LD_{50} (mg/kg)	0-50	50-500	500-5,000	>5,000
Approximate oral lethal dose for a 150 lb person	A few drops to 1 teaspoon	1 teaspoon to 1 ounce	1 ounce to 1 pint or 1 pound	>1 pint or >1 pound
Dermal LD_{50} (mg/kg)	0-200	200-2,000	2,000-20,000	>20,000
Inhalation LC_{50} gas or vapor (mg/l)	0-0.2	0.2-2	2-20	>20
Effects on eyes	Corrosive for 7 days	Irritation persists for 7 days	Irritation reversible	None
Effects on skin	Corrosive	Severe irritation	Moderate irritaion	Mild irritation

from reddening of the skin to blisters or rashes. Symptoms of an allergic reaction range from reddening and itching of the eyes and skin to respiratory discomfort often resembling asthma.

The symptoms of a internal or systemic poisoning begin as fatigue, headache, giddiness, sweating, dizziness or blurred vision, cramps, nausea, vomiting, and diarrhea. Moderate symptoms include numbness, changes in heart rate, general muscle weakness, difficulty in breathing and walking, pinpoint pupils, excessive salivation, and an increase in the severity of the earlier symptoms. In advanced poisoning cases, there may be convulsions and coma which could ultimately lead to death.

Recognizing the symptoms early and making the appropriate response may save a life. Whenever symptoms appear after contact with pesticides, seek medical attention immediately. Be sure to *take the label with you*, or the container (but not in the passenger section of the vehicle). A medical professional will need to know the pesticide ingredients, and an antidote may be listed on the label.

In the event of a pesticide emergency, a single, nationwide number will connect you with the nearest Poison Center, 1-800-222-1222. The Maine Poison Center is located in Portland. The National Pesticide Information Center (NPIC) is also available for both general information and emergencies.

Maine Poison Center
Maine Medical Center
22 Bramhall Street
Portland, ME 04102
1-800-442-6305 (Maine only)
TDD/TTY: 1-877-299-4447 (Maine only)
1-207-871-2950 (administration)
Open 24/7

National Pesticide Information Center
1-800-858-7378
9:30am - 7:30pm EST
7 days a week, excluding holidays
http://npic.orst.edu/

Pesticides most often implicated in symptomatic illnesses, 2000

Pesticide or pesticide class	Reported human exposures, by age			
	Less than 6 years old	6 to 19 years old	Over 19 years old	Total
Rodenticides	16,829	661	1,790	19,280
Herbicides	2,615	906	5,551	9,072
Hypochlorite disinfectant	4,852	680	2,059	7,591
Pyrethrins	2,589	921	3,785	7,295
Organophosphates	3,224	841	3,160	7,225
Pine oil disinfectants	4,657	630	1,768	7,055
PBO + pyrethrins	2,337	814	3,160	6,311
Insect repellents	4,415	976	718	6,109
Other insecticides	2,783	306	1,110	4,199
Moth repellants	3,120	266	777	4,163
Veterianary insecticides	2,124	517	1,470	4,111
Unknown insecticides	1,042	396	2,152	3,590
Phenol disinfectants	2,078	318	676	3,072
Carbamates	1,145	272	1,290	2,707
Insecticide combinations	873	308	1,430	2,611
Borates and boric acid	2,167	116	322	2,605
Organochlorines	818	353	867	2,038
Fungicides	463	162	988	1,613
Total	58,131	9,443	33,073	100,647

Source: *American Association of Poison Control Centers, Toxic Exposure Surveillance System*, 2000 data. http://www.aapcc.org/poison1.htm

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APPENDIX B

PESTICIDE REGULATIONS AND LICENSING REQUIREMENTS

Chemical pesticide use has increased sharply during the past 35 years, not only in the United States but worldwide. Pesticides have helped control malaria and other insect-vectored diseases; they have helped increase the yield and quality of numerous crops, resulting in more food and fiber for more people; and they have helped control nuisance pests. However, the wide scale use and misuse of pesticides is of worldwide concern because of associated human health and environmental problems. In order to protect the public health and welfare and to prevent adverse effects on the environment, it is essential to regulate pesticides.

Both the United States Congress and the Maine Legislature have passed laws regulating the production, transportation, sale, use, and disposal of all pesticides. The purpose of these laws is to regulate the labeling, distribution, storage, transportation, use, and disposal of pesticides in the best public interest. Pesticides are under regulatory scrutiny from the time they are discovered until their use or disposal. With the possible exception of human and veterinary drugs, no other class of chemicals receives such extensive testing in the United States prior to being registered and marketed.

On school property, pesticides, including ant traps, weed and feed fertilizers, and rodent baits, may only be applied by state licensed commercial applicators.

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), first enacted in 1947, was amended significantly in 1972, 1975, 1978 and 1988. This statute is administered by the United States Environmental Protection Agency (EPA). Some of the major provisions of FIFRA include:

- The EPA can stop the sale or use of any hazardous pesticide.
- The EPA has the authority to issue removal orders and to seize products to keep them out of the market.
- State restrictions on pesticides cannot be more liberal than those of FIFRA. Individual states may, however, impose stricter regulations on a pesticide, although the labeling and packaging must be uniform nationwide. Uniform packaging standards include container type, size, and color. Regulations also provide for the disposal of pesticide containers and surplus of unwanted pesticides.
- The applicator is not permitted to use any pesticide for any use other than that stated on the label, except those specific exemptions granted under regulations of the amended Maine Pesticide Control Act, Maine Board of Pesticides Control Statute, and Section 2 (ee) of FIFRA.
- No pesticide can be registered or offered for sale unless its labeling provides for reasonable safeguards to prevent injury to humans and adverse effects on the environment.

Food Quality Protection Act (FQPA)

This law, passed in 1996, amends both FIFRA and Federal Food, Drug, and Cosmetic Act setting a tougher standard for pesticides used on food. FQPA establishes a single, health based standard to be used when assessing the risks of pesticide residues in food or feed. The new safety standard considers the aggregate risk from dietary exposure and other non-occupational sources of exposure, such as drinking water and residential pesticide use.

- When setting new or reassessing existing tolerances, EPA must carefully assess exposures and risks to infants and children and include additional safety factors to account for uncertainty in data.
- EPA may only establish a tolerance if there is "a reasonable certainty" that no harm will result from all combined sources of exposure to pesticides (aggregate exposures).
- FQPA also considers the combined effects of human exposure to different pesticides that may act in similar ways on the body (cumulative exposure).
- EPA must review all old pesticides to make sure that the residues allowed on food meet the new safety standard.
- FQPA requires that pesticides be tested for potential endocrine disruption.
- To better inform the public, EPA must distribute a brochure to supermarkets discussing pesticides on foods.

Maine Pesticide Control Act & Board of Pesticides Control Statute of 1975

These are companion laws to FIFRA that enable the State to administer approved pesticide certification and enforcement programs. including all aspects of pesticide-use within the state. Both have been significantly amended. Complete copies of current Maine Regulations are available from the BPC.

The Maine Pesticide Control Act of 1975 (Title 7), available at http://janus.state.me.us/legis/statutes/7/title7sec601.html, provides for the registration of pesticides so that they may be legally distributed in the state of Maine.

Registration is a tool for determining if pesticides distributed, sold, or offered for sale in Maine meet the labeling requirements. It also ensures that proper use of a product will not cause unreasonable adverse effects to the public health or the environment. Pesticide use that is inconsistent with the label is considered a violation of state law.

The primary purposes of Board of Pesticides Control Statute (Title 22), available online at http://janus.state.me.us/legis/statutes/22/title22ch258-A0sec0.html, is to create a certification and licensing system for applicators and dealers, and to ensure the safe and proper use of pesticides. Other sections of the statute empower the BPC to:

- Require record keeping;
- Cooperate with other state and federal agencies;
- Establish critical pesticide control areas for the protection of natural resources;
- Develop rules and regulations to satisfy the overall purpose of the law; and
- Establish storage regulations for dealers.

The BPC, created in 1965, consists of seven members appointed by the Governor to serve four-year terms. Members are professionally involved in agriculture, forestry, commercial pesticide application, medicine and integrated pest management. Two members, from different areas of the state, are selected to represent the public at large. The Board meets monthly to establish policies, which are carried out by the BPC staff.

Penalties and procedures

Title 7 permits the establishment of penalties for violation of federal and state regulations, or violation of municipal ordinances affecting pesticide use. There is also an appeal process defined by the statute to contest fines, revocations and suspensions.

An offense is punishable by a fine of up to $1,500 for first-time violations and $4,000 for subsequent violations within a four year period. The BPC can seek suspension or cancellation of a license when a violation is severe, or when there are repeated offenses. Grounds for this action include, but are not limited to:

- Using, distributing or storing pesticides in a faulty, careless, or negligent manner;
- Filing false or fraudulent reports;
- Violating the provisions of state or federal pesticide laws; and
- Using chemicals contrary to label directions.

In cases where there is intentional or willful violation of any pesticide law, persons may be subject to a fine up to $7,500 and/or 30 days imprisonment per offense. Considerations used by the court to set the actual penalty include:

- History of prior violations;
- Degree of environmental and/or public harm;
- Degree of damage that has not been corrected;
- The importance of deterring the violator or others;
- The foreseeability of the violation;
- The extent to which the violation continued after notification;
- The standard of care demonstrated by the violator; and
- Whether the violator reported the incident to the BPC.

Pesticide classification

General use pesticides

All pesticides are classified according to their potential hazard in specific circumstances. General use pesticides usually have lower toxicity with less potential hazard to humans and the environment than restricted use chemicals. They can be purchased without a license but application on school grounds requires a state applicator license.

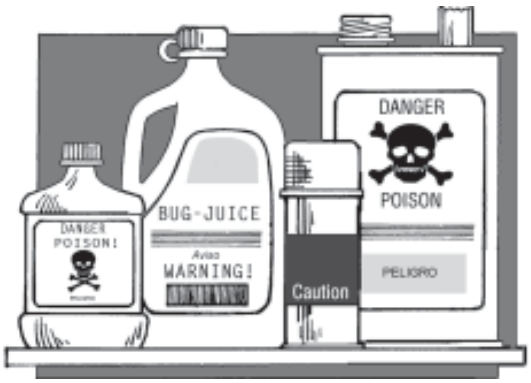
Restricted use pesticides

Restricted use pesticides may be sold only by dealers licensed by the Board, and they may be purchased and used only by applicators licensed by the Board. Federally restricted pesticides must bear the word **RESTRICTED** in bold letters on the top, front label. Maine restricted use pesticides are listed in Chapter 40 of the BPC regulations. All products restricted by the EPA are automatically restricted use pesticides in Maine. In addition, several other products are restricted within Maine; a current list is available at http://www.state.me.us/agriculture/pesticides/registration.htm.

Limited-use pesticides

Title 7 and 22 allow the BPC to restrict the use of pesticides more stringently than federal laws if they present considerable human or environmental hazards. These limited-use pesticides require a special permit issued by the BPC before purchase and use.

Limited-use pesticides may be sold only by dealers licensed by the Board. They may be purchased and used only by applicators licensed by the Board and holding a permit from the Board. A list of limited-use pesticides is available from the BPC at http://www.state.me.us/agriculture/pesticides/registration.htm.



Empty pesticide containers must be rinsed and disposed of legally and responsibly.

Certification and licensing for commercial applicators

Commercial applicators are individuals who:

- Use or supervise the use of any limited or restricted use pesticide, other than as a private applicator;
- Apply pesticides as a service for which compensation is received;
- Apply pesticides to non-agricultural sites open to public use; or
- Apply pesticides as an employee of federal, state or local government, including municipal governments, schools, universities, etc.

The Maine Board of Pesticides Control (BPC) defines two levels of commercial applicators. A commercial applicator-master certification is required for one individual in each school that applies its own pesticides. Persons who carry out applications as prescribed by others, such as grounds keepers or custodians, are certified as commercial applicator-operators. These licenses are valid only when the person is employed or supervised by a licensed master applicator.

Commercial certification

- Every commercial applicator must be either:
  1. Licensed as a commercial applicator/master;
  2. Licensed as a commercial applicator/operator; or
  3. Supervised on-site by either a licensed commercial applicator/master or a commercial applicator/operator who is physically present and directly overseeing the application. This supervision must include visual and voice contact. Visual contact must be continuous except when topography obstructs visual observation for less than five minutes. Video contact does not constitute visual observation. The voice contact requirement may be satisfied by real time radio or telephone contact.
- Each branch office of any company, agency, organization or self-employed individual ("employing entity") required to have personnel licensed commercially under state pesticide law shall have in its employment at least one master applicator. This Master must be licensed in all categories which the branch office of the company or agency performs applications and any Operators

must also be licensed in the categories in which they perform or supervise pesticide applications. This master applicator must actively supervise persons applying pesticides within such employing entity and have the ability to be on site to assist such persons within six (6) hours driving time. Whenever an out-of-state employing entity is conducting a major application project, they must have a master applicator within the state.

- Persons wishing to obtain a commercial applicator/ master license must meet certain experience and educational requirements (see BPC Regulations, Chapter 31) before taking written, closed book examinations covering general pesticide information, appropriate categories and regulations. After successful completion of the tests (with a score of 80% or better), an oral examination is conducted by the BPC staff.
- Persons wishing to obtain a commercial applicator/ operator license must be certified by passing written, closed book examinations (with a score of 80% or greater) covering general pesticide information (core material) and categories that represent each type of application to be performed or supervised.
- Tests are scheduled by the BPC after receiving a completed application form and a $10 fee for each category exam requested. Forms are available online at http://www.state.me.us/agriculture/ pesticides/forms.htm. Tests are conducted at the BPC offices in Augusta and, with special arrangements, at its Presque Isle office. A $15 surcharge will be incurred whenever a commercial level examinee fails to notify the BPC staff at least 24-hours prior to canceling a scheduled exam.
- Commercial license examinees must pass both the core and at least one category or commodity exam within one year. If an applicant passes only one of the required exams within a year, he or she must retake even those previously passed before qualifying for certification.
- Persons who unsuccessfully complete the exams may retest after 14 days. If the second attempt to pass a category exam is not successful, then the core test must be retaken, as well. A 30-day waiting period will pass before an applicant can retake exams for a third time.
- In order to maintain certification status, commercial applicators are required to accumulate 12 recertification credits over the six-year certification period. Master applicators must accumulate 18 credits in six years. Of these credits, at least three must be in a category for which they are licensed and at least one credit hour must be in environmental science, ecology or toxicology. The BPC assigns and records credit for certain pesticide applicator training sessions offered by Cooperative Extension, industry and trade organizations. The BPC may assign credit to training sessions offered in other states after receiving a detailed agenda and proof of attendance.
- Certification lapses if insufficient credits are accumulated during the five year period. Renewal requires successful completion of all exams and obtaining the balance of recertification credits required within one year. In all other cases, recertification credits expire at the end of the certification period and are not carried over to the next certification period.

Commercial licensing

- A biennial $70 application fee is required to obtain a commercial applicator license at the master or operator level.
- Each school making its own applications must have at least one licensed commercial applicator/master. This master must directly supervise all other operator-licensed employees, and must be present at all application sites when unlicensed employees apply pesticides.
- All commercial applicators must keep records of all pesticide applications.
- Commercial applicators must submit an annual summary reports to the BPC on or before January 15th. Failure to submit required reports will result in refusal to renew licenses.
- Commercial applicators may be required to report inventories of pesticides.
- Commercial applicators are allowed to apply pesticides only in their licensed categories. Summary reports reveal several applicators apply in areas they are not licensed to treat. An area of concern is weed control on sidewalks, patios, driveways or parking lots. Commercial applicators must be licensed in Category 6D (Industrial/ Commercial/Municipal Vegetation Management) to make these applications. These areas cannot legally be treated if the applicator is only licensed in Category 3A (Outdoor Ornamentals) or 3B (Turf).

Commercial Certification and Licensing Chart

License type	Where to get study materials	Types of exams	Where to take exam	Exam fees	Certification Period	License Fee	License Duration
Commercial Master	UMCE[1] sells core and category manuals	Minimum of 3 written (core, one or more categories, and regulation exams) *plus* Master's oral exam	BPC offices by prefiled exam application only	$10 each for the core and for each category exam	6 years	$70	2 year renewable 12/31
	BPC[2] regulations manual			$50 for regulation and Master's oral exams			
Commercial Operator[3]	UMCE core and category manuals	Minimum of 2 written (core and one or more category exams)	BPC offices by prefiled exam application only 207-287-2731	$10 each for the core and for each category exam	6 years	$70	2 year renewable 12/31

[1] UMCE—Univ. of Maine Cooperative Extension, Pest Management Office, 491 College Avenue, Orono, ME 04473. Phone 1-800-287-0279. Manual prices vary.

[2] BPC—Board of Pesticides Control, 28 State House Station, 333 Deering Bldg., AMHI, Augusta, ME 04333-0028. Phone 207-287-2731. Regulations study manual will be sent once complete exam application is received.

[3] A school must have a licensed Commercial Master applicator *before* Commercial Operators may be licensed.

An Act to Provide for the Return & Proper Disposal of Pesticide Containers

The purpose of the Returnable Pesticide Container Regulation is to ensure the triple rinsing, or equivalent, and proper disposal of limited and restricted use pesticide containers. An incentive is provided through a deposit system mandated by the BPC. Cardboard, fiberboard and paper containers are exempt from this program, as well as containers of less than one-half pint.

Dealers collect deposits at the time of sale. Deposits are $5 for containers less than 30 gallons, and $10 for containers 30 gallons or larger. Dealers may require additional charges for reusable containers. Stickers identifying the dealer and purchaser are attached to individual containers or unopened cases. Dealers are required to maintain records of restricted or limited use pesticide sales subject to this regulation for two years.

The BPC provides purchasers with affidavits for listing the containers subject to this regulation. When the containers are emptied and triple rinsed, the affidavits are completed and signed by the purchaser and the applicator that performed the rinse procedure. All rinsates must be added to the spray mix or applied to a labeled site.

Applicators deliver empty containers to collection sites where BPC personnel inspect and certify the proper rinsing and return of containers. Purchasers may then return affidavits to dealers for the refund of deposits.

Pesticides obtained from out-of-state sources are also subject to this regulation. In this case, the BPC supplies stickers and collects deposits.

Drift management

The Maine Drift Regulations set specific performance standards that must be met by all outdoor applicators using powered equipment (except when using granular or injection treatments). The intent of these regulations is to minimize off-target drift and other non-consenting forms of pesticide exposure. To achieve these goals, applicators must minimize all off-target drift with extra precaution taken near specifically defined sensitive areas. These areas are:

- Residential buildings and 100 feet of adjoining property;
- School buildings playgrounds, athletic fields, or others school facilities and 100 feet of adjoining property;
- Businesses, churches institutions, commercial buildings and 100 feet of adjoining property;
- Public or commercial recreational areas;
- Apiaries;
- Critical pesticide control areas designated by the BPC;
- Public wells, springs and water intake points;
- Private drinking water sources;
- Surface waters, except where totally confined to property receiving the application;
- Fresh water and coastal wetlands; and
- Pastures, cropland and gardens.

The drift regulations define standards for off-target residue in sensitive areas. Off-target residues above 20% of the residue levels on the target site are considered *prima facie* evidence of violation and, therefore, require the applicator to prove that the level of drift was unavoidable using currently available technology. Off-target drift of residues below 20% of the on-target level can also be considered a violation of Chapter 22. In this instance, the BPC must prove that the applicator did not reduce drift to the maximum extent practical. Off-target residues must not cause organic produce to exceed organic tolerances. There must be no damage to off-target crops, vegetables, or other species in adjacent sensitive areas.

The drift regulations prescribe actions that will minimize the risk of off-target drift. Weather conditions must be monitored before application begins to determine when the risk of drift is low. If conditions become unfavorable during application, or if sprays are not settling properly, spraying should be stopped. Record keeping is required and includes logging weather conditions during the application.

All applicators subject to the spray regulations are required to calibrate sprayers at regular intervals and maintain records of these procedures. All sensitive areas within 500 feet of the target area are also recorded. All records for outdoor applications must be maintained for two years and be available for BPC review, upon request.

Persons owning property within 500 feet of target areas may request general information about planned applications. If a neighbor requests information, the applicator must provide it within a week of the request. Both the school and the applicator share responsibility for notification. Applicators are encouraged to develop drift management plans that identify nearby sensitive areas and describe all methods or tactics used to minimize drift. Although

these plans are retained by applicators, notice of their existence should be filed with the BPC. When the BPC determines that alternative methods provide comparable drift reduction, they may grant requests for variances from the drift regulations.

The OSHA Hazard Communication Standard (HazCom)

The Bureau of Labor Standards (BLS), 207-287-6460, is responsible for administering and enforcing HazCom in Maine schools. Under the OSHA hazard communication standard, also known as right-to-know laws, all employees must be informed about the chemicals to which they may be exposed. In Maine, students in public educational programs must be informed about chemicals they use in their classes. In addition, schools must:

- Develop a written policy on how they comply with the law.
- Inventory and label all chemical products.
- Obtain Material Safety Data Sheets (MSDS) on all hazardous materials or products (Request pesticide suppliers to provide MSDS).
- Provide warning labels for secondary containers that hold hazardous materials.
- Provide documented training for each person who may be exposed to chemical substances, including:
  - an explanation of the written hazard communication program, chemical inventory, MSDS, secondary warning label system. Inform employees of location and provide access to these documents;
  - the physical and health hazards of the chemicals used;
  - areas or tasks where hazardous materials are present;
  - chemical inventory and methods of detecting presence or release of hazardous chemicals in work areas;
  - protective measures, including the use and limitations of personal protective equipment; and
  - emergency procedures.

The Superfund Amendments and Reauthorization Act of 1986 (SARA)

SARA Title III is commonly known as the Emergency Planning and Community Right-to-Know Act of 1986. It establishes procedures for emergency planning preparedness and reporting of specific

quantities of stored or spilled hazardous chemicals, including pesticides. It is administered by the EPA and the Maine Emergency Management Agency. Each county also has an emergency planning committee. Applicators using products that contain many commonly used active ingredients must comply with this law. The Maine BPC has manuals to help with compliance.

Current Notification Law for Non-Agricultural Applications

Notification laws establish procedures and standards for informing interested members of the public about outdoor pesticide applications in their vicinity. The regulations set forth the requirements for requesting notification about pesticide applications, for posting property on which certain commercial pesticide applications have occurred and also establishes the Maine Pesticide Notification Registry structure and fees.

Maine currently requires outdoor pesticide applicators to post areas of likely human use, to "reasonably ensure that persons entering such areas will see the notice" as outlined in Chapter 28 of the Board of Pesticides Control, Notification Provisions for Outdoor Pesticide Applications (http://www.state.me.us/agriculture/pesticides/Ch28pro0.htm).

Notification signs should be located to inform people at points of ingress and egress, in common areas and in places obvious to abuttors. The posting must be made before spraying starts, and must remain at least two days after completion of spraying.

The notification signs must alert people to the fact that pesticide spraying has occurred or is about to occur. The sign must be sturdy, weather resistant, and able to endure at least 48 hours of outdoor conditions. It must be at least 5 inches wide and 4 inches high, light-colored with dark, bold letters. The word **CAUTION** must be written in 72-point type and the words **PESTICIDE APPLICATION** must be written in 30-point type or larger. The sign must bear the BPC's designated symbol ("keep children/pets-off-the-grass" logo) as well as the name and phone number of the company making the pesticide application. The pesticide label may require other information on the warning, such as the Statement for Practical Treatment.

The bottom of the sign, when in place, must be at least 1 foot above the surface of the turf. The sign must also include the date and time of pesticide application, the phone number of the applicator, date and time to remove the sign (48 hours after application), and any re-entry precautions as listed on the label. If no re-entry precautions are on the label, you should put "Keep Off Until Dry" or "Keep Off Until Watered In" or some other appropriate warning.

Beyond these minimum requirements, it is recommend that signs be enlarged to 5-6 inches and that the information on the signs be expanded to include the common name of the pesticide used and phone number of the BPC.

In addition to the posting, owners, lessees or other legal occupants within 500 feet of an outdoor pesticide application may request prior notification. The request is made of the person responsible for management of the property. If a school receives a request from a neighbor to be certified of pending, outdoor pesticide applications, the school must inform the applicator of this request so that the applicator (a licensed staff member or contractor) may provide the required information. The person responsible for giving the information must provide the approximate date of application, the manner of application and the name, address and phone number of the applicator, who can provide additional information. This general notification must be given within one week after the request is received, and at least one day before the actual application. The notification process can be somewhat streamlined by covering all applications planned over an entire year. If the person seeking notification needs more information, a further request can be made. The person responsible for the notification must make reasonable efforts to comply with the request. If the person seeking notification is dissatisfied with the compliance, a complaint can be filed with BPC, which will then attempt to reach a fair resolution.

Front

Back

An example of a notification sign displaying the minimum content requirements for both sides. Re-entry precautions from the pesticide label may also be placed on the sign.

Notification Registry

In July of 1998 the BPC approved the Notification Registry. This establishes a list of citizens to be contacted, by both commercial applicators and neighbors, prior to their use of pesticides. For an annual fee of $20, residents will have their names and addresses distributed to licensed commercial masters. Applicators must provide pretreatment notification via telephone, personal contact or mail, between six hours and 14 days ahead of outdoor pesticide use within 250 feet of a registrant's property.

Notification enables individuals to avoid pesticide exposure by closing windows, keeping pets and children indoors, or staying clear of a sprayed area. The registry will be made available to commercial applicators statewide by March 1, 1999, and will be updated annually. For further information call the BPC. More information is available at http://www.state.me.us/agriculture/pesticides/rights.htm or from the BPC, 207-287-2731.

Record keeping

In March 1995 the Maine Board of Pesticides Control adopted changes to its record keeping and reporting rules. The new Chapter 50, Record Keeping and Reporting Requirements consolidates the record keeping and reporting requirements contained in Chapter 22 (the BPC's "drift regulations"), the 1990 Farm Bill, and the EPA Worker Protection Standard.

These regulations describe the types of records and reports that commercial applicators, commercial agricultural producers, limited/restricted use pesticide dealers, spray contracting firms and monitors must maintain and submit to the BPC.

All commercial applicators, including licensed school staff, must keep records of all pesticide applications for a minimum of two years and summary reports are required for both indoor and outdoor applications. These summary reports—previously due each quarter—are now expected only on an annual basis.

State/Federal resources

Applicator certification; licensing; recertification training; pesticide diposal; pesticide spills; and pesticide regulations:

Maine Board of Pesticides Control
28 State House Station,
Augusta, Maine 04333-0028
207-287-2731
http://www.state.me.us/agriculture/pesticides/

Pesticide transportation, disposal, and spills:

Maine Department of Environmental Protection
17 State House Station
Augusta, Maine 04333-0017
207-287-7688
800-452-1942
http://www.state.me.us/dep/index.htm

Pesticide spills; reporting pesticide inventories:

Maine Emergency Management Agency
State House Station #72
Augusta, ME 04333
207-626-4503
800-452-8735
http://www.state.me.us/mema/memahome.htm

The "worker's right-to-know" laws; the requirements of employers who work with pesticides:

Bureau of Labor Standards
45 State House Station
Augusta, Maine 04333-0045
207-624-6400
http://www.state.me.us/labor/bls/blsmain.htm

Federal pesticide regulations:

US Environmental Protection Agency, Region 1
1 Congress Street
Boston, MA 02114-2023
888-372-7341
http://www.epa.gov/region01/eco/pest/

Certification manuals; pesticide education; pest identification; pesticide recommendations; integrated pest management; pesticide applicator training:

University of Maine Cooperative Extension Pest Management Office
491 College Avenue
Orono, Maine 04473-1295
207-581-3880
800-287-0279 (in Maine)
http://www.umext.maine.edu/topics/pest.htm

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APPENDIX C

GLOSSARY

ABDOMEN - The posterior of the three main body divisions of insects.

ABSORPTION - The movement of a chemical into plants, animals (including humans), microorganisms, or soil.

ACARICIDE - A pesticide used to control mites and ticks. A miticide is a type of acaricide.

ACTION THRESHOLDS - The number of pests or level of pest damage requiring action to prevent damage from exceeding tolerable levels. Including written action thresholds in the IPM Plan presents a clear statement of intentions, before a pest event occurs. This guidance can be invaluable to those called to respond to a pest situation, and can prevent under or over-reactions to pest problems.

ACTIVE INGREDIENT - The chemical or chemicals in a pesticide responsible for killing, poisoning, or repelling the pest. Listed separately in the ingredient statement on the label.

ACUTE TOXICITY - The capacity of a pesticide to cause injury from a single exposure. LD50 and LC50 are common indicators of the degree of acute toxicity. (See Chronic Toxicity)

ADJUVANT - A substance added to a pesticide to improve its effectiveness or safety; same as additive. Examples: Penetrants, spreader-stickers, and wetting agents.

ALGAECIDE (ALGICIDE) - A pesticide used to kill or inhibit algae.

ANNUAL - A plant that completes its life cycle in one year.

ANNUAL PLANT - A plant that germinates from seed, flowers, produces seed, and dies in the same year; it has a one-year life cycle.

ANTAGONISM - The reduction of pesticide activity when two or more different pesticides are mixed together.

ANTICOAGULANT - A chemical which prevents normal blood clotting; the active ingredient in some rodenticides.

ANTIDOTE - A practical treatment used to counteract the effects of pesticide poisoning or some other poison in the body.

ANTI-MICROBIAL PESTICIDE - A pesticide used for control of microbial pests including viruses, bacteria, algae and protozoa or the purpose of disinfecting or sanitizing. Anti-microbials do not include fungicides used on plants.

APPLICATION RATE - the amount of a pesticide product or active ingredient applied to a unit area, such as liters per square meter.

ARACHNID - A wingless arthropod with two body regions and four pairs of jointed legs. Spiders, ticks, and mites are arachnids.

ARTHROPOD - An invertebrate animal characterized by a jointed body and limbs and usually a hard body covering that is molted at intervals. Insects, mites, and crayfish are arthropods.

ATTRACTANT - A substance or device to lure insects or other pests to a trap or poison bait.

AVICIDE - A chemical used to kill or repel birds.

BACTERICIDE - Chemical used to control bacteria.

BAT PROOFING - See Pest proofing.

BENEFICIAL INSECT - An insect that is useful or helpful to humans. Examples are pollinators and parasites and predators of pests.

BIENNIAL - A plant that completes its life cycle in two years.

BIOLOGICAL CONTROL - The use of beneficial species, such as predatory and parasitic insects, birds, nematodes, or disease organisms to suppress populations of pests. May be naturally occurring or introduced.

BIOMAGNIFICATION - The process where some organisms accumulate chemical residues in higher concentrations than those found in the organisms they consume.

BOTANICAL PESTICIDE - A pesticide produced from chemicals found in plants. Examples are nicotine, pyrethrum, and strychnine.

BRAND NAME - The name, number, or designation of a specific pesticide product or device made by a manufacturer or formulator.

BROADCAST APPLICATION - An even application of a pesticide over an entire area, as opposed to treating part of the area or only individual plants in the area.

BROADLEAF PLANTS - Plants with broad, rounded, or flattened leaves with netted veins (examples: dandelion and rose). Different from the narrow blade-like leaves with parallel veins of grasses, sedges, rushes, and onions.

BROAD SPECTRUM PESTICIDE - A pesticide that is effective against a wide range of organisms in addition to the target pests. The opposite of a selective pesticide.

BUFFER ZONE - A strip of land between a pesticide free zone and the pesticide treatment area. Pesticides are not applied in the buffer zone; the width of the buffer zone is to ensure that no pesticides or pesticide residues reach the pesticide free zone, either by drifting in the air or moving with surface or ground water.

CARBAMATES - A group of pesticides containing nitrogen, formulated as insecticides (Sevin, Furadan, Lannate), fungicides (Mancozeb, Maneb), and herbicides (IPC, CIPC).

CARCINOGENIC - The ability of a substance or agent to induce malignant tumors (cancer).

CHEMICAL NAME - The scientific name of the active ingredient(s) found in the formulated product. This complex name is derived from the chemical structure of the active ingredient.

CHLORINATED HYDROCARBON - A pesticide containing chlorine, carbon, and hydrogen. Many are persistent in the environment. Examples: Chlordane, DDT, methoxychlor.

CHOLINESTERASE - A chemical catalyst (enzyme) found in animals that reduces the activity of nerve impulses.

CHRONIC TOXICITY - The ability of a material to cause injury from repeated, prolonged exposure to small amounts. (See Acute Toxicity)

COMMON NAME - A name given to a pesticide active ingredient by a recognized committee on pesticide nomenclature. Many pesticides are known by a number of trade or brand names but the active ingredient(s) has only one recognized common name. Example: The common name for Sevin insecticide is carbaryl.

CONTACT PESTICIDE - A compound that causes the death of an organism when it comes in contact with it; the pesticide does not need to be eaten or inhaled by the organism to be effective.

CORROSIVE POISON - A poison containing a strong acid or base which will severely burn the skin, mouth, stomach, etc.

DECIDUOUS PLANTS - Plants that lose their leaves in the fall and have bare branches in the winter.

DEFOLTANT - A chemical that initiates the premature drop of leaves.

DEGRADATION - The process by which a chemical compound is broken down to a simpler compound by the action of microorganisms, water, air, sunlight, or other agents. Degradation products are usually, but not always, less toxic than the original compound.

DEPOSIT - The amount of pesticide on the treated surface after application.

DERMAL TOXICITY - The ability of a pesticide to cause injury to a human or animal when absorbed through the skin.

DESICCANT - A chemical that promotes drying or loss of moisture from a leaf or plant part.

DICOT - A plant with two seed leaves (cotyledons); a broadleaf.

DISINFECTANT - A chemical or other agent that kills or inactivates disease-producing microorganisms in animals, seeds, or other plant parts. Also, commonly refers to chemicals used to clean or surface-sterilize inanimate objects.

DORMANT SPRAY - A pesticide application made in late winter or in early spring prior to the resumption of active growth by plants.

DORMANT/DORMANCY - The seasonal halt to visible plant growth, usually for the winter season.

DOSE, DOSAGE - Quantity of pesticide applied to a given area or target.

DRIFT - The airborne movement of a pesticide spray or dust beyond the intended contact area.

DUST - A finely ground, dry pesticide formulation containing a small amount of active ingredient and a large amount of inert carrier or diluent such as clay or talc.

EMULSIFIABLE CONCENTRATE - A pesticide formulation produced by dissolving the active ingredient and an emulsifying agent in a suitable solvent. When added to water, a milky emulsion is formed.

ENCAPSULATED PESTICIDE - A pesticide formulation with the active ingredient enclosed in capsules of polyvinyl or other synthetic materials; principally used for slow release.

ENVIRONMENTAL PROTECTION AGENCY (EPA) - The federal agency responsible for implementing pesticide rules and regulations, and registering pesticides.

EPA ESTABLISHMENT NUMBER - A number assigned to each pesticide production plant by EPA. The number indicates the plant at which the pesticide product was produced and must appear on all labels of that product.

EPA REGISTRATION NUMBER - A number assigned to a pesticide product by EPA when the product is registered by the manufacturer, or the designated agent. The number must appear on all labels for a particular product.

EXPOSURE - With respect to pesticides, this is when someone comes in contact with a pesticide, through the skin, by mouth or by breathing it in.

FETOTOXIC - The ability of a substance to cause harm to a developing fetus but not necessarily cause deformities. (See Teratogenic).

FIFRA - The Federal Insecticide, Fungicide, and Rodenticide Act; a federal law dealing with pesticide regulations and use.

FLOWABLE - A pesticide formulation in which a very finely ground solid particle is suspended (not dissolved) in a liquid carrier.

FORMULATION - The pesticide product as purchased, containing a mixture of one or more active ingredients, carriers (inert ingredients), and other additives diluted for safety and ease of application.

FRASS - The combined feces, shed skins, and particles of food left by an insect pest; or the combined feces and wood fragments left by a wood-boring insect.

FUMIGANT - A pesticide that forms gases that are toxic to plants and animals when absorbed or inhaled.

FUNGI - A group of often microscopic organisms lacking chlorophyll (green coloring); they grow from microscopic spores. Many fungi cause plant diseases, such as rots, rusts, mildews and blights; some species of fungi attack wood or cause decay in buildings. (Singular: fungus).

FUNGICIDE - A chemical used to control fungi.

FUNGISTATIC AGENT - A chemical that prevents the germination of fungus spores or the growth of mycelium, but does not kill the fungus.

GENERAL USE PESTICIDE - A pesticide that can be purchased and used by the general public. (See Restricted Use Pesticide).

GERMINATION - Refers to the sprouting of a seed or the production of a germ tube (mycelium) from a fungal spore.

GRANULAR PESTICIDES - A pesticide incorporated into tiny beads of clay or other materials to make relatively coarse particles; they are applied dry using a spreader, seeder or special applicator.

GROUNDWATER - Water sources located beneath the soil surface from which well water is obtained or surface springs are formed.

GROWTH REGULATOR - A chemical that alters the growth processes of a plant or animal.

GRUB - The larval stage of some beetles.

HABITAT MODIFICATION - The process by which the food, water, harborage, and entry points that attract and sustain pest populations are eliminated.

HARBORAGE - Shelter or refuge; the hiding places or protected areas, such as cracks and crevices, that cockroaches or other pests inhabit.

HERBACEOUS PLANTS - Plants that do not develop woody tissues.

HERBICIDE - A pesticide used to kill or inhibit plant growth.

HONEYDEW - A sweet liquid discharged by certain homopterous insects including aphids.

HOST - with respect to pests, hosts are the living organisms that a pest or parasite depends upon for survival.

HUMUS - Highly decomposed plant and animal matter that makes up good soil.

INERT INGREDIENT - An inactive material in a pesticide formulation that does not have pesticidal activity.

INGREDIENT STATEMENT - The portion of the label on a pesticide container that gives the name and amount of each active ingredient and the total amount of inert ingredients in the formulation.

INHALATION TOXICITY - The property of a pesticide to be poisonous to humans or animals when breathed in through the lungs.

INOCULUM - That portion of the pathogen that can cause disease in a host.

INSECT GROWTH REGULATOR IGR - A chemical that controls insects by interfering with insect hormones, usually affecting the insect's ability to develop from pupa to adult, or to reproduce.

INSECTICIDE - A pesticide used to kill or repel insects.

INSECTS - Arthropods characterized by a body composed of three segments and three pairs of legs.

INTEGRATED PEST MANAGEMENT - A decision making process for managing pest populations that uses a combination of techniques. IPM includes prevention, accurate identification, monitoring, injury thresholds, a combination of controls (physical, mechanical, biological, and chemical), and evaluation.

INVASIVE PLANT - Aggressive, usually non-native plants that can rapidly expand and replace native plant species. They may alter the structure and function of habitats making them less suitable to native plants and animals.

IPM COMMITTEE - This group addresses pest management issues on an ongoing basis. The committee should include representation from all segments of the school community, including administration, staff and parents. The role of the committee is to formulate IPM policy and plans and provide oversight and ongoing decision - making, incorporating input from all interested parties.

IPM COORDINATOR - The school employee responsible for day-to-day interpretation of the IPM policy for a school or school system. The IPM Coordinator may or may not be a pest management professional, but is the decision - maker who receives specialized training in IPM, accesses the advice of professionals and chooses a course of action. For example, the IPM Coordinator may be the facilities manager or environmental manager. For schools with an in-house professional pest management program, the IPM Coordinator may also be the Pest Manager.

IPM PLAN - A written document including specific information regarding the operation of the school's IPM program, such as IPM roles for all school staff, parents, students and other community members; pesticide application notification policies; list of key pests; action thresholds, a risk-based hierarchy of control options and prevention/ avoidance strategies to be used for key pests; inspection schedules for school facilities; policies for working with outside contractors; lists of resources for resolving technical questions; and other pertinent information. The IPM Plan provides an excellent tool for training new personnel including during management transitions. The Plan is a living document, updated frequently with new information as it becomes available. IPM Plans are often developed in binder format, so that information can be easily added and updated.

IPM POLICY - A written document stating a school's commitment to IPM and defining overall IPM goals. This document is updated periodically, and used to guide decision-making as the IPM program is implemented.

LABEL - All printed material attached to or part of a pesticide container.

LABELING - Supplemental pesticide information that complements the information on the label, but which is not necessarily attached to or part of the container.

LARVA - The immature, second life stage of an insect; a larva hatches from an egg; most are worm-like, such as caterpillars, maggots and grubs. Many pest insects cause the most damage in the larval stage, particularly those that eat plants. (Plural: larvae).

LARVACIDE - An insecticide that controls the larval stage.

LC50 - The concentration of a pesticide, usually in air or water, which can kill 50 percent of a test population of animals. LC50 is usually expressed in parts per million (ppm)—the lower the LC50 value, the more acutely toxic the chemical.

LD50 - The dose or amount of a pesticide that can kill 50 percent of the test animals when eaten or absorbed through the skin. LD50 is expressed in milligrams of chemical per kilogram of body weight of the test animal (mg/kg). The lower the LD50, the more acutely toxic the chemical.

LEACHING - The movement of a substance through soil with water.

LEAST-TOXIC - Refers to pest management products and techniques that have one or more of the following characteristics: have low or no acute or chronic toxicity to humans; are formulated to be applied in a manner that limits or eliminates exposure of humans and other nontarget organisms.

LOGBOOK - A permanent record book, usually a loose-leaf, that is the centerpiece of IPM operations. The logbook contains general information, notes on pest activity, monitoring data, IPM service reports, pesticide labels, MSDSs, and other information about the IPM program.

MAGGOT - the larval stage of flies and midges (Order Diptera). Maggots are legless.

MANAGEMENT UNIT - Dividing landscapes into management units permits more accurate response to site-specific conditions. For example, it is often a good idea to divide school lawns into front and back lawn management units. Front lawn and back lawns may have different soil types, shading, slopes, etc. By sampling and testing soil from those areas separately, test results and fertilization will be more precise and give better results. Pest monitoring can also be conducted separately and action thresholds set higher for front lawns because appearance is more critical than for less visible back lawns. In school buildings, pool and locker room areas, food preparation and service

areas, and boiler rooms are examples of specific management units.

MATERIAL SAFETY DATA SHEET (MSDS) - an informational form, required by the Occupational Safety and Health Administration, and provided by the manufacturer or distributor of a hazardous material. The MSDS provides detailed technical and safety information on use of and exposure to the chemical product.

METABOLITE - In the case of pesticides, a compound derived from changes in the active ingredient through chemical, biological, or physical reactions. The metabolite may be simpler or more complex and may or may not be more poisonous than the original chemical.

METAMORPHOSIS - A change in the shape, size, and/or form of an animal.

MICROBIAL DEGRADATION - Breakdown of a chemical by microorganisms.

MICROBIAL PESTICIDE - Bacteria, viruses, fungi, and other microorganisms used to control pests. Also called biorationals.

MICROCLIMATE - The local, rather uniform climate of a specific place or habitat, compared with the climate of the entire area.

MICROORGANISM - An organism that is so small it cannot be seen without the aid of a microscope.

MITE - A small arthropod similar to an insect but with eight legs. Its body is divided into two parts and has no antennae.

MITICIDE - A pesticide used to control mites; synonymous with acaricide.

MODE OF ACTION - the way a pesticide works to kill pests. For example, a poison that works on contact or as a stomach poison.

MODE OF ACTION - The way in which a pesticide exerts a toxic effect on the target plant or animal.

MOLLUSCICIDE - A pesticide used to control snails and slugs (molluscs).

MONITORING - A systematic pest inspection that is conducted at regular intervals to determine the numbers of a pest, the amount of damage caused by a pest, the effectiveness of treatment methods, and to evaluate other factors related to an IPM program.

MONOCOT - A plant with a single seed leaf (cotyledon); grassy plants.

MSDS - Material safety data sheet; technical documents meant to supplement the information on the label; they provide detailed hazard, precautionary, and emergency information for a pesticide product.

MUTAGENIC - The ability of a substance or agent to cause genetic changes in living cells.

MYCELIUM - The mass of filaments that forms the body of a fungus.

MYCOPLASMA - A microorganism possessing many virus-like properties. Some cause plant diseases.

NECROSIS - Death of plant or animal tissues that results in the formation of discolored, sunken, or necrotic (dead) areas.

NEMATICIDE - A pesticide used to control nematodes.

NEMATODES - A group of elongated, cylindrical worms, often microscopic, also called thread-worms or eel-worms. Some species attack roots or leaves of plants, others are parasites on animals or insects.

NEUROTOXIC - The ability of a substance or agent to cause disorders of the nervous system.

NOCTURNAL - Active at night.

NONCHEMICAL CONTROLS - Pest control measures that do not use pesticides or other chemicals, but employ instead sanitation, pestproofing, trapping, structural alterations, and other nontoxic methods.

NONPERSISTENT PESTICIDE - A pesticide that breaks down soon after application into non-toxic compounds.

NONSELECTIVE PESTICIDE - A product that kills or controls a wide range of organisms or related organisms; for example, a non-selective herbicide can kill or damage all plants it contacts.

NONTARGET ORGANISM - Any plant or animal other than the intended target(s) of a pesticide application.

NOXIOUS WEED - A plant defined by law as being particularly troublesome, undesirable, and difficult to control.

NYMPH - The immature stage of an insect that passes through three stages (egg, nymph, and adult) in its development.

ONCOGENIC - The property to produce tumors (not necessarily cancerous) in living tissues. (See Carcinogenic.)

ORAL TOXICITY - Ability of a pesticide to cause injury when taken by mouth.

ORGANOPHOSPHATES - A large group of pesticides that contain the element phosphorus. Most are nonpersistent insecticides/miticides. Many are highly toxic. Examples: Malathion, parathion, diazinon.

OVICIDE - A material that destroys eggs.

PARASITE - An organism that lives in or on the body of another organism and obtains nourishment from it.

PATHOGEN - A living microorganism, usually a bacterium, fungus, mycoplasm or virus, that can cause disease when a host is present under the right environmental conditions.

PENETRANT-An adjuvant added to a spray mixture to enhance the absorption of a pesticide.

PERENNIAL - A plant that continues to live from year to year. The tops may die back in winter or in drought, but the roots or rhizomes persist to resume growing in favorable conditions.

PERSISTENT PESTICIDE - A pesticide chemical (or its metabolites) that remains active in the environment more than one growing season. These compounds sometimes accumulate in animal and plant tissues. Examples: DDT, chlordane, dieldrin.

PEST - A term applied to an organism (e.g., insect, mite, disease, nematode, weed, vertebrate, microbe) when it causes a problem to humans. A pest in one environment can be very beneficial in another, e.g., many plants considered weeds when found in lawns can be essential to the restoration of wild landscapes after a disturbance such as flood or fire.

PEST CONTROL OPERATOR (PCO) - Any licensed operator who is in the business of providing the service of controlling pests.

PEST MANAGEMENT ROLES - The responsibilities assumed by individuals in the school system to maintain an environment free of interference from pest and pesticide risks.

PEST MANAGER - The individual who conducts actions and/or directs others to maintain effective pest management at a site. The Pest Manager receives specialized pest management and IPM training, and is licensed and certified to apply pesticides in schools. The Pest Manager may be a school employee or a professional Pest Manager contracting with the school. For schools with an in - house professional pest management program, the IPM Coordinator may also be the Pest Manager.

PESTICIDE - A chemical or other agent used to kill or otherwise control pests, or to protect from a pest.

PEST PROOFING - A non-chemical, physical control measure to prevent the entry or movement of pests into or out of a structure or area. Includes sealing and caulking of crevices and holes, installation of screens, etc.

PESTS - Living organisms, such as insects, weeds, fungi, rodents, and others, that cause damage, irritation or are otherwise troublesome or harmful.

pH - A measure of the acidity/alkalinity of a liquid; acid below pH7, basic or alkaline above pH7.

PHEROMONE - A chemical substance produced by an animal which acts as a stimulus to individuals of the same species for one or more behavioral responses.

PHOTODEGRADATION - Breakdown of chemicals by the action of sunlight.

PHYTOTOXICITY - Injury to plants.

PISCICIDE - A chemical used to control pest fish.

POINT OF RUNOFF - When a spray starts to run or drip from the leaves and stems of plants or the hair or feathers of animals.

POISON CENTER - An agency, generally a hospital, which has current information as to the proper first aid techniques and antidotes for poisoning emergencies. In Maine, dial 1-800-442-6305.

POSTEMERGENCE - After the weed or crop plants have appeared through the soil. Usually used to specify the timing of herbicide applications.

PPM - Parts per million. A means to express amounts of chemicals in or on food, plants, animals, water, soil, or air. One part per million equals 1 pound in 500 tons. PPB is parts per billion.

PREDATOR - A living organism that preys upon another animal. Many birds are predators of insects; many species of insects and mites prey upon other insects.

PREEMERGENCE - Before the weed or crop plants have appeared through the soil. Usually used to specify the timing of herbicide applications.

PROTECTANT - A pesticide applied to a plant or animal prior to infection or attack by the pest in order to prevent infection or injury by the pest.

PROTECTIVE EQUIPMENT - Equipment intended to protect a person from exposure during the handling and application of pesticides. Includes long-sleeved shirts and long trousers, coveralls, suitable hats, gloves, shoes, respirators, and other safety items as needed.

PUPA - the stage between the larva stage and the adult in insects that undergo complete metamorphosis; a non - feeding and usually an inactive stage. (Plural: pupae)

RATE OF APPLICATTON - The amount of pesticide applied to a plant, animal, unit area, or surface; usually measured as per acre, per 1,000 square feet, per linear feet, or per cubic feet.

RAT PROOFING - See pest proofing.

REGISTERED PESTICIDES - Pesticide products that have been registered by the Environmental Protection Agency for the uses listed on the label.

REPELLENT - A compound that keeps insects, rodents, birds, or other pests away from plants, domestic animals, buildings, or other treated areas.

RESIDUAL PESTICIDE - A pesticide that continues to remain effective on a treated surface or area for an extended period following application.

RESIDUE - The pesticide active ingredient or its breakdown product(s) which remains in or on the target after treatment.

RESISTANT - A population of organisms that are uninjured or unaffected by a certain dosage of pesticide chemical used to control other populations of the same organism successfully. Also, plants and animals that are unaffected by a pest species.

RESPIRATOR - A device worn over the nose and mouth to prevent the wearer from inhaling harmful substances.

RESTRICTED USE PESTICIDE - A pesticide that can be purchased only by certified pesticide applicators and used only by certified applicators or persons directly under their supervision. Not available for use by the general public because of the high toxicities and/or environmental hazards.

RODENTICIDE - A pesticide used to control rats, mice or other rodents.

RUNOFF - The movement of water and associated materials on the soil surface.

SANITATION - The use of measures to promote cleanliness and healthy surroundings. The steps taken to remove the source of a pest's food or harborage sites.

SAPROPHYTE - An organism that obtains its food from dead or decaying organic matter.

SCOUTING (MONITORING, INSPECTION) - Planned, regular monitoring of a crop, ornamental planting, landscape or structure for the purpose of detecting pests, pest damage or conditions conducive to pests or pest damage.

SECONDARY PEST - A pest, other than the main pest, which normally causes little damage or concern, but which may become a primary pest if conditions change.

SELECTIVE PESTICIDE - A pesticide that is toxic to some pests, but has little or no effect on other similar species. For example, a selective herbicide may kill broad leafed weeds in a lawn, without injuring the grass plants.

SENSITIVE SITE - a place such as a school or hospital where pesticides could cause great harm if not used with special caution.

SIGNAL WORDS - Required word(s) which appear on every pesticide label to denote the relative toxicity of the product. The signal words are either DANGER POISON used with a skull and crossbones symbol for highly toxic compounds, DANGER for skin and eye irritants, WARNING for moderately toxic, or CAUTION for slightly toxic compounds.

SILVICIDE - A herbicide used to destroy brush and trees such as in wooded areas.

SOLUBLE POWDER - A finely ground, dry pesticide formulation that will dissolve in water or some other liquid carrier.

SOLUTION - Mixture of one or more substances in another substance (usually a liquid) in which all the ingredients are completely dissolved. Example: Sugar in water.

SOLVENT - A liquid such as water, oil, or alcohol which will dissolve another substance (solid, liquid, or gas) to form a solution.

SPORE - The reproductive unit of a fungus. A spore is analogous to a plant seed.

SPOT TREATMENT - Pesticide application to small areas.

STATE LEAD AGENCY (SLA) - Agency within a particular state that is responsible for administering the FIFRA laws within that state. The SLA in Maine is the Board of Pesticides Control.

STERILANT - A non-selective chemical that kills any organisms; soil sterilant pesticides stop the germination of seeds and growth of plants, usually for long periods of time after application.

STOMACH POISON - A pesticide that must be eaten by an animal in order to be effective; it will not kill on contact.

SUMMER ANNUAL - Plants that germinate in the spring or summer, completing their life cycle within one year.

SURFACTANT - A component of many adjuvants that improves the spreading, dispersing, and/or wetting properties of a pesticide mixture.

SUSPENSION - A pesticide mixture consisting of fine particles dispersed or floating in a liquid, usually water or oil. Example: Wettable powders in water.

SYSTEMIC - A chemical that is absorbed and translocated within a plant or animal.

TAMPER-RESISTANT BAIT STATION - A holder for toxic bait used in rodent control that will provide the least amount of risk to children, pets, and other animals. As defined by EPA, the bait station must be durable, lockable, have warning labels, and must be anchored to keep it in place.

TECHNICAL MATERIAL - The pesticide active ingredient in pure form, as it is manufactured by a chemical company. It is combined with inert ingredients or additives in formulations such as wettable powders, dusts, emulsifiable concentrates, or granules.

TERATOGENIC - The property of a substance, or agent, able to produce abnormalities or defects in living human or animal embryos and fetuses. These defects are not usually inheritable.

TERMITICIDE - An insecticide used to control termites.

THATCH - In lawns, this is a layer of dead plant material at the roots of the grasses; a certain amount is beneficial in protecting roots from heat, cold and drought, whereas a thick layer smothers roots and blocks fertilizer and water from reaching the soil.

TOLERANCE - A regulation that establishes the maximum amount of pesticide residue (active ingredient or certain metabolites) that may legally remain in or on a raw agricultural commodity (food or feed product) at harvest or slaughter.

TOXIC - Poisonous to living organisms.

TOXICANT - A poisonous substance such as the active ingredient in a pesticide formulation.

TOXICITY - The degree to which a substance is poisonous or injurious to a plant or animal. Toxicity is one consideration in assessing the hazard in handling a particular pesticide.

TRANSECT - Transects are randomly chosen lines crossing the turf. By walking a series of transects and taking observations at uniformly paced intervals, the average percentage weed growth and bare ground can be accurately measured.

TRANSLOCATION - The movement of materials within a plant or animal from the site of entry. A systemic pesticide is translocated.

VECTOR - An animal (insect, nematode, mite) or plant (dodder) that can carry and transmit a pathogen from one host to another.

VERTEBRATE - Animal characterized by a segmented backbone or spinal column.

VIRUS - Ultramicroscopic parasites composed of proteins. Viruses can only multiply in living tissues and cause many animal and plant diseases.

VOLATILITY - The ability of a pesticide to vaporize (turn into a gas) when exposed to air.

WATER DISPERSIBLE GRANULE - A dry, granular pesticide formulation that forms a suspension in water.

WATER TABLE - The upper level of the water saturated zone in the ground.

WEED - An unwanted plant.

WETTABLE POWDER - A dry pesticide formulation in powder form that forms a suspension when added to water.

WETTING AGENT - An adjuvant used to reduce the surface tension between a liquid and contact surface for more thorough coverage.

WINTER ANNUAL - Plants that germinate in the fall and complete their life cycle within one year.

School IPM Resources

Phone Contacts

Location	Contact	Resource Area	Phone Number
University of Maine	Jim Dill	IPM Coordinator	1-800 287-0279
University of Maine	Clay Kirby	Insect Specialist	1-800 287-0279
University of Maine	Bruce Watt	Plant Disease Specialist	1 800 287-0279
University of Maine	Lois Stack	Horticulturist	1-800 870-7270
University of Maine	Soil Test Lab	1-207 581-2945	
University of Maine	Don Barry	Structural Pests	1-800 287 0279
A&L Agricultural Labs		Soil Test Lab	1 804 743-9401
Department of Agriculture	Kathy Murray	School IPM	1 207 287-7616
Board of Pesticides Control	Gary Fish	Licensing & Training	1 207 287-2731
UNH	Stan Swier	Turf Insects	1 603 862-1733
UNH	John Roberts	Turf General	1 603 862-3200
U-Mass	Pat Vittum	Turf Insects	1 413 545-0268
U-Mass	Mary Owen	Turf IPM	1 508 892-0382
URI	Noel Jackson	Turf Disease	1 401 792-2932

On The Web

Resource	URL
School IPM Web Site	http://www.thinkfirstspraylast.org/schoolipm
Board of Pesticides Control	http://www.thinkfirstspraylast.org
UMCE Pest Management Office	http://www.umext.maine.edu/topics/pest.htm
Univ of Minnesota Sustainable Lawn Care Information Series	http://www.sustland.umn.edu/maint/maint.htm
Center for Urban Ecology and Sustainability - Low Input Lawn Care	http://www.extension.umn.edu/distribution/horticulture/DG7552.html
Brooklyn Botanic Garden - Easy Lawns: Low Maintenance Native Grasses	http://www.bbg.org/gar2/topics/sustainable/handbooks/lawns/index.html
Univ of Minnesota - Thatch Control in Lawns & Turf	http://www.extension.umn.edu/distribution/horticulture/DG1123.html
Lawn Care Practices to Reduce the Need for Fertilizers and Pesticides	http://www.extension.umn.edu/distribution/horticulture/DG5890.html
Univ of Massachusetts Agroecology Program	http://www.umass.edu/umext/programs/agro/
Guelph Turfgrass Institute Links Page	http://www.uoguelph.ca/GTI/linkfram.htm
The Ultimate Turfgrass Links Page -UTLP	http://www.msu.edu/user/karcherd/turflinks/
The Pest Web	http://www.pestweb.com
Purdue University Urban IPM Site	http://www.ipm.uiuc.edu/urban/
National IPM Network Search Engine	http://search.ipm.iastate.edu/
The IPM Institute	http://www.ipminstitute.org

Pesticide Applicator Training Manuals	Topics Covered
Turfgrass Pest Management	Athletic Fields, Lawns
Outdoor Ornamental Pest Management	Trees, Shrubs, Flowers
Industrial, Institutional, Structural, and General Pest Control	Mice. Rats, Bees, Wasps
Industrial, Commercial, Municipal Vegetation Management	Weeds on sidewalks, driveways, fence rows

These manuals are all available through the UMaine Pest Management Office, 1-800 287-0279

University of Maine Cooperative Extension
County Offices

Androscoggin and Sagadahoc
24 Main St.
Lisbon Falls, ME 04252-1507
(207) 353-5550
1-800-287-1458 (in Maine)
FAX: 1-800-924-7508
e-mail: andsag@umext.maine.edu

Aroostook
22 Hall St., Suite 101
Fort Kent, ME 04743-7131
(207) 834-3905
1-800-287-1421 (in Maine)
FAX: (207) 834-3906
e-mail: cesnas@umext.maine.edu

Houlton Road
PO Box 727
Presque Isle, ME 04769-0727
(207) 764-3361
1-800-287-1462 (in Maine)
FAX: (207) 764-3362
e-mail: cescas@umext.maine.edu

Central Building
PO Box 8
Houlton, ME 04730-0008
(207) 532-6548
1-800-287-1469 (in Maine)
FAX: (207) 532-6549
e-mail: cessas@umext.maine.edu

Cumberland
PO Box 9300
15 Chamberlain Ave.
Portland, ME 04104-9300
(207) 780-4205
1-800-287-1471 (in Maine)
FAX: (207) 780-4382
e-mail: cescmb@umext.maine.edu

Franklin
147 Farmington Falls Road, #2
Farmington, ME 04938-6403
(207) 778-4650
1-800-287-1478 (in Maine)
FAX: 1-800-287-1478
e-mail: cesfrk@umext.maine.edu

Hancock
63 Boggy Brook Road
Ellsworth, ME 04605-9540
(207) 667-8212
1-800-287-1479 (in Maine)
FAX: (207) 667-2003
e-mail: ceshnk@umext.maine.edu

Kennebec
125 State St., 3rd Floor
Augusta, ME 04330-5692
(207) 622-7546
1-800-287-1481 (in Maine)
FAX: (207) 621-4919
e-mail: cesken@umext.maine.edu

Knox and Lincoln
235 Jefferson St.
PO Box 309
Waldoboro, ME 04572-0309
(207) 832-0343
1-800-244-2104 (in Maine)
FAX: (207) 832-0377
e-mail: ceskl@umext.maine.edu

Oxford
9 Olson Rd.
South Paris, ME 04281-6402
(207) 743-6329
1-800-287-1482 (in Maine)
FAX: (207) 743-0373
e-mail:cesoxf@umext.maine.edu

Penobscot
307 Maine Ave.
Bangor, ME 04401-4331
(207) 942-7396
1-800-287-1485 (in Maine)
FAX: (207) 942-7537
e-mail: cespen@umext.maine.edu

Piscataquis
Court House Complex, 59 E. Main St.
Dover-Foxcroft, ME
04426-1396
(207) 564-3301
1-800-287-1491
FAX: 1-800-287-1491 (in Maine
e-mail:cespsq@umext.maine.edu

Somerset
7 County Drive,
Skowhegan, ME 04976-4209
(207) 474-9622
1-800-287-1495 (in Maine)
FAX: (207) 474-0374
e-mail: cessom@umext.maine.edu

Waldo
992 Waterville Road
Waldo, ME 04915-3117
(207) 342-5971
1-800-287-1426 (in Maine)
FAX: 1-800-924-4909
e-mail:ceswal@umext.maine.edu

Washington
HC71 Box 640
Machias, ME 04654-1017
(207) 255-3345
1-800-287-1542 (in Maine)
FAX: (207) 355-6118
e-mail:ceswsh@umext.maine.edu

York
41 Shaw's Ridge Road
Sanford, ME 04073-9502
(207) 324-2814
1-800-287-1535 (in Maine)
FAX: (207) 324-0817
e-mail:cesyrk@umext.maine.edu

Administrative Offices
UMCE
5741 Libby Hall
Orono, ME 04469-5741
(207) 581-3188
1-800-287-0274 (in Maine)
TDD: 1-800-287-8957 (in Maine)
FAX: (207) 581-1387

In case of suspected pesticide poisoning, get prompt medical attention!

MAINE POISON CENTER **1-800-442-6305**

Board of Pesticides Control	**207-287-2731**
Maine School IPM Program	**207-287-2731**
Pest Management Office	**1-800-287-0279**

AMBULANCE .....

HOSPITAL .....

DOCTOR .....

FIRE DEPARTMENT .....

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For information on pesticide products, health and environmental effects, safety, and clean-up and disposal procedures, 9:30am-7:30pm EST, except holidays:

National Pesticide Information Center 1-800-858-7378