CHAPTER ONE: INTEGRATED PEST MANAGEMENT

A pest is any insect, mite, rodent, nematode, fungus, weed, or other organism that is injurious to humans or their structures, or to plants or animals of interest to humans. Effective pest control requires determining whether a pesticide application is necessary or whether the pest can be controlled or managed by other means. Often the use of pesticides is not necessary. **Integrated pest management (IPM)** is an approach to plant protection that is recommended for efficient pest control with minimal environmental impact.

IPM uses the most appropriate practices to achieve these goals: (1) to keep pest populations below the economic injury level in production crops and below the aesthetic injury level in noncrop or ornamental plantings and (2) to avoid adverse effects on humans, wildlife, and the environment.

Elimination of all pests is *not* the goal in IPM. For example, the presence of even a few weeds can reduce soil erosion and slow germination of later weeds. Many insects and nematodes can be present at low populations without harming the desirable crop or plant. In addition, leaf spot diseases on many ornamentals never reach damaging levels. The goal of IPM is to optimize, not maximize pest control. This can be done by understanding the concepts of economic threshold and economic injury level.

PEST CONTROL

The **economic threshold** or **action threshold** is that number of pests per plant or the amount of damage to a plant at which point control measures should begin. If controls are applied at the economic threshold, the pest population will not reach the economic injury level. Generally, such thresholds are most helpful with insect problems. Where studies have been able to estimate the economic threshold for a specific pest, knowing the threshold numbers can help avoid unnecessary chemical application, labor expense, and other control practices.

The **economic injury level** is the breakeven point at which the cost of pest control equals the revenue loss caused by a pest. The economic injury level clearly defines how much damage can be tolerated. A certain amount of damage or loss from pests can be tolerated without treatment if the value of the yield loss is less than the cost of treatment. In ornamental plantings, an **aesthetic injury level** might be the concern. This is the number of pests that might cause enough damage to the appearance of a plant to warrant the cost of control. Aesthetic injury level is determined at each individual site and is based on the desirable "look" or condition. The number of pests acceptable on a park site may be unacceptable on a golf course.

The key to a successful IPM program is **scouting**. The scout may be the owner, grower, maintenance technician, or a hired individual who regularly monitors pest populations and plant or crop conditions. Information on scouting techniques is available in the individual category manuals used in pesticide applicator training.

Control Methods

In most cases an IPM approach is the most efficient and environmentally safe approach to pest control. Integrated pest management combines chemical and nonchemical control methods to reduce losses from pests. Chemical control is the use of pesticides. Nonchemical control includes cultural, mechanical, biological, and preventive control methods (Figure 1.1).

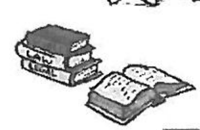
Figure 1.1 IPM Control Methods

- **Cultural Control**
  Soil preparation, fertility, planting date & site, spacing, plant selection, crop rotation, mulching, mowing.

- **Mechanical Control**
  Cultivating, pruning, hoeing, weed pulling, mowing, hand picking.

- **Biological Control**
  Predators, parasites, diseases.

- **Preventive Control**
  Quarantines, inspections, certified seed.



- **Chemical Control**
  Apply at proper time based on scouting after considering other options.

Cultural control improves plant health so that the plants are able to compete better against pests. For example, a dense, vigorous stand of turfgrass that has been properly fertilized and mowed is the best defense against invading weeds. Mulches in ornamental areas help control weeds by preventing sunlight from reaching weed seeds. Smother crops, such as oats, grass, or groundcovers, may be used in nurseries or orchards to control weeds between rows. In field crops, manipulating planting and harvesting dates, planting rates, and row widths maximize crop competitiveness. Healthy trees are much less susceptible to borers.

Crop rotation is also a common cultural control method. Rotation of corn and soybeans (plant corn in year one, soybeans in year two, corn in year three, etc.) helps reduce the levels of corn rootworms and foliar corn diseases. Vegetable growers are advised to rotate tomato plants every three years to help prevent problems with bacterial diseases such as bacterial spot, speck, and canker. Trees are not planted exactly where other trees had been to avoid root rots and other diseases.

Host plant resistance (that is, selecting plants that are less susceptible to insects or disease pathogens) is another way to practice cultural control. For example, whitespire birch is less susceptible to bronze birch borer. Resistant varieties of wheat have prevented damage by the Hessian fly. Bt corn, cotton, and potatoes are genetically modified to contain *Bacillus thuringiensis* toxins that control caterpillar and beetle pests. Many varieties of field corn and sweet corn in Illinois are resistant to Stewart's wilt. Choosing resistant varieties is probably the most efficient method of disease control in many plantings.

Mechanical control physically eliminates the pest. Hand pulling, hoeing, rotary hoeing, cultivating, mowing, and aquatic weed harvesting can control weeds and minimize the need for herbicides. Pruning trees to remove borer and caterpillar infestations is effective. Hand-picking is effective in reducing injury from Japanese beetles and bagworms. Aphids are removed from trees and shrubs by hitting them with high pressure water. Screening and effective use of double doors keep many insect pests out of greenhouses and interiorscapes. Burning or burying dead plant material reduces the spread of disease spores.

Biological control uses living organisms to reduce pest populations to economically acceptable levels. Insects and diseases can be used as control agents to reduce weed competitiveness. Beneficial organisms that are natural enemies of pests will attack, live in, or infect their pest hosts. Some examples used for pest control are parasitic wasps to control alfalfa weevil, mealybugs, and scale. *Bacillus thuringiensis kurstaki (B.t.k.)* is used to control caterpillar pests of trees, shrubs, and vegetables; *Bacillus thuringiensis israeliensis (B.t.i.)* and *Bacillus sphaericus* are used to control mosquitoes. Weed-eating fish, triploid Amur carp, have been used successfully in some aquatic areas, and weevils are used to control musk thistle.

Preventive control helps prevent the entry and spread of pests. Regulatory controls include plant, animal, and vehicle quarantines and inspections at national, state, and even local borders. These controls have helped prevent the entry and spread of destructive insects. Gypsy moths, Asian longhorned beetle, Mediterranean fruit fly, boll weevil, and screwworm fly are examples of insect pests that have been kept out of, or at least limited, in this country through regulatory control. Regulations have been established on the importation of agricultural and horticultural products because many of our common pests were imported from other countries. For the same reason, other countries regulate their imports (our exports) to prevent new pests in those countries.

Preventive weed control aims at preventing the spread of weeds by seed or plant parts. These measures include using weed-free seed and transplants; cleaning equipment used for tillage, mowing, pruning, harvesting, and transport before leaving an infested area; controlling small patches of undesirable weeds before seed production and further infestation occurs; and controlling nutrients in aquatic areas.

Chemical control offers an economical and dependable method of pest management in many situations and may be an integral part of an IPM program. Before using pesticides consider the following:

- Are there other, nonchemical control methods that are effective?
- Has scouting indicated that the pest population is large enough to warrant control?
- Is this the correct time to apply pesticides for optimal control?

There are many reasons why pesticide might fail to control a pest. Always read pesticide labels and their Directions for Use section carefully to avoid these problems. One or more of the following factors might contribute to a pesticide failing to control a pest.

a. Applying the wrong type of pesticide. For example, the use of a miticide to control an insect pest will usually not be effective; and the application of B.t.k., which controls only caterpillars, would be ineffective in controlling aphids. Using a pesticide at the wrong application rate may also result in a control failure.

b. Applying the pesticide when the pest is not in a susceptible stage. For example, treating for caterpillars when only the moths are present would be ineffective. Weed control may be unsuccessful if an herbicide is applied to weeds that have grown too large.

c. Failing to apply the pesticide to that part of the plant or animal where the pest is located. For example, spraying the foliage of rhododendrons for root rot control would be ineffective. Spraying corn plant foliage to control the root-feeding larvae of corn rootworm would be ineffective.

d. Applying a pesticide to a resistant pest population. For example, Indian meal moths are usually resistant to the insecticide malathion, and some are resistant to B.t.k. Some weeds are resistant to certain triazine herbicides. In these cases, the pesticide does not effectively kill or suppress the pest.

Once you have decided to use pesticides, you need to understand their characteristics and how to apply them properly and safely with minimal impact to the environment. Later chapters in this book discuss how pesticides work, how they should be mixed and sprayed, how to avoid adverse human and environmental consequences from their use, what you will find on a pesticide label, and the laws and regulations governing the use of pesticides.

Whether you use chemical pest controls, nonchemical controls, or both methods, you should have information on hand about the recommended pest controls for your crop in your state. The Illinois pest management handbooks list and discuss specific recommendations for pest control for most crops and planting situations in Illinois. You can purchase copies from

University of Illinois
Marketing and Distribution
1917 S. Wright St.
Champaign, IL 61820
Phone 800-345-6087 or 217-333-2007

PESTS

Pests are generally categorized as insects and other animals, weeds, or diseases. Effective integrated pest management relies on identifying the pest correctly and knowing the pest's life cycle and biology. For additional help in pest identification, consult your local Extension office, private laboratories, or the University of Illinois Plant Clinic. The Plant Clinic mailing address, from May through September 15, is 1401 West St. Mary's Road, Urbana, Illinois 61801. Details on specific pests of specific crops are discussed in individual category pesticide applicator training manuals.

INSECTS AND OTHER ANIMALS

Most insects and other animals function as part of the ecology with little impact on people, either beneficial or harmful. Many insects and other animals that are pests are kept from being more numerous and harmful by beneficial insects and other animals.

Beneficial and Injurious Insects

Many people think of **insects** merely as pests, assuming that the world would be better off without them. Most insects, though, are not pests, and many are a beneficial part of the ecology. Beneficial insects contribute at least an estimated $20 billion to the U.S. economy annually, mostly through the pollination of plants. Harmful insects, on the other hand, cause about $5 billion of damage annually, with $3 billion due to plant injury.

Insects are beneficial by being **predators** or **parasites** of other insects, including dragonflies, praying mantids, lacewings, lady beetles, and parasitic wasps. Insects feed on various weeds; for example, monarch butterfly caterpillars feed on milkweed, dagger moth caterpillars feed on cattails, and woollybear caterpillars feed on lambsquarters. Honey bees, bumblebees, other wild bees, wasps, ants, butterflies, moths, some flies and beetles, and still other insects pollinate plants. Insect pollination is valued, according to a U.S. government estimate, at about $19 billion annually. Insects also serve to produce honey and silk and are used in medicine to treat wounds and arthritis. Primarily, insects are important components of the earth's ecology, serving as scavengers that eat decaying organic matter, pollinate native plants, and are parts of many food webs.

Insects are also injurious, however, to human pursuits. They damage food, feed crops, and ornamental plants. Insects attack and transmit diseases to humans and domestic animals.

Insect Identification

Before applying a control measure for an insect, you must identify the insect and understand its life cycle so that you can use the correct management techniques at the appropriate time. The shape and number of body parts are used to identify insects. If you need help in identifying a particular insect, consult your local cooperative Extension office.

Insects have an **exoskeleton**, that is, a skeleton that covers the outside of the body. This exoskeleton is usually very hard and helps protect the internal organs and other soft parts. In order to grow larger, insects molt (shed the exoskeleton) and form a new larger one. Insects molt several times in their lifetimes. Adult insects have three pairs of jointed legs and three distinct body regions: the head, thorax, and abdomen (Figure 1.2).