Greenhouse Curriculum Introduction

Notes about these lessons:

These lessons are designed to address multiple Pennsylvania Academic Standards in different subject areas, not just Integrated Pest Management (IPM). Lessons focus on students actually doing and using IPM as opposed to just learning about it; they offer hands-on, inquiry-based practice in greenhouse IPM, which may be especially useful for students looking towards careers in greenhouses. The lessons are designed to build on one another, and some lessons may be ongoing. Information learned and data collected in each lesson is to be kept and used in following lessons. Students will work individually, as well as collaboratively in pairs, small groups, and as a class.

In trying to accommodate a large audience, the lessons are written generally and not for specific greenhouse crops. The school greenhouses in Pennsylvania and surrounding states grow and sell different plants, but the principles of IPM are the same. It is up to each teacher to adapt the lessons to what is specifically happening in their greenhouse. The lessons are appropriate for teachers who are just beginning a greenhouse curriculum and for those who have been teaching and want to do more with IPM in the greenhouse.

Unless otherwise noted, the background information and recommendations are based on the manual "Greenhouse IPM with an Emphasis on Biocontrols" produced by the Pennsylvania Integrated Pest Management program, which is a collaboration between The Pennsylvania State University and The Pennsylvania Department of Agriculture. This manual is available for purchase or as a free download. It serves as an excellent reference, especially for Lessons 2-4.

Greenhouse IPM with an Emphasis on Biocontrols – a manual produced by the Pennsylvania Integrated Pest Management Program

- Available from:

  Publications Distribution Center
  The Pennsylvania State University
  112 Agricultural Administration Building
  University Park, PA 16802
  Phone: 814-865-6713

- Free download from http://extension.psu.edu/ipm/program/greenhouse/greenhouse-manual (accessed on 6/8/2012)

Introduction to Integrated Pest Management:

In the spring of 2002, the Pennsylvania governor signed two new bills, Acts 35 and 36, affecting the school districts, vocational-technical schools, and the intermediate units throughout the state. These two bills mandate that these entities adopt an Integrated Pest Management (IPM) plan for addressing pest issues and require a 72-hour notification before and after pesticide use in schools or on school grounds. Greenhouse facilities on school property are included in the mandates. In addition, Pennsylvania law requires a 7-hour reentry period to common access areas whenever pesticides are applied, which means students are not legally allowed to apply pesticides or be present when they are applied even as part of a greenhouse curriculum. The Pennsylvania Department of Education has also made IPM a part of the Environment and Ecology Academic Standards requiring it to be taught in K-12 classrooms.

Integrated Pest Management is a science-based, decision-making process that incorporates a variety of technological and management tactics to achieve long-term, environmentally sound pest suppression. IPM is not a difficult concept to understand, and it relates to everyone. Every person has had experience at one time or another with some sort of pest. To begin understanding IPM, consider each term individually. "Integrate" means

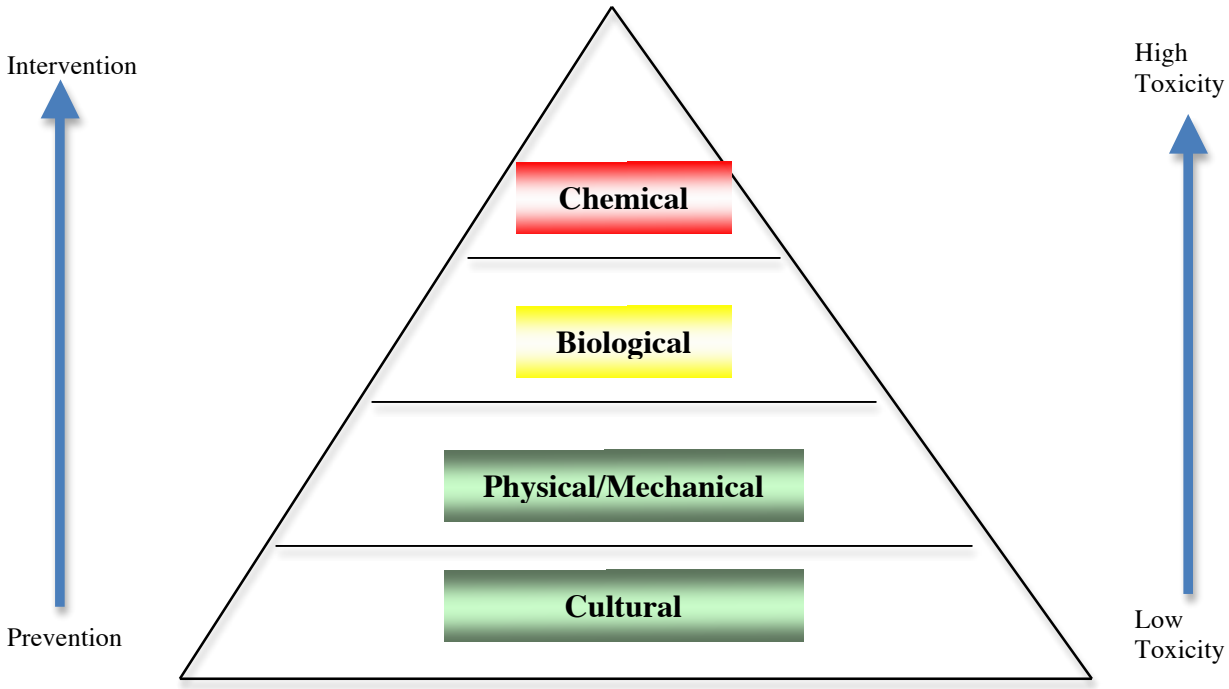
to bring multiple parts together into a unified whole. A "pest" is an organism, which humans feel is in an undesirable location. "Management" refers to controlling or handling a pest problem, not exterminating the pest population. So, IPM involves using a variety of methods, or tactics, to keep a pest organism at an acceptable population level. IPM promotes being proactive to prevent pest problems rather than being reactive to a pest problem that has gotten out of hand.

When a pest is sighted, it doesn't automatically mean intervention is necessary. The six steps of IPM listed below help to scientifically determine if there is truly a pest problem, and if so, the pyramid of tactics provides insight on how to treat the problem.

Steps of IPM:

1. Properly identify the pest. (*What is it?*)
2. Understand the pest's biology, life cycle, and conditions it requires to survive. (*Where does it live? What does it eat? Does it undergo metamorphosis? Why is it here? What is it looking for to live?*)
3. Monitor (scout) for pest presence, locations, and abundance. (*How many are there? Where are the pests located? Are there males, females, offspring present?*)
4. Establish an action threshold (*What is the point when a pest population is large enough that something must be done to manage it? Based on economics, aesthetics, health, and/or tolerance level*).
5. Consider and select multiple tactics for pest management (*pyramid of tactics – an integration of cultural, physical/mechanical, biological and chemical actions you can take*).
6. Evaluate the results. (*Did the tactics chosen work? What should been done differently? How can this problem be prevented from happening again?*)

Greenhouse IPM Pyramid



Examples of IPM Tactics for Each Pyramid Level:

Cultural: greenhouse construction, control temperature and humidity, maintain proper water and nutrient amounts, monitor soil pH for plants, sanitation, rotating crops, vary timing of plantings, eliminate standing water, proper plant spacing, good air flow throughout greenhouse

Physical/Mechanical: place screens over vents, physically remove weeds (inside and outside around the greenhouse), keep doors closed, cover soil floors with concrete, black plastic or weed barrier.

Biological: predators, parasitoids, parasites (entomopathogenic nematodes), pathogens (entomopathogenic fungus)

Chemical: Conventional pesticides (herbicides, insecticides, fungicides, etc.)
**Requires licensed applicator when using on school grounds and must follow state mandates

In the pyramid above, we start at the bottom level. The cultural and physical/mechanical levels indicate the safer levels of treatment and the tactics that should be tried first before advancing up the pyramid. These tactics are also the ones to employ to prevent pests in the first place. Think about a traffic light and what the different colored lights indicate. The cultural and physical/mechanical levels are green in color copies indicating "safe to use." The biological level is yellow indicating "use with caution." As you move up the pyramid, the chemical methods of treatment are located at the red level, indicating you should stop and evaluate the tactic that's going to be used, read and follow all label directions properly, and have a licensed pesticide applicator apply pesticides in the school setting. Additionally, there are two arrows, one on each side of the pyramid. On the right, the arrow indicates the level of toxicity, which increases while moving up the pyramid. The items found in the chemical level are the most toxic tactics available when managing pests, while the cultural tactics are low toxicity or not toxic. The arrow along the left side shows prevention verses intervention. As you move up the pyramid and the tactics increase in toxicity, the pest situation is often times to the point of intervention, not prevention. A key component to IPM is to incorporate tactics and practice techniques that will prevent pests from becoming a problem. The lessons in this curriculum incorporate tactics from the cultural, physical/mechanical and biological levels of the pyramid.

Many people already use IPM in their daily life at home, work, or school to prevent or manage pests and don't even realize it. Whether it's cleaning up crumbs on the counter, removing water sources, using a fly swatter, setting a mouse trap, or closing the screen door, it's all IPM. Using science and technological advancements to find safer, less toxic ways to prevent and manage pests is vital to maintaining human and environmental health. Individuals have the responsibility to make wise, educated decisions when managing pests, because the decision of one person will affect many.

Pesticide Use, The Environment, & Human Health:

Pesticides are chemical substances designed to be toxic. They include herbicides for killing weeds, insecticides for killing insects, and fungicides for killing fungi. Pesticides are used in agriculture, greenhouses, and many products are readily available to homeowners. They are registered with the Environmental Protection Agency (EPA). On a pesticide label, you can find information about the active ingredient, toxicity (signal word), directions for use, storage and disposal, and precautionary statements. If a pesticide is chosen to manage a pest problem, it needs to be effective against the pest to be managed and all of the directions on the label must be followed exactly. The pesticide label is considered the law.

When looking at a product label, pay attention to the signal word. It indicates the hazards of the product. Types of chemical hazards include toxicity (poisonous), flammability, and chemical burns. "Danger-Poison," "Danger," "Warning" and "Caution" are the possible signal words on pesticide labels. "Danger-Poison," "Warning," and "Caution" signal words are used when classifying products with hazards associated with exposures through ingestion, absorption through the skin, or inhalation of the product. The "Danger" signal word is used when possible skin irritation and eye effects or damage is more severe compared to other routes of exposure. If a pesticide is to be used when managing a pest problem, the least hazardous choice should be made. The signal word "Caution" indicates the pesticide product is less toxic than those with "Warning," "Danger," or "Danger-Poison" signal words.

Information about environmental hazards and hazards to humans and domestic animals can also be found on the pesticide label. When a pesticide is used, it has to go somewhere, and often it goes into water, the air, the soil and animals. For example, consider a pesticide being sprayed on an agricultural field growing food crops. As the spray is applied, it is being carried in the air and deposited on the soil and on part of our food supply. Precipitation and irrigation allows the pesticide be transported by surface water and runoff to nearby streams, lakes, and it goes through the soil into the groundwater supply. Once the pesticide reaches streams and lakes, it can be absorbed or ingested by aquatic life. In turn, other wildlife or humans may eat this aquatic life. This cycle can occur whether the pesticide is used in an agricultural setting, by a homeowner, if it is not used correctly or not disposed of properly. It can take time for pesticides to show up in the water cycle and the environment. It may not happen as soon as it's applied. And once a pesticide has entered the water supply and environment, it can take a very long to time to remove it. For example, the pesticide DDT was used for almost three decades in the United States before it was banned from use in 1972. Decades later, it's still being found in the environment.

As more and more research is conducted, the importance of using other means of managing pests grows. Pests themselves can cause health problems. They can be triggers of asthma and allergy attacks, transmit diseases and contaminate food. However, the pesticides used to treat the pests can irritate the lungs, triggering asthma attacks or cause many other health problems. Modern, synthetic pesticides are relatively new. They were developed in a lab during the time of World War II. Seventy years later the effects from prolonged use and exposure to pesticides are now being recognized. The active ingredient of a pesticide is listed on its label. Information about it, including short and long term health effects, can be researched on the Internet or obtained from the product's Material Safety Data Sheet (MSDS).

This brief introduction to the relationships between pesticides, the environment and human health only begins to scratch the surface. It is a very complex subject that cannot be summed up in a few paragraphs. New research is continually being conducted to learn more about these relationships. Listed below are a few resources that provide more in-depth information on pesticides and how they can effect the environment and human health. Remember, part of IPM is being educated and informed about the products chosen to use to manage a pest problem. And, as an educator you have the opportunity to help students develop the skills to become informed, educated consumers of the future.

A special thank you to the following individuals for sharing their time and knowledge of using IPM in a greenhouse with K-12 students for the development of these lessons: Cathy Thomas, Todd Biddle, Flora Eyster, and Mark Adami.

Resources:

Pennsylvania Integrated Pest Management Program at Penn State University
Phone: (814)-865-1896
Email: paipm@psu.edu
Website: www.paipm.org

Pesticide Education Program at Penn State University
Phone: (814) 863-0263
Website: www.pested.psu.edu

United States Geological Survey
Phone: 1-888-275-8747
Website: www.usgs.gov
http://water.usgs.gov/nawqa/pnsp/ (National Water-Quality Assessment Program: Pesticide National Synthesis Project)

Center for Disease Control (CDC)
Phone: 1-800-232-4636
Website: www.cdc.gov
www.cdc.gov/asthma/ (Asthma information)

Environmental Protection Agency (EPA)
Phone (Region 3): 1-800-438-2474
Website: www.epa.gov
www.epa.gov/region03/index.htm (Region 3 page)
www.epa.gov/iaq/ (Indoor Air Quality - IAQ)