

How to Do... IPM at School A How to Manual for New Jersey Schools



**New Jersey Department of
Environmental Protection
Pesticide Control Program**



**For School District Superintendents and Local School
Boards
Principals / Lead Administrators
And
IPM Coordinators**

New Jersey's Education Profile

PUBLIC SCHOOLS

Approximately 1.4 million students are enrolled in New Jersey public schools.

Number of full-time classroom teachers: 109,832

Number of districts: 616

Operating: 593 (those that have operating schools)

Non-operating: 23 (those that have a board of education but send their students to another district)

Number of public schools: 2413

There will be 49 operating charter schools in 2004-05.

NONPUBLIC SCHOOLS

Approximately 211,891 students attend nonpublic schools

Number of Non-public Schools: 1227

TOTAL SCHOOLS

At the time of development for this IPM manual, there were 3689 schools in New Jersey.

Each of those schools are filled with our children and our teachers and the support staff that assist our children through the school process.

That's a lot of reasons to reduce chemical use in and around schools.

IPM is a good place to begin.

Please allow the New Jersey Department of Environmental Protection to assist you.

Contact: Tim Boyle (609) 984-6908 tim.boyle@dep.state.nj.us

ACKNOWLEDGEMENTS:

This manual was developed with materials taken in whole or in part from various other publications both from the public domain (Internet) or with the permission of the authors. Special thanks to

- ▶ United States Environmental Protection Agency, IPM for Schools: A How-to Manual. EPA 909-B-97-001. March 1997.
- ▶ Pennsylvania IPM program, Large portions of text were borrowed directly from IPM for Pennsylvania Schools (A How To Manual).
- ▶ Natural Resource, Agriculture, And Engineering Service (NRAES) Cornell University Cooperative Extension for use in part of their publication Integrated Pest Management for Northeast Schools.
- ▶ Rutgers, the New Jersey State University; IMP Cooperative Extension and Research Program.
- ▶ Liberty Science Center; Staff Urban Entomologist; Betty Faber Pd.D. Scientist, Educator.

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CHAPTER 1

INTRODUCTION

This manual was developed to help New Jersey schools comply with the School Integrated Pest Management Act or the School IPM Act, a state law that became effective for schools on June 12, 2004. It is also designed as a resource and training manual for school Administrators and IPM Coordinators, who will oversee IPM activities. The School IPM Act requires schools to establish an IPM program, which includes adopting a broad IPM Policy statement and implementing an IPM Plan, which is a comprehensive **site-specific document**, intended to guide a school's day-to-day activities for controlling pests. The Policy and Plan cover the management of indoor pests such as rodents and cockroaches as well as outdoor pests such as weeds or stinging insects.

This manual also includes various samples or model documents to help schools successfully implement their IPM Policies and Plans. Model documents for such things as IPM plans, parental and staff notification of pesticide use, bid specifications for pest control contractors and other model documents are included to help schools comply.

Following is a list of documents that are available on the State's IPM in Schools web site at www.njipm.org

- ▶ **Model IPM Policy**
- ▶ **A guidance document for writing an IPM plan**
- ▶ **Model IPM Plan**
- ▶ **Model IPM Contract**
- ▶ **Annual Notification Form**
- ▶ **72 Hour Notification Form**
- ▶ **Emergency Notification Form**
- ▶ **Compliance Certification Form**
- ▶ **Model Posting Form**
- ▶ **List of "Low Impact" Pesticides**

Other documents that may be helpful, but that are not required for compliance, are included in the appendix of the Model IPM Plan. Be sure to review these documents, some of which will be very helpful for successfully implementing an IPM Plan at your school.

While many schools contract for the services of a professional to manage indoor and outdoor pest problems, Chapters 8 through 12 have been included as a resource guide for common pests found in schools. School administrators and IPM Coordinators can use these chapters to educate themselves about these pests, and the common techniques used to manage them in an IPM program.

CHAPTER 2

WHAT IS INTEGRATED PEST MANAGEMENT (IPM)?

The legal definition for IPM from New Jersey State regulations at N.J.A.C. 7:30-1: Integrated pest management, or IPM, means a sustainable approach to managing pests by using all appropriate technology and management practices in a way that minimizes health, environmental and economic risks. IPM includes, but is not limited to, monitoring pest populations, consumer education, and when needed, cultivation practices, sanitation, solid waste management, structural maintenance, physical, mechanical, biological and chemical controls.

IPM is a thoughtful, holistic approach to controlling pests that uses a wide variety of tools such as sanitation, structural modifications and other management techniques rather than automatically turning to chemical controls as a first option. Pesticide use is an important tool in the pest control "toolbox" but an effective IPM program can greatly reduce reliance on chemical controls. In a typical IPM program, pertinent information about a pest is combined with careful selection of suitable management techniques to eliminate the causes of pest outbreaks or to otherwise manage the pest in an economical manner that also represents the lowest possible hazard to people, property, and the environment.

The School IPM Act adds another aspect to the decision-making process for controlling pests as described above. When a school decides after considering all available pest control options, that pesticide use is needed, the law indicates that preference should be given to using a "low impact" pesticide. This term is explained in detail later in this manual.

Aside from the fact that state law mandates IPM in New Jersey schools, there are a number of potential health and economic benefits to schools. Reducing the potential for pesticide exposure to children is the driving force behind the School IPM Act. Children are more vulnerable to the effects of pesticides than adults. The school environment is therefore an ideal place to reduce the potential for pesticide exposure through an IPM program. In addition, pests have their own set of acknowledged risks to personal health, property, and the food supply. An effective IPM program can manage the risks from both pesticide and pest, and protect human health by:

- ▶ reducing student and staff exposure to pesticides
- ▶ suppressing pests that may carry or vector allergens or disease pathogens
- ▶ reducing environmental pollution

Implementing IPM may provide cost savings and other economic benefits by:

- ▶ reducing pest damage
- ▶ reducing unnecessary pesticide applications
- ▶ minimizing emergency repairs
- ▶ improving maintenance and sanitation
- ▶ reducing waste caused by infested food products

CHAPTER 3 - WHY PRACTICE IPM?

The Environmental Protection Agency (EPA) is responsible for the registration and regulation of pesticides in the United States. A pesticide product must be registered with the EPA to be legally used in the United States. Before the EPA will register a product they review a lot of data to gain an understanding of the possible risks that use of the product may expose people and the environment to. Label restrictions and other requirements are then imposed to reduce the possibility of these risks.

So then, why is the use of IPM in schools necessary? There are several reasons.

Uncertainties

Despite the substantial amount of scientific information that EPA reviews prior to registering a pesticide, it is virtually impossible to identify all conceivable risks and to address all the uncertainties of pesticide use. This means that from time to time new risks are uncovered. Some examples are: groundwater contamination, pesticides that mimic hormones, and the more recent discovery that pesticides used in combination may have the effect of increasing the potency of each individual products behavior. The amount of testing that would be required to resolve these uncertainties would result in no pesticides being registered. Because science cannot, in any practical sense, assure complete safety through any testing regime, pesticide use should be approached cautiously.

Overuse of pesticides causes problems. Aside from the potential for toxic effects to people, overuse of pesticides may cause problems such as:

- ▶ killing beneficial organisms that would otherwise help control pests
- ▶ promoting development of pesticide resistance in pests, which starts a vicious cycle in which more and more pesticides are needed
- ▶ resurgence of pest populations
- ▶ contamination of the environment.

Economics

Integrated pest management, when viewed by traditional economics, may result in slightly higher costs than conventional pest management. However, if other costs for which dollar signs are not readily available are considered, then the balance shifts towards IPM.

Some of these poorly accounted-for costs are:

- ▶ potential long term health effects
- ▶ contamination of the environment
- ▶ effects of pesticides on non-target animals and plants
- ▶ health effects to anyone who may be particularly sensitive to pesticides
- ▶ other effects of pesticides that are not now understood, but will be uncovered over time.

Even though these costs are not traditionally considered in economics, they are costs and should not be ignored.

Unique Characteristics of Children

The National Academy of Sciences, in their 1993 report ‘Pesticides in the Diets of Infants and Children’, found that children differ from adults both in the potential for exposure to pesticides and the potential for adverse health effects. This adds a degree of uncertainty to the studies required for registration of a pesticide, as all studies are conducted on laboratory animals.

Educational Opportunities

While this manual is intended for school personnel with pest management responsibilities, the concepts of IPM can also be used for teaching about pests in biology and other science classes. This will also promote IPM in homes and ultimately, through the fostering of informed consumers in agriculture, city parks, roadsides, right-of-ways, and other areas that have been subjected to high use of pesticides.

The EPA, the New Jersey Department of Environmental Protection and Rutgers Cooperative Extension, promote integrated pest management through documents such as this because it represents a prudent approach to understanding and dealing with environmental concerns.

IPM does not blindly embrace new technology nor does it reject technology. IPM promotes a thoughtful awareness of the pest management inherent in natural systems through an understanding of pest life cycles, and through the use of beneficial organisms, cultural modifications, physical barriers and other mechanical controls. IPM does not rule out the use of pesticides, but requires that their use be thoughtfully considered.

This prudence and thoughtfulness applied to pest management also has lessons for our dealing with the environment in other ways. It will help produce the thinking needed for environmental preservation, and there can be no better place for this lesson than in our schools.

CHAPTER 4 - HOW TO GET STARTED

IPM begins with learning how to prevent indoor and outdoor pests from becoming established. If the school or school district has a pest control professional under contract, then regular communication with the pest control professional, who should be knowledgeable in IPM, is essential for success. With an understanding of how pests live, problems can often be prevented simply by denying them food, shelter, or water, the resources pests need to survive and reproduce. Be sure your pest control company has the resources (an entomologist or plant pathologist) on staff or available to them, that can help to make these determinations.

Good facilities management is essential to IPM. Preventing an indoor pest may be as simple as blocking the pest's access into buildings or paying extra attention to sanitation and maintenance. Promoting healthy turf on athletic fields may prevent the need for chemical weed or insect control. Buildings must be kept clean, uncluttered, and in good repair to ensure healthy indoor air, maintain structural integrity, and conserve maintenance costs and energy. This will also help keep pests below harmful levels. IPM can be a cost-effective way to provide a safe and healthy environment in which students and staff can learn and work.

School Integrated Pest Management Policy

A school integrated pest management policy means a written pest control policy that is officially adopted by the school or school district that outlines how the school will eliminate or mitigate economic, health, and aesthetic damage caused by pests in and around schools.

A policy that provides for effective pest management, while reducing the volume of pesticides used, minimizes the potential hazards posed by pesticides to human health and the environment. The document establishes the use of integrated pest control methods such as, building and grounds inspections, the monitoring of pest populations, an evaluation of the need for pest control, and multiple pest control methods including, sanitation, structural repair, mechanical and biological controls and other non-chemical methods. When non-chemical options are ineffective or unreasonable, the policy allows for the use of a pesticide, with a preference toward first considering the use of a low impact pesticide.

Components of an IPM Program

An IPM program consists of a cycle of inspecting the site, identifying potential pest problems, monitoring pest numbers, evaluating their potential damage against an action threshold, implementing appropriate control methods, keeping careful records, and evaluating the outcomes of all actions.

Routine Inspection / Identification / Monitoring

Routine inspection and accurate identification of pests are vital to ensuring that control methods will be effective. Inspection includes determining potential locations of pest entry; determining sources of food, water, and harborage; and looking for pest signs. For example, rodent droppings and rub stains, feeding damage, frass (debris produced by insects), and cast skins of insects.

Identification involves confirming the type or species of a pest (for example, a mouse versus a rat or a German cockroach versus a brown-banded cockroach). Once the pest is identified and the source of its activity pinpointed, habitat modifications - primarily repair, exclusion, and sanitation efforts - may greatly reduce the prevalence of the pest.

Monitoring is the continuous, ongoing estimation of relative pest population levels. Information gained through monitoring is evaluated to determine whether control measures are required, and when they should occur.

It is essential that all the information and knowledge gained through inspection, identification and monitoring be recorded. A good IPM program makes no sense if there is poor record keeping. The idea is that anyone with access to the school's IPM records can come to an informed decision regarding whether or not to act, and how to act in reference to pest pressures, in the absence of the school's IPM coordinator, if for some reason the coordinator is not available.

Record Keeping

Careful record keeping leads to a better educated school IPM team and informed decision making in managing school pest problems. Knowing where, when, and what pests have been seen on school grounds can help focus pest control efforts and can be helpful to professional pest control operators. Such documentation is critical in an IPM program, as treatment is based on monitoring and other information.

Records can be maintained in a logbook or file dedicated to this purpose, in the main office of the school. Maps of the school building and grounds (**part of the IPM Plan**) aid in describing where pests are sighted or pesticides are used. These maps must be developed (hand drawn is all you need) if they are not available. Records should be kept of maintenance and structural deficiencies as well as all corrective actions taken to make repairs.

Maintenance staff, teachers, students and school support staff should all contribute to pest-sighting logs or other forms designed for the purpose of keeping track of pest sightings in or around school. The school community should be educated on how your school will keep track of pest sightings, and what they should do when they need to report a pest. Records of any follow-up actions should also be maintained, so if a pest control professional needs to be called in, they will be aware of all of the school's actions before calling them in to assist with the pest problem.

Any person applying pesticides must record the details of the pesticide application. In New Jersey, only a licensed and registered pesticide applicator or pesticide operator may do pesticide

applications in schools, this includes over the counter pesticides such as aerosol ant and roach killers and weed control products. These licensed pesticide applicators must provide detailed records of any pesticide application to the school, on the day of the application. These records must be kept in the school and not at a central or district location. Copies of pesticide labels and material safety data sheets (MSDS), if available, for any product used, should be kept in the IPM logbook or file. This information must be made available to concerned students, parents or school staff upon request and also to State and county officials.

Finally, the name of the pesticide applicator business, and the name of the pesticide applicator or operator and a photocopy of his or her pesticide license should be on file at the school.

Education

Education is a cost-effective pest management strategy essential to a successful school IPM program. Changing people's behaviors, particularly how they dispose of wastes and how they store food, plays an important part in the management of pest problems in schools. For an IPM program to be successful, all of the school community, administrators, teachers, support and maintenance staff, guardians and parents of the students, and the students, must be made aware of the school's policies on pest control and their respective roles in the overall pest management plan. In New Jersey the person who is responsible for providing or conducting this education is detailed in the schools IPM Plan.

Educational materials for IPM in schools may be available from the State Department of Environmental Protection, or Rutgers University Extension Programs, and the United States Environmental Protection Agency. Check web sites at:

- ▶ <http://www.njipm.org>
- ▶ <http://www.epa.gov/pesticides/ipm/>
- ▶ <http://www.pestmanagement.rutgers.edu/IPM/schoolipm/>

Action Thresholds

An action threshold defines the point above which specific pests cannot be tolerated, thus initiating a pest-specific treatment action. Action thresholds may be based on different criteria, including health problems associated with pests, pest damage resulting in monetary loss, or aesthetic damage to plants or buildings. Public health threats should take precedence over other factors.

Action thresholds should reflect the pest management objectives for the site. The presence of some pests does not necessarily require application of pesticides or other pest control actions. However, when pest populations exceed action thresholds, action should be taken. The tolerable number of any one pest is likely to be adjusted for different sites with different histories, conditions, and pest management objectives.

As an example, one rat or one German cockroach may lead to some form of action, meaning the action threshold has been reached, while one ant or one or two flies may not call for action, meaning the action threshold has not been reached.

Treatment Options

Many methods are available to treat pest problems, including habitat modification, physical and mechanical controls, biological control, and chemical control. Selection of an appropriate treatment involves choosing from available options using appropriate criteria, which may include doing nothing at all. The control methods selected should complement one another. Careful record keeping is crucial to the evaluation of individual treatment options and the IPM program as a whole.

Habitat Modification

Pests need food water and shelter to survive. Eliminating or reducing these resources provides an environment that supports fewer pests. Examples include practicing good sanitation to reduce food available for rodents, flies, yellowjackets, ants, and cockroaches; repairing leaks and keeping surfaces dry overnight to reduce water available to pests; removing clutter and caulking cracks and crevices to eliminate cockroach and flea harborage; and sealing food tightly in pest-proof containers to prevent access to food by flour moths and beetles.

Because cardboard boxes provide shelter for rodents and cockroaches, when shipments are received in cardboard boxes, the boxes should be inspected upon arrival for pests, unpacked, and promptly discarded outside of the school building whenever possible. No items should be stored in a school in cardboard boxes.

Cracks and crevices in walls, floors or along the building foundation should be repaired. Pipe chases throughout the school building should be blocked and sealed to prevent pests from finding shelter in places such as behind or within walls. These are just a few examples of habitat modification.

Understanding Various Pest Control Types

Physical And Mechanical Controls

Traps are common mechanical control methods, and they are available for a variety of pests, especially rodents, wasps, and cockroaches. A heavy-duty vacuum can be used to remove cockroaches, spiders, and many temporary invading insects. Barriers such as window screens are simple but effective controls. Removing pests with a vacuum cleaner, a fly swatter, or even a jar may be the simplest and most effective control for occasional pests.

Biological Controls

Introducing and conserving natural enemies to control pest species is often appropriate for around interior ornamental plants and on school grounds. Avoiding the use of broad-spectrum insecticides (which kill a wide range of pests) helps conserve beneficial insects such as ladybugs and lacewings. Some natural enemies can be purchased for controlling pest insects on indoor or outdoor ornamental plants or in greenhouses.

Chemical Controls

Many different kinds of pesticides are currently available for use against urban and structural pests. Pesticides include; insecticides, rat and mouse poisons (rodenticides) weed-killers (herbicides, including “weed and feed” lawn-care products), disinfectants, mold and mildew products, products that control plant disease (fungicides), and other chemicals designed to kill pests.

The health of school residents and the long-term suppression of pests are the primary objectives of a school IPM program. To accomplish these objectives, the program should first look for non-chemical alternatives. When non-chemical methods are unavailable or ineffective, pesticide use, often in combination with non-chemical methods, is justified. This approach will reduce the need for pesticides and will maximize their effectiveness when they are used

**IMPORTANT
IN THE STATE OF NEW JERSEY
ONLY LICENSED PESTICIDE APPLICATORS AND LICENSED PESTICIDE
OPERATORS WORKING UNDER THE DIRECT SUPERVISION OF A
LICENSED APPLICATOR MAY APPLY PESTICIDES IN SCHOOLS OR ON
SCHOOL PROPERTY**

If you don't have a license you should not be applying pesticides in or around New Jersey schools, including products such as over the counter aerosol ant and roach killers or weed and feed lawn and turf products.

If you do have a license then read and follow the pesticide label directions carefully. The fact that a particular product is registered does not mean that it is 'safe' under all conditions of use. Know how to apply and handle these chemicals, and try to minimize the exposure of children, adults, and non-target species.

CHAPTER 5

ESTABLISHING AN IPM PROGRAM AT YOUR SCHOOL

The following eight steps outline a general procedure for implementing an IPM program for a school or school district:

1. Develop and adopt an official school IPM policy statement, see the model IPM policy developed for New Jersey schools at the DEP web site www.njipm.org. An advisory committee may be useful in implementing an IPM program.
2. Designate an IPM coordinator, and be aware of the level of responsibility this job title carries, adjust other job responsibilities accordingly.
3. Designate IPM program roles for other school personnel, contracted pest control professionals, and other key players in your IPM program. Some examples of the roles members of the school community play regarding an IPM program are briefly described in the next section.
4. Using your IPM policy, develop a site specific IPM plan, see a model plan at www.njipm.org
5. If you're using a vendor or contracted pest-control professionals, develop contract bid specifications. See model contract at www.njipm.org
6. Apply the strategies outlined in the school or school district's IPM policy and detailed in the individual school's site-specific IPM plan.
7. Develop an IPM priorities list for the school or for each school in the school district.
8. Evaluate the IPM programs' results on an annual basis to determine if pest management objectives are met or if modifications to the plan are required. Update the school's site-specific IPM priorities list.

Roles Of The School Community In A School IPM Program

Implementing a school wide IPM program involves the cooperation of the entire school community. For members of the community to accept their roles in the program, they must understand how IPM benefits the members individually and the community as a whole.

IPM Advisory Committee

Although not required by law, an IPM Advisory Committee can help develop and implement the school IPM program. In some situations, this could be a district wide committee; in others, IPM decisions will be made at each school. The principal or superintendent may appoint members to serve on the school committee, a neighborhood pastor or rabbi may ask for volunteers. In addition to an IPM Coordinator, the IPM Advisory Committee should consist of individuals with concerns related to pest management, as well as individuals with appropriate technical expertise.

Members of an IPM advisory committee may include the school principal, teaching staff, facilities director, maintenance and custodial staff, athletic program director or coaching staff

members, food service director or staff, school nurse, office staff, or parents of the student body.

The IPM Advisory Committee can help implement the school IPM plan by addressing specific issues set forth in the plan, examples of which might include:

- ▶ Do individuals who apply pesticides at the school have an appropriate license?
- ▶ What forms should be used for reporting pests, documenting repairs, and recording pesticide applications? See model forms at www.njipm.org
- ▶ Where should reporting documents be kept?
- ▶ How can communication of IPM issues and practices be improved? How can notification of parents regarding IPM practices be improved?
- ▶ What specific pest action thresholds are appropriate?

School IPM Coordinator

The IPM Coordinator is designated by the local school board or school administration or by the IPM Advisory Committee and could be the school principal, the facilities manager, a custodian, a teacher, or someone under contract with the school to serve as the IPM Coordinator.

Regardless of who is appointed, the IPM coordinator must be, or be willing to become, knowledgeable about integrated pest management systems.

The school IPM Coordinator plays a major role in a school IPM program and is responsible for the day-to-day requirements of the program. The IPM Coordinator has an important responsibility and must be given the authority to make requests for facility repairs, renovations, or other improvements to manage and prevent pest problems at the school, now and in the future. In other words, to manage the school's IPM priorities list, which should be updated at least once each year during the IPM Program's Annual Review between the IPM Coordinator and the school administration, i.e., the Principal. The IPM Plan annual review is required by the IPM in School law. The administration must also recognize the time required to take on the many added responsibilities involved with the IPM Coordinator position.

Maintenance/Custodial Staff

Maintenance, custodial, and grounds superintendents and their staffs play key roles in an IPM program. They are responsible for recognizing and correcting conditions that may lead to pest problems, such as water leaks, potential pest entryways, and poor sanitation practices. It is essential that all facilities and grounds maintenance and custodial staff be adequately trained to recognize and prevent pest problems.

Kitchen Staff

Food handling and preparation areas are among the most critical areas for pest management. Kitchen staff must understand the importance of good sanitation and proper food storage. Good sanitation includes things like moving and cleaning under and behind refrigerators and freezers etc., on a regular schedule, and more often as necessary following a spill. Whenever possible, any food that must be kept in a school should be sealed in a plastic container or stored in a container with a screw on lid. Kitchen staff must play a very active role in implementing an IPM program.

Administrators/Principals

Administrators, Principals and school boards set the tone for the IPM program. Administrators should have a general understanding of any state law pertaining to IPM in schools and regarding application of pesticides in schools. The most important responsibilities of administrative staff are designating an IPM Coordinator; adjusting the new coordinator's responsibilities as necessary; developing a pest management policy and plan, and possibly forming an IPM Advisory Committee. Another important role of administrators is to, in concert with the IPM coordinator, assign priorities for building maintenance requests submitted by the IPM Coordinator. Without administrative support for such requests, IPM programs will have limited effectiveness.

School Nurse

The school nurse should maintain copies of material safety data sheets (MSDS) for any chemicals used on school property and be aware of any children or staff with asthma or chemical sensitivities. The nurse may help coordinate notification about the use of pesticides at the school.

Because head lice are a common problem for children between 3 and 10 years old, the school nurse should educate parents and staff about preventing the spread of lice, but it must also be understood that head lice are considered a medical problem, not a pest problem. Applications should almost never be made at a school for control of head lice.

Students and Staff

The first and most important pest management responsibility of students and staff is sanitation! Often, success in preventing and reducing pest infestations depends on whether or not food is left in classrooms, common areas like the teacher's lounge, and student's lockers. Whenever possible, any food that must be kept in a school should be sealed in a plastic container or stored in a container with a screw on lid. The second responsibility for students and staff is to help with pest monitoring. Students and staff can provide important information by reporting the presence of pests; what did you see, when did you see it, and where did you see it. It is essential that students and staff understand their role, and are familiar with the correct method for reporting pest sightings at their school.

Parents

Parents want their children to experience a safe and pleasant learning environment in school. For this reason, parents are usually among the first to speak up about perceived unsafe conditions in a school. Unsafe conditions can occur when pest problems are improperly managed or when pesticides are overused or used improperly. Parents should never hesitate to bring their concerns about safety issues to the attention of school personnel. Parents should be aware of pest management practices in their children's schools. Schools should welcome questions and encourage parents to seek information. Visible interest and concern by parents' serves as a stimulus to the school to do the best job it can to provide effective, safe pest control. Parents should express their views to the school IPM Coordinator, the school district superintendent, the school principal, school-based improvement committees, and to the local Parent Teacher Organization or Association (PTO or PTA).

Vendors and Contractors

While it is in the interest of vendors and contractors to foster good customer relations, the only way to enforce good sanitation practices by vendors and contractors is by putting specific language in their bid specifications and contracts. Contracts should specify regular maintenance service, cleaning under and behind machines (photo-copy machines, soda machines and vending machines are examples) during service visits, and the immediate correction of problems that may foster pests (such as breakage, leaks, or excessive condensation from machinery).

Pest Control Contractors

As with other contractors, a pest control professional is responsible for adhering to a contract. This contract should include such elements as maintaining and using pest sighting logs and pesticide use records at the school site, conducting inspections, consulting with the IPM Coordinator, providing specific recommendations, in writing, to correct pest-promoting conditions, using proper posting and notification, and implementing appropriate least-hazardous procedures to correct pest problems. Any desired restrictions concerning the use of sprays and aerosol formulations, known carcinogens, and baseboard applications should be clearly noted in the contract. See the model contract at www.njipm.org.

Pest Management Plan

A written pest management plan specifically establishes pest thresholds and pest control methods that will be used to maintain pests below threshold levels. It is a reference for the IPM coordinator, pest control contractors, school staff, and others to ensure implementation and compliance with the school's IPM policy. The plan also includes procedures for record keeping, notification, education and communication. There are many ways to write a pest management plan; however, every plan should include at least the following components:

- ▶ A copy of the school pest management policy.
- ▶ Designation of the IPM Coordinator and possibly an IPM Advisory Committee.
- ▶ A description of how the IPM philosophy will be applied at the school, for example, all activities designed to reduce pest populations will be based on an accurate determination of the pest's identity and knowledge of the pest's biology and life cycle.

- ▶ A description of the pest-monitoring plan. Everyone must know his or her role with regard to pest monitoring. For example, what does a student do following a pest sighting; what does a teacher do, what does the kitchen staff do, etc.
- ▶ Predetermined action thresholds for important pest problems and a statement emphasizing the adoption of these thresholds for making treatment decisions. This should be done for any pest that is likely to become a problem at your school. Examples include mice, bees and yellowjackets, cockroaches, ants, flies, weeds, etc.
- ▶ A description of the management options to be considered before the use of a chemical control. These options include increased sanitation, physical controls, mechanical controls, biological controls, and of course the option of no control at all.
- ▶ A description of the educational activities to be conducted to gain the cooperation of the school community. Detail who shall be given training as well as who will give the training.

CHAPTER 6

THE NEW JERSEY SCHOOL IPM LAW

This section is designed to outline the requirements of the School IPM Law and explain the regulations needed to supplement and carry out the law. Where needed, the State will provide model documents, notification forms, or other references to aid schools in complying with these requirements.

The School IPM Law supplements existing laws and rules at the federal and state level regarding pesticides. Detailed requirements already exist for pesticide applicator licensing, proper pesticide use, sale, storage, and transport. Pesticide product labels are mentioned throughout this manual as an important component related to school IPM. It is important to note that label directions on pesticide products are the equivalent of federal and state law and must be followed. However, state regulations can be more stringent than the pesticide label, but never less stringent (since less stringent would violate federal law). One example in the School IPM Law where New Jersey is more stringent than pesticide labels is student re-entry into a pesticide treated area. The use of certain pesticides will trigger a seven hour wait before students may re-enter the area. An example would be pesticide label directions that direct the applicator not to allow entry until the product has dried and settled. However, the new law says that if a product label does not give a specific numeric re-entry time then the re-entry time defaults to seven hours.

Full review of this manual should answer many questions about implementing a school IPM program that complies with New Jersey law. Further questions can be directed to the Department of Environmental Protection (DEP), Pesticide Control Program at (609) 984-6908, or by forwarding an email through the Contact Page found at DEP's internet web site for IPM at www.njipm.org.

The Law

The requirements of the School IPM Act to be implemented by June 12, 2004 are listed below. Public school boards, trustees of charter schools, and principals or lead administrators of private schools are responsible for complying. The individual named by the school as the IPM coordinator has joint responsibility for many of the requirements as well.

- 1. IPM Policy and Plan:** The law required that DEP develop a “model School IPM Policy” in cooperation with the New Jersey School Boards Association, the Department of Education, and Rutgers Cooperative Extension, by December 12, 2003. Part of this Policy requires the development of an IPM Plan that is a more detailed and site-specific document that covers how the school will carry out IPM on a day-to-day basis, and covers all elements of the IPM Policy in greater detail. Guidance for creating an IPM Plan is provided at the end of this manual.
- 2. Schools Adopt the Policy:** The law requires the superintendent of each public school district, the board of trustees of a charter school, or the principal or lead administrator of a private school to adopt and implement a School IPM Policy consistent with the model

mentioned above. Public, private and charter schools with grades pre-kindergarten through 12 must comply. Not covered by the law are colleges, universities, or day care centers (unless the day care center is on a school property).

3. **IPM Coordinator:** Each public school board, charter school, or private school must appoint an IPM Coordinator to carry out the School IPM Policy and related IPM Plan.
4. **Record Keeping:** The school must keep records of pesticide application on school property at each school for three years after the date of application and for five years after the application of a pesticide for termite control. Records are obtained from the licensed pesticide applicator performing the work.
5. **Use of “Low Impact” Pesticides:** Schools must consider the full range of pest management options that IPM requires, and the law additionally requires a school to consider using a "low impact" pesticide when it has been determined that pesticide use is needed. A full discussion of what constitutes a low impact pesticide is contained on page 22.
6. **Annual Notice:** The school must provide annual notification at the beginning of each school year to all staff and to the parents or guardians of the student body. This notice includes the school's IPM Policy and other information about pesticide use at the school, and contact information for the school IPM coordinator so anyone wanting additional information knows who to contact. See the DEP (njipm.org) and Rutgers Cooperative Extension web-sites for a model annual notification form that has all of the required elements. After the annual notice is distributed at the beginning of the school year, new staff and parents or guardians of new students must receive this notice upon employment or enrollment, respectively. They must never be made to wait until the next school year to receive this information.
7. **Notification and Sign Posting:** The school must provide prior notice and post signs before the use of any pesticide (except that notification and signs are not needed when “low impact” pesticides as defined by the law are used). The notice must be given at least 72 hours before the pesticide application to all staff and parents or guardians of students enrolled at the school. Additionally, signs must be posted at least 72 hours before the pesticide application. These requirements apply when school is in session (September through June). During holiday periods or during the summer months when school is not in session, only staff and the parents or guardians of students using the school in an authorized manner need to be notified.

The notice to staff and parents or guardians may be made by:

- ▶ Written note that the student takes home
- ▶ Written note mailed at least one week prior to an application
- ▶ Phone call
- ▶ Direct contact
- ▶ Electronic mail

The posted notice requirements are:

- ▶ Signs must be posted in or adjacent to area of the pesticide application
- ▶ Signs must also be posted at each entrance to the school building or school grounds being treated with pesticides
- ▶ The sign must be posted from 72 hours before until 72 hours after the application
- ▶ The size of the sign must be at least 8.5 inches by 11 inches.

Refer to the DEP (njipm.org) and Rutgers Cooperative Extension web-sites for a model notice and sign that contains all of the required elements. Communication with the pest control professional is essential for obtaining all necessary information about the planned use of pesticides. The name and EPA registration number of pesticides to be used, dates and times for the pesticide use, pesticide product labels, and Material Safety Data Sheets (MSDS) should all be available from the pesticide applicator. Since the notices and signs must contain pesticide label precautions that relate to public safety and possible adverse effects from the MSDS, IPM Coordinators must familiarize themselves with these documents.

8. **Emergency Pesticide Use:** The law provides for slightly different notification requirements in the event of a “school pest emergency” that is defined as an “urgent need to mitigate or eliminate a pest that threatens the health or safety of a student or staff member.” It is the responsibility of a school official such as the IPM Coordinator to determine if an emergency exists. Whoever is charged with this responsibility, it should be clearly stated in the IPM Plan. One example of an emergency would be the presence of stinging insects such as ground hornets in an athletic field where events are scheduled. If a pest emergency exists, the school may use pesticides, but the posting must be done at the time of the application, and the notice to parents and staff must be done within 24 hours (or by the next school morning, whichever is earlier) after the emergency application. The notice that goes to parents and staff must explain what the reason for the emergency was, and if possible, what can and will be done to prevent such an emergency use of pesticides in the future. A model form for use as an emergency notice that contains all required elements is included in the Tools and Templates area of the DEP IPM in Schools web-sight (njipm.org).
9. **Re-entry:** The law requires schools and pesticide applicators to carefully time applications and strictly control when students re-enter pesticide treated areas. The following is a summary of these requirements:

- ▶ Applications of pesticides (except for low impact pesticides) are not allowed in a school building when students are present, unless the area being treated is served by a separate ventilation system and is also separated from the untreated area by smoke or fire doors.
- ▶ For applications of pesticides (except for low impact pesticides) whether indoor or outdoor, students are not allowed in the treated areas prior to the time allowed for re-entry on the pesticide product label. If the label gives no numeric time for re-entry, then the law mandates that seven (7) hours must pass before students can re-enter.
- ▶ For applications of low impact pesticides, students are not allowed to re-enter until the pesticide application has dried or settled, or if the label specifies a re-entry or ventilation time, until that time has passed.

10. **Additional Information/Responsibilities:** The IPM Coordinator for the school is jointly responsible along with the school itself (the local school board and or the lead administrator or principal), for carrying out all aspects of the IPM program. Additional logistical items the IPM Coordinator must comply with are:

- ▶ Maintaining information about the IPM Policy and Plan at the school.
- ▶ Maintaining information about pesticide applications at each school the coordinator is responsible for (not at a central or district location) including records obtained from the pesticide applicator, MSDS when available for pesticides used, and labels for all pesticide products used.
- ▶ Maintaining records of all pest monitoring or other IPM-related evaluations and activities.
- ▶ Responding to inquiries and providing information to students, staff, and parents or guardians regarding pest management, and to State and County representatives.
- ▶ Educating the school community.
- ▶ Providing access to the above information for public review.

Regulations

Adopting regulations allows a state agency (the DEP in this case) to enforce the requirements of the law. Laws are generally written in broad terms, and regulations are designed to be more specific and carry out the intent of the law. This section will give a general preview of concepts that DEP covers in regulation that are different from the summary of the law in the previous section. The regulations were adopted on December 6, 2004 and were effective on that date. Please visit the Pesticide Control Program Internet web site for the complete regulations. <http://www.njpcp.org> or <http://www.nj.gov/dep/enforcement/pcp/index.htm>.

Concepts covered in regulations that are in addition to requirements from the law outlined above:

- ▶ Educational component for School IPM Coordinators - training based on this manual.
- ▶ Educational component for pesticide applicators, an additional license (category 13) specific to school IPM will be required for applicators operating on school property.
- ▶ Formalizing the model School IPM Policy elements in the regulations.

Guidance On “Low Impact” Pesticides

Introduction

The law requires that after non-chemical means of pest control have been considered and exhausted and pesticide use is deemed necessary, preference be given to using a pesticide that is classified as “low impact.” The use of a low impact pesticide prevents the need for the school to post warning signs or send notices to all staff and parents. This section is designed to clarify what pesticides or pesticide ingredients fit into this “low impact” classification, and how reducing risk is a process that goes beyond mere product selection.

The law's preference for pesticides classified as low impact, is an attempt to reduce exposure risk by choosing pesticides that the law considers to be of *relatively* minimal risk, compared to other pesticides. This leads to a very important point for IPM programs, and pesticide use in general. All pesticides have some degree of risk associated with them, including those that the law considers “low impact.” In order for a pesticide to be truly low impact, other considerations beyond the choice of pesticide product must be considered, including the timing, methods and site of the pesticide application. Actual risk reduction from pesticide use can only be achieved by careful and knowledgeable product selection, well placed product application, and appropriately timed applications.

For example, when a pesticide such as boric acid is classified as “low impact”, consumers or school officials may be led to believe that it can be used without risk. However, children may have adverse reactions when exposed to oral or dermal contact with the product due to improper application. Boric acid will repel and kill cockroaches when it is applied as a fine dust in wall voids inaccessible to people. When applied in this fashion, boric acid could appropriately fulfill its designation as low impact. It has a low volatility and is *relatively* low in risk to mammals. However, when applied in clumps along baseboards and heating elements where it can become airborne or be picked up and handled by small children, this particular application of boric acid is not fulfilling the intent of its low impact designation. In this scenario, boric acid poses a high risk of exposure and can be quite toxic to children when used in this manner.

In order for a pesticide selection to truly reduce risk in an IPM program (whether or not it is classified as low impact under the law), the following questions must be asked:

- ▶ What is the pesticide being used for?
- ▶ When will it be used?
- ▶ Where is it going to be applied?
- ▶ What methods will be used to apply the pesticide?
- ▶ What organisms will it potentially effect other than the target organism?
- ▶ How much control does the pest control professional or school official have over the application of this pesticide (will it drift? translocate? be carried around?)

Now that it is clear that reducing pesticide risk goes beyond the selection of the product, it is time to discuss the actual list of pesticides and categories of pesticides deemed “low impact” under the law.

List of Low Impact Pesticides

Low impact pesticides as defined in the School IPM Law can be classified in two categories. The first category is, pesticides or substances that the Federal Environmental Protection Agency (EPA) has decided are not necessary to regulate, generally because of the minimal risk they represent. The second is a group of other pesticide ingredients or formulation types that the School IPM Law considered to be of lesser risk because of the nature of the product formulation, the ingredient, or how it is used. Become familiar with the products described or listed here. If your IPM decision making leads you to the conclusion that pesticide use is needed, consult with the pest control professional for your school to determine if any of these pesticides will adequately solve the problem. Questions about whether a product qualifies as low impact should be directed to the Pesticide Control Program at (609) 984-6568.

EPA Exempt Pesticides or Substances

The following pesticides have been determined by EPA to not require regulation, and are listed in the federal regulations at 40 CFR § 152.25:

- ▶ Treated articles or substances, for instance, wood treated to repel insects. Although the wood has been treated with a pesticide, the wood itself is not considered a pesticide.
- ▶ Pheromones or pheromone traps, substances produced by insects that can be used to lure or trap insect pests of the same species.
- ▶ Preservatives, for biological specimens, such as embalming fluids, when used for that purpose.
- ▶ Food or food products used to attract pests.
- ▶ Cedar wood; blocks, shavings, chips, etc., used to repel insects.

Minimum Risk Pesticides

The following is a list of “active” ingredients (the ingredient with the pesticide value) that are exempt from EPA regulation assuming the product meets certain conditions. If these ingredients are in a product that is properly labeled with all ingredients (both active and “inert”) and the product does not claim to control disease carrying pests, and does not make false or misleading claims, they are considered “minimum risk” and thus able to be used as a low impact pesticide under New Jersey law.

The active ingredients listed here may be combined with any of a number of "inert" ingredients from a list published by EPA. This list of minimum risk inert ingredients is known as List "4A". The “4A” list changes periodically and is re-published by EPA after changes are made. Updates of list 4A can be obtained from EPA's Internet web site at www.epa.gov/opprd001/inerts/inerts_list4.pdf.

Castor oil (U.S.P. or equivalent)	Malic acid
Cedar oil	Mint and mint oil
Cinnamon and cinnamon oil	Peppermint and peppermint oil
Citric acid	2-Phenethyl propionate (2-phenylethyl propionate)
Citronella and citronella oil	Potassium sorbate
Cloves and clove oil	Putrescent whole egg solids
Corn gluten meal	Rosemary and rosemary oil
Corn oil	Sesame (includes ground sesame plant stalks) and sesame oil
Cottonseed oil	Sodium chloride (common salt)
Dried blood	Sodium lauryl sulfate
Eugenol	Soybean oil
Garlic and garlic oil	Thyme and thyme oil
Geraniol	White pepper
Geranium oil	Zinc metal strips (consisting solely of zinc metal and impurities)
Lauryl sulfate	
Lemongrass oil	
Linseed oil	

Other Pesticides the School IPM Law Considers “Low Impact”

The following ingredients or types of pesticides are also considered low impact.

Formulation Types - gels, pastes, or baits. Ant traps and insecticide gels are good examples of this class of low impact pesticides. Rodent baits also fit into this designation, although rodent baits should be rare in an effective school IPM program.

Antimicrobial Products - pesticides used to kill microorganisms such as bacteria and fungus. Disinfectants, cleaners, mold and mildew removers all fall into this classification. The full definition of these products from state pesticide regulations at N.J.A.C. 7:30-1.2 is as follows:

“Antimicrobial agents” means:

1. Disinfectants intended to destroy or irreversibly inactivate infectious or other undesirable bacteria, pathogenic fungi, or viruses on surfaces or inanimate objects;
2. Sanitizers intended to reduce the number of living bacteria or viable virus particles on inanimate surfaces, in water, or in air;
3. Bacteriostats intended to inhibit the growth of bacteria in the presence of moisture;
4. Sterilizers intended to destroy viruses and all living bacteria, fungi, and their spores, on inanimate surfaces; or
5. Fungicides and fungistats intended to inhibit the growth of, or destroy fungi (including yeasts) pathogenic to man or other animals on inanimate surfaces;
6. Commodity preservatives and protectants intended to inhibit the growth of, or destroy bacteria in or on raw materials (such as adhesives or plastics) used in manufacturing, or manufactured products (such as fuel, textiles, lubricants, and paints); or
7. General use algicides labeled for use in:

- i. Swimming pools, hot tubs, whirlpools, spas, ornamental ponds, fountains, fish tanks, and waterbeds;
- ii. Water, wastewater and sewerage treatment plants, but only where there is a controlled inlet and outlet; and
- iii. Industrial, commercial, and manufacturing processes.

Specific Active Ingredients - Specific pesticide ingredients the School IPM Law has added to the low impact designation are:

- ▶ boric acid
- ▶ disodium octoborate tetrahydrate
- ▶ silica gel
- ▶ diatomaceous earth

Microbe Based Insecticides - the most common example of this would be bacillus thuringiensis or “Bt”, a widely used microbe that is the ingredient in many home and garden products, mosquito larvicides, and gypsy moth control products.

Botanical Insecticides (not synthetic) - a common example of this would be pyrethrum, extracted from the chrysanthemum plant, or neem oil that is extracted from kernels of the neem plant. Synthetic versions of botanicals (pyrethrin) or those that contain “toxic” synergists to enhance the potency do not qualify as low impact. So a product with pyrethrum is low impact while a product with pyrethrin is non-low impact.

Biological, Living Control Agents - a common example of this would be a pesticide that uses parasitic nematodes (a small worm-like organism) as its active ingredient. These nematodes are used to control a wide variety of insects. Beneficial insects would be another type of control agent that would fit into this category. For more information about beneficial insects, see the New Jersey Department of Agriculture's Internet web-site at www.nj.gov/agriculture/plant/pabil

When pesticide use is needed, careful product selection, good communication with the school's pest control professional, and a realization that risk reduction is more than just product selection are the keys to remember.

CHAPTER 7

INFORMATION FOR ADMINISTRATORS

This section is directed at the school administrator and contains several documents, listed below, which should be used as part of an IPM plan. A complete list of the model documents and forms that are available for download will be included at the end of this section.

Policy Statement

New Jersey schools must develop and adopt an IPM policy. The Department of Environmental Protection, along with the Department of Education, the NJ School Boards Association and Rutgers University has developed a model IPM policy for schools in the state to use. The first step in an IPM program is to establish a school IPM policy and inform the school community regarding the policy. The policy must be provided to parents and guardians of the students as well as all school staff at least once a year. The model Policy contains the minimum IPM standard for New Jersey Schools.

Contracts

Contract Guide Specifications in the form of a model contract for Integrated Pest Management Programs in New Jersey Schools has been developed and is available for download. School officials may find these guidelines useful when creating bid specifications for integrated pest management proposals from vendors. These specifications are provided as a starting point for schools that outsource pest management. If used as a template for contracts, these guidelines should provide the pest control professional with descriptions and details sufficient to deliver quality IPM in schools.

Notification

Annual Notification

The New Jersey School IPM Act calls for annual notification to the school community, at the beginning of the school year, regarding the school's IPM policy. The notification includes a copy of the schools IPM Policy, along with a complete list of pesticides the school is using or has used during the previous 12 months (both low impact and non-low impact pesticides). The notice also includes the name and contact information for the school's IPM coordinator, and the date, time and place of any meeting, if one is to be held, for the purpose of adopting or modifying the school integrated pest management policy or plan.

Pre-Notification of Non-Low Impact Pesticide Application

In New Jersey, when a school decides that a non-low impact pesticide must be used, the school community must be informed 72 hours in advance of the application. The application of a non-low impact pesticide in a school environment is a last-resort management option. It is important

to make the parents and guardians of the student body, teachers and staff aware when this type of application is necessary, and when and where the application will occur.

The **72 Hour Notification** form should be completed with the assistance of the pest control professional, and sent to the school community. **In a well-integrated IPM Plan**, responsibility for this notification may fall to the IPM Coordinator or to the School Principal or both. The IPM coordinator may consult with the pest management professional to complete the form, and the form is then sent through the Principal's office for distribution to the school community.

Responsibility for this form should be clearly stated in the school's IPM Plan. See chapter 6 for details on how to properly send notifications. Questions regarding notification may be made directly to the DEP at (609) 984-6908

Other Forms

(IPM) Pest Sighting Log

A pest sighting log should be kept at each facility, building, floor, or room depending on your specific IPM plan. The district IPM coordinator or building IPM coordinator should be responsible for this document. All employees in the given area should know to report any pest sightings either directly to this Log or to the IPM coordinator responsible for the Log. Review of this form should be included as part of the pest control professional's periodic inspection process. The pest control professional reviews this document at the beginning of each visit and responds appropriately. Any treatments should then be recorded in this Log by the IPM coordinator.

Integrated Pest Management Cafeteria Inspection Checklist

Because food-handling areas tend to be the source of many pest infestations, a separate inspection form is provided for cafeterias. The pest control professional can use this document to ensure that a thorough inspection has been completed. A checklist should be completed during each inspection. The pest control professional, however, should not limit the inspection solely to what is indicated on the checklist. The IPM coordinator should review the pest control professional's comments on the checklist and take appropriate action. This checklist can be found in the appendix of the model IPM Plan, or the school can create its own checklist.

Model Documents and Forms Available for Download

All of the model documents and forms discussed in this section and throughout this manual are available for down-load from both the Department of Environmental Protection and Rutgers' Cooperative Extension IPM in School web sites located at:

<http://www.njipm.org>

<http://www.pestmanagement.rutgers.edu/IPM/SchoolIPM/index.htm>

Forms

Most forms are available in both Microsoft Word and Adobe pdf format:

Model IPM Policy

A guidance document for writing an IPM Plan

Model IPM Plan

Model Contract

Annual Notification Form

72 Hour Notification Form

Emergency Notification Form

Compliance Certification Form

Posting Form

Pest Sighting Log

Cafeteria Check List

*** These and other helpful forms can be found in the appendix of the Model Plan listed above. ***

IPM Plan

The IPM Plan is the key to a successful IPM program at your school. Guidance on creating an IPM Plan is also included at the end of this manual.

The New Jersey IPM in School Act calls for each school Principal to be directly involved in writing the school's site specific IPM Plan along with the school's IPM coordinator, and others at the schools discretion. It's advisable to include the pest control professional whenever possible. Other possible participants might include members of your IPM Advisory Committee if one has been formed, the Athletic Director (or possibly a coach) or anyone familiar with the schools day-to-day operations, needs, goals etc....

School Districts are permitted to have a single IPM Policy, however, each school in the district must have it's own site specific IPM Plan. An IPM Plan includes, among other things, maps of the buildings and grounds (hand drawn maps are all that is necessary) and a site specific IPM priorities list based on a through IPM inspection of the school and school grounds. Each school's site specific IPM Plan will be maintained at the school, not at a central or district location. This IPM plan will be asked for and reviewed during random inspections by State and County representatives.

The school IPM Plan also goes through an annual review between the IPM coordinator and the School Principal, during this review the IPM priorities list is maintained, and the effectiveness of the plan is analyzed. Following this review, the Principal will report on the effectiveness of the plan to the local school board, and the plan may be revised as needed. Your plan may change considerably during the first few years and then become more stable as you address considerations from your IPM priority list.

CHAPTER 8 – COMMON SCHOOL PESTS

Ants

Ants become pests when they invade buildings in search of food or shelter. It is often very difficult and laborious to eliminate most ants from their outside habitat, so management efforts should aim at preventing ants from invading structures. Unfortunately, prevention is not always successful and management actions must be implemented.

Although ants often are regarded as pests, they are beneficial in several ways. Ants are predators of numerous pest insects, including fly larvae and termites. By aerating soil and recycling dead animal and vegetable material, they aid in the formation of topsoil. Ants are also responsible for pollinating plants in some areas. Ants provide a great service to the environment, and management efforts that prevent or suppress ants are preferred over practices that aim to eliminate ants.

Identification and Biology

Ants are social insects. They live in colonies whose members are divided into three castes, workers, queens, and males. The workers enlarge and repair the nest, forage for food, care for the young and the queen, and defend the colony. The queen lays eggs, and the males serve only to mate with the queens.

Ants pass through four stages of development: egg, larva, pupa, and adult. After mating with males, queens lay eggs that hatch into blind, leg-less larvae. The larvae are fed and cared for by worker ants. At the end of the larval stage they turn into pupae, which do not feed. After a short period of time, adult ants emerge from their pupae cases and become worker ants.

The first step in managing pest ants is proper identification, since many types of ants may invade a structure. It is critical to identify the type of ant you want to manage, because most ants differ in their habits and food preferences.

Damage

Many species of ants, such as pavement ants, are particularly prone to infesting food. Inside buildings, these ants are merely a nuisance, since they almost never bite. However, ants walk over many different kinds of surfaces and sometimes feed on dead animals and insects, so it is possible that they can carry disease-causing organisms to human food. Assume that ant-infested food has been exposed to organisms that can cause spoilage, and throw it away.

Carpenter ants may cause some structural damage as they excavate moist, rotting wood and other soft materials (such as foam insulation board) to make satellite nests. If you have carpenter ants, you have a moisture problem somewhere. Along with a pest control professional you will likely also need a carpenter and or a plumber to correct the problem. Carpenter ants may mean a leaky roof or pipes, repair any water leaks and replace moist or rotting wood as needed.

Detection and Monitoring

Visual inspection is the most useful monitoring technique for detecting ants, and can be very useful in preventing a developing infestation. A thorough inspection and prevention program is required to locate the ant source. Ants are most likely to be indoor pests in kitchens and food preparation areas, e.g., cafeteria, home economics areas and teachers lounge areas.

- ▶ Make a map of the school on which you can note problem areas and areas needing repair.
- ▶ A bright flashlight, kneepads, and a mirror are helpful.
- ▶ Carry a caulking gun to seal holes and cracks during inspection to prevent ants from gaining entry to the structure.
- ▶ Keep accurate records during the monitoring program (inspections) to help formulate an IPM plan and evaluate its effectiveness.
- ▶ Ants are most likely to be indoor pests in kitchens and food preparation areas.
- ▶ An ant infestation may indicate that there has been a change in the methods of storing food or food waste that allows increased food sources for ants. Note how food and food wastes are stored in the area, and whether refuse containers are emptied and cleaned regularly. Inspect recycling bins to ensure that recyclable items have been cleaned before being placed in bins. A quick rinse is all it takes.
- ▶ Talk with kitchen staff and custodians to learn more about the problem from their perspective.
- ▶ Ants can be attracted to snacks kept in classrooms or teachers' lounges and to sweet drinks accidentally spilled on the floor.
- ▶ Glue boards or sticky traps placed in areas ants are likely to be found can be useful in monitoring.
- ▶ Carpenter ants are attracted to moist areas. Check any areas where there might be a water leak, or moist or rotting wood (including firewood, logs, sick looking trees or tree stumps outside the building).

Management Options

Habitat Modification

The environment should be modified to reduce ant entryways and access to food. With quality materials and careful work, the alteration will be permanent and will make a long-term impact on the number of ant invasions.

Caulking

- ▶ Caulk all potential entryways with a silicone caulking compound.
- ▶ Use mildew-resistant caulk in moist areas.
- ▶ It is not necessary or practical to seal all cracks, but begin with the access point that the current trail of ants is using.
- ▶ Always carry caulk when making inspections, and seal as many cracks as time allows, especially those around baseboards, cupboards, pipes, sinks, toilets, and electrical outlets. Silicone caulks are flexible, easy to apply, and long-lasting.
- ▶ Use weather strip around doors and windows where ants may enter.
- ▶ Repair any water leaks and replace moist or rotting wood as needed.

Sanitation

Sanitation eliminates food for ants. Thorough daily cleaning of school kitchens and food preparation areas is essential.

- ▶ Sweep and mop floors.
- ▶ Drain all sinks and remove any food debris.
- ▶ If children regularly receive snacks in classrooms, these floors should be vacuumed and/or mopped daily.
- ▶ Periodically give all food preparation areas a complete cleaning, focusing on areas where grease and food debris accumulate. These include drains, vents, deep fat fryers, ovens, stoves, and hard-to-reach areas behind or between appliances. Thoroughly clean these areas with a powerful vacuum.
- ▶ At the end of each day, remove all garbage that contains food from the building.
- ▶ Use soapy water to wash any bottles, cans, wrappings, and other items that have food residues before storing them for recycling.
- ▶ If dishes cannot be washed right away, it is very important that they at least be rinsed to remove all food debris.
- ▶ Place garbage in sealed plastic bags, then place the bags into a rodent-proof dumpster or other storage receptacle.
- ▶ Keep garbage cans and dumpsters as clean as possible to deny food to ants, as well as roaches, flies, mice, and rats.

Anyplace a trail of ants has been seen should be cleaned with soap/detergent and water to remove ant pheromone trails (a scent trail left for other ants to follow).

Proper Food Storage

- ▶ Food not kept in the refrigerator should be kept in containers that close tightly. Cardboard boxes are not ant or roach-proof.
- ▶ Keep particularly attractive substances, like sugar and honey, in a refrigerator.
- ▶ Although refrigerator storage is usually safe, ants sometimes get into refrigerators even when the seals appear intact. When this occurs, a light, temporary coating of petroleum jelly on the edge of the refrigerator seal will exclude the ants.
- ▶ Screw-top jars are ant-proof only if the lid has a rubber seal, because some ants can follow the spiral ridges to get into the jar.
- ▶ Glass containers with rubber gaskets or plastic containers with tight-fitting, snap-top lids are also ant-proof.
- ▶ Upon delivery, transfer packaged food into plastic or glass containers. To prevent roach problems, do not bring shipping boxes into the food preparation area. Instead, boxes should be broken down and stored away from the kitchen in a cool area until removed for recycling.
- ▶ Advise students and teachers not to leave unsealed food items in their desks or lockers.
- ▶ Any food kept in offices or classrooms should be stored in ant-proof containers.
- ▶ Storage shelves should be far enough off the floor to facilitate cleaning and to reduce the possibility of access by insects or rodents. No supplies should be stored on the floor.

Chemical Controls

At times, non-chemical methods alone may prove insufficient to solve a pest problem. Integrating a pesticide into your management program may be necessary to gain control.

Pesticides must be used in accordance with their EPA approved label directions. Licensed applicators should always wear protective equipment during pesticide applications. All labels and Material Safety Data Sheets (MSDS) for the pesticide products authorized for use in an IPM program should be maintained in a file or logbook designated for this purpose. This logbook or file must be kept within an individual school building, not at a district or other central location, and should always be available to the IPM Coordinator or his/her surrogate.

The law also mandates a 7-hour re-entry period whenever a pesticide without a specific numeric re-entry period is applied. This means that if the label says the treated area cannot be re-entered for four (4) hours then the re-entry period is four (4) hours, if the label says the re-entry period is twelve (12) hours, then the re-entry period is twelve (12) hours. However, if a label does not say what the re-entry period is, then the re-entry period is seven (7) hours. An example would be a product that says re-enter after product has dried and settled, this product would default to a seven hour re-entry period in New Jersey.

New Jersey law allows pesticide applications in schools by licensed professional pesticide applicators only, or by a licensed pesticide operator working under the direct supervision of a licensed applicator. Even over-the-counter products such as ant & roach sprays, weed killers or weed & feed lawn care products require a license if being applied at a New Jersey school.

Cockroaches

Good sanitation is key in cockroach control, it's also important to understand that most roaches can go for about a month without food but will die within a few days without water.

Cockroaches are the most important pests within schools, homes, and restaurants. They consume human foods and contaminate them with saliva and excrement. They produce secretions that impart a characteristic fetid odor, and their shed skin contains allergens that may cause allergic reactions such as asthma and other bronchial problems in people inhabiting or visiting infested buildings.

Identification and Biology

Except for size and markings, cockroaches are generally similar in appearance: all species are flattened, oval-shaped insects with long legs and antennae. Only four species are common pests in New Jersey. These are the German, Brown-banded, American, and Oriental cockroaches.

In general, cockroaches like to squeeze into warm cracks and crevices, but the places they inhabit differ from one species to another. German cockroaches prefer kitchens and lavatory areas, while brown-banded cockroaches are most often found in dryer classroom and office areas. American and oriental cockroaches are generally found where there is high moisture, such as in sewers, basements, and mulch.

The life cycle of the cockroach begins with the egg case, or ootheca. In German cockroaches, the female transports the egg case around with her until the eggs are about to hatch. The brown-banded, American, and oriental cockroaches deposit the egg case in a sheltered place. Cockroaches undergo a gradual metamorphosis during their life. An immature cockroach, or nymph, looks much like an adult, but is smaller and wingless. As a nymph grows, it sheds its skin (molts) a number of times. The time it takes a cockroach to become an adult is affected by temperature. Cockroaches in the nymph stage develop more rapidly when it is warm.

Cockroaches eat carbohydrates, protein, and fat. They will discriminate among foods if given a choice, but when hungry they eat almost anything. Some products not normally considered food, starch-based paints, wallpaper paste, envelope glue, and bar soaps contain carbohydrates, and therefore are food for cockroaches.

Cockroaches are generally active at night and remain hidden during daylight. Daylight sightings usually indicate a large population that has overrun available harborage or a recent emigrant cockroach seeking shelter.

Damage

Cockroaches can carry and transmit many common pathogens that cause human and animal disease (Smith and Whitman, 1992). Consequently, their presence in kitchens and cafeterias should be deemed hazardous. However, the most important health issue associated with cockroaches is the production of allergens that can cause severe bronchial problems in sensitive individuals, most notably in children and the elderly.

Detection and Monitoring

Efforts to manage cockroaches should begin with a thorough visual inspection and a continuous monitoring program. Once cockroaches have located a suitable harborage (living area) they tend to concentrate in that site, which they leave only periodically to forage for food and water. Thus, the first step in any inspection is to locate potential cockroach harborage sites. This effort should be followed by monitoring of the area to locate specific cockroach infestations. This monitoring must continue after treatment to determine whether management efforts have satisfactorily reduced the cockroach population.

Tools Used to Inspect and Monitor for Cockroaches

- ▶ **Flashlight.** Use a heavy-duty, corrosion-resistant model with a bright-colored body, shatterproof lens, and halogen or krypton bulb. A smaller halogen flashlight with a flexible neck is useful in tight, confined locations. Flashlight holders that can be attached to a belt are available.
- ▶ **Telescoping Mirror.** Use a furnace inspector's or mechanic's metal mirror with a telescoping handle and rotating head. To illuminate areas inside equipment and fixtures, reflect the flashlight beam off the mirror.
- ▶ **Clipboard and Pen.** Use the clipboard to carry monitoring forms, floor plans, and other documents during inspections.
- ▶ **Floor Plan Maps and Building Plans.** Carry a floor plan with the major equipment and fixtures marked. In large buildings, construction drawings that show utility lines, heating/cooling ducts, shaft connections, pipe chases, and other features are very useful for locating entry points, harborages, and runways.
- ▶ **Sticky Traps.** These are used to locate harborage areas and estimate populations.
- ▶ **Flushing Agent.** A pocket-sized can of pressurized air is useful for spot-flushing roaches out of inaccessible areas where trapping is not sufficient.
- ▶ **Utility Tools.** A pocketknife equipped with various blades, screwdrivers, and forceps will enable you to open grills, electrical boxes, and other equipment for inspections. Carry small vials and adhesive labels to collect cockroach specimens. A 10-power (10x) hand lens (small magnifying glass) will help you identify roach species. Colored adhesive labels can be used to mark hot spots, the location of traps and bait stations, and other areas. These tools can be kept in a tool pouch worn on a belt.
- ▶ **Knee Pads and Bump Cap.** For personal safety, these are useful when crawling around for floor-level inspections, which will be necessary in all schools.
- ▶ **Camera.** A digital or Polaroid camera is useful for illustrating specific conditions (such as unsanitary situations or areas needing pest-proofing) in reports to staff supervisors and other decision makers or subcontractors not on the premises.

Establishing a Communication System

A successful monitoring program depends on clear and frequent communication with principals, teachers, custodians, and food-service personnel. These people have firsthand knowledge of pest sightings, sanitation problems, and other contributing factors, such as leaks, condensation problems, and harborage sites. With a small investment of time, school personnel can be trained to serve as additional sources of valuable information for the monitoring program.

Make sure personnel understand the following:

- ▶ the goals of the cockroach IPM program and the important role monitoring plays.
- ▶ their role in the IPM program, what they can do to help reduce the number of cockroaches and what kind of information they can provide.
- ▶ how they can best communicate with the IPM Coordinator, using some type of record keeping (a form) to write down pest sightings and other information, or via email or voice mail to record sightings.

If you don't have a cockroach problem or have successfully mitigated a problem, monitor for cockroaches or continue monitoring on a monthly or quarterly basis to ensure that new infestations are detected early.

Visual Inspection

- ▶ Note any sanitation problems, such as food or grease spills, food or grease buildup behind or under kitchen equipment, or improper garbage disposal procedures.
- ▶ Note any leaks or condensation.
- ▶ Look for cockroach entry points, such as holes in walls or floors, around pipes where they may enter a wall around electrical conduits, or in vents.
- ▶ Record in a "Pest Sighting Log" locations where cockroaches have been found for repeat monitoring.

Where to Inspect

Define the specific areas on a map that are to be inspected for cockroaches. Inspect these areas from floor to ceiling in a systematic and logical fashion, making sure no potential harborage areas are overlooked. Be sure to inspect:

- ▶ in corners of rooms at floor and ceiling level
- ▶ under, behind, and around sinks, toilets, showers, bathtubs, drinking fountains, ice machines, dishwashers, beverage dispensers, and floor drains
- ▶ the engine compartments of refrigerators, beverage dispensers, toasters, air conditioners, and other equipment
- ▶ in and under stoves, hot plates, heaters, hot water pipes and radiators
- ▶ in and around stove vents, hoods, and grease traps
- ▶ between equipment and walls, and between adjacent appliances
- ▶ behind picture frames, mirrors, bulletin boards, and wall-mounted shelving
- ▶ in false ceilings, vents, light fixtures, ceiling-mounted fixtures, and railings
- ▶ in cupboards, linen closets, drawers, filing cabinets, lockers, and cluttered areas

- ▶ in and under cash registers, computers, telephones, electric clocks, televisions, light-switch boxes, and fuse boxes
- ▶ in and around check-out stands, vegetable bins, and meat counters
- ▶ cracks and crevices in walls and baseboards
- ▶ under edges and in comers of tables, desks, counters, and other furnishings and equipment, especially tube style table and chair legs or frames
- ▶ indoor and outdoor trash containers, dumpsters, and recycling containers
- ▶ loading docks and storage areas where incoming food, supplies, equipment, and other potential sources of migrating cockroaches are received and stored

When to Inspect

Most inspections are conducted during daylight hours for the convenience of the inspector. However, since cockroaches tend to remain hidden during the day, it is difficult to assess the size and location of a population until after dark. Some individuals schedule at least one inspection after dark, when the majority of the cockroaches are active. This will give you more information about the location of the cockroaches and the level of sanitation at a time when the building is supposed to be clean. Begin your inspection with the lights off, if possible. A flashlight covered with a yellow filter (Roscoe # 12) will prevent cockroaches from being disturbed while you look for their harborages and sources of food and water. Then turn on the lights and examine areas where cockroaches were observed. Note this information on your map.

Flushing

Flushing is a method of locating cockroaches in harborages that are difficult to see or reach. It is usually not necessary, especially if you conduct thorough inspections. If you do encounter situations where flushing is necessary you can use pressurized air (available in an aerosol can) or a hair dryer. A blast of pressurized air will flush the cockroaches from the cracks or crevices. Scattered cockroaches will soon return to the harborage, where they can be monitored and treated.

Monitoring with Sticky Traps

A visual inspection may not provide all the information needed about the location and number of cockroaches, so you may need to use sticky traps as well. Many brands of sticky traps are available, but most have a similar design. They are usually rectangular or triangular cardboard boxes with bands of sticky glue, inside. Some models may contain a dark strip that releases a cockroach attractant. The best sites for traps are near harborages and along cockroach travel routes. Cockroaches may not enter traps placed in the open or outside their normal routes of travel. Initially, it is best to place traps near all suspected harborages, water resources, and travel routes. However, avoid placing traps in extremely dusty or moist areas, because they will quickly lose their stickiness. The more traps that are used the sooner cockroaches can be located. Later, fewer traps can be used for ongoing monitoring. Try to “think like a cockroach” as you decide where to place the traps. Using the site map required by the IPM in School Act and the following examples will help in identifying the best spots.

Trap Locations

Keeping in mind the habitat cockroaches prefer; place traps in the following types of locations:

- ▶ near and under sinks and stoves
- ▶ in or near motors of refrigerators and other appliances or vending machines
- ▶ in or near electric clocks, light-switch plates, and conduits
- ▶ next to computer equipment (where possible)
- ▶ near leaky plumbing fixtures
- ▶ near steam pipes or hot water pipes with insulating jackets
- ▶ near drains
- ▶ in drawers and cupboards
- ▶ in closets, on their floors and upper shelves
- ▶ in false ceiling or sub-floor areas
- ▶ in areas where packaged goods and equipment are delivered and stored

Trap Placement

Cockroaches are *thigmotactic*, meaning they like to be in close contact with surfaces. So it is important that traps be placed against the wall, countertop, etc. and for the opening to be perpendicular to it so a cockroach traveling along the edge of the floor or wall can walk into the trap.

Examples for Trap Placement Include

- ▶ floors and wall junctions
- ▶ floors and cabinets or other solid furnishings
- ▶ floors and appliances (stoves, refrigerators, vending machines)
- ▶ counters and walls
- ▶ hanging cabinets or shelves and walls

Number and date each trap before you put them out. Record on a map drawn for this purpose, the trap locations, so none are neglected later. After 24 to 48 hours, count and record the number of cockroaches in each trap. Record the date, type of cockroach and the number of cockroaches on the monitoring form. If you can not identify the type(s) of cockroach (or other pest), consult with your pest control professional, or with your Rutgers Cooperative Extension County Agent. It is of the utmost importance to correctly identify the pest you are dealing with, in order to know the correct way to manage the pest.

Evaluating Trap Counts

A single building may have several different or unrelated cockroach infestations. These may be of a single species of cockroach or multiple species. For example, a school in rough condition may have American and Oriental cockroaches in the basement and German cockroaches in the kitchens and bathrooms with Brown-banded cockroaches in classrooms and offices. It is important to learn the type of cockroach you are dealing with.

Use the trap counts located on your map to pinpoint sites of infestation.

- ▶ Traps with high numbers of cockroaches indicate nearby harborages, and this is where management efforts should be concentrated.
- ▶ Traps with few or no cockroaches should be moved to other locations until all main harborage areas are pinpointed. For most programs, even one cockroach is enough to start management methods.

Post-Treatment Monitoring to Evaluate Effectiveness

After the initial monitoring to pinpoint sites of infestation, treatment efforts can be concentrated at these locations. A week or two after treatment, traps should again be placed at the infestation sites to see how well management efforts are working. Place fresh traps at the previous locations and count the number of cockroaches in the traps after 24 hours. If the trap catch has dropped considerably, the cockroach population has most likely declined and progress has been made. If not, another treatment strategy should be considered and greater efforts must be made to eliminate food, water, and harborage resources. To assess the continued success of treatments and detect any new infestations, continue to monitor after the IPM program is under way. Vigilance is important, and good record keeping will save time and energy.

Continuous Monitoring

To avoid future infestations, monitoring should be continued on a monthly or quarterly basis. This will alert pest management personnel to a new invasion before a population can become established. Cafeterias and other food-handling locations should be monitored at least once a month because of the constant transport of food and packaging (which may contain cockroaches) into and out of these areas.

Management Options

Education

Food service and custodial staff play an essential part in any successful cockroach management program. Provide them with information on how to maintain cockroach-free kitchens, dining rooms, and waste disposal areas by applying the methods described below. Teachers, students, and other staff can and must play a significant role in maintaining a high level of sanitation in all other areas of the school, so they also must be educated regarding their responsibilities.

Sample IPM Program for a Cockroach Infestation in a Kitchen

- ▶ Use sticky traps to locate cockroach habitat.
- ▶ Lower cockroach populations by vacuuming areas where traps indicate cockroaches are residing. Steam-clean infested kitchen equipment and appliances to remove grease when possible. If necessary, add steam cleaning to your IPM priority list for future budget consideration.
- ▶ Initiate an education program for students, staff, custodians, and building maintenance personnel to gain cooperation.

- ▶ Inspect all incoming items for cockroaches and their eggs. Empty and properly dispose of corrugated cardboard boxes. No item should ever be stored in a school in a corrugated cardboard box.
- ▶ Improve sanitation and waste management procedures to reduce cockroach food sources.
- ▶ Reduce cockroach access to water and habitat by repairing water leaks, caulking cracks, and scheduling other building repairs.
- ▶ Contaminate cockroach water supplies in toilet bowls and drain traps with a small amount of detergent and water at the end of each day. The detergent /water solution will float on the water surface, thus removing a source of cockroach drinking water.
- ▶ If the previous activities have failed to reduce cockroach numbers, apply insecticidal dusts, baits, or gels in cracks and crevices and hard-to-clean areas. Blow boric acid or silica aerogel into wall voids, underneath appliances, or in other inaccessible areas where roaches live.
- ▶ Monitor weekly and fine-tune management methods as needed until the problem has been solved. Continue monitoring monthly or quarterly to ensure that sanitation measures are maintained and to detect any incipient buildup of cockroach numbers. Monitor more frequently during the warmer weather.

Habitat Modification

Cockroaches need food, water, and harborage to survive, with harborage being the primary limiting factor. By modifying the environment of an infested building, you can reduce cockroach access to these resources. Repair leaking pipes and faucets, and caulk all cracks. With good-quality materials and a careful job, these alterations will produce a long-term reduction in the capacity of the structure to support cockroaches. It is important to note that the simple act of increasing the distance between food, water, and harborage will dramatically reduce the number of cockroaches a structure can support.

Limiting Areas for Eating

If you expect to contain and limit pest problems (including rodents and ants, as well as cockroaches), it is very important to designate appropriate areas for eating, and to enforce rules about eating only in these areas. The fewer designated eating areas there are, the easier it will be to limit pests.

Proper Food Storage

- ▶ Food not kept in the refrigerator should be placed in a sealed container. Cardboard boxes and paper are not cockroach-proof.
- ▶ Screw-top jars are cockroach-proof only if the lid has a rubber seal, because young cockroaches may be able to follow the spiral ridges to get into the jar.
- ▶ Glass containers with rubber gaskets or plastic containers with tight-fitting, snap-top lids are cockroach-proof.
- ▶ Remove food products from cardboard shipping containers before moving them into kitchens or storage areas. Transfer food packaged in cardboard or paper to plastic or glass containers as soon as the food arrives in the building. Do not bring shipping boxes into the food preparation area.
- ▶ Advise students and teachers not to leave unsealed food items in their desks or lockers. Any food kept in offices or classrooms should be stored in ant and cockroach proof containers.

Eliminating Water Sources

German cockroaches can survive for a couple of weeks without food but they must have regular access to moisture or they will die within a few days. Cockroaches find drinking water in:

- ▶ sink traps
- ▶ appliance drip pans
- ▶ drain pipes
- ▶ wash basins and tubs
- ▶ toilet bowls and flush tanks
- ▶ spills
- ▶ condensation on cold water pipes and windows
- ▶ leaky pipes and faucets
- ▶ pet dishes and aquariums
- ▶ vases
- ▶ beverage bottles
- ▶ various high-moisture foods
- ▶ houseplant's soil and houseplant overflow pans

Much can be done to limit cockroach access to water by increasing sanitation and making repairs. Clean up spills and dispose of drink containers immediately after use. Keep aquariums and terrariums sealed with tight fitting screened lids. Repair leaks and dripping faucets, then drain or ventilate moist areas. Kitchen surfaces should be kept dry when they are not in use, especially overnight. Contaminate the water available to cockroaches in toilet bowls, drains and traps, in bathrooms and kitchen areas by adding a small amount of detergent to each at the end of the school day.

Sample IPM Program for a Cockroach Population in an Office or Classroom

Initiate an education program for students, staff, custodians, and building maintenance personnel to gain cooperation with the program. Since monitoring and management activities will probably involve desks, computers, lighting fixtures, and other equipment used by staff, it is essential that they be given advance warning that work needs to be done. They also should be made aware that the problem cannot be solved without their cooperation.

- ▶ Place sticky traps to locate cockroach habitat and prioritize areas to be treated.
- ▶ Vacuum areas where traps indicate cockroaches are living.
- ▶ Improve sanitation and waste management in office, snack, and lunch areas to reduce cockroach food sources.
- ▶ Caulk cracks, and schedule other building repairs to reduce cockroach habitat.
- ▶ If traps indicate cockroaches have infested computers or other electrical equipment, place bait stations next to infested machines. Never put baits directly on or inside computers or electrical equipment. Never use aerosol insecticides around computers because of the danger of shorting out the equipment. Give office and custodial staff a map showing where bait stations have been placed and request that the stations not be moved.

- ▶ If traps indicate that cockroaches have infested electrical conduits and are moving into the room through lighting switch plates, spot-treat the switch box with roach baits, gel, or dust.
- ▶ If traps indicate that storage boxes containing paper files are infested with cockroaches, treat with bait stations or tiny gel bait placements.
- ▶ If the previous activities have failed to reduce cockroach numbers sufficiently, apply roach baits, gel, or dust in cracks and crevices, and blow insecticidal dusts into wall voids, underneath counters, or in other inaccessible areas where cockroaches reside.
- ▶ Baits incorporating an insect growth regulator (IGR) will help prevent future cockroach problems.
- ▶ Continue monitoring until the cockroach population has been reduced to a tolerable level.
- ▶ Circulate a memo announcing that the cockroach problem has been solved and thank staff for their cooperation.
- ▶ Continue monitoring on a monthly or quarterly basis to ensure that new infestations are detected early. Remember that monitoring should occur more frequently during the spring and summer months.

Eliminating Cracks and Crevices

Start by caulking where cockroach populations are highest. If cockroaches remain a problem, caulk additional areas.

- ▶ Use silicon or mildew-resistant caulk around sinks, toilets, and drains.
- ▶ Before beginning the sealing process, vacuum and wash the area to eliminate egg cases, fecal material, and other debris.
- ▶ Caulk or paint over cracks around baseboards, wall shelves, cupboards, pipes, sinks, toilets, and similar furnishings in the locations indicated by monitoring traps.
- ▶ Screen drain covers in boiler rooms.
- ▶ Repair holes in window screens.
- ▶ Weather-strip around doors and windows where cockroaches may enter.
- ▶ Where gaps can't be sealed, they can be widened to make them less attractive to cockroaches. For example, the crack between freestanding shelving and adjacent walls can be widened by simply moving the shelving an inch or so away from the wall.

Eliminating Clutter

Removing clutter, especially from areas near prime cockroach habitats such as sinks, stoves, refrigerators, and vending machines is one of the most important components of cockroach management.

Clutter in these areas increases available harborage near food and water. All useless, idle, or outdated items should be removed from the premises. Also, all in-house storage of food products, cleaning supplies, paper and other goods, should be kept to a minimum, and items should never be kept in corrugated cardboard boxes. Part of receiving a shipment should be to unpack boxes and properly store items, after properly disposing of the corrugated cardboard boxes. The best type of shelving for schools is metal shelving on wheels so that they can be moved for regular cleaning of storage areas.

Installing Cockroach-proof Fixtures and Appliances

Whenever food preparation areas are scheduled for remodeling, the school or school district can take the opportunity to install cockroach-proof kitchen appliances and fixtures, such as stainless-steel open shelving units. The round shape of the metal and the general openness of the design offer few hiding places for cockroaches. Freestanding storage units and appliances on casters enable them to be rolled away from walls to facilitate thorough cleaning.

Sanitation

Sanitation disrupts and eliminates cockroach resources. This disruption of the environment can play a significant role in slowing cockroach population growth. Sanitation creates an additional advantage by making the cockroach environment so barren that they have a much greater chance of contacting baits or dusts.

Thorough daily cleaning is essential.

- ▶ Sweep and mop the floors.
- ▶ Drain all sinks and remove any food debris.
- ▶ If children regularly consume snacks in classrooms, vacuum and mop their floors daily.
- ▶ Ensure that corners and similar areas are thoroughly cleaned, mopping with a ‘school-type’ mop will not properly clean corners, around the legs of tables or other free standing equipment, etc ...
- ▶ Periodically, give food preparation areas an all-inclusive cleaning, focusing on areas where grease accumulates; drains, vents, deep fat fryers, ovens, and stoves. Steam-clean drains and infested appliances. Thoroughly vacuum the area with a powerful vacuum cleaner.
- ▶ At the end of each day, remove all garbage containing food from the building to prevent cockroaches from feeding at night.
- ▶ Use soapy water to wash any bottles, cans, wrappings, and other items that have food residues clinging to them before storing them for recycling, preferably outside the building.
- ▶ If dishes cannot be washed immediately, it is very important that they at least be rinsed to remove all food debris.
- ▶ Place garbage in sealed plastic bags before putting it into a rodent-resistant dumpster or other storage receptacle.
- ▶ Keep garbage cans and dumpsters as clean as possible to deny food to cockroaches, as well as ants, flies, mice, and rats. Cleaning of your garbage cans and dumpsters should be done on no less than a quarterly basis, and more often as needed.

Brown banded cockroaches can survive for some time without access to freestanding water, and they can live on soap or the glue on stamps, so simple sanitation alone will not have as significant an impact on a brown banded cockroach population as it will on German cockroaches. Temporary removal of potted plants (a water source) may be necessary. Also consider what cockroaches eat when ‘cleaning’ a room. For a time it may be necessary to remove stamps, soap or glue products.

Physical Controls

Mechanical Barriers

Screens can also be placed behind grill covers and over vents and floor drains to prevent cockroach entry. Use caulk around the edges of the screen material to make a complete seal. Cockroaches can travel within and between buildings on runways formed by electrical conduits, heating ducts and plumbing pipes. Seal openings around these runways with caulk, steel wool, or screening material.

Vacuuming

A strong vacuum can be used to pick up live cockroaches, as well as their egg cases and droppings. A vacuum with a HEPTA filter (capable of filtering out particles as small as 0.3 microns) will greatly reduce the amount of cockroach debris that becomes airborne during cleaning. Airborne cockroach debris (fecal material, body parts, and cast skins) can cause allergic reactions in sensitive people. If the cockroach population is large, vacuuming is a way of quickly reducing the population. Once a large portion of the population has been eliminated, it is much easier to affect the remaining cockroaches with other treatment measures. Although the dust in the vacuum bag will usually clog the cockroaches' breathing apparatus and suffocate them, you can vacuum up a tablespoon of cornstarch to be sure they die.

Trapping

This is not a good option due to cockroach allergens. Although traps will often capture a number of cockroaches, in most situations trapping alone will not produce a sufficient degree of control.

Chemical Controls

At times, non-chemical methods alone may prove insufficient to solve a pest problem. Integrating a pesticide into your management program may be necessary to gain control.

Pesticides must be used in accordance with their EPA approved label directions. Licensed applicators should always wear protective equipment during pesticide applications. All labels and Material Safety Data Sheets (MSDS) for the pesticide products authorized for use in an IPM program should be maintained in a file or logbook designated for this purpose. This logbook or file must be kept within an individual school building, not at a district or other central location, and should always be available to the IPM Coordinator or his/her surrogate.

The law also mandates a 7-hour re-entry period whenever a pesticide without a specific numeric re-entry period is applied. This means that if the label says the treated area cannot be re-entered for four (4) hours then the re-entry period is four (4) hours, if the label says the re-entry period is twelve (12) hours, then the re-entry period is twelve (12) hours. However, if a label does not say what the re-entry period is, then the re-entry period is seven (7) hours. An example would be a product that says re-enter after product has dried and settled, this product would default to a seven hour re-entry period in New Jersey.

When insecticides are needed, they should be applied as crack and crevice treatments or in a bait formulation. Crack and crevice treatment is the application of small amounts of chemical directly into cracks and crevices where insects hide or enter. This type of treatment is particularly effective against German cockroaches, which spend over 90 percent of their day hidden away in dark cracks, crevices, and voids.

Broadcast spraying of insecticides greatly increases exposure risk and can lead to cockroach resistance when the pesticide's residual activity begins to decline and cockroaches are exposed to sublethal doses. This type of general treatment should be avoided whenever possible. Also do not use spray formulation insecticides around computers, because they may short-circuit the equipment. Plastic bait stations can be placed in and around computer equipment if cockroaches establish a harborage inside.

Management Strategies

The most recent technological advances in cockroach management have been in bait formulations and insect growth regulators (IGRs). Other currently used products include desiccating dusts. Each of these treatment methods are discussed in detail below, including how they can be incorporated into a complete integrated cockroach management program.

Cockroach Baits

Cockroach baits consist of a toxicant mixed with a food source. Current indoor bait formulations are applied as bait stations, gels, dusts or pastes. The bait station is one of the more popular application methods for educational facilities because the stations are easy to place and have residual (long-term) activity. Gel and dust bait formulations are also packaged for injection into cracks and crevices that are not readily accessible.

Insect Growth Regulators (IGRs)

Insect Growth Regulators (IGRs) are compounds that disrupt the normal growth and development of insects. IGRs are considered safe compounds. They generally have little toxicity to mammals because they act by disrupting hormonal processes specific to insects.

IGRs that mimic the juvenile hormones of cockroaches (and other insects) are called juvenile hormone analogues (JHAs). JHAs are chemical compounds whose structures are very similar to the hormones that cockroaches produce naturally to regulate development and reproduction. Juvenile hormone analogues disrupt both of these processes. For instance, JHAs interfere with the proper development of cockroaches. Instead of nymphs molting into reproductive adults, they molt into "adultoids," which often have twisted wings and are sterile.

As more and more cockroaches in a population are exposed to JHA, the adultoids become predominant. Because the adultoids are unable to reproduce, the cockroach populations slowly decline over time. JHAs are a very effective method of long-term German cockroach management. However, because JHAs do not kill existing cockroaches, they are slow-acting, taking from 4 to 9 months to achieve management. For this reason, JHAs often are combined with residual insecticides. Most of the population is eliminated by the insecticide, and immature cockroaches that survive are sterilized by the JHA.

Inorganic Dusts

Inorganic dusts, such as silica gel and boric acid, have been used frequently for cockroach management. These dusts can be applied with a bulb duster into cracks and crevices under sinks, stoves, behind refrigerators, along baseboards, and in electrical outlets, cabinets, and wall voids. Silica gel is finely ground sand or glass that adheres to and abrades the protective waxes on the cockroach cuticle, which causes death from dehydration. Boric acid is a stomach poison that is picked up by cockroaches walking across dusted areas. The boric acid adheres to the cockroach cuticle and when the cockroach grooms itself, it ingests the boric acid.

New Jersey law allows pesticide applications in schools by licensed professional pesticide applicators only, or by a licensed pesticide operator working under the direct supervision of a licensed applicator. Even over-the-counter products such as ant & roach sprays, weed killers or weed & feed lawn care products require a license if being applied at a New Jersey school.

Fleas

Fleas can be a problem in all parts of the country except in very dry areas. The most common species in school buildings is the cat flea (*Ctenocephalides felis*). This flea feeds on cats, dogs, and humans, as well as rodents, chickens, opossums, raccoons, and other animals. The dog flea (*C canis*) and the human flea (*Pulex irritans*) are less commonly encountered.

Identification and Biology

Adult cat fleas are small (1/8 inch long), wingless insects with powerful hind legs that are adapted for jumping and running through hair. The adult body is reddish-brown to black, oval, and laterally flattened. Unlike many other flea species, adult cat fleas remain on their host. After mating and feeding, adult female fleas lay oval, white eggs. These smooth eggs easily fall from the host into cracks, crevices, carpet, bedding, or lawn covering. A mature female flea may lay up to 25 eggs per day for three weeks.

Small, worm-like larvae (1/16 to 3/16 inches long) hatch from the eggs in 2 to 12 days. They have a distinct brown head and are eyeless, legless, and sparsely covered with hairs. The larval body is translucent white and a dark colored gut can be seen through the flea's skin. Flea larvae feed on dried blood excreted by adults. They will also eat dandruff, skin flakes, and grain particles. Larvae live in cracks and crevices or on the ground where eggs have fallen. Under favorable conditions, they take 8 to 21 days to develop, but they can take up to 200 days under unfavorable conditions.

Larval fleas eventually spin silken cocoons in which they metamorphose into adults. The cocoons are sticky and attract dirt and debris, which camouflages them. Under optimal conditions, new adults are ready to emerge from their pupal cocoons within two weeks. They can, however, remain in their cocoons up to 12 months in the absence of a host or under unfavorable climatic conditions. Several factors stimulate adults to emerge from their cocoon, vibrations, elevated temperatures and humidity. This ability to wait until a host arrives can result in a sudden increase of adult fleas when they emerge simultaneously from many cocoons.

As soon as the adult fleas emerge from the pupal case, they seek a host from which to take their first blood meal. Adults can live 1 to 2 months without a meal and can survive 7 or 8 months with one. Adults are the only stage that lives on the host and feeds on fresh blood.

The flea population builds up all year long in the form of eggs, larvae, and pupae, but rapid development into biting adults cannot be completed until temperature and humidity are optimal and host cues signal for adult emergence from the pupal cocoon.

Associated Problems

Fleabites cause irritation, and sometimes serious allergic responses in animals and humans. Other, more serious, yet far less common problems are associated with the cat flea. Cat fleas can carry or transmit various organisms, such as *Yersinia pestis*, which causes bubonic plague; *Rickettsia typhi*, which causes murine typhus; and *Dipylidium caninum*, the double-pored dog tapeworm, which can live in dogs, cats, or humans.

Detection and Monitoring

Fleas can be a problem in schools even when no pets are kept in the buildings. Adult fleas can be brought in on the clothing of staff, students, or visitors. Other possible sources include urban wildlife such as rats, feral cats, raccoons, opossums, chipmunks, squirrels, or birds that may live in unused parts of buildings. Detection is as simple as seeing fleas or noticing bites around the ankles of people in the building. Flea dirt, adult flea feces that dries and falls off a host, also may be visible.

Areas to Monitor

- ▶ In and around the cages of pets kept in classrooms (also check the pets themselves for signs of fleas).
- ▶ Places where animals might find harborage, such as basements, crawlspaces, attics, eaves, rooftop structures, and secluded shrubbery near buildings.

Monitoring Traps

Flea Sock Traps

These are homemade, knee-high, white flannel booties that fit over the shoes and lower pant legs. When you walk through a flea-infested area, fleas will jump onto the flannel and become temporarily entangled in the nap where you can easily see and count them. Long, white athletic socks worn over the shoes and trouser legs will also work, as will wide strips of sticky-backed paper wrapped around the lower legs (sticky side out). Socks can also provide protection from bites if a person must enter a severely flea infested area for a short period of time.

Light Traps

These compact traps, roughly 4 by 6 inches in size, consist of a small electric light and a sheet of sticky paper. Adult cat fleas seeking a host appear to be attracted to the warmth of the trap and the light emanating from it. Research has shown that fleas are most attracted to green light and are more attracted to light traps if the light is turned off for 10 seconds every 5 to 10 minutes; therefore, it is important to use a trap with a green light that can flicker on and off.

Light traps are especially useful for monitoring in offices or classrooms where no animals are present and the flea population is likely to be small. Check the traps once a week. If no fleas are caught by the second week, move the trap to another location or remove it. If the traps catch only a few fleas, the infestation is very small and can probably be managed with the traps alone. In this case, leave the traps in place until no fleas have been caught for at least a week. If more fleas are caught per trap in a week, this indicates a more serious infestation, and time must be devoted to finding its source (such as an animal living in or under the building).

Persistent Flea Problems

Persistent flea problems in buildings where there are no pets may indicate the presence of rodents or other wildlife. In this case, it may be helpful to have a professional identify the fleas. A flea's identity can be used to determine the host animal and where to search for the host or its nest.

Management Options

An integrated management program for fleas can be designed by selecting from the following strategies and tactics. See the sample emergency flea management plan below.

Physical Controls

Wild Animal Removal

Wild animals can be trapped by trained animal management technicians. Consult your Yellow Pages or obtain recommendations from your Rutgers Cooperative Extension county agent. Make appropriate repairs to exclude animals.

Vacuuming

- ▶ Vacuuming on a regular basis throughout the year will keep developing flea populations low by eliminating adult fleas and their eggs.
- ▶ Vibrations caused by vacuum cleaners will stimulate new adult fleas to emerge from their pupal sacs. These new adults will be either exposed to any residual insecticide on the floor or captured in the next vacuuming.
- ▶ Vacuuming is not very effective at capturing flea larvae in carpeting because the larvae coil themselves around the fibers. Vacuuming does, however, remove the dried blood on which the larvae feed.
- ▶ Use vacuum attachments to clean cracks and crevices. Caulk or seal these openings.
- ▶ Most fleas will be killed when dust in the vacuum bag suffocates them. To be sure they are killed, you can vacuum up a tablespoon of cornstarch.
- ▶ Vacuum badly infested areas thoroughly every day until the infestation is managed.
- ▶ When infestations are severe, you may need to supplement vacuuming with steam-cleaning or other management tactics.

Steam-Cleaning

The services of a steam-cleaning firm may be warranted when flea populations are severe. This process kills adult and larval fleas and probably some eggs as well; however, since the warmth and humidity from the steam also stimulates the remaining flea eggs to hatch a day or two after the cleaning, some fleas may reappear. If the other steps recommended in this section are followed, the few fleas that hatch after steam-cleaning should represent the last of the flea population.

Flea Combs

Classroom pets in a flea-infested room should be combed regularly with a special flea comb that can be purchased at a pet store. Fleas and eggs removed from the animal should be dropped into soapy water.

Laundry

Wash removable floor coverings, such as rugs, located in areas where there are known infestations. Any bedding for classroom pets should be washed regularly.

Ultrasonic and Heat Devices

It has been suggested that ultrasonic flea collars keep fleas off pets, but recent investigations have shown these devices to be ineffective.

Heat tests have indicated that cat flea larvae die after exposure to 103°F for one hour, and techniques to raise the temperature in a room to provide this exposure have been developed. The heating process uses a common heating unit modified to include special blowers and flexible ducts. Companies have been using heat to kill termites and wood-boring beetles for a number of years, and now some companies are experimenting with heat to manage fleas. One potential problem with this technique is that fleas can burrow into carpets and upholstery, and perhaps escape lethal temperatures.

Drying or Flooding Infested Areas Outside

Outside, organic matter can temporarily harbor flea larvae. Either drying out these areas or saturating them with water will kill eggs and larvae. You can also treat these areas with insect-attacking nematodes (see Biological Controls below) or with an insecticide labeled for outdoor use.

Biological Controls

Beneficial Nematode When pesticide use is needed, careful product selection, good communication with the school's pest control professional, and a realization that risk reduction is more than just product selection are the keys to remember. Insect-destroying nematodes (*Steinernema carpocapsae*) can be applied to the lawn as a spray. These microscopic, worm-like organisms live in the soil and kill insects by entering their bodies, feeding on their tissue, and releasing harmful bacteria. They do not affect people, pets, or plants. When the nematodes mature and reproduce, the nematode larvae leave to search for other hosts. They cannot move far (only 1 or 2 inches) and die if they fail to contact other insects. The nematodes sold for flea management are native to the United States and are found naturally in the soil nationwide. They will not adversely affect earthworms, but may attack insects other than fleas. Nematodes may not be effective in some situations and may also require monthly applications (Mallis,1992).

Tips for using Nematodes

- ▶ Use the number of nematodes recommended by the manufacture
- ▶ Treat outdoor areas where you have found evidence of sleeping animals or areas that you know are regularly traveled by animals
- ▶ Moisture is critical to the effective use of nematodes, so water before and after the application

Chemical Controls

At times, non-chemical methods alone may prove insufficient to solve a pest problem. Integrating a pesticide into your management program may be necessary to gain control.

Pesticides must be used in accordance with their EPA approved label directions. Licensed applicators should always wear protective equipment during pesticide applications. All labels and Material Safety Data Sheets (MSDS) for the pesticide products authorized for use in an IPM program should be maintained in a file or logbook designated for this purpose. This logbook or file must be kept within an individual school building, not at a district or other central location, and should always be available to the IPM Coordinator or his/her surrogate.

The law also mandates a 7-hour re-entry period whenever a pesticide without a specific numeric re-entry period is applied. This means that if the label says the treated area cannot be re-entered for four (4) hours then the re-entry period is four (4) hours, if the label says the re-entry period is twelve (12) hours, then the re-entry period is twelve (12) hours. However, if a label does not say what the re-entry period is, then the re-entry period is seven (7) hours. An example would be a product that says re-enter after product has dried and settled, this product would default to a seven hour re-entry period in New Jersey.

New Jersey law allows pesticide applications in schools by licensed professional pesticide applicators only, or by a licensed pesticide operator working under the direct supervision of a licensed applicator. Even over-the-counter products such as ant & roach sprays, weed killers or weed & feed lawn care products require a license if being applied at a New Jersey school.

FLIES

Many species of flies can be problems in schools. Each kind of fly has a distinct breeding site inside or outside the school building. To manage pest flies, you must know which fly is causing the problem and where it is breeding.

Garbage and Manure Breeding Flies

Identification and Biology

House flies, dump flies, blue and green bottle flies, and others that breed in food wastes (garbage) and or animal feces generally are referred to as “filth flies”. Sometimes flies are confused with wasps, however, flies have two wings, while wasps and all other winged insects have four wings arranged in two pairs. Wasps, unlike flies, fold their wings alongside their bodies when at rest. Most pest wasps are colorfully marked with yellow, red, black, and white, and have narrowly constricted waists. Generally, wasps are less likely to come indoors, and are aggressive in their flight around foods, particularly sweets, and are larger than filth flies. Filth flies are not aggressive and do not bite. The cluster fly, which is larger than filth flies, can be identified by its stout body and crinkled yellow hairs.

Filth flies pass through four distinct stages in their life cycle: egg, larva (maggot), pupa, and adult. Adult female filth flies look for moist places with the right smell to lay their eggs. This can be in food waste in a garbage can or dumpster, in dog or cat feces, in dead animals, in kitchen drains, in grass clippings allowed to rot in a pile, and even in moist soil that is mixed with garbage. The larva hatches from the egg and grows until it is ready to form a puparium (a kind of cocoon), from which an adult fly will emerge. Once the adult fly emerges, it doesn’t grow any larger; small flies do not grow into larger flies.

Damage

Flies that invade cafeterias and kitchens are not just a nuisance, they also carry bacteria and other microbes that can contaminate food, utensils, and surfaces.

Detection and Monitoring

It is important to correctly identify the problem flies and pinpoint their breeding sites. Specimens can be taken to a Rutgers Cooperative Extension county office for assistance with identification.

To collect specimens inside, use sticky flypaper or gather dead specimens from windowsills and light fixtures. Outside, trapping is one of the easiest methods of catching flies for identification. If adult flies consistently avoid baited traps, the pest fly may not be a filth fly.

Management Options

To manage flies, you must find and reduce breeding sites, install and maintain screens to keep flies out of buildings, kill those flies that do get inside with a fly swatter or flypaper, and reduce or eliminate the odors that attract flies.

In a school with a frequent waste removal program, it is very possible that few flies are breeding on the school property. It is more likely that odors from dumpsters, garbage cans, kitchens, and cafeterias are attracting flies to the school from the surrounding neighborhood. House flies and blow flies, the species that most commonly invade buildings, usually develop outside and follow odors into the building. They can also be pests when students or staff are eating outside. In schools where waste removal is infrequent, fly populations can be breeding at the waste collection site.

Habitat Modification

Modifying habitat is one of the most important aspects of fly management. It is impossible to manage filth flies without controlling wastes and odors.

Food Waste

- ▶ All food waste from the kitchen, cafeteria, and other areas should be separated from other garbage, drained so it will be as dry as possible, and then stored in sealed plastic bags before discarding.
- ▶ Place containers with small amounts of food waste, such as milk or yogurt cartons, into sealed plastic bags before disposal. This will reduce access by flies.
- ▶ 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 the broken drain, and then clean the area thoroughly.

Other Garbage

In food preparation areas, rinse all cans, bottles, and plastic containers before recycling or discarding.

Exterior Garbage Cans and Dumpsters

- ▶ Inform students, teachers, and staff about the importance of placing garbage inside the proper containers. Garbage should not be left lying on the 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. When dumpsters are downwind, flies are attracted to the waste odors and then find the odor trails that the breeze blows down from the doorways. Following these odor trails, they find their way into the building.
- ▶ Wastes should be collected and moved off-site at least once a week. Since flies breed faster in warm weather, garbage collection twice a week may significantly reduce fly problems.

- ▶ Make sure garbage can and dumpster lids seal tightly when closed and remain closed when not in use. Do not leave lids open at night; garbage can attract other pests, such as rodents. Repair or replace garbage cans that have holes or lids that do not close tightly.
- ▶ Regularly clean garbage cans and dumpsters to prevent the buildup of food waste. Use a high-pressure stream of water or a brush and soapy water, if necessary. A solution of borax and water will eliminate odors. Do not allow soured milk to collect in trash receptacles; it is a powerful attractant to flies. If possible, dumpsters should be fitted with drains so they can be hosed or scrubbed out as needed. Another option is to require the refuse company to clean the dumpster or replace it with a clean one more frequently. Some pest management companies will power-wash dumpster and dumpster areas as part of their service.
- ▶ Flies can develop in soil 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.
- ▶ Inspect dumpsters and other outdoor trash receptacles daily, and remove any wastes lying on the ground.
- ▶ Garbage cans on the school grounds should have removable domed tops with self-closing, spring-loaded swinging doors. Cans should be lined with plastic bags that can be tightly sealed and removed daily.
- ▶ If children do not have access to dumpsters, baits inside and residual insecticides on the outsides of dumpsters work well.

Animal Feces

Remove droppings promptly and put them into plastic bags that are sealed before disposal. Dog feces that dry quickly may attract adult flies with their odor, but are unlikely to host many maggots. Droppings that remain damp because of humidity or rain can breed a number of maggots.

Odor

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. Storing garbage in sealed plastic bags and having cans and dumpsters cleaned and emptied frequently to eliminate odors is very important. Removing pet feces also helps to reduce odors that attract flies.

Flies attracted to open kitchen or cafeteria doors, or to dumpsters or garbage, will rest on nearby walls, eaves, and rafters. While resting, they leave fly-specks, which have a strong fly-attracting odor. These brown-to cream colored specks should be washed off with an odor eliminating cleaner (a mild solution of borax and water can be particularly effective); otherwise, they will continue to attract flies.

Physical Controls

Screens

Install screens over windows, doors, and vent holes to prevent flies from entering buildings. Weather-stripping or silicone caulk can be used to ensure a tight fit. Torn screens can be repaired

with clear silicone caulk. Screen doors should be fitted with springs or automatic-closing devices that close the screen door firmly after it is opened. External doors that cannot be screened should be fitted with automatic closing devices, or vertical strips of overlapping plastic that allow human access but prevent fly entry. “Air curtains” that force air across openings are another alternative to screen doors.

Fly Swatters

In many instances, the old-fashioned fly swatter is the safest and quickest way to kill flies that have found their way into a room. Aim the fly swatter about 1.5 inches behind the fly, rather than directly at it, because research has shown that when a housefly takes off from a horizontal surface, it jumps upward and backward. Stiff plastic swatters seem to work better than wire-mesh ones. The fly's unblurred range of vision is about 1.5 feet, and the swatter can be moved to this distance before striking.

Flypaper

Sticky flypaper is effective at catching flies because it takes advantage of their natural habit of moving up to the ceiling to rest. It will take several days for a new strip of flypaper to start catching flies. Use a number of strips at a time and replace them when they are covered with flies or when they begin to dry out. Flypaper can be very useful in areas where there are too many flies to kill with a fly swatter, and where aesthetic appeal is not of primary importance. Flypaper is also a useful monitoring tool. Do not place flypaper or sticky strips above or near food preparation areas.

Fly Traps

Flytraps can be used to reduce adult fly populations, capture specimens for identification, and monitor the effectiveness of management programs. Flytraps are not toxic and are more selective than using insecticide. Traps need to be serviced regularly, placed appropriately, and repaired or replaced when damaged. Check the **IPM for Pennsylvania Schools ‘A How To Manual’** (a major resource for this manual) for flytrap details.

Trapping Flies Indoors

Electrocuting light traps are often used indoors. The Food and Drug Administration states that they should be “installed no closer than 5 feet from exposed items”. Light traps will not work well in a room with very large or too many windows, because the bright light coming in the windows is a much more powerful attractant than the comparatively weak light coming from the trap. Light traps do work well at night.

Some companies are now producing fly traps that lure the flies to a hidden glue board with a near-UV black light specially designed to attract flying insects. These were developed for cafeterias, fast food operations, and school lunchrooms.

Contrary to the advice provided in some promotional literature for ultraviolet light or electrocution traps, these traps should not be used outdoors. They are relatively nonselective in the insects they attract and will kill many more beneficial and innocuous insects than pests.

The following are key points to remember when using light traps for indoor flies:

- ▶ Use the number of traps recommended by the manufacturer, or as a general rule, one trap for every 30 feet of wall.
- ▶ Ideally, traps should be mounted 3 feet from the floor on the perimeter walls of the room, because hungry flies circle the perimeter of a room close to the floor when looking for food. They should also be placed 5 feet away from any open food and 25 feet from any doors or windows. Traps work best in rooms without windows. A pest management professional can help with trap placement recommendations.
- ▶ Empty and clean the traps weekly to prevent dead flies from becoming an attractive food source for other insects
- ▶ Replace lamps (the light bulb) at least once a year, because they lose their effectiveness
- ▶ The more expensive black light "blue" bulbs do not attract more flies than regular black light bulbs
- ▶ The lamp should be directed towards the interior of the building. Do not place traps where flies from the outside can see the light bulb. This may attract more flies
- ▶ Place traps near odor sources such as cooking areas, garbage cans and outdoor restrooms, since odors will be more attractive (especially from a distance) than the light.

Fruit Flies, Cluster Flies, Phorid Flies, Moth Flies

Identification and Biology

Fruit Flies

Fruit flies are small flies commonly seen flying around ripe fruit. They are about 1/8 inch long. They lay their eggs near the surface of fermenting fruits and vegetables and other moist organic materials (including damp mops and cleaning rags, as well as residues in bottles, cans, and drains). Their life cycle, from egg through maggot and pupa to adult, takes little more than a week, and the number of flies that can be produced by a single piece of fruit is enormous. These flies are most often a problem in late summer and early fall, so careful storage of fruit and vegetables is necessary at these times of the year.

Cluster Flies

Cluster flies are larger and darker than house flies, and have a distinctive yellowish color caused by the crinkled yellow hairs on their bodies. In the summer, cluster flies lay their eggs in soil, where the maggots parasitize earthworms. Soil containing many earthworms is a common source of these flies. In the fall, the adults can be seen clustering on the south and west sides of buildings. As the weather gets cooler, these flies begin looking for sheltered places to spend the winter and often enter buildings.

Phorid Flies (*Humpbacked Flies*)

The most common phorid fly, *Megaselia scalaris*, is small (1/16 to 1/8 inch long) with a yellowish-brown body and light brown wings. The adults seem reluctant to fly, and they run

around on walls, windows, and tables with a characteristic quick, jerky motion. The females are strongly attracted to odors and lay their eggs on or next to decaying material, both plant and animal. Food sources for the larvae are highly varied, from decomposing fruit, vegetables, and meat to open wounds in animals and people to human and animal feces. The life cycle from egg to adult takes from 14 to 37 days.

Moth Flies (*Drain Flies*)

Moth flies (*Psychoda spp.*) are about 1/16 to 1/4-inch long, fuzzy, dark or grayish insects. Their body and wings are densely covered with hairs. Wings, appearing too large for the body, are held roof-like over the body when at rest, giving a moth-like appearance. During the day, adults often rest in shaded areas or on walls near plumbing fixtures and on the sides of showers and sinks. During the evening, these flies can be seen walking about drains and sinks.

They may breed in large numbers at sewage filter plants and then be carried by prevailing winds to nearby buildings up to a mile away. Adults are small enough to pass through ordinary window screening.

Management Options

Fruit Flies

Fruit flies are most active from early summer through early fall. Problems with these flies can be avoided by ripening fruit in paper bags. Seal the bags by folding the top over several times and closing them with paper clips or clothespins. Once fruit is ripe, store it in the refrigerator. Careful storage of fruit during the rest of the school year may not be necessary.

If an infestation is discovered, look for and remove the material that is breeding the flies. Begin by searching for the obvious sources, such as ripe fruit and vegetables, then look at water from refrigerators, humidifiers, or sink drains that may be fermenting; spoiled animal food; or even damp, sour mops or rags. Areas outside the building near windows and doors should be checked for rotting vegetable matter. All breeding sources should be removed and disposed of in a sealed plastic bag. Make sure that screens and windows near food preparation areas are in good repair.

Fruit Fly Trap

To make a simple trap for fruit flies, combine 1 cup of vinegar, 2 cups of water, and 1 tablespoon of honey in a 2-liter soda bottle. Replace the cap, shake the mixture well, and punch holes in the side of the bottle above the liquid so the flies can get in. Using string, hang the bottle about 5 feet above the ground. Periodically, the dead flies should be strained out and the liquid reused.

Cluster Flies

Cluster flies are not as strong fliers as house flies and can easily be killed with a fly swatter or removed with a vacuum. Cluster flies also can be allowed to exit by opening the window. They can find their way into buildings through unscreened doors and windows, openings under siding and around roofs, unscreened ventilating spaces, cracks around windows, and holes where wires

penetrate the walls of the building. During warm winter periods, cluster flies hidden in buildings become active and are attracted to windows.

Phorid Flies

Phorid flies breed in diverse sources of organic matter, so it may take considerable sleuthing to find their breeding sites. Once a site is found, it must be thoroughly scraped, cleaned, and dried. Large infestations of these flies are often the result of broken drains or garbage disposals that allow organic matter to accumulate in out-of-the-way places such as wall voids, under floors, in basements, or in the soil of crawl spaces.

Moth Flies

Moth flies do not bite humans, but may become a nuisance by their presence in large populations. Concentrate on eliminating larval breeding sites from drains in floors, sinks, wash basins, showers, and similar places. To determine if the flies are coming from a drain, place a glue board, sticky side down on a collar made of cardboard, over the drain during a down time. Leave in place overnight or for a few days to monitor for the flies.

Often the most effective method is to clean the drain pipes and traps regularly to eliminate the gelatinous, rotting organic matter, thus eliminating the larval food source. Infestations developing in drains often can be eliminated by flushing these areas with sink cleaning materials followed by very hot water. Clean dirty garbage containers, standing water in air conditioners, or other sources of stagnant water in the area.

Borates

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.

Chemical Controls

At times, non-chemical methods alone may prove insufficient to solve a pest problem. Integrating a pesticide into your management program may be necessary to gain control.

Pesticides must be used in accordance with their EPA approved label directions. Licensed applicators should always wear protective equipment during pesticide applications. All labels and Material Safety Data Sheets (MSDS) for the pesticide products authorized for use in an IPM program should be maintained in a file or logbook designated for this purpose. This logbook or file must be kept within an individual school building, not at a district or other central location, and should always be available to the IPM Coordinator or his/her surrogate.

The law also mandates a 7-hour re-entry period whenever a pesticide without a specific numeric re-entry period is applied. This means that if the label says the treated area cannot be re-entered for four (4) hours then the re-entry period is four (4) hours, if the label says the re-entry period is twelve (12) hours, then the re-entry period is twelve (12) hours. However, if a label does not say

what the re-entry period is, then the re-entry period is seven (7) hours. An example would be a product that says re-enter after product has dried and settled, this product would default to a seven hour re-entry period in New Jersey.

Except for odor-eliminating chemicals (such as borax) and baits, pesticides are not recommended for fly management. However, where children do not have access to dumpsters, baits inside and residuals on the outsides of dumpsters work well.

New Jersey law allows pesticide applications in schools by licensed professional pesticide applicators only, or by a licensed pesticide operator working under the direct supervision of a licensed applicator. Even over-the-counter products such as ant & roach sprays, weed killers or weed & feed lawn care products require a license if being applied at a New Jersey school.

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Silverfish, Firebrats And Booklice

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

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

Silverfish And Firebrats

Identification and Biology

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

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

Characteristics of the Silverfish:

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

Characteristics of the Firebrat:

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

Booklice (*Psocids*)

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

Characteristics of the Booklouse:

- ▶ has a life cycle from egg to adult lasting about 110 days
- ▶ prefers warm, moist conditions that are conducive to the growth of mold and mildew and require humidity of at least 60 percent
- ▶ found in books and paper products
- ▶ sometimes found on houseplants, where they may be feeding on honeydew (a protein-rich substance excreted by plant-eating insects such as aphids), or more likely, on the sooty mold that grows on the honeydew

Detection

Silverfish are found in bookcases, on closet shelves, behind baseboards, and in wallpaper, window or door frames, wall voids, attics, and sub-floor areas. They prefer bathrooms and kitchens because of the moisture. Firebrats will be found in similar but warmer areas. Both silverfish and firebrats molt as many as 50 times during their life, so the appearance of cast skins can be used to detect their presence. Booklice prefer damp and warm habitats, so they are most numerous during the spring and summer. New buildings are not immune to booklice infestation.

If you suspect that damage to books, carpets, curtains, or other materials is due to silverfish or firebrats, confirm your suspicions using the following test:

- ▶ Mix flour and water to the consistency of house paint.
- ▶ Coat one or more 3-by-5-inch index cards with the paste.
- ▶ Let the cards dry, and place them where you have spotted the damage.
- ▶ If silverfish or firebrats are in the vicinity, they will be attracted to the card and will feed on the paste. Characteristic feeding marks appear as minute scrapings in irregular patterns. In addition, the edge of the card may be notched.

If you see groups of small, whitish insects in damp areas, suspect booklice, particularly if mold is present or the area smells moldy. Remember that booklice are considerably smaller than silverfish, and lack the telltale three long bristles at their hind end.

Silverfish, firebrats, and booklice also can be detected by placing sticky cockroach traps in the area where damage is occurring. When the insects are caught they should be preserved in alcohol for professional identification.

Management Options

Physical Control

Dehumidifying

Booklice, silverfish, and firebrats are living indicators of excessive moisture. If the moisture is not eliminated, it may bring more serious problems, such as termites, carpenter ants, and wood rot.

Dehumidifying reduces the moisture content of the air. Some methods for dehumidifying an area include:

- ▶ Mending leaking pipes.
- ▶ Ventilating closed rooms and attics.
- ▶ Eliminating standing water.
- ▶ Using a dehumidifier.
- ▶ Replacing any single-glazed windows that repeatedly accumulate condensation with double-glazed windows.
- ▶ Using anhydrous calcium carbonate or silica gels to absorb free moisture. Do not use these agents in areas open to children.

Drying Stored Articles

Periodic airing and drying of articles stored in damp areas may help reduce the mold on which booklice feed. Disposing of moldy articles is often the simplest way of removing an infestation in an area.

Chemical Controls

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Head Lice

Few conditions seem to cause as much concern and anxiety in schools and homes as an infestation of head lice in the hair of children. Many people associate head lice with filth, but in reality these insects do not discriminate according to social class or level of personal hygiene.

Lice are parasites of humans. Three types of lice can infest humans: head lice, body lice, and crab lice. This section deals primarily with *Pediculosis humanus capitus*, the head louse.

Remember: Head Lice on a student is a medical problem and as such should be treated by a doctor. An IPM Program should almost never make a treatment for head lice.

Identification and Biology

Head lice (*Pediculosis humanus capitus*) are wingless insects measuring about 1/8 inch long. They are flat and gray-brown in color, with special mouth parts for piercing and sucking. Their laterally positioned eyes are small, and the female is generally larger than the male. Adult lice have six legs with large tarsal claws, which enable them to cling to hair shafts of a host.

Lice are unable to jump or leap from victim to victim, but adults and newly hatched nymphs can move rapidly from hair shaft to hair shaft. They live their entire life as an external human parasite. They do not survive for more than one or two days without a blood meal.

Eggs of lice, called nits, are glued to hairs of the head near the scalp, especially near the ears and on the back of the head. A female can lay 8 to 10 eggs per day and a total of 50 to 100 eggs during her life. Usually the nits hatch in 7 to 10 days, leaving behind empty shells attached to the hairs. (Unhatched nits are clear in color, hatched or empty nits are milky in color, with a missing top). The young lice must feed within 24 hours, or they die. It takes about a week to 12 days for lice to become adults.

When lice feed on human blood, they inject their saliva into the host to prevent clotting. Meanwhile, they deposit fecal material onto the scalp. People previously unexposed to lice usually experience little irritation from their first bite. After a short time, some individuals become sensitized to the bite and experience a general allergic reaction, which may involve reddening of the skin, itching, and general inflammation.

Body Lice

(*Pediculosis humanus corporis*) are practically indistinguishable from head lice. The chief features distinguishing them are:

- ▶ Body lice attach eggs to clothing fibers instead of hair.

- ▶ Adults and nymphs spend most of their time on clothing. They move to the skin to feed and are most numerous where clothing is in continuous close contact with the body, such as at the armpits and belt line.
- ▶ Clothing plays a greater role in the transmission of body lice. Body lice survive longer off the host (4 - 10 days) than head lice, eggs also survive longer off the host (up to 30 days).
- ▶ Body lice are unlikely to become permanently established on a host who maintains good personal hygiene, including regular changes to clean clothing.

Crab Lice

(*Phthirus pubis*) are shorter (about 1/16 inch long) than the other lice, are oval in shape, and have greatly enlarged second and third pairs of legs with large claws.

Other epidemiologic features are:

- ▶ Crab lice mainly infest pubic hair; they occasionally infest other coarse hair, axilla, eyelashes, eyebrows, mustache, or beard.
- ▶ Eggs are always attached to hair.
- ▶ Clothing plays an extremely small role in transmission. When separated from the human host, crab lice die in less than 24 hours.
- ▶ Transmission is almost always venereal; on occasion, indirect transmission occurs from clothing, bedding, and towels.

Chemical Controls

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Spiders

Despite their small size, spiders have evoked fear and revulsion in humans throughout history. Nursery rhymes and horror films malign them, but fears about spiders are largely unwarranted since most spiders are too small or have venom too weak to harm humans. In fact, they provide a great benefit to mankind by consuming vast numbers of insects in and around our homes and schools.

Spiders have 8 legs and 2 body regions, the cephalothorax (a head joined with a thorax) and abdomen. They lack wings and antennae. Almost all spiders have fangs and venom but only a few are considered dangerous to humans, so it is important to be able to differentiate between relatively harmless spiders and those that should be avoided and or controlled.

The species of spider that causes the most concern in the home or school environment is the black widow spider. Since there have been reports of the brown recluse spider being found in New Jersey, some information concerning it will be included. Both of these spiders are potentially dangerous to humans, and their bites may cause severe reactions or even death. However, these spiders usually will bite only if provoked, and then only under certain circumstances.

Other spiders that may produce painful bites or be of health importance may be grouped as:

- ▶ Active hunters: some wolf spiders, jumping spiders and sac spiders.
- ▶ Web builders: some cobweb spiders and funnel weavers (Mallis, 1997).

It is prudent to use caution when handling any larger spiders, even though most are harmless. Generally, spiders are not aggressive. Most bites occur when a spider accidentally becomes trapped against the skin or when a person picks it up.

Removing a Relatively Harmless Spider

Most spiders found in and around a school can be used as an educational opportunity to teach some interesting facts about these fascinating creatures. If any spider found in the classroom creates anxiety on the part of the teacher or children, and the teacher wishes to remove it, invert a container of some sort over the spider, slide a stiff piece of paper over the mouth of the container, and then release the spider outside.

General Spider Management

You can manage the number of spiders in an area by reducing their food supply. If flies are getting in, screens should be installed or repaired. Security lighting may attract insects at night, and spiders feed on them, so outside lighting should not be placed directly over a doorway. Insects also may be attracted to poorly stored food or mishandled organic wastes. Eliminating the food source for these insects will reduce the food source for the spiders.

Removing debris and excess clutter also will reduce the number of harborage sites available. Debris and stacks of wood, pallets, blocks, and similar materials should be moved a distance from schools and elevated off the ground as much as possible. Vegetation should be removed

from the sides of buildings and grass should be kept mown. For spiders already in residence, removing their webs and egg sacs discourages subsequent infestation. In most cases, vacuuming and reducing the spiders' food source will be sufficient to manage the problem.

The two potentially dangerous spiders, the black widow and the brown recluse, nest in undisturbed areas, often near the floor (but not always) so thorough vacuuming in these areas from time to time may also help in their control.

Black Widow Spiders

Identification and Biology

There are several species of widow spiders in the United States, but the black widow (*Latrodectus mactans*) is the only native species found in New Jersey.

Southern black widow *Latrodectus mactans* is found in southern New England states to Florida and west to eastern Oklahoma, Texas and Kansas and is more common in the southern range.

The Northern widow (*L. variolus Walckenaer*) is found in New England and adjacent Canada south to Florida, and west to eastern Texas, Oklahoma and Kansas, and is more common in the northern part of the range.

The adult female black widow is normally a shiny, jet-black spider about 1/2 inch in body length. With legs extended, the female measures about 1.5 inches long. The female has the well-known reddish hourglass marking on the underside of her abdomen. Because their webs are near the ground and the spiders hang upside down in the web, their distinctive marking is readily apparent. The adult male, which is not dangerous, is small (about 1/6 inch long) and patterned with black and white body markings.

Black widows like dry, undisturbed places, such as lumber and rock piles, stacked pots or baskets, rodent burrows, water meters, the underside of bricks and stones, and dry crawl spaces. Females stay in the web.

The female black widow spider spins an irregular, tangled web. The webs are typically constructed in quiet, undisturbed locations that are usually, but not always, close to the ground. The female spends her entire life in the web. If disturbed she may drop to the ground to escape. Her eggs are placed in white, spherical sacs within the web. After hatching, the young spiders stay near the sac for a few hours to several days, and then climb to a high point, wait for suitable air currents, and spin a silken thread so they can float on the breeze like a kite. This method of "ballooning" distributes them over a considerable distance. Once they land, the spiders begin to construct their own webs. The abdomen of a young black widow is patterned with red, white, and yellow, but has the black legs and general appearance of the adult.

Bites

Black Widows are shy, retiring creatures that bite reluctantly, and then only in self-defense when threatened. However, when a female is defending her egg sac, she can become quite aggressive.

A bite may not cause pain at first. However, after a few minutes, the bite site becomes quite painful. Symptoms from the bite of a black widow include headache, general body ache, nausea, chills, slight fever, shortness of breath, intense muscle pain, and rigidity of the abdomen and legs. Seek medical attention. If reactions are mild, treatment usually is not administered. However, medicine is available if symptoms do become severe. The bite of the black widow is usually more serious for a small child or an elderly person.

Detection and Monitoring

Monitor for black widows at night with a flashlight or headlamp. This is the time when they move to the center of their webs and will be most visible. When making your inspections, focus on areas that are dark and undisturbed during the day, but not necessarily close to the ground.

Look In and Around the Following Places:

- ▶ small crevices anywhere from the foundation to the eaves of buildings
- ▶ the undersides of outdoor wooden furniture (for example, beneath the seats in the corners where the legs are braced)
- ▶ piles of wood, bricks, stones, or similar materials
- ▶ the openings of rodent burrows
- ▶ water meters
- ▶ cellar doors
- ▶ outhouses
- ▶ storage rooms

Black widow webs have high tensile strength and, with a little experience, can be identified by the way they “pop” when broken. An experienced pest control professional can use this information to find webs during the day.

Brown Recluse Spiders

Identification and Biology

Brown recluse spiders (*Loxosceles spp.*) are extremely uncommon in New Jersey and probably are found only in boxes brought in from the south. One species, *Loxosceles rufescens*, may be found in basements and utility tunnels. Brown recluse spiders, *L. reclusa*, are identified by their long, thin legs, an oval-shaped abdomen that is light tan to dark brown in color, and a very distinctive violin-shaped mark on their back. This marking, with the violin “body” near the eyes and the “stem” of the violin extending backwards gives rise to their other common name, violin spiders. They have six eyes in three groups of two. Their overall size is $\frac{3}{4}$ inch to $1\frac{1}{4}$ inches long with the legs extended. The males are slightly smaller than the females.

As the common name “recluse” suggests, these spiders are shy, retreating from humans when possible. They prefer to build their webs in dark, undisturbed places on or near the ground. Unlike the black widow, brown recluse spiders hunt for prey some distance from their webs. They usually come into contact with humans because they have taken temporary refuge in clothing or bedding. Items left lying undisturbed on the floor, such as supplies, toys, or clothing, are perfect daytime refuges for these spiders. Such objects should be shaken out thoroughly if

they have been on the floor for any length of time, particularly in regions where the brown recluse is prevalent.

Bites

Brown recluse spiders avoid areas of human activity. Bites are rare and are usually the result of unused rooms suddenly being put to use, or accidental contact resulting from pressing the spider between the body and either clothing or sheets. The bites are almost always very unpleasant, producing an ulcerous wound called a necrotic lesion that turns dark within a day and takes a long time to heal. Young children the elderly and the infirm are most likely to be affected severely. Victims should seek medical attention.

Detection and Monitoring

The brown recluse spider wanders at night searching for prey. It seeks dark, uninhabited areas for protection. Brown recluse spiders usually are found on floors and baseboards. Only rarely are they seen on desks and tables.

Searches for this spider should concentrate on uninhabited areas close to the floor, particularly in boxes, around piles of paper, clothing, and debris, in closets, and under furniture. Periodic outdoor checks should focus on storage sheds, piles of debris or wood, cracks in the soil or in foundations, walls, and window wells, especially if small children play near these places. Employing sticky traps in monitoring is useful in establishing the extent of brown recluse infestations, and also is helpful in providing a measure of control.

Avoiding Spider Bites

If either of these spiders is found around your school, it is important to be cautious when working near these places. Gardeners and custodians should be careful about where they put their hands when doing outdoor work, and wear gloves and a long-sleeved shirt when working around woodpiles and other items stored outdoors that are likely to harbor the spiders.

Make sure students and staff can identify any dangerous spiders in your area and know their likely nesting and hiding places. Children should be taught not to tease spiders in their webs or poke at them, and not to put their hands in dark crevices without looking first. The dangers of spider bites should be explained without exaggeration to avoid unnecessary fears. Teach students and staff that black spiders they see walking around are not likely to be black widows, since the females do not travel away from their webs and the males are not dangerous.

Other Spiders of Concern

Wolf Spider (Lycosidae)

These large spiders are sometimes found indoors in basements in late summer and fall when cooler temperatures arrive. They do not construct webs, but run rapidly after prey. They are not aggressive, but may bite if handled. The bite is generally not dangerous.

These and other spiders are best managed by cleaning and exclusion. Keep screens in good repair, fix gaps around doors, and caulk cracks around window frames, as well as around pipes and wires coming into the building.

Jumping Spider (*Phidippus audax*)

These spiders move in jumps or short rapid runs. They are hairy, stocky, and about ½ inch long. This species is black with spots of orange or red on the top surface of the abdomen. At times, they are confused with black widow spiders, which are not at all hairy. Active during the day and usually outdoors, sometimes they are found inside on walls, windows, and screens. They can bite. Generally, they do not appear in large numbers and can be removed individually.

Yellow Sac Spider (*Chiracanthium spp.*)

These spiders have been associated with numerous cases of spider bites and cause a small irritating spot, which may not heal for 8 to 10 days. They are suspected of being responsible for most indoor bites (Lyon, 1995).

This yellow spider, which is about ¼ to ¾ inch long, may have a greenish tinge to the abdomen. The jaws are brown and the legs are very smooth, with the front legs longer than the rear. The egg sac is a white, paper-like disk usually placed in a protected area, such as under a stone.

They enter buildings principally in the early fall and are active for several months. They make small white webs in confined spaces where they spend the winter. In spring, they usually emerge from their white web cells and find their way outside. Outside, they do not build webs but instead construct a flat tubular sac opened at both ends inside rolled leaves or crevices, or under loose bark or stones.

Chemical Controls

At times, non-chemical methods alone may prove insufficient to solve a pest problem. Integrating a pesticide into your management program may be necessary to gain control.

A wide variety of chemicals are available for the control of spiders. However, misapplied chemical treatments may cause more harm than real or perceived threat from spiders. Also crack and crevice treatments may be necessary for the hunting spiders.

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Yellowjackets and Hornets

Yellowjackets and hornets are both beneficial and problematic wasps. They are important predators and scavengers, helping to manage pests and recycle organic materials, but they can also sting humans and their pets. Although often grouped together with bees, yellowjackets pose a more serious threat to people. Yellowjackets can sting repeatedly, while a bee can sting only once. Multiple stings from yellowjackets are common, because they aggressively defend their nest when it is disturbed.

Identification and Biology

Yellowjacket and hornet are the common names given to wasps in the *genera Dolichovespula, Vespula, and Vespa*; but for the sake of simplicity, the term yellowjacket will be used. Note that these common names are not reliable indicators of whether or not they are pests.

Yellowjackets are relatively short and stout, and hold their legs closer to their bodies than other wasps do. Paper wasps are more slender and have long dangling legs. All yellowjackets are black and either yellow or white. They are rapid fliers, and are more aggressive than other types of wasps. Their nests are always enclosed with a paper envelope and can be found in the ground, hanging from eaves or tree branches, and occasionally in wall voids.

The queen begins her nest by building a small comb of chewed wood. She lays eggs in the cells and, after the eggs hatch, tends the larvae herself. Once the larvae develop into adult workers, they expand the nest into tiers, built one on top of the other. In the late summer or early fall, males and new queens are produced. After mating, the queens seek a sheltered place to spend the winter and all the workers die. The nest is not reused and eventually disintegrates.

Early in the warm season, colonies are small and yellowjackets are usually not a problem. Later in the season, when colonies are at their peak, these insects become pestiferous. In their search for protein and carbohydrate sources, they are attracted to garbage cans, dumpsters, lunch counters, and playgrounds, where they scavenge for food.

Stings

Insect stings are the leading cause of fatalities from venomous animals in the United States. The people who die from yellowjacket or bee stings are people who experience large numbers of stings at once or who suffer severe allergic reactions to the inflammatory substances in the insect venom. These allergic reactions include soreness and swelling, not only at the site of the sting, but also on other parts of the body that may be distant from the site. Other symptoms include fever, chills, hives, joint and muscle pain, and swelling of the lymph glands and small air passageways. In severe cases, the individual may suffer a sudden drop in blood pressure and lose consciousness. While many individuals who experience allergic reactions have become sensitized over time by previous stings, half of all fatalities occur in individuals stung for the first time.

Ordinary reactions to stings include localized pain, itching, redness, and swelling that may last for hours and up to a day or two after the event.

Nest Disturbance

Yellow jackets that are foraging for food usually will not sting unless physically threatened, such as being squashed or caught in a tight place. But if they feel their nest is in danger, they will vigorously defend it. All wasps defend their colonies, but some yellowjackets are more sensitive to nest disturbance and more aggressive in their defense. Disturbing a yellowjacket nest can result in multiple stings. This can occur when someone accidentally steps on an underground nest opening or disturbs a nest in a shrub or building. Sometimes merely coming near a nest, especially if it has been disturbed previously, can provoke an attack.

Something as simple as vibrations can disturb underground nests. Thus, mowing lawns or athletic fields can be hazardous, and operators may need to wear protective clothing when mowing during the late summer season when colonies are large. It can be very frightening to be the victim of multiple wasp stings. If there are only one or two wasps, back slowly away from them until they stop attacking you. Otherwise, it is best to run away from a colony rapidly, protecting your face and eyes as much as possible.

It is important to educate children about the beneficial role of these wasps (they feed on pest insects, particularly caterpillars) and to remind them repeatedly of ways to avoid stings. Since problems with yellowjackets are most common in late summer and fall, teachers can be provided with this information at the beginning of the fall term.

Detection and Monitoring

If there is a chronic problem with yellowjackets around outdoor lunch areas or school athletic fields, inspect the area methodically to locate the nests. Nests can be found in the ground, under eaves, and in wall voids of buildings. Ground nests are frequently, but not always, located under such things as shrubs, logs, piles of rocks, and other protected sites. Entrance holes sometimes have bare earth around them. Nest openings in the ground or in buildings can be recognized by observing the wasps entering and leaving.

Management Options

The objective of a yellowjacket management program should be to reduce human encounters with the wasps, but not to eliminate them from the entire area since they are beneficial predators of insects. The two most productive and least environmentally destructive ways to do this are to modify the habitat to reduce yellowjackets' access to food in the vicinity of human activities, and to use physical controls such as trapping and nest removal. Areawide poison baiting should be used only as a last resort when other methods have failed and stings are frequent.

Physical Controls

Habitat Modification

Garbage containers on school grounds should have tight-fitting lids. The cans should be emptied frequently enough to prevent the contents from impeding the closure of the lid. The lids and cans should be periodically cleaned of food wastes. Disposable liners can be used and replaced when soiled or damaged. When these practices are not followed, school garbage (and the flies around

it) becomes a food source for yellowjackets in the area. If a large number of wasps are around garbage containers, students may be afraid to get close enough to place garbage all the way inside, and spilled food will attract more wasps. Dumpsters should be cleaned frequently by washing them with a strong stream of water. If the dumpster service company has a cleaning clause in their contract, make sure it is enforced. To limit yellowjacket infestations inside the school buildings, repair windows and screens and caulk holes in siding. Building inspections for yellowjackets can be done at the same time as inspections for other pests, such as rats, mice, and termites. Inspections should be conducted monthly to ensure that developing nests are found before they get large enough to be problematic.

Trapping

Trapping with a sturdy trap and an attractive bait can significantly reduce yellowjacket numbers if a sufficient number of traps are used. There are a variety of traps on the market. In general, cone-type traps are more useful for long-term trapping that will last many weeks. In some schools, unbaited yellow sticky traps (like those used to catch whiteflies) affixed to fences near underground nests have provided sufficient management to protect children from stings.

A homemade, cone-type flytrap can be used to catch yellowjackets simply by using the captured flies inside the trap as bait. The yellowjackets enter the trap to get the flies and become trapped themselves. If you use baits such as dog food, ham, fish, or other meat scraps, or fermenting fruit and jelly, make sure the traps are placed in areas inaccessible to students, because large numbers of yellowjackets may be attracted to the baits.

However, the traps should be placed near the nest if it can be found, or near the area where the yellowjackets are troublesome. Teachers can be instructed to make a short presentation on the purpose of the traps to satisfy the curiosity that students will undoubtedly have. Show students the traps, explain how they work, and try to impress upon them the importance of the traps in maintaining the safety of the playground. Then be sure to move the traps to an area inaccessible to students.

When traps are full they can either be placed in a freezer for a day to kill the wasps, or enclosed in a heavy-duty plastic garbage bag and placed in the direct sun for several hours. A third way of killing the wasps is to submerge the traps in a bucket of soapy water until the wasps drown.

The traps should be out only during the period that yellowjackets are a problem, usually late summer and early fall. When the traps are taken down for the year, they should be cleaned with soap and water and stored.

Tips on Trapping Yellowjackets in a Homemade Cone-Type Fly Trap

Yellowjackets can be caught in a cone-type fly trap using only the trapped flies as bait. The following tips will help improve yellowjacket trapping:

- ▶ Use this trapping method where students cannot gain access to the traps or at a time when students are not in school.
- ▶ Mix the fly bait according to instructions (check the IPM for Pennsylvania Schools ‘A How To Manual’ {a major resource for this manual} for flytrap details).
- ▶ Set up the fly trap with the fly bait in the area where the yellowjackets are a nuisance.

- ▶ If the trap is still attracting only flies after a day or two, move the trap to a new spot around the perimeter of the nuisance area.
- ▶ If your trap stops catching yellowjackets at some point, but is still catching flies, try switching to a sweet bait such as fruit punch or jam.

Note: To avoid being stung, you should replenish the fly bait or move the trap in the cool parts of the day, early morning or late evening. To kill everything in the trap before emptying, put the trap into a large plastic garbage bag and seal the bag. Place the bag in direct sunlight for several hours or in a freezer overnight.

Nest Removal

A nest can be destroyed through physical removal (vacuuming) or by using a pesticide (see Chemical Controls). Either way, great care must be exercised, because any disturbance around a nest can cause multiple stings. It is best to have a pest management professional or other experienced person remove the nest. Nest removal should take place at night, when the children are out of school and the yellowjackets are in the nest. When illumination is needed, use a flashlight covered with red acetate film so it will not disturb the wasps.

Adequate protective clothing and proper procedures can minimize problems and stings. It is important to wear protective clothing when removing wasp nests. Complete body coverage is essential, because yellowjackets and other wasps can find even the smallest exposed area. Use clothing made for beekeepers.

This includes:

- ▶ A bee veil or hood that either contains its own hat or can be fitted over a light-weight pith helmet or other brimmed hat that holds the veil away from the head.
- ▶ A metal-screen faceplate that extends around the head is a desirable feature. Check the veil carefully for tears before each use.
- ▶ A bee suit or loose-fitting, heavy-fabric coverall with long sleeves. This is worn over regular pants and a long-sleeved shirt to provide extra protection from stings.
- ▶ Sturdy, high-topped boots. Secure pant legs over the boots with duct tape to prevent wasps from getting into trousers.
- ▶ Gloves with extra-long arm coverings so sleeves can be taped over them to protect the wrists.

Vacuuming

Vacuuming out entire nests is not recommended unless it is done by a pest management professional, experienced in handling stinging insects. Vacuuming is particularly effective when nests occur in wall voids, in emergencies where nests have already been disturbed, and in environmentally sensitive areas where nests should not be treated with insecticides. Some pest management professionals in some cities will perform this service for free so they can collect the wasps to sell to pharmaceutical companies for their venom. If the school is interested in this option, take time to find a company that will perform this service for you.

Chemical Controls

At times, non-chemical methods alone may prove insufficient to solve a pest problem. Integrating a pesticide into your management program may be necessary to gain control.

Pesticides must be used in accordance with their EPA approved label directions. Licensed applicators should always wear protective equipment during pesticide applications. All labels and Material Safety Data Sheets (MSDS) for the pesticide products authorized for use in an IPM program should be maintained in a file or logbook designated for this purpose. This logbook or file must be kept within an individual school building, not at a district or other central location, and should always be available to the IPM Coordinator or his/her surrogate.

The law also mandates a 7-hour re-entry period whenever a pesticide without a specific numeric re-entry period is applied. This means that if the label says the treated area cannot be re-entered for four (4) hours then the re-entry period is four (4) hours, if the label says the re-entry period is twelve (12) hours, then the re-entry period is twelve (12) hours. However, if a label does not say what the re-entry period is, then the re-entry period is seven (7) hours. An example would be a product that says re-enter after product has dried and settled, this product would default to a seven hour re-entry period in New Jersey.

New Jersey law allows pesticide applications in schools by licensed professional pesticide applicators only, or by a licensed pesticide operator working under the direct supervision of a licensed applicator. Even over-the-counter products such as ant & roach sprays, weed killers or weed & feed lawn care products require a license if being applied at a New Jersey school.

When an insecticide is considered necessary for the management of yellowjackets, the best approach is to confine it to the nest itself. Anyone applying insecticides should use special clothing that protects against the chemical as well as against wasp stings. Insecticides should be applied in the evening or very early morning when children are absent, the wasps are inside the nest, and cooler temperatures reduce insect activity. A number of insecticides are registered for use against yellowjackets. The following are most appropriate for use in schools:

Silica Aerogel and Pyrethrins

Silica aerogel combined with pyrethrins is an effective insecticidal dust that can be used to destroy an underground nest or a nest in a wall void. Silica aerogel is made from sand and works by abrading the outer waxy coating on insect bodies. Once this coating is damaged, the insects cannot retain water and die of dehydration.

Products with Components That “Freeze” Wasps

Pyrethrins can be used to quickly knock down guard wasps at the nest entrance and to kill yellowjackets in an aerial nest when they must be destroyed in the daytime. These aerosol products are designed to project a stream of spray 10 to 20 feet and contain highly evaporative substances that “freeze” or stun the yellowjackets.

Remember; in New Jersey any pyrethrum combined with a synergist forms a non-low impact pesticide. Also, any synthetic pyrethroid is considered to be a non-low impact pesticide and will trigger the notification process in New Jersey Schools.

Do Not Use Gasoline

Gasoline should never be poured into underground nest holes. This dangerous practice creates a fire hazard, contaminates the soil, and prevents the growth of vegetation for some time. A ground application of gasoline poses greater harm to children and the environment than a yellowjacket nest.

Avoid Area-Wide Control Measures

Mass control measures are seldom, if ever, necessary, and they are expensive due to the labor involved in the frequent mixing and replacement of bait. The effectiveness of bait mixtures is also questionable, since the baits face considerable competition from other food sources that are more attractive to scavenging yellowjackets.

CHAPTER 9 - RODENT PESTS

Rats and mice often enter schools and warehouses in search of food and shelter. The most common rodent pests are the commensal rats and mice. These are Old World rodents that have adapted to live with humans. They include the roof rat, Norway rat, and house mouse. These commensal rodents have been carried by humans to every corner of the Earth. Rats and mice consume or contaminate large quantities of food and damage structures, stored clothing, and documents. They also serve as reservoirs or vectors of numerous diseases, such as rat bite fever, leptospirosis (Weil's disease), murine typhus, rickettsial pox, plague, trichinosis, typhoid, dysentery, salmonellosis, hymenolepis, tapeworms, and lymphocytic choriomeningitis (Mallis 1997).

In most cases of rodent infestation, the pest animals can be managed without having to resort to the use of poisons. Practicing good sanitation and exclusion will prevent most problems. If rodents do find their way indoors, small populations can be easily eliminated with various nontoxic methods. Rodenticides (rodent baits) need only be used in cases of large or inaccessible infestations. Trapping rodent pests is often preferable to using baits. Traps prevent rodents from dying in inaccessible places and causing odor problems. Traps can also be used in situations where baits are not allowed.

Rodent Ecology

The house mouse is the most common commensal rodent invading schools. It is primarily nocturnal and secretive. The presence of mice is usually indicated by sightings, damage caused by gnawing into food containers, or the presence of droppings. In the wild, house mice feed primarily on seeds. In the school, they prefer grain products, bird-seed, and dry pet food. They tend to nibble on many small meals each night. House mice are inquisitive and actively explore anything new. They also are good climbers. However, they have a small home range and usually stay within 10 to 30 feet of their nest. Nests usually are built in structural voids, undisturbed stored products or debris, or in outdoor burrows. Mice and rats are very nervous about moving in the open. The more cover they have, the more comfortable they are. They would rather run behind an object or along the baseboard of a wall than across an open space.

The roof rat or black rat is more commonly encountered in buildings in the south but is sometimes found in New Jersey. These rats are excellent climbers and often nest in attics, wall voids, and hollow trees. They prefer to travel off the ground and enter houses from nearby trees or along power lines. Roof rats prefer fruit, but will eat any type of human pet, or livestock food. Rats usually fear new items in their environment and avoid them for several days. This means that traps should be left in place for at least one week before they are moved to a new location. The presence of roof rats can be determined by gnawing damage, the presence of droppings, sightings, sounds of scratching, squeaking, or gnawing in walls or ceilings, and characteristic dark, greasy rub marks along frequented paths along walls and on rafters. Rats have large home ranges and may travel more than 50 yards to reach food or water. Concentrating traps along rat runways or favorite routes of travel is most effective.

Rats occupying buildings and sewers in New Jersey are generally Norway rats. These rats are strong burrowers, but can also climb well. They are excellent swimmers and can swim under

water for up to 30 seconds. They can enter buildings by coming up toilet pipes. These rats usually dig burrows along building foundations and under debris piles. They have a strong preference for meat and fish, but will do well on any type of human or pet food. Raw or cooked meat and fish, especially sardines, are excellent baits, but peanut butter also works well.

Like the roof rat, the Norway rat is cautious around new objects and has a very large home range, more than 50 yards in radius. The Norway rat is very aggressive and will drive roof rats out of an area. However, both species of rats may be found in the same building, with roof rats in the attic and Norway rats in the basement.

Sanitation and Exclusion

Proper sanitation will do a great deal to manage rodent pests. All animals have three requirements for life: food, water and cover (or harborage, a place to live). Removing any one of these will force an animal to leave. Removing debris, such as piles of waste lumber or trash, used feed sacks, and abandoned large appliances, will substantially reduce the harborages for rodent pests. Trim trees, vines, bushes, grass, and weeds at least 12 to 18 inches from all buildings to decrease cover for rodent runways and prevent hidden access to buildings. Stacked firewood stored for long periods provides good harborage for all three common rodents.

Store pet food and seeds, such as wild bird seed in rodent-proof glass or metal containers to eliminate rodent access to these food sources. Collect and remove fallen fruit from backyard trees and orchards. Keep lids on trash cans and close dumpsters at night to make an area less attractive to rats and mice. The drainage holes in dumpsters should be covered with screening such as a galvanized hardware mesh (or hardware cloth) to keep rodents out.

Exclusion is also called rodent-proofing. This involves making your structure a fortress that rodents cannot breach. Rodents can squeeze through any opening that their head can fit through. A ¼ inch opening can admit mice, and a ½ inch opening can give access to rats. Young rats and mice are the dispersing individuals, so these are the ones most likely to invade new areas, like schools. Any opening that a pencil can fit through will admit a mouse.

Below is a list of recommended materials for excluding rats and mice.

- ▶ Galvanized, stainless, or other non-rusting metal
- ▶ Sheet metal, 24 gauge or heavier
- ▶ Expanded metal, 28 gauge or heavier
- ▶ Perforated metal, 24 gauge or heavier
- ▶ Hardware cloth, 19 gauge or heavier, ¼ inch or smaller mesh
- ▶ Cement mortar with a 1 part cement: 3 parts sand mix or richer
- ▶ Concrete with a 1 part cement: 2 parts gravel: 4 parts sand mix or richer
- ▶ Broken glass added to mortar or concrete will deter rodents from tunneling through a patched hole before the material hardens
- ▶ Brick, concrete block, tile, or glass will exclude rodents if in good repair
- ▶ Wood will exclude rodents if no gnawing edges are present

Traps

There are four main types of rodent traps; snap traps, multi-catch traps, single-catch live traps, and glue boards. Some people consider live trapping the least humane method of killing rodents, claiming psychological stress on the animal. The most humane method of killing them would be rodenticides (not the preferred method for New Jersey schools), followed by snap traps, glue boards, and live traps. Using rodenticides may cause rodents to die within wall or structural voids causing other problems.

Snap Traps include both the classic rodent traps with the wood base and the newer metal clothespin traps. They are designed to kill the trapped animal quickly and humanely. Snap traps should not be set where children or pets may come in contact with them. They have three different types of triggers: wood/prebaited, metal for holding bait, and expanded trigger, which is used in runways. The expanded trigger is the most versatile, since it also can be baited. Older snap traps with other types of triggers can be modified to produce an expanded trigger.

Traps should be placed where rodents are likely to be. Rodents are creatures of habit and prefer to follow the same runways they usually use. It is important to identify these runways and place traps there. Runways can be identified by sprinkling a fine layer of flour or baby powder in suspected areas and then looking for tracks. This is a safe diagnostic method for determining rodent activity, but should not be confused with the use of rodenticide tracking powders, which require a restricted-use pesticide license. Rodents often run along edges, so traps should be set along walls, especially where objects such as a box or appliance will guide them into the trap. Traps for mice should be set 6 to 10 feet apart. Roof rats prefer to travel above the ground and are easier to trap along these precarious pathways than on the ground.

The type of bait used depends on the species of rodent pest. Peanut butter, pieces of fruit or nutmeats are the best baits for roof rats. Peanut butter or gumdrops stuck to the trigger or rolled oats or birdseed sprinkled on the trap are good baits for house mice. When food is abundant, nesting material, such as a cotton ball tied to the trigger can act as an effective lure.

Multicatch Traps are designed to repeatedly catch mice and reset themselves for another capture. These traps have the ability to capture several mice with one setting, and the scent from the captured mice entices others to the trap. However, these traps are expensive. Also, the captured mice are still alive and must be dealt with. Methods of dealing with the captive rodents include submerging the entire trap in a bucket of water and drowning them, using drowning attachments available for some traps, placing glue boards in the holding compartment of the trap, or finding someone with a pet snake that eats mice. Releasing captured rodents outside is not a solution, since they will quickly find a way back into the structure. Trap-wise rodents also are more difficult to trap than naive ones. Like any other trap, multi-catch traps must be checked regularly to prevent the captured rodents from starving or dying of thirst and creating an odor problem.

Single-catch Live Traps are rodent-sized cage traps of various styles. These traps capture the rat or mouse alive and unharmed, but you have to deal with the captured rodent. Rodents should not be released, because they will return to buildings. The best way to dispatch rodents caught in these traps is to submerge the entire trap in a bucket of water. These traps should be placed

against walls or in runways. The most effective bait for mice with this type of trap is rolled oats (uncooked oatmeal) sprinkled inside the trap, with a fine trail leading out.

Glue Boards are used just like snap traps. While both rat and mouse sized glue boards are made, these traps are most effective against juvenile mice. Rats are often strong enough to pull themselves free from glue boards. Glue boards should not be set in wet or dusty areas, because these conditions render the traps ineffective. Wet feet and fur will not stick to the glue, and dust coats the glue until it is no longer sticky. These traps also should not be set where children or pets will come into contact with them: Glue boards are not hazardous to children or pets, but an encounter will create a frustrating mess. If that happens, clean up hands with room temperature cooking oil and clean surfaces with paint thinner or mineral spirits. The best glue boards have at least a 1/8 to 1/4 inch layer of glue. Do not set glue boards near open flames or above carpets. Glue boards should be secured with a tack or small nail, wire, or double-sided tape if they are placed on ledges, pipes, or rafters over food preparation surfaces or carpets.

Ultrasound Devices The principle behind ultrasonic devices is to create a loud noise above the range of human hearing (above 18 to 20 kHz) that is unpleasant to pest species. The problems with ultrasound devices are numerous. Animals can adapt to most situations, and in a short time they become accustomed to the sound. If the original attractant, such as food, is still present, the rodents will return. The short wavelengths of ultrasound are easily reflected, creating sound shadows. The rodents simply shift their activity to these low-noise shadows. Ultrasonic devices will not drive rodents from structures if food, water, and shelter are available. However, they may have a part to play in rodent integrated pest management. Ultrasonic devices may increase trapping effectiveness by altering the normal movement patterns of individual rodents. Traps set in the sound-shadow areas will become more effective since the rodents will be concentrated in these areas. The high cost of the units must be weighed against the increase in trapping effectiveness to determine if they are cost-effective.

Chemical Controls

At times, non-chemical methods alone may prove insufficient to solve a pest problem. Integrating a pesticide into your management program may be necessary to gain control.

Pesticides must be used in accordance with their EPA approved label directions. Licensed applicators should always wear protective equipment during pesticide applications. All labels and Material Safety Data Sheets (MSDS) for the pesticide products authorized for use in an IPM program should be maintained in a file or logbook designated for this purpose. This logbook or file must be kept within an individual school building, not at a district or other central location, and should always be available to the IPM Coordinator or his/her surrogate.

The law also mandates a 7-hour re-entry period whenever a pesticide without a specific numeric re-entry period is applied. This means that if the label says the treated area cannot be re-entered for four (4) hours then the re-entry period is four (4) hours, if the label says the re-entry period is twelve (12) hours, then the re-entry period is twelve (12) hours. However, if a label does not say what the re-entry period is, then the re-entry period is seven (7) hours. An example would be a product that says re-enter after product has dried and settled, this product would default to a seven hour re-entry period in New Jersey.

If non-chemical methods alone cannot solve the problem, integrating a pesticide into your management program may be warranted. **However, pesticide use for a rodent infestation in New Jersey schools should only be used as a last resort.** Pesticides must be used in accordance with their EPA approved label directions. Applicators should always wear protective gear during applications. All labels and Material Safety Data Sheets (MSDS) for the pesticide products authorized for use in the IPM program should be maintained in a file or logbook.

New Jersey law allows pesticide applications in schools by licensed professional pesticide applicators only, or by a licensed pesticide operator working under the direct supervision of a licensed applicator. Even over-the-counter products such as ant & roach sprays, weed killers or weed & feed lawn care products require a license if being applied at a New Jersey school.

CHAPTER 10 - TURF / LAWN PESTS

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

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

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

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

Detection and Monitoring

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

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

When beginning a monitoring program, some effort should be made to become familiar with the common pest insects, weeds, and lawn pathogens in the local area. Learn about their life cycles and how to recognize them. Additional information can be obtained from the Rutgers Cooperative Extension office in your county. It is also important to learn to recognize the natural enemies of common lawn pests and factor their presence into deciding if treatments are needed and which ones to use.

Gathering Background Data on the Site

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

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

You will need to compile an inventory of existing lawn maintenance equipment. In addition to mowers, do you have an aerator, dethatcher, and fertilizer spreader that can handle organic materials? Is there a spring-tooth harrow for removing weeds from infields and running tracks? These are useful tools in non-chemical lawn management. Inspect the condition of the equipment, too. Are mower blades kept sharp? The importance of sharp mowing blades can not be overstated. Can mowing height be adjusted easily? Does the equipment have flotation tires to reduce soil compactions? Prepare a list of equipment needs so they can be worked into the budget process.

Developing Pest Tolerance Levels

Most lawns can tolerate some pest presence without compromising appearance or function. The challenge is to determine how much damage is tolerable, and when action is needed to keep pest damage within tolerable levels. Since the users of the lawn must be taken into account when deciding whether or not treatments are warranted, it is a good practice to involve representatives of these interest groups (such as an athletic director or coach) in setting pest tolerance levels for lawn areas.

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

Tolerance levels can be quantified in a number of ways. The Transect Method for monitoring weeds (discussed later in this section) is a method for quantifying the amount of weeds growing in turf. This permits expression of tolerance levels by percentage of weeds. For example, “Up to 25 percent weed growth is tolerable on the back lawn at the elementary school, while only 10 percent is tolerable on the football field at the high school.”

Tolerance for insect damage can be correlated with numbers of insects present and amount of visible damage. For example, white grubs can be monitored by examining several areas of soil

underneath the grass. A spade is used to cut three sides of a 1-foot square of grass. The grass is carefully folded back, using the uncut edge as a hinge. Soil from the roots is removed, and the number of exposed grubs is counted. Then the grass can be folded back into place, tamped, and watered in. In well-managed lawns, depending on the species, up to 15 grubs per square foot can be present without causing any appreciable damage to the turf. In stressed or poorly managed lawns, however, 15 grubs per square foot might seriously damage the grass.

By setting tolerance levels, pest control professionals and groundskeepers can gear their management efforts to keeping pest populations within tolerable levels, and apply treatments only if, when, and where necessary. Involving members of the school's Athletic Department and the school community in setting treatment guidelines can minimize after-the-fact confrontations and help develop broad support for the IPM program.

Evaluating IPM Programs

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

Management Options

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

Stress and Pests

The pest problem of greatest concern on school lawns and the target of highest pesticide use, is the growth of weeds, such as dandelions (*Taraxacum officinale*) or crabgrass (*Digitaria* spp.). Presence of weeds is a symptom of a lawn undergoing stress or poor management, a common occurrence on school lawns and athletic fields.

Lawn stress can contribute to the development of insect and disease problems as well. Sources of stress include levels of use unsuited to the grass species that has been planted, compacted soils, improper mowing heights, too much or too little irrigation or fertilization, accumulation of thatch, and uneven grading. Knowing the identity of the pest and something about its biology often reveals the specific source of stress. Relieving the stress can reduce or eliminate the pest problem. For example, the weed yellow nutsedge (*Cyperus esculentus*) often grows in waterlogged soils, so its presence could indicate a faulty or broken irrigation valve or a low spot in the lawn. The presence of chinch bug (*Blissus* spp.) damage, on the other hand, indicates drought stress. Brown patch disease, caused by the fungus *Rhizoctonia solani*, suggests excessive fertilization with soluble nitrate or slow-release fertilizers, especially during hot, wet conditions. So knowing or identifying the pest can determine what the correct course of action should be. Remember that the Rutgers Cooperative Extension Agents for your county can help you to identify your specific pest.

Transect Method for Monitoring Weeds in a Lawn

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

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

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

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

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

c. Divide the length of the field by the length of the pace ($360 \text{ feet} \div 2 \text{ feet per pace} = 180 \text{ paces}$). This establishes the number of paces it takes to walk the transect.

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

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

4. Beginning at one end of the first transect, walk the calculated number of paces (9 paces in the above example), stop and look at a 3-by-3-inch area (this is about the circumference of a softball or the lid to a 1-pound coffee can) immediately in front of your toe. If this area contains part or all of a weed, check the 'yes' box on the first line under 'Transect A' on the monitoring form (see Figure). If you know the identity of the weed, write it down. If the toe sample area contains grass, check the 'no' box on the monitoring form. If 25 percent or more of the toe area sample is bare soil, check the box marked 'bare.' If less than 25 percent is bare, but a weed is present, check 'yes.' Continue pacing the transect line and marking the monitoring form. Repeat along the two other transect lines.

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

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

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

Reducing Stress on Lawns

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

Maintaining Healthy Soil

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

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

Planting Appropriate Grass Species

School lawns are subject to high levels of use and wear, and maintenance budgets are usually low, so it is important to select blends of grass species tolerant to such conditions and resistant to local pest problems. The NJ State Cooperative Extension office in your county can recommend grass species suited to local climate and conditions. In many New Jersey areas, tall fescue (*Festuca arundinacea*) is recommended for school situations. Be sure to check with your Rutgers County Extension Office for the correct grass for your specific area

Reducing Soil Compaction

When lawns are heavily used, or simply mowed on a regular basis, the soil eventually becomes compacted, and the pore spaces that allow water and air to pass through the soil become compressed, creating adverse conditions for root growth. Compaction can be reduced through core aeration and amending soils with organic matter. Core aeration involves removing plugs of grass to improve air exchange and water penetration into the soil. Ideally, heavily used turf should be aerated at least two times per year, although even a single aeration is better than none. After aeration, and before seeding the desired lawn grass, drag the lawn with a heavy drag mat to break up cores of soil left by the aerator and to fill in holes. Mowers and other maintenance equipment compact the soil. By rotating the point of mower entry onto the lawn from week to week, compaction at entry points can be minimized.

Increasing the Mowing Height

Most temperate grasses used on school lawns (tall fescues, perennial ryes, bluegrasses, and others) can be mowed at a height of 2¹/₂ to 3 inches without sacrificing vigor or function as ball fields or recreational areas. If this is not possible for the entire year, then it should be the case for as much of the year as possible. The taller the grass can be kept the healthier the root system and the denser the canopy. The denser the canopy the greater the interception of available sunlight. Because taller grass shades the soil, weed seeds are less likely to germinate, and if they do germinate, the stronger root system will work against the weed's ability to take over.

Adjust mowing frequency to changes in the growing season. Weekly intervals may be appropriate when grasses are growing vigorously, but when grasses are semi-dormant, 14 days or longer may be more appropriate. The right interval between mowing allows grasses to recover from the previous cut.

Careful Irrigation

Too much or too little water stimulates pest problems. For example, many lawn diseases result from excessive irrigation. Development of a disease can often be arrested by letting the lawn dry out, then keeping irrigation to a minimum. On the other hand, chinch bugs require hot dry conditions for optimal survival and reproduction.

Irrigation during the spring and early summer may increase the incidence of pathogen spread, especially the lethal fungus, *Beauveria* spp. The adults can withstand water because of the protective hairs on the body but the nymphs readily get wet and can be damaged by large water droplets.

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

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

Keeping Thatch to a Minimum

Thatch is the accumulation of dead but undecomposed roots and stems that collect in a layer at the soil surface. If the thatch becomes excessively deep, greater than ³/₄ inch water and nutrients do not penetrate the soil adequately. When water puddles on thatch, it enhances the habitat for disease organisms. Regular aeration keeps thatch at an acceptable level. Excessive nitrogen applications may result in organic matter production rates that exceed breakdown, encouraging thatch accumulation. Excessive layers of thatch can be removed with dethatching rakes, or with power dethatchers available from equipment rental companies. It is wise to over-seed the area

with desired grasses (check with your Rutgers Cooperative Extension Office) wherever lawns are thinned by dethatching procedures.

Fertilizing with Restraint

Excessive nitrogen fertilizer produces weak grass that is susceptible to disease attack. A soil test should be obtained before planning annual fertilization programs. Only the levels of nutrients needed should be applied. Split applications (one in spring, one in fall) should be used, rather than a heavy single application in the spring. Use slow-release fertilizer to prolong the availability of nutrients throughout the growing season. Fertilization can be used to directly suppress weeds and lawn pathogens. A study by Ohio State University Extension Service researchers in the 1940s showed that an application of 20 pounds of composted poultry manure per 1,000 square feet of lawn in late fall and early spring stimulated early spring growth of lawn grasses, enabling them to crowd out crabgrass. In this study, crabgrass was reduced by up to 75 percent within one year.

Direct Pest Suppression

When the horticultural methods listed above are not sufficient to solve the pest problem, direct suppression methods, including physical, biological, and chemical tactics, can be integrated into the program. Physical controls include using a flamer to spot-treat weeds, or using a bamboo pole to flick off dew from grass blades in the early morning to deny nourishment to lawn pathogens. Biological controls include applying microscopic, insect-attacking nematodes to kill soil-dwelling white grubs, or topdressing lawns with microbially enhanced soil amendments to kill lawn pathogens. Chemical controls are available. Check with the NJ State Cooperative Extension office in your county for information about pesticides appropriate for your pest problems.

IPM Program for Hairy Chinch Bugs

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

Identification And Biology

Adult chinch bugs over-winter in dry grass and other debris that offers them protection. In spring or early summer, depending on temperature and moisture, over-wintering females lay from 200 to 300 eggs on leaves of grass, or push them into soft soil and other protected places. Young nymphs (the immature stages) emerging from the eggs are bright red with a distinct white band across the back. The red changes to orange, orange/brown, and then to black as the nymph goes through five growth stages in 30 to 40 days.

Nymphs range from about $\frac{1}{20}$ inch soon after hatching to nearly the size of the $\frac{1}{4}$ inch long adult. The nymphs mature into adults, which are black with a white spot on the back between the wing pads.

Damage

Chinch bugs suck the juices from grass leaves with their needle-like mouth parts. They also inject toxic saliva into the plant that disrupts the plant's water-conducting system, causing it to wilt and die. Most damage is caused by nymphs and adults concentrated in limited areas and feeding on the same plants until all the available juice has been extracted from the grass. This feeding pattern results in circular patches of damaged grass that turn yellow and then brown as they die. In the yellow stage, the grass superficially resembles grass that is drought-stressed. As it dies, the chinch bugs work outward from the center of the infestation, destroying a larger area as they advance. Populations of chinch bugs increase under hot, dry conditions. In wet, cool years, or when lawns are kept properly irrigated and not over-fertilized, chinch bug populations decrease significantly because the moisture encourages the growth of the lethal fungus, (*Beauveriaspp.*), a pathogen of chinch bugs.

Detection And Monitoring

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

Any lawn can tolerate a low population of chinch bugs and most other pests without sustaining significant damage. If the monitoring techniques described below indicate that there are fewer than 10 to 15 chinch bugs per square foot, generally no action is needed. It is a good idea to begin monitoring as early as mid May, before over-wintering adults have finished laying their spring eggs. A quick check of the lawn once a month until September should be sufficient in most areas.

Since nymphs tend to congregate in groups, it is important to check several areas of the lawn. Infestations often begin on the edges of lawns, particularly in sunny, dry spots, so check these areas carefully. Spread the grass apart with your hands and search the soil surface for reddish nymphs or black adults. Chinch bugs may also be seen on the tips of grass blades, where they climb during the day. Be certain to distinguish between the chinch bugs and their predator, the big-eyed bug, which they superficially resemble.

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

Management Options

Physical Controls

Chinch Bug-Resistant Grass Cultivars

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

Habitat Management

Chinch bugs are attracted to lawns that have an excessive build up of thatch, are insufficiently irrigated (often due to soil compaction), or have either too little or too much Nitrogen. The discussion of good lawn culture provided at the beginning of this section includes suggestions on overcoming these problems. Proper habitat management will go a long way toward suppressing these bugs.

Manual Removal

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

Biological Controls

One of the primary tactics for the biological control of chinch bugs is conserving its natural enemies. At least two beneficial organisms often move in to feed on chinch bugs: the big-eyed bug and a tiny wasp. The big-eyed bug (*Geocoris* spp.) superficially resembles a chinch bug, so pest control professionals must learn to distinguish between the two. According to Ohio State University turf specialist Harry Niemczyk, “the body of the chinch bug is narrow, the head small, pointed, triangular-shaped, with small eyes, while the body of the big-eyed bug is wider, the head larger, blunt, with two large prominent eyes. Big-eyed bugs run quickly over the turf surface and are much more active insects than the slower-moving chinch bugs.” (Niemczyk, 1981). Although big-eyed bugs cannot be purchased from insectaries at this writing, recent research indicates that members of this genus can be reared easily and inexpensively, so they may become commercially available in the near future.

Soap-and-Flannel-Trap Method for Chinch Bugs

Put 1 fluid ounce of dishwashing soap in a 2-gallon sprinkling can and drench a 2-square-foot area of lawn where you suspect there are chinch bugs. Watch the area for 2 or 3 minutes. Larger areas can be covered by putting the detergent in a hose attachment designed to hold pesticides for spraying the lawn. If chinch bugs are present, they will crawl to the surface of the grass.

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

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

Chemical Controls

At times, non-chemical methods alone may prove insufficient to solve a pest problem. Integrating a pesticide into your management program may be necessary to gain control.

Pesticides must be used in accordance with their EPA approved label directions. Licensed applicators should always wear protective equipment during pesticide applications. All labels and Material Safety Data Sheets (MSDS) for the pesticide products authorized for use in an IPM program should be maintained in a file or logbook designated for this purpose. This logbook or file must be kept within an individual school building, not at a district or other central location, and should always be available to the IPM Coordinator or his/her surrogate.

The law also mandates a 7-hour re-entry period whenever a pesticide without a specific numeric re-entry period is applied. This means that if the label says the treated area cannot be re-entered for four (4) hours then the re-entry period is four (4) hours, if the label says the re-entry period is twelve (12) hours, then the re-entry period is twelve (12) hours. However, if a label does not say what the re-entry period is, then the re-entry period is seven (7) hours. An example would be a product that says re-enter after product has dried and settled, this product would default to a seven hour re-entry period in New Jersey.

New Jersey law allows pesticide applications in schools by licensed professional pesticide applicators only, or by a licensed pesticide operator working under the direct supervision of a licensed applicator. Even over-the-counter products such as ant & roach sprays, weed killers or weed & feed lawn care products require a license if being applied at a New Jersey school.

CHAPTER 11 - WEED PESTS

A “weed” is commonly defined as a plant growing in a place where it is not wanted. Plants can be unwanted because they compete with desired species, because they cause harm to people or structures, or because their appearance or odor is offensive. The designation “weed” can be quite subjective. For instance, the dandelion can be considered a weed in one setting and a wildflower or culinary herb in another.

On school grounds, there is usually consensus on the weedy nature of certain plant species, such as thistles, docks, crabgrass, and poison ivy, that spring up where they are not wanted. These species have common characteristics that enable them to “take over” when conditions are right. Landscapes can be designed and maintained in ways that minimize conditions suited to weed growth, reducing or eliminating the need for herbicides. The goal is to encourage desirable plants to out compete weeds in habitats where plant growth is acceptable (shrub beds, turf areas, tree wells, student gardens), and to remove conditions conducive to weeds in areas where vegetation is not wanted (in pavement cracks, on running tracks, under fences). A review of basic principles of weed biology and ecology will help identify conditions that promote weed growth and suggest methods for encouraging competitive desirable vegetation and discouraging weeds.

Identification and Biology

Weeds can be found among both broadleaf plants and grasses. Like all plants, weeds are classified within 3 general categories according to the duration of their life cycle and their methods of reproduction.

Annuals - These are the most common weeds; they live 1 year and reproduce by seed. These plants have a rapid life cycle that enables them to germinate, shoot up, blossom, set seed, and (he within the space of a few weeks or months. Their rapid life cycle allows them to thrive on a minimum of nutrients and water.

Biennials - These weeds live 2 years, and reproduce both vegetatively and by seed.

Perennials - These weeds live more than 2 years. Although perennials produce seeds, the main means of reproduction is usually vegetative; for example, by forming new plants from bulbs or corms, or by producing new top growth from buds located on underground stems (rhizomes).

Weed Habits

Weeds tend to grow in places where the soil is bare or disturbed:

- ▶ Areas that have been cultivated (shrub and flower beds)
- ▶ Trampled or close-mowed lawns
- ▶ Unpaved play areas and paths
- ▶ Sports fields
- ▶ Fence lines
- ▶ Graded roadsides
- ▶ Cracks in sidewalks or other pavement

- ▶ Areas where the same herbicide has been used repeatedly and plants tolerant to that material have moved in

Weedy areas found on school grounds tend to be hot, dry, sunny habitats, often with low nutrient levels and soil moisture. Certain plants, such as thistles, knotweeds, plantains, and barnyard and crab grasses, take advantage of these conditions. As they grow, die, and decompose, the soil is stabilized, erosion is reduced, and the soil environment becomes more moist and fertile. Under these improved conditions, plant species with less weedy characteristics may eventually displace the weeds. Thus, a meadow left undisturbed may eventually become a forest.

Detection and Monitoring

The purpose of monitoring is to determine if, when, where, and why weeds are growing or posing a problem, and to assign priorities for habitat change and least-toxic weed suppression. The components of effective weed monitoring are described here.

Mapping Weed Habitats

The first step in monitoring is to map areas where weeds are growing. This does not need to be a detailed, time consuming process, a rough map will do. For areas to monitor see the list under Weed Habitats above.

Identifying Weed Species

It is important to accurately identify the most common weed species on your school grounds in order to determine appropriate management methods. Knowing the scientific name of the weed makes it much easier to obtain information from research professionals and the scientific literature. Assistance is available from County Cooperative Extension personnel or pictorial weed guides at the Rutgers Extension web-site. Learn about the growing conditions required by the weed as well as its growth characteristics and methods of reproduction. Weeds can be indicators of soil conditions that need to be changed to discourage weed growth. For example, yellow nutsedge (*Cyperus esculentus*) often grows in waterlogged soils, indicating excessive water perhaps due to a broken irrigation pipe or valve. Conversely, prostrate knotweed (*Polygonum aviculare*) indicates dry, compacted soil that requires aeration and addition of organic matter. Changing the conditions indicated by the weed can discourage these unwanted plants from growing.

Record Keeping

It is important to record the time of year a particular weed species appears, its abundance, and its impact on the landscape. This information will help determine:

- ▶ Which weeds and how many of each can be tolerated in a specific area without the weeds impairing the function of the landscape or its aesthetic appeal
- ▶ Whether or not management strategies are effective
- ▶ Whether weed populations are rising, falling, or staying about the same from year to year
- ▶ Whether new species of weeds are becoming a problem (as often happens as a result of weed management efforts)

Without this information, it is impossible to determine the long-term effectiveness of management methods.

Establishing Weed Tolerance Levels

School landscape maintenance budgets rarely stretch far enough to suppress all weeds, even if that were desirable. Aesthetic standards should be adjusted to take this into account. Assigning tolerance levels helps prioritize budget allocations, facilitate long-term plans, and provide justification for weed management action-or lack of action.

Identify areas where weeds pose potential health or safety hazards or threaten damage to facilities, and distinguish these locations from those where weeds are considered aesthetic problems alone. For example, poison ivy can cause severe skin rashes and itching, and weeds growing in playing fields or running tracks can pose tripping hazards. Assign low tolerance levels to weeds in such areas, and place high priority on their management. On the other hand, assign higher tolerance levels and lower priority for management, to weeds growing in shrub beds or along fence lines.

Since most weed tolerance levels are subjective, one way to establish them is to invite a representative group to tour the school grounds and decide where weed levels are acceptable and where they are not. Such a group might include the school principal, coach, landscape maintenance supervisor, PTA officers, students, and parents. It is important that this group reach a consensus on overall weed management objectives for various school sites, and that weed tolerance levels and weed action levels are derived from this agreement. Tolerance levels can be reevaluated on an annual basis.

Long Term Weed Management Plans

Long-term plans should focus on making changes to the habitat to permanently exclude weeds in areas where weed tolerance levels are low. In some cases this may require augmented budget allocations. Developing plans can help spread budget needs over several years.

Evaluation of Weed Management Programs

The availability of herbicides has often helped perpetuate poor landscape designs and inappropriate maintenance practices, because herbicides could be used to compensate for them. Gathering monitoring data can pinpoint the underlying causes of weed presence. The data can be used to change design specifications for landscapes, sport fields, playgrounds, and pavement to avoid encouraging weeds.

The long-term costs, risks, and benefits of various weed management approaches also should be evaluated. A one-time cost to install concrete or asphalt mow strips under backstops and fence lines and thereby permanently remove weed habitat may be less costly in the long run than repeated herbicide use that may pose a potential health risk, possibly resulting in lawsuits and poor public relations.

Management Options

Horticultural Controls

This approach involves manipulating plant selection, planting techniques, and cultural practices so that desired vegetation grows so densely and vigorously that weeds are crowded out.

Planting beds can be roto-tilled and irrigated to force weed seeds to germinate. As soon as sprouted weeds appear as “green fuzz” on top of the soil, they can be killed by a second cultivation with the tiller set at 1 inch. Shallow cultivation prevents weed seeds from being moved to the top 2 inches of soil—the germination range. This will reduce weed growth while ornamental plants are becoming established.

Plant Selection

In shrub beds, you can include ground covers with rapid, spreading growth habits that can out compete weeds.

Competitive Interplanting

When shrubs or ground covers are installed, weeds often colonize the spaces between individual plants before the ornamentals can spread and shade them out. These weed habitats can be eliminated by over seeding newly planted areas with fast-growing annual flowers such as sweet alyssum (*Lobularia maritime*), farewell-to-spring (*Clarkia amoena*), and scarlet flax (*Linum grandiflorum* var. *rubrum*).

Mulching

Mulches are used primarily to exclude light from the soil, thus limiting weed seed germination. Mulches can be composed of organic materials (compost, wood chips), stones or gravel, or synthetic landscape fabric. Landscape fabric is preferred over black plastic, since it allows air and water to move through the soil to benefit ornamental plant roots, but excludes light at the soil surface to thwart weeds. To be effective, mulches should be applied immediately after plants are installed. Bark or compost mulches should be 3 to 4 inches deep to exclude light. If landscape fabric is used, it should be covered with an inch or two of bark, stones, etc. to improve the aesthetic appearance of the planting area and reduce degradation of the fabric by sunlight. Landscape fabric can last for years if properly maintained.

Physical Controls

Hand-pulling, cultivation, and using string trimmers and mowers are very effective weed suppression techniques. If labor is in short supply, make good use of parent and student volunteers, community service groups, and youth groups. Classrooms can adopt a flower bed or a section of the schoolyard to maintain and beautify. If students are involved in grounds maintenance, they will be more careful around the plants and take pride in a clean, well maintained schoolyard.

Weeds on baseball infields, running tracks, and other bare soil areas can be suppressed by periodic shallow cultivation with a tractor-mounted rotary harrow, also called a rotary hoe or power rake (Rhay, 1994). In areas with heavy clay soils, this method can be combined with adding sawdust to reduce the crusting and puddling characteristics of these soils.

Eliminate Weed Habitat

Creating a “mow strip” under and immediately adjacent to fence lines can solve a common weed problem. When fences surround paved playing surfaces such as basketball courts, the steel fence posts can be installed directly into the paving material, 8 to 12 inches to the inside of the paving edge. The paving prevents weeds from growing under or adjacent to the fence, and provides a paved strip for the wheel of a mower that can keep adjacent grass trimmed. The strip also provides access for use of string trimmers when shrub beds abut the fence line. Pouring a 16-inch-wide concrete or asphalt strip to cover the soil under and beside the fence can modify existing cyclone fence lines. This retrofit can be performed in stages over several years as budgets permit. The one-time paving cost will produce many years of savings in weed management.

Use asphalt or cement crack filler to fill cracks in paved areas where weeds are a problem.

Flaming

Flamers are used by a growing number of parks and school districts to treat weeds in pavement cracks, under picnic tables and benches, along fence lines, and similar places. This technique uses a small gas or propane-fired torch to sear the tops of young weeds. The heat raises the temperature of the sap in the plant cells, the cell walls rupture, and the weed wilts and dies. Flaming is most effective on young annual and perennial weeds in the seedling (4- to 5-leaf) stage, because at that point the fragile root system is killed along with the top growth. Grasses are difficult to kill by flaming because a protective sheath covers their growing tips.

Keep the torch about 6 inches above the vegetation and pass it slowly over the plants. Hold the flamer over each plant briefly so 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 or plant death, for several to many hours. Leaves that have been heated sufficiently to burst cell walls will feel very soft to the touch and may turn a purplish color.

Soil Solarization

This technique uses a covering of clear plastic to raise soil temperatures high enough to destroy weeds and their seeds. For solarization to be effective, daytime temperatures should average 85°F or more, so it should be done during the hottest and sunniest time of the year. Solarization can kill annual or perennial weeds as well as soil pathogens and nematodes. Solarization can also be used to destroy weed seeds and other soil pests in roto-tilled beds scheduled for new plantings.

To solarize a section of soil, do the following:

- ▶ Mow any existing vegetation to the ground.
- ▶ Cultivate to incorporate the vegetation into the soil.
- ▶ Provide a smooth surface by raking the soil so it is level.
- ▶ Encourage weed seeds to germinate by irrigating the soil 1 to 2 weeks before covering it.
- ▶ Irrigate again just before laying down the plastic.
- ▶ Use UV-stabilized plastic 2 to 4 mils thick.
- ▶ Anchor the tarp by burying its edges in a small soil trench around the area to be solarized.

Chemical Controls

When non-chemical weed management methods are not sufficient to solve weed problems, pesticides are available for integration into the program. For information on the efficacy and hazards of various herbicides and on how to select an appropriate product for your situation, consult the Rutgers Cooperative Extension office in your county.

Whenever possible, apply pesticides as spot-treatments to the target weeds. For example, a tool called a “rope wick applicator” can be used to wipe a small amount of pesticide on a single plant or patch of weeds. This reduces human exposure and helps to protect non-target vegetation and beneficial soil organisms that can be damaged or killed by pesticide residues.

When applying pesticides, use a colorant to mark the treated area. This will not only ensure even coverage, but also will help passersby see and avoid the treated area. Do not allow children or pets to play in or lie on the treated area, rope it off and post required signage. Pesticides must be used in accordance with their EPA approved label directions.

All labels and Material Safety Data Sheets (MSDS) for the pesticide products authorized for use in the IPM program should be maintained in a logbook or file at the school NOT at a district or other central location. Never apply these materials where they might wash into storm drains, sanitary sewer, creeks, ponds, or other water sources.

The law also mandates a 7-hour re-entry period whenever a pesticide without a specific numeric re-entry period is applied. This means that if the label says the treated area cannot be re-entered for four (4) hours then the re-entry period is four (4) hours, if the label says the re-entry period is twelve (12) hours, then the re-entry period is twelve (12) hours. However, if a label does not say what the re-entry period is, then the re-entry period is seven (7) hours. An example would be a product that says re-enter after product has dried and settled, this product would default to a seven hour re-entry period in New Jersey.

New Jersey law allows pesticide applications in schools by licensed professional pesticide applicators only, or by a licensed pesticide operator working under the direct supervision of a licensed applicator. Even over-the-counter products such as ant & roach sprays, weed killers or weed & feed lawn care products require a license if being applied at a New Jersey school.

CHAPTER 12 - TREE AND SHRUB PESTS

Introduction

Landscapes vary so greatly that it would be impossible to provide specific management suggestions for all the pest problems on the many trees and shrubs that might be encountered on school grounds. Instead, we will try to provide a basic framework that will enable you to solve your own problems using information from your specific site.

Plant Health Care Management

Plant health care management (PHC) is a new concept in managing landscapes that was developed from the concept of integrated pest management (IPM). Many arborists, horticulturists, and landscape managers have long felt that IPM's focus on "pests" is too narrow when applied to landscape plants. More than half of the problems encountered in landscapes or gardens probably are not caused by insects, mites, or disease; instead, they are the result of compacted soil, drought stress, over watering, frost damage, and many other factors. To manage landscapes effectively, plant health and the ecosystem in which the plant is growing must be taken into consideration. PHC takes just this kind of broad approach. PHC incorporates all the principles of IPM, including monitoring, record keeping, and integrating treatments, but PHC emphasizes plant health and proper horticultural practices. PHC is plant management, not just pest management. By focusing only on pests, we often overlook the horticultural or environmental factors that affect plant growth and health.

Components of a PHC Program

Van Bobbitt, community horticulture coordinator for Washington State University Cooperative Extension, lists the following 5 components of a PHC program:

- ▶ Know your plants.
- ▶ Determine key problems.
- ▶ Study your landscape ecosystem.
- ▶ Promote plant health.
- ▶ Consider a variety of strategies to manage pests.

Know Your Plants

Before you can properly care for the trees and shrubs on your school grounds, you must know what they are. Make a map of the grounds and identify every tree and shrub. There are books that can help you with this, or you can take a specimen to a nursery, the Rutgers Cooperative Extension office in your county or a landscaping professional. Once you know the names of all your plants, do some research on each of them. Talk to nursery personnel and horticulturists, and read about your plants in gardening books. From your research, you should be able to answer the following questions:

- ▶ What kind of soil does the plant prefer?
- ▶ How much water does it need?
- ▶ When should it be fertilized?
- ▶ How should it be pruned?
- ▶ Does it prefer shade or sun?
- ▶ How much heat or cold can it tolerate?
- ▶ What are its most common pest problems?
- ▶ What environmental problems, soil compaction, salt damage, etc., is it susceptible to?

Your research and your experience can help you identify key plants that are prone to problems and need more of your time and attention than other plants. If there are many trees and shrubs on the school grounds, this information can help you focus your maintenance activities. You also may want to use this information to remove plants that are not suited to their sites, that have too many problems, or that require too much care.

Determine Key Problems

Many things affect the health of a tree or shrub. They are generally divided into biotic factors and abiotic factors. Biotic factors are living organisms, such as diseases, insects, mites, and deer. Abiotic factors include maintenance practices (fertilizing, pruning, irrigation), weather, soil quality, amount of sunlight, and human activities such as vandalism or soil compaction caused by constant foot traffic. These abiotic factors probably are responsible for the majority of landscape plant problems.

Determining key problems involves deciding which situations or factors are most likely to affect the health of your plants. Ask yourself if the problem is a serious threat to plant health, a minor threat, or just an aesthetic problem. Your research and your experience will help you answer these questions. For instance, one plant disease may kill a tree, but another disease may cause premature leaf drop year after year without seriously affecting tree health.

It is likely that you will have not only key problems, but also key problem sites. For example, perhaps the heavy equipment used in remodeling the school last year severely compacted the soil in several areas, or perhaps drainage is poor in one corner of the schoolyard because of heavy clay soil. These sites will need special attention, and most likely special plants, too.

Learn as much as you can about your key problems. If they are living organisms, learn about their life cycles, how to identify various stages of the pest, and how to recognize symptoms of damage. Do enough research to help you decide which management options are both safe and effective.

You also will need to research abiotic problems. Are there specific symptoms that you can learn to recognize? What techniques are available for solving the problem? Which solutions can you afford and which are best suited to the particular site? Are there specific plants that can tolerate the abiotic factors?

Study Your Landscape Ecosystem

The grounds of your school make up an ecosystem with complex relationships among the plants, animals, water, soil, sunlight, weather, and other components. Because of these complex relationships, there are many things you will need to pay attention to when promoting plant health. Questions you will need to answer include:

- ▶ What is your climate? What are the maximum and minimum temperatures?
- ▶ Are there microclimates in the school yard that might affect plant growth?
- ▶ Where do the prevailing winds come from? Are they unusually strong?
- ▶ What are your seasonal patterns of precipitation?
- ▶ Where are the sunny and shady parts of the yard/field? (These will change over time as plants grow and die.)
- ▶ What are the characteristics of the soil in each part of the yard/field?
- ▶ What are the drainage patterns?
- ▶ What is the history of each area in the school yard or field? What plants were grown there? (This can be an important factor for some plant diseases.) Was the area covered with asphalt or concrete at some point? Did a road or path go through the site?
- ▶ Are animals such as squirrels, deer, and dogs having an impact on the landscape? (The salts in dog urine can be very damaging to plants.)
- ▶ What human activities are having an impact on the landscape? Are children vandalizing plants? Are lawns growing right up to the trunks of trees so that mowers regularly damage the trees? Are city de-icing operations salting up the soil?
- ▶ What kind of irrigation system is installed in the landscape, and is it in working order? Are plants getting too little or too much water?
- ▶ Is air pollution a problem in your area? (Air pollution affects plants as well as animals.)

Since landscapes are constantly changing, you will need to monitor frequently in order to detect problems early. Monitor at least every two weeks during the growing season. In mild climates, you also should monitor once a month during the winter. Focus your monitoring efforts on your key plants and your key problems. Be aware that plants growing in poor conditions are under stress and are often more likely to suffer from insects and disease. As you monitor, look for the kinds of damage symptoms you learned about in your research.

Promote Plant Health

Proper plant care is the foundation of a PHC program. Healthy plants mean healthy landscapes, and healthy landscapes have fewer problems and require less special attention. The following points will help you to minimize cultural and environmental problems, as well as pest problems.

- ▶ Match the plant to the site. For example, you cannot grow a subtropical swamp plant in a cold, dry site. Some plants cannot grow in full sun, and some plants are better adapted to salty or compacted soil or soil with poor drainage. For help with finding plants for your area or for problem sites, talk to local gardening clubs, nurseries, or extension personnel, or consult books on regional gardening.
- ▶ Select pest and disease resistant species.
- ▶ Know what kind of care each plant needs, and pay special attention to how you water, prune, and fertilize them.

- ▶ Plant a diversity of species so that a single pest problem will not devastate your landscape.
- ▶ Include “insectary” plants in your landscapes. These are plants that attract and feed beneficial insects with their nectar and pollen; for example, sweet alyssum (*Lobularia* spp.), flowering buck-wheat (*Eriogonum* spp.), members of the parsley family (*Apiaceae*) such as fennel and yarrow, and members of the sunflower family (*Asteraceae*), such as sunflowers, asters, daisies, marigolds, and zinnias.
- ▶ Use proper planting techniques when installing vegetation.
- ▶ Improve the soil with organic matter and mulches.

Consider a Variety of Strategies

If you determine that a problem needs to be treated, it is important to consider a variety of strategies and to integrate those strategies into a comprehensive program. Treatment strategies can be divided into several general categories:

Education

This can include educating students and teachers about respect for landscape plantings; the more that students can be involved in the planting and care of various portions of the school yard, the less they will vandalize these areas. Education can also involve training maintenance staff in various aspects of plant care and plant selection.

Cultural Controls

These usually include modifying horticultural practices to prevent plant problems or to improve plant health.

Biological Controls

Biological control uses other organisms to combat pests. More and more beneficial organisms are becoming commercially available, and by planting “insectary” plants, you can attract beneficial insects already in your area.

No Action

This can be a valid strategy in many situations when the problem does not seriously affect the health of the plant. Your research will help you understand which problems are serious and which are minor or simply aesthetic problems.

Chemical Controls

Chemicals are not prohibited in a PHC program, but they are used as a last resort, and then they are used judiciously and in the least toxic formulations. Always spot-treat to minimize the amount of active ingredient used.

At times, non-chemical methods alone may prove insufficient to solve a pest problem. Integrating a pesticide into your management program may be necessary to gain control.

Pesticides must be used in accordance with their EPA approved label directions. Licensed applicators should always wear protective equipment during pesticide applications. All labels and Material Safety Data Sheets (MSDS) for the pesticide products authorized for use in an IPM program should be maintained in a file or logbook designated for this purpose. This logbook or file must be kept within an individual school building, not at a district or other central location, and should always be available to the IPM Coordinator or his/her surrogate.

The law also mandates a 7 hour re-entry period whenever a pesticide without a specific numeric re-entry period is applied. This means that if the label says the treated area cannot be re-entered for four (4) hours then the re-entry period is four (4) hours, if the label says the re-entry period is twelve (12) hours, then the re-entry period is twelve (12) hours. However, if a label does not say what the re-entry period is, then the re-entry period is seven (7) hours. An example would be a product that says re-enter after product has dried and settled, this product would default to a seven hour re-entry period in New Jersey.

New Jersey law allows pesticide applications in schools by licensed professional pesticide applicators only, or by a licensed pesticide operator working under the direct supervision of a licensed applicator. Even over-the-counter products such as ant & roach sprays, weed killers or weed & feed lawn care products require a license if being applied at a New Jersey school.

Guidance for Creating a School Integrated Pest Management Plan In Compliance with New Jersey Law



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Use the guidance provided in this document to help your school to create it's own IPM Plan.

Each school is different and has it's own special and unique situations and personnel. This document helps to make clear what needs to be done and offers suggestions as to who should do it.

Only you know your school, school grounds and school personnel (including the school community) well enough to create a plan that will work for your school. Using the guidance in this document, going one section at a time, will help you to get the seemingly difficult job of creating an IPM Plan done, and you'll find it was not too difficult a task after all.

General school information:

This section of the plan should contain a statement that identifies the School and names the key parties involved with the implementation of the IPM plan. The statement should contain the name, address, email and phone numbers for the school. The statement should also contain the name and contact information for the school IPM Coordinator, as well as contract information of any pest control professionals under contract with the school.

Integrated Pest Management Statement:

Include an Integrated Pest Management statement as a part of your plan. As an example, an IPM statement may read as follows.

Integrated Pest Management on school property is a long-term approach to maintaining healthy landscapes and facilities that minimizes risks to people and the environment. Our school will use ongoing site assessment, pest monitoring, and pest prevention in combination with a variety of pest management tactics to keep pests within acceptable limits. Instead of routine chemical applications, our school will employ mechanical, physical, and biological controls with selective use of pesticides when needed

School IPM Policy:

Attach a copy of your school IPM Policy to your school IPM plan. A model policy is available at the NJDEP Pesticide Control Program web-site at <http://njipm.org> or at the Rutgers Cooperative Extension web-site at <http://www.pestmanagement.rutgers.edu/IPM/SchoolIPM> New Jersey law states that,the superintendent of the school district, for each school in the district, the board of trustees of a charter school, and the principal or chief administrator of a private school, shall adopt and implement a school integrated pest management policy for the school property consistent with the model policy.....

School IPM Plan Goals:

- ▶ The roles, responsibilities, and training requirements of all members of the School Community regarding integrated pest management at the school are clearly defined. The school community consists of all groups associated with your school, and will vary from location to location. Some fairly standard groups include the school administration, the IPM coordinator, students, teachers and other school staff, parent-teacher associations or organizations and vendors or contractors including pest control professionals.
- ▶ School pest identification. Initially identify interior and exterior pests for your school by historic account and by direct monitoring. List and then learn about the pests that are in your

school now or that can be expected at a given point during a normal school year. Establish monitoring methods and schedules. Establish record keeping policies and record keeping forms. Some good forms are available for download at the NJDEP or Rutgers IPM in Schools web sites, or you can make your own.

- ▶ Pest prevention and control to maintain a healthy school environment. Decide what non-chemical pest controls will be routinely practiced at the school. Establish action threshold levels for all anticipated pests. The importance of this step can not be over-stated. Action thresholds are the number of or frequency of a pest that will trigger the need for action and the possibly the use of a chemical control. Define the prescribed use of a low impact versus a non-low impact pesticide for identified pests. Maintain records of all pesticide applications.
- ▶ Keep the School Community informed. The law requires that all schools issue an annual notice of their school IPM program. Make records available for public inspection. Establish pre-notification procedures for when or if you must use non-low impact pesticides. Adopt notification procedures for the emergency use of non-low impact pesticides. Establish posting procedures for interior and exterior areas that are treated with non-low impact pesticides.
- ▶ Evaluate and revise your School IPM Plan annually. Update your school's IPM priority list as projects are completed. Discuss what is working well in your plan and what is not, what was cumbersome and what went easily, and adjust your plan accordingly. Your school IPM plan will always be a 'living document' subject to change, but in the first several years it's likely to be a very dynamic document as your school becomes less and less pest friendly.

School IPM Roles & Responsibilities

For an IPM program to be successful, all members of the School Community should be involved. School administrators, IPM coordinators, students, teachers and other school staff, vendors or contractors, along with the parents or guardians of the student body. Each of these groups must be made aware of the school's policies on pest control and their roles in the schools pest management plan. Many of the roles, responsibilities and training requirements regarding pest management at a school are outlined below.

Keep in mind that this is a guidance document.
Different roles and responsibilities may be assigned differently at your school.
However, all responsibilities should be clearly stated in your IPM plan. The IPM plan will be reviewed during random State and County school inspections.

School Administrators:

Specific duties of New Jersey School Administrators as required by law.

- ▶ Adopt and begin to implement a school IPM policy that requires the development of a site-specific IPM plan for the school property by June 12, 2004. Implement these IPM procedures to control pests and minimize exposure of students, teachers, and other school staff to pesticides.
- ▶ Designate a School IPM Coordinator. The IPM Coordinator should be someone who is familiar with the school's building(s) and property, such as buildings and grounds or janitorial service personnel. The School IPM coordinator may also be a teacher or other school staff member. The IPM Act does not intend for the IPM Coordinator and the pesticide applicator servicing the school to be one in the same; however, there is nothing in the statute that prohibits the school from employing an outside pesticide contractor or consultant in this capacity. In the case of contracted services the ultimate compliance responsibility will remain with the school administration and not the contractor.

A primary job for school administrators early in an IPM program will be to help in evaluating the responsibilities of an IPM coordinator. Once a program becomes established, the duties of a coordinator will become more predictable, but may be very time consuming early in an IPM program.

Other duties to be performed in a successful IPM program are listed below
Remember these duties may be assigned differently at your school, but must be clearly
stated in your IPM plan

- ▶ Maintain records of pesticide applications and issue annual notices of IPM policy.
- ▶ Permitting the use of certain pesticides and providing the notifications required.
- ▶ Posting of signs prior to use of certain pesticides in all required areas.
- ▶ Providing the notifications required of the emergency use of certain pesticides.
- ▶ Develop contracts, bid specifications, and contract addenda that foster school IPM.

School IPM Coordinator:

The School IPM Coordinator, by law, is jointly responsible with the school administration for the implementation of your School IPM Plan.

New Jersey law calls for "...each local school board of a school district, each board of trustees of a charter school, and each principal or chief administrator of a private school' to designate an IPM coordinator.

The IPM Coordinator is usually an individual within a facility in charge of pest control activities. This individual has the authority and backing of the school administration. The IPM coordinator

has the primary responsibility for ensuring that the IPM plan is carried out. The IPM coordinator is also the primary contact for the school community and the public with regard to pests or pesticide use. Ultimately, this person is directly responsible for the integration of all IPM activities through the coordination of all parties involved.

Some specific duties of a New Jersey School IPM Coordinator as required by law include:

- ▶ Maintain information about the IPM Policy and Plan in place at the school.
- ▶ Maintain information about pesticide applications on school property including records obtained from the pesticide applicator, material safety data sheets (MSDS) when available for pesticides used, and labels for all pesticide products used.
- ▶ Maintain non-pesticide pest control records as required by law.
- ▶ Respond to inquiries and provide information to teachers and other school staff, students and parents or guardians regarding IPM at school.
- ▶ Provide access to the above information for public review.

Other duties to be performed in a successful IPM program are listed below. These duties may be assigned to an IPM coordinator, or may be assigned differently at your school. All assigned responsibilities should be clearly stated in the school IPM plan.

- ▶ Provide training in IPM practices to the school community. This training should reflect your school's IPM plan 'roles and responsibilities' section.
- ▶ Consider all available actions (including no action) prior to determining what pest control(s) should be used. Consult with the school's pest control professional if the school has one under contract.
- ▶ Ensure that the pest control professional(s) make accurate and readable entries on record forms. If a form can not be easily read, it should be done over, don't allow a sloppy application form be the reason your school is found to be out of compliance. Maintain pesticide application records for a minimum of 3 years; or in the case of termites, maintain records for a minimum of 5 years.
- ▶ Oversee all pest management personnel to ensure that they have the correct NJDEP-required license for pesticide applications. The State requires that applicators have specific licenses. For example license category 7A is General and Household (for in and around buildings), which, is not the same as category 3B which is for turf and lawn applications.
- ▶ Coordinate pre-notification and post-notification of parents and staff regarding non-low impact pesticide applications according to the school's notification policy and procedure.
- ▶ Prepare and send out the school's annual IPM policy notification to parents and staff.
- ▶ Serve as the point of contact for contracted pest management services for the school.
- ▶ Distribute forms and train the school community in the use of forms, if any were developed for your school's IPM program, for reporting pests or suspected pest activity.
- ▶ Compile all reports of pest sightings as well as suspected or actual pest activity and record actions taken to remedy pest problems in an IPM logbook or file.
- ▶ Develop and maintain a map(s) of the school and school grounds for the purpose of tracking all pest-monitoring activities. Maintain records of all pest-monitoring activities, including

the locations of all traps used for monitoring. This information should also be kept in an IPM logbook or file.

- ▶ Maintain a prioritized list of interior and exterior pest management issues, including such items as key pests, needed structural and landscape improvements, poor sanitation practices, leaky pipes etc...for the school.
- ▶ Prepare and post signs, as required, in areas where non-low impact pesticides are to be applied.
- ▶ Work with administrators when contracting for pest control services to ensure that the bid specifications comply with the school IPM policy and plan.
- ▶ Provide a signature when a pest management professional requests that a School Integrated Pest Management Act Compliance Certification Form be signed.

School IPM Coordinator Training - The School IPM Coordinator must receive NJDEP-approved training, when it becomes available, that provides an overview of the principles of IPM, legal requirements, and how to implement the IPM Policy and Plan at your school in compliance with the rules and regulations adopted by the NJDEP.

School Nurse:

The school nurse will consider potential pesticide exposure when evaluating a child's health complaint. The school nurse should have access to the Material Safety Data Sheets (MSDS) for any chemical used on school property (when available) and be aware of any children with asthma or chemical sensitivities.

Possible other responsibilities for the School Nurse in the School IPM Program may include those listed below. All IPM responsibilities should be clearly stated in the school IPM plan.

- ▶ Keep copies of and review the MSDS of all pesticides used on school property.
- ▶ Maintain easy access to Poison Control Center hotline at 1-800-222-1222 in case acute poisoning is suspected.
- ▶ Monitor for head lice, a common problem for children between the ages of three and ten. Head lice are a medical problem (not considered a pest problem) and should be treated as such.
- ▶ Educate students, teachers and other school staff and parents about preventing the spread of head lice if or when they occur.
- ▶ Following your school's policy, reports any pest sighting(s), and suspected or actual pest activity to the school IPM coordinator using whatever system your school has in place. Suggestions include filing a form or using email or voice-mail to inform the IPM coordinator, who will then keep records of all such reports.

School Nurse Training - In addition to required professional training, be aware of public health pests of significance that may impact student health; see EPA's List of Pests of Significant Public Health Importance at http://www.epa.gov/oppmsd1/PR_Notices/pr2000-draft.htm. Obtain copies of selected pesticide resources on poisoning which may include: *Recognition and Management of Pesticide Poisonings*, Routt Reigart and James Roberts, 5th edition, U.S. Environmental Protection Agency, March 1999.

Kitchen Staff:

Food handling, preparation and distribution areas are among the most critical areas for pest management. Kitchen staff must keep all food areas free of crumbs and food residues after each use. Suggested duties of an IPM plan that may be assigned to kitchen staff.

These responsibilities may be assigned to an individual from the kitchen or to other school staff. All IPM responsibilities should be clearly stated in the school IPM plan.

- ▶ A strict practice of good sanitation in all kitchen and food service areas is essential, clean all areas daily.
- ▶ The supervisor of the kitchen staff will inspect the kitchen and food service areas daily to verify proper sanitary maintenance of food service areas. A record of these daily inspections will be kept in accordance with your schools policies.
- ▶ On a monthly basis, the IPM coordinator will inspect kitchen and food services areas, and keep a record of these inspections in an IPM logbook or file.
- ▶ Pest sightings or evidence of pest activity in these areas should be reported on a daily basis or according to school policy.

Kitchen Staff Training - The School IPM coordinator will be responsible for training the kitchen staff in proper sanitation procedures when hired and annually thereafter. The School IPM Coordinator will also train the kitchen staff in the pest detection and monitoring program in place in the kitchen, when hired and annually thereafter. See the **NOTE** in the next section.

Maintenance Staff:

Maintenance staff usually maintains the sanitation and structural needs of the school building and grounds on a day to day basis. These staff members may be assigned to both interior and exterior maintenance. It is important to **NOTE** that just because staff has been cleaning or maintaining the building and grounds ‘for a long time’, does not mean the way they clean or maintain is acceptable in a school with an IPM program. The ‘old’ way may have been fine in a school that relied completely on chemical controls for pest management issues, but not acceptable in an IPM program. For example, mopping alone is not going to keep a kitchen area clean enough to deny cockroaches a free meal. The gook that accumulates in corners and around the legs of food prep tables and such, may contain enough organic matter to feed cockroaches. Some good old fashion floor scrubbing may be required once a month or so to prevent this type of build-up. This new type of activity should be on a schedule, and staff will need to be somewhat re-trained in cleaning and maintaining a school that is trying to become both pest and pesticide free.

Some IPM responsibilities that may be assigned to School Maintenance Staff are listed here. All IPM duties should be clearly stated in the school IPM plan.

- ▶ Practice all sanitation and maintenance techniques according to the school IPM policy.
- ▶ Recognize, report and correct conditions that may lead to pest problems such as water leaks, potential pest entryways, and poor sanitation practices, in and around the school.
- ▶ Following your school's policy, reports any pest sighting(s), and suspected or actual pest activity to the school IPM coordinator using whatever system your school has in place. Suggestions include filing a form or using email or voice-mail to inform the IPM coordinator, who will then keep records of such reports.
- ▶ Manage specific pest issues as directed by the IPM Coordinator. This will not include pesticide applications unless you are a licensed Pesticide Applicator.

Maintenance Staff Training - Maintenance staff must understand that even over the counter products such as weed killers, bug sprays, and weed & feed lawn care products are not to be used by school maintenance staff unless they hold a valid pesticide applicator license.

The School IPM Coordinator will be responsible for training the maintenance staff, when hired and annually thereafter, in the following areas.

- ▶ Proper sanitation procedures for your school, according to the school IPM plan.
- ▶ The pest detection and monitoring program and devices in place throughout the school.
- ▶ Pest control products they are allowed to use and the pest control products they are not allowed to use on school property.

Students Teachers and other School Staff:

The duties of the students' teachers and other school staff in the school IPM program should be clearly explained in the IPM plan.

- ▶ The most important responsibility of students' teachers' and other school staff is sanitation. Much of the prevention and reduction of pest infestation at the school site depends on whether or not students teachers and staff clean up food leftovers, food in lockers, teacher and staff lounges, gum under desks, paper clutter, etc..., and perform proper maintenance according to school IPM policy.
- ▶ Following your school's policy, reports any pest sighting(s), and suspected or actual pest activity to the school IPM coordinator using whatever system your school has in place. Suggestions include filing a form or using email or voice-mail to inform the IPM coordinator, who will then keep records of all such reports.
- ▶ Students' teachers and other school staff will not remove or move sticky traps or other pest monitoring devices found in or around the school. If a student, teacher or other school staff member thinks a trap or monitoring device has been moved or tampered with they should report it to the school IPM coordinator, following school IPM policy.

Training - Students teachers and other school staff - The School IPM Coordinator will train students, teachers and other school staff in their role in the school's integrated pest management program.

Specifically, students, teachers and other school staff will be given a brief overview on pest identification and the conditions that they, as building occupants, may create that promote pests. This information will focus on pest reduction strategies connecting people's behavior; such as over watering plants, eating at desks, leaving crumbs on floor, etc., to pest problems.

Education will be focused to increase people's willingness to share their environment with other organisms so that people are less likely to insist on toxic treatments for innocuous organisms. They will be instructed on how to follow your school's policy, and to report any pest sighting(s), and suspected or actual pest activity to the school IPM coordinator using whatever system your school has in place. Suggestions include filing a form or using email or voice-mail to inform the IPM coordinator, who will then keep records of all such reports.

Pamphlets and fact sheets will be made available at the time of training and posted on bulletin boards in specific areas such as the cafeteria and teachers' lounge.

Parents and Guardians:

Some of the duties required of Parents and Guardians in the School IPM Program.

- ▶ Learn about IPM practices and follow them at home so pests are not carried to school in notebooks, lunch boxes, clothing etc....
- ▶ Make their children aware of their role in the IPM Program at their school.
- ▶ Encourage children to lend a hand in cleaning up.
- ▶ Discourage children from keeping food in their lockers and desks, for extended periods of time.
- ▶ Be aware of the current pest management practices in their children's school(s). Review the 'Annual School IPM Program Notification' to Parents as well as all notices of pesticide application at the school.
- ▶ Parents may and should express their views regarding pesticide use to the school.

Training for Parents and Guardians of Students – The school IPM coordinator will make parents and guardians of students aware of the School IPM Program. Pamphlets and fact sheets, MSDS's and product labels will be made available upon request.

The annual IPM Program Notification that is sent home each year at the beginning of the school year may count as a level of education for most of the school community. However, the positive effect of additional training, especially for the student body and school staff can not be overstated.

Vendors and Contractors:

The duties of vendors and contractors who work in and around the school or who have machines in or around the school will be clearly defined within the School IPM Plan as well as within each

contract the school has with a contractor or vendor. IPM duties for vendors and contractors will be clearly spelled out in contracts or in a contract addendum for each contract. Contracts or contract addenda will specify regular maintenance service, cleaning under and behind machines during service visits, and immediate correction of problems that may foster pests (e.g., breakage, leaks, or excessive condensation from machinery).

Pest Management Professional:

As part of a school IPM plan the following are specific duties of Pest Management Professionals.

New Jersey Administrative Code Title 7 Chapter 30; Subchapters 1-13 state that all pesticide applications which are made on school property must be done by applicators or operators licensed to apply pesticides by the New Jersey Department of Environmental Protection Pesticide Control Program.

- ▶ Inspect the school building and grounds to identify potential problem areas and any structural **or** management practices, which may contribute to pest problems. This may take several inspections or visits from the pest management professional, and includes such things as garbage maintenance and food service area maintenance evaluations.
- ▶ Notify the IPM Coordinator in writing when pests or signs of pest activity are found.
- ▶ Make written recommendations to the School IPM Coordinator detailing corrective actions to be taken to reduce potential pest problem conditions.
- ▶ Recommend to School IPM Coordinator appropriate non-pesticide procedures to correct pest problems.
- ▶ Offer a selection of a low impact pesticide first, when it is determined that a pesticide must be used.
- ▶ Provide School IPM Coordinator with material safety data sheets (MSDS), when available, and product labels of all pesticides that are applied on school property.
- ▶ Provide application information as specified by the IPM in Schools Law and other New Jersey regulations to the IPM coordinator, when pesticides are applied at the school.
- ▶ If a non-low impact pesticide must be used, request that a ‘School Integrated Pest Management Act Compliance Certification Form’ be signed by the School IPM Coordinator, ensuring all advance notification and posting has been performed by the school as required.
- ▶ Provide comments in writing regarding any necessary modifications to the School IPM plan at the time of the annual review.

NOTE: Applicators will not be held liable for damages resulting solely from the failure of the School Administration to provide the required notifications and postings. However, applicators **may be** held liable if it is determined that they made an application knowing the school was not in compliance, e.g., no posting signs are visible when entering a building to be treated etc...

Pest Management Professional Training - The pest management professional should become aware of school policies and procedures that may effect pest populations or pest control measures in or around the school. Examples may include learning the kitchen maintenance routine and the garbage maintenance routine. Others areas of interest may include the schools recycling program, trash or dumpster locations, and the school's open window policy etc...

Pest Identification

Preliminary Site Assessment and Ongoing Monitoring

One of the key components of school IPM is site assessment to precisely define the presence of pests and the site conditions that contribute to their presence. Interior and exterior pests will be identified for the school by historic account, interviews, and by direct monitoring. When an IPM program is implemented at your School the IPM coordinator, in conjunction with the pest management professional if one has been contracted, will perform a thorough inspection of the school, both inside and out, to identify pest activity and conditions that are contributing to any pest problem

Interior site assessment

The IPM coordinator for the school, in conjunction with the pest management professional if one has been contracted, will conduct a thorough inspection and make a record of the following information.

- ▶ Areas that currently have pests or show signs of pest activity.
- ▶ Areas that historically have had pests and when this occurs during the year.
- ▶ Conditions or behaviors contributing to pest problems that can be corrected.
- ▶ If already in use, note the location of detection and monitoring devices and bait stations.
- ▶ Recommendations for sanitation, structural repairs, and habitat modification.

This information will also be recorded or indicated on a site-map drawn for this purpose.

Exterior site assessment

The IPM coordinator for the school, in conjunction with the pest management professional if one has been contracted, will conduct a thorough inspection and make a record of the following information.

- ▶ Locations of trees, shrubs, and ornamentals.
- ▶ Assign and divide the landscape into management units (turf areas, front lawn, athletic fields, shrubs etc...).
- ▶ Note key plants and any pest problems, either current or historical.
- ▶ Horticultural recommendations.

This information will also be recorded or indicated on a site-map drawn for this purpose.

NOTE: The Rutgers Cooperative Extension ‘IPM Report Card for School Grounds’ provides a series of self-assessment tools for schools to measure their adoption of IPM on school grounds. Additionally, each Report Card in the series can be used as a guide to incrementally or completely implement IPM by simply following the practices outlined. IPM practices are precisely outlined for control of common pests of New Jersey schools. Report Cards for School Grounds include: General Requirements; Athletic Fields; Turf; Ornamental Plants; and Landscape Plantings.

<http://www.pestmanagement.rutgers.edu/IPM/SchoolIPM/reportcard.html>

Pest Identification

It is important that pests be accurately identified in order to gather information about the pest’s life cycle and habits. Identification is essential for selecting the combination of strategies, which will be most effective, and knowing when to implement them. If the IPM coordinator for the school, or the pest management professional if one has been contracted, is unable to identify the pest(s), the county office of Rutgers Cooperative Extension (RCE) will be consulted and samples will be submitted for identification if needed. Information is available at the following web address <http://www.rcrc.rutgers.edu/extension/>. Once at this web-site, click on the county’s tab for your county’s contact information.

Ongoing Pest Monitoring

Once a pest is correctly identified, monitoring methods and schedules, as well as pest control strategies will be determined based on the pest’s life cycle, food sources, habitat preferences, water needs and natural enemies.

Interior pests will be monitored by direct inspection. Direct inspection means sticky traps, pheromone baits or traps, tracking powder, mechanical traps, and glue-boards etc... to determine the presence of a pest. If baits or traps of any kind are used each one will be tracked as follows.

- ▶ Each bait station or trap is assigned an identification number.
- ▶ A map is prepared showing the location and number of each trap or bait placement.
- ▶ Each trap or bait station is marked with appropriate warning language.
- ▶ Traps will be checked by the IPM coordinator or the pest management professional weekly during the early stages of solving a pest infestation, then taper off to monthly once the pest problem is under control.
- ▶ Captured rodent pests will be recorded and disposed of on a daily basis.

Exterior pests, whether animal or plant, will also be monitored by direct inspection. Landscape plants are scouted at least monthly during the growing season for conditions requiring action. Examples include damaged, diseased or dead limbs; soil erosion or compaction; insects, disease, weed pests and damage. Scouting usually begins when plants put out new leaves in

spring and ends when leaves fall in autumn. Plants with annually recurring pest problems will be scouted according to pest appearance timetables.

Additionally, areas surrounding the school, school playgrounds or school athletic fields can be scouted for stinging insect activity. Problems can and will be avoided if you can stop a nest early in its construction.

Monitoring Records

Following your school's policy, the school IPM coordinator or pest management professional will maintain and keep records of any pest monitoring activities, including the placement of all traps used, using whatever system (a log book or file) your school has in place, including the placement of this information on site-maps drawn for this purpose.

Pest Prevention and Control

Wherever possible the school will take a preventive approach by identifying and removing, to the degree possible, the basic causes of the problem rather than merely attacking the pests. This prevention-oriented approach is also best achieved by integrating a number of strategies. It is easier to spot a potential problem when the interior and exterior of the school is clean and uncluttered.

IPM employs a multi-tactic approach, integrating several strategies to combat a particular pest. Control strategies that remove a pest's food, water, and shelter (harborage), and limit its access into and throughout buildings and on school grounds will be used at the school as follows:

Cultural Control

For example, improve sanitation, reduce clutter, get people to change habits like leaving food in the classroom, maintain plant health by taking care of plant habitats, fertilization, plant selection, the right plant for the right place, and cultural exclusion techniques to keep problematic pests and weeds away.

Physical control

For example, pest exclusion; removing pest access to the school building by sealing openings with caulk and copper mesh; repairing leaks and screens; removing pests by hand.

Mechanical control

For example, trap rodents, till soil prior to planting to disrupt pest life cycles.

Biological control

For example, use of a pest's natural enemies, by the conservation and augmentation of natural enemies of pests in the landscape; introduce beneficial insects or bacteria to the environment or, if they already exist, provide them with the necessary food and shelter and avoid using broad-spectrum chemicals that will inadvertently kill them.

Least hazardous chemical control

For example, give preference to low impact pesticides as defined in the School IPM Act.

Pesticides will only be selected for use when other control methods are not effective or practical in resolving a pest problem. Pesticides will not be used at the school unless the pest has been both identified and its presence at the school verified through monitoring. This will be reflected in you IPM records along with whatever non-pesticide control methods that were tried before going to a chemical control.

It is neither possible, nor desirable to completely exterminate every pest and potential pest from school property. Also, there will never again be on going chemical controls of any type. The days of scheduled pesticide applications are over in New Jersey Schools (low-impact and non-low-impact pesticides). The goal of IPM is to use pesticides only when necessary to get a problem under control. If the problem is on going, then it is incumbent on the IPM Coordinator to find where the program is failing and correct the situation, that is what an IPM Coordinator does!

Thresholds

The school will establish injury levels also known as tolerance levels or threshold levels or action thresholds for each individual pest species before making any chemical treatment. Appropriate injury levels will be set, and may take into consideration economic losses (the amount of foodstuffs contaminated by pantry pests), health risks (the occurrence of disease-bearing pests), aesthetic evaluations (weeds in the school lawn), and nuisance problems (stinging insects).

The New Jersey School IPM law defines a low impact pesticide. The law and resulting model school IPM policy published by DEP make it clear that when a pesticide is needed, preference must be given to choosing a low impact pesticide, whenever possible.

NOTE: A low impact pesticide is a pesticide that is considered to have relatively minimal risk as compared to pesticides in general. The New Jersey School IPM Law specifically defines what a low impact pesticide is in two parts.

1. The first part consists of a federal EPA list of pesticides that EPA considers to be minimal risk and thus do not require formal registration. These pesticides are listed in the federal code at 40 CFR § 152.25. <http://pcpnj.org/ipm-lowimpact.htm>
2. The second part consists of a list of pesticide ingredients (such as boric acid or diatomaceous earth) and formulation types (such as gels or pastes) that are considered low impact. It is important to note that a substance considered "low impact" does not necessarily mean zero risk. All pesticides must be used properly to reduce potential risk from their use.

See the Rutgers Cooperative Extension School IPM web-site for information on low impact pesticides as it becomes available.

<http://www.pestmanagement.rutgers.edu/IPM/SchoolIPM/NJAct/lowimpact.htm>

When it is determined that a **non-low impact pesticide** must be applied to adequately control pests within the established pest thresholds for your school, certain pesticide application guidelines will be followed according to the law.

Specifically, a non-low impact pesticide may only be applied in a school building if students are in another area of the building, which is separated by fire doors **AND** a different air handling system serves the area being treated with the non-low impact pesticide. Also, applications of non-low impact pesticides on school property will only be made when students will not be present, in the treated area, for instruction or extra-curricular activities, for a minimum of seven hours, unless the label states specific numeric re-entry restrictions below 7 hours.

The New Jersey School IPM Act allows for the emergency application of a non-low impact pesticide only when the health or safety of a student or staff member is threatened. A "school pest emergency" as defined in the law is.... an urgent need to mitigate or eliminate a pest that threatens the health or safety of a student or staff member...

One example would be the presence of stinging insects such as ground hornets in an athletic field where events are scheduled. If a pest emergency exists, the school may use pesticides without the normal posting of signs warning of a pesticide application and the 72-hour notice to parents and staff. Rather, the posting must be done at the time of the application, and the notice to parents and staff must be done within 24 hours of the emergency application or on the morning of the next school day whichever is earlier. The notice that goes to parents and staff must explain what the reason for the emergency was, and if possible, what could be done to prevent such an emergency in the future.

Treatments, either low impact pesticides, or non-low impact pesticides will only be applied at the school when and where they are needed. It is rarely necessary to treat an entire building or landscape area to solve a pest problem. The school will use monitoring to pinpoint where pest numbers are beginning to reach the action level and confine 'spot' treatments to those areas.

The school IPM coordinator and the pest management professional, if the school contracts one, will meet on a set schedule to review monitoring results and reports and determine corrective actions. This schedule will be determined according to the needs of the school and stated in your school IPM plan. If one is under contract, the pest management professional should make recommendations for corrective actions to the School IPM Coordinator. The IPM coordinator will share suggested pest control options with the correct school officials and someone will make a decision. Who will make the final decision? This decision making process must be clearly defined in your school IPM plan. The person or persons making the final decision will consider all options, including the option to do nothing at all, and look at pest activity levels versus the pest thresholds that were decided upon before making a final decision.

They will consider EPA-defined criteria for selecting a treatment strategy:

- ▶ Least hazardous to human health
- ▶ Least disruptive of natural controls
- ▶ Least toxic to non-target organisms
- ▶ Most likely to be permanent
- ▶ Easiest to carry out safely and effectively
- ▶ Most cost-effective

- ▶ Most site-appropriate

All controls that are actually implemented should be documented in an IPM logbook or file.

The school IPM coordinator will generate a pest management priority list to optimize a plan of corrective and preventative actions throughout the school buildings and grounds. This should be done with the advice of someone familiar with the schools budgeting process. Realistically some necessary projects may have to wait for monies before work can be started or completed. Be realistic and look at the big picture or the long-term picture. Annually, assign appropriate staff to carry out individual tasks on the IPM priority checklist, and update the checklist as necessary.

Notification and Posting

It is important to keep the school community informed of the school's IPM Plan. Accordingly, this section outlines the annual notification of the School IPM program, the pre-notification of planned use and the notification of emergency use of non-low impact pesticides. Also covered in this section are the posting (warning sign) requirements for both interior and exterior areas that are treated with pesticides.

Annual Notification

At the beginning of each school year, the school will prepare and send out an annual notice regarding the school IPM program to the parents and guardians of the student body. The annual notice will also be sent to teachers and all other school staff members. Once the annual notice has been sent, the school will give this information to new staff or the parents or guardians of new students when they arrive. Late arrivals will not have to wait for the next annual notice to receive this information.

New Jersey law requires that the annual notice inform the school community of the following:

- ▶ A copy of the School IPM policy
- ▶ The name, address, and telephone number of the school integrated pest management coordinator
- ▶ A list of any pesticide that is in use or that has been used within the last 12 months on school property
- ▶ Information stating that the integrated pest management coordinator maintains the product label and material safety data sheet (MSDS), when available, of each pesticide that may be used on school property and that the label and data sheet is available for review by a parent, guardian, staff member, or student
- ▶ The integrated pest management coordinator is available to parents, guardians, and staff members for information and comment
- ▶ The time and place of any meetings that will be held to adopt or to modify and readopt the school integrated pest management policy
- ▶ And the following statement:

As part of a school pest management plan (insert school name) may use pesticides to control pests. The United States Environmental Protection Agency (EPA) and the New Jersey Department of Environmental Protection (DEP) register pesticides to determine that the use of a pesticide in accordance with instructions printed on the label does not pose an unreasonable risk to human health and the environment. Nevertheless the EPA and DEP cannot guarantee that registered pesticides do not pose any risk to human health thus unnecessary exposure to pesticides should be avoided. The EPA has issued the statement that where possible persons who are potentially sensitive such as pregnant women infants and children should avoid unnecessary pesticide exposure.

Notification and Posting of Non-Low Impact Pesticide Use

When it has been decided that a non-low impact pesticide must be used on school property, notification must be given to a large section of the school community, and warning signs must be posted at the school. This section explains when and where warning signs must be posted on school property and when and to whom notifications must be given.

Pre-Planned Application of Non-Low Impact Pesticides

When it is known in advance that a school must use a non-low impact pesticide, these are the procedures that must be followed. Use this information to develop your own specific policies. Be sure to name the responsible persons in your school IPM plan.

Pre-Notification and Pre-Posting of Non-Low Impact Pesticide Use

During the school year AND during holidays and the summer months, the school will issue prior notification of all non-low impact pesticide use. Specifically your school will issue notice to all staff, and the parents or guardians of the student body. During the summer months and during holiday breaks, notification will go to staff members and to the parents or guardians of students using the school in an authorized manner. Signs giving notice of the up-coming pesticide application must be posted in an area in or adjacent to where the pesticide is going to be applied AND at each entrance to the school building or school ground to be treated. Note: the posting signs for a notice of application must be at least 8.5 inches by 11 inches.

Your school IPM plan should clearly state who will be responsible for which duties. For example, ‘notifications regarding non-low impact pesticide use will be conducted by the principal’s office. Posting signs regarding non-low impact pesticide use will be hung by the lead custodian following a directive from the principals office’.

Assign the duties however it makes sense in your school, but clearly communicate your decisions in your IPM plan.

Emergency Application of a Non-low Impact Pesticide:

Sometimes you just can't wait!

An example would be when a ground-nest of hornets is discovered on a field, where a game is scheduled on the following day. Some events can and should be rescheduled (intramural games) while other events can not be rescheduled because they involve so many other people (league games). In this case you will not be able to fully comply with the law, and have the pest situation dealt with in time for an event that can not be rescheduled.

The IPM in School Act states that in an emergency situation these procedures will be followed:

Rather than posting signs 72 hours before a non-low impact pesticide application, the signs will be posted at the time of the application and left in place for 72 hours following the treatment. The signs will be posted in an area, in or adjacent to, where the pesticide is going to be applied AND at each entrance to the school building or the school grounds to be treated. Notifications will still be sent to the school community but rather than 72 hours in advance they will be sent within 24 hours of the application, or on the morning of the next school day, whichever is earlier.

Who will decide if there is a pest emergency? Be sure to clearly state in your IPM Plan who will make these decisions for your school.

The content of the notices and signs we have discussed are also spelled out in the New Jersey law. You can make your own notices and signs or use the model posting signs and the model notices available at the www.njipm.org web site or the Rutgers Cooperative Extension web-site <http://www.pestmanagement.rutgers.edu/IPM/SchoolIPM/NJAct/nj.htm>.

Both the notices and the posting signs must include the following information.

- ▶ The common name of pesticide used
- ▶ The EPA registration number
- ▶ The location, date, and time of application, one date for an indoor application; three dates for an outdoor application, in case of weather related cancellations
- ▶ The potential adverse effects of the product
- ▶ The reasons for the application
- ▶ The contact information for the School IPM Coordinator
- ▶ Any further label information or precautions listed for public safety
- ▶ A statement by the EPA that...

...Where possible, persons who are potentially sensitive such as pregnant women, infants, and children, should avoid any unnecessary pesticide exposure...

For consideration in deciding your school's policies, note that the required notification may be given in any of the following methods or a combination of these methods.

- ▶ Written note that the students take home
- ▶ Written note that is mailed at least one week prior to the application
- ▶ A phone call
- ▶ By direct contact
- ▶ Via an e-mail

Record Keeping and Evaluation

Record Keeping

Much of this topic has already been covered in the roles and responsibilities section. The law requires that records are kept for three years following a pesticide application and that records are kept for five years following a pesticide treatment for termites. The school will keep records on site at the school (not at a district or central location) in an IPM logbook or file. Remember to spell out all the details in your school IPM Plan, including the storage location for the logbook or file, which should always be available for review.

The following are examples of records that may be maintained in an IPM logbook or file. An * indicates a form that is required for compliance with the New Jersey Law. The records at your school may be different, you may have more or less depending on the policies you set and the information you decide to track..

- ▶ * A copy of the school IPM Policy
- ▶ * A copy of the school IPM Plan
- ▶ * A copy of any Contract for Pest Management
- ▶ * A copy of the Annual School IPM Program Notification
- ▶ * A copy of any 72 hour pre-notification of the use of pesticides forms used
- ▶ * A copy of any Emergency pesticide use notification forms used
- ▶ * A copy of any School Integrated Pest Management Act Compliance Certification Forms signed by the IPM Coordinator at the request of a Pest Control Professional
- ▶ * A copy of any Posting Sign for indoor or outdoor use – The Notice of Pesticide Application sign
- ▶ * A copy of any Applicator Use Records Form (for all pesticide applications at the school)
- ▶ School IPM Report Cards
- ▶ Service reports will also be placed in the IPM logbook or file when or if action needs to be taken by a pest management professional.
- ▶ Pest Sighting/Problem Reports
- ▶ Food Services Area Reports
- ▶ IPM Priority Checklists
- ▶ Non-Low Impact Pesticide Application Log

All of the model documents and forms discussed in this section and throughout this guidance document are available for down-load from both the Department of Environmental Protection and Rutgers' Cooperative Extension IPM in School web sites located at:

DEP web-site <http://www.njipm.org> (Look in the Tools and Templates area)

Rutgers web-site <http://www.pestmanagement.rutgers.edu/IPM/SchoolIPM/index.htm>.

Available Forms

Most forms are available in both Microsoft Word and Adobe .pdf format:

Model IPM Policy

A guidance document for writing an IPM Plan

Model IPM Plan

Model Contract

Annual Notification Form

72 Hour Notification Form (of Non-Low Impact Pesticide Use)

Emergency Notification Form (of Non-Low Impact Pesticide Use)

Compliance Certification Form

Posting Sign / Form (Notice of Pesticide Application)

Applicator Use Records Form

****Pest Sighting Log****

****Cafeteria Check List****

****These and other helpful forms can be found in the Appendix of the Model Plan listed above.****

Evaluation

To design a truly effective plan will take some work, and it might not happen on your first try. Your plan should be constantly evaluated and tweaked to get it just right. During the first few years of an IPM Program your plan will be a very dynamic document. However, while the 'plan' will always be a living document, subject to change annually, it will be less dynamic then in the first few years.

Continued re-evaluation of your school IPM plan may lead to a change or changes in your school IPM policy, which will then be reported to the school community in the annual notification letter. IPM priority lists will be changed each year as projects are completed and new projects are added until there are no major IPM projects planed. When you achieve this level of a 'plan' then your IPM Plan document will be changed less and less frequently, but will always be subject to change.

Program evaluation involves reviewing pest-monitoring data, actions taken, treatment impacts and effectiveness, and any other relevant observations. Records will provide information on previous and current pest populations and which strategies were successful and which were not.

Comparing data will clearly indicate which pest management strategies were most effective for the amount of time and money spent. IPM practices and procedures will be modified, as necessary, based on past experience, recent results and the IPM knowledge you have gained.

The school building Principal is required to do an annual evaluation in concert with the IPM Coordinator. This should be clearly stated in your school IPM plan. If more than one person will have input, identify the others involved in the process as well. Choose a date that everyone can get together on (schedule it in writing) and discuss the previous years activity. If the school is using a pest control professional, invite that person to the evaluation meeting as well.

Possible topics of discussion for an evaluation meeting include:

- ▶ Adequacy of pest control both interior and exterior
- ▶ Areas of concern
- ▶ Sanitation issues
- ▶ Building maintenance issues
- ▶ New less toxic pest control tactics
- ▶ Adequate support by all members of the school community
- ▶ Adequacy of pest threshold levels
- ▶ Revise integrated pest management priorities list

Following the evaluation meeting, changes to the plan will be reported to those who are effected by the changes. If the changes to the plan require changes to the School IPM Policy, the policy will be revised and any changes will be reported to the school community in the annual notification letter concerning integrated pest management at your school. The school community must have a chance to provide input when there is going to be changes to the school's IPM Policy.