



Insect Management

Gary L. Hein

The concept of integrated pest management of insects contains three basic elements. These include: maintaining insect populations below levels that cause economic damage, the use of multiple tactics to manage insect populations, and the conservation of environmental quality.

The objective of insect pest management is to manage insect populations to reduce pest status to a tolerable level. Reducing the insect pest status means that the presence of insect pests should be expected but at levels that will not cause economic damage. Complete elimination of a pest may not be feasible or even desirable. The acceptance of pest presence sets pest management apart from many other approaches to pest control.

Conservation of environmental quality (air, water, soil, wildlife, and plant life) is an important element of integrated pest management. Practices that maintain environmental quality can conserve natural enemies that may help lower the pest status of target insects. Pest management tactics that minimize environmental impact will contribute to the stability of agricultural systems.

Pest Management Tactics

Pest management tactics are the actual practices or tools used to lower the pest status of an insect. The most common tactics used for insect control are insecticidal chemicals and cultural practices. Many different insecticides exist with several modes of action. Insecticides have the ability to inflict high mortality quickly, and are the most common and effective form of rescue treatment. These chemicals vary in toxicity to humans or other animals, and also in their potential impact on the environment.

Cultural practices are a manipulation of the cropping environment to increase pest mortality or reduce rates of pest increase and damage. There are many different cultural practices that can help to reduce pest impact. Some of the more common techniques include improving plant vigor with fertilization and water, tillage practices that disrupt the insect's life cycle and destroy crop residue, changing planting dates to minimize insect impact, and crop rotations that include nonsusceptible crops. Some cultural controls may also increase or decrease pests' natural enemy populations. Good cultural control methods often become stable farming practices that serve multiple purposes.

When available, use of resistant crop varieties is another useful tactic in managing insect pests. By using resistant varieties, other insect control measures may not be needed because the crop is less likely to be economically injured by the insect pest.

Biological control is the use of any biological agent to reduce insect pest populations. Predators, parasitoids, and pathogens are common and effective biocontrol agents. Biological control agents may occur naturally in the cropping environment or may be introduced as needed. This tactic usually has low environmental impact but often requires a long time before natural enemy populations are established and control is achieved.

An important tool for evaluating an insect problem is the economic threshold of the pest. The economic threshold is the pest density at which management action should be taken to prevent an increasing pest population from doing economic damage to the crop. The economic threshold takes into consideration market value of the crop, injury and damage, insect density, lag time before implementation occurs, and cost of management. This threshold information is important in distinguishing the difference between trivial plant injury and true economic damage. Economic threshold information is available for some but not all insect pests. When economic threshold information is not available, other expertise must be used to determine damage potential of a given pest to a crop. Although the concept of the economic threshold can be applied to the use of many tactics, it is primarily used in association with insecticidal control.

Pest Management Strategies

A pest management strategy is the plan developed to lower pest status to a tolerable level. The strategy developed will depend on the biology of the insect and the cropping system involved. Since the pest status is determined by both insect and crop, a management strategy may focus on modification of either or both of these. The types of strategies to use are as follows:

1. No Intervention.

2. Reduce pest numbers.
3. Reduce crop susceptibility to pest damage.
4. Combine reduction of pest population with reduction in crop susceptibility.

No Intervention Strategy: Not taking insect control action is sometimes difficult when insect pests are damaging a crop. From a casual observation it appears that the insect pest is doing harm, but is it really? Mistaking minor insect injury for true economic injury is a common occurrence. When pest densities are below the economic threshold, the best strategy is to avoid spending more money on management than is gained by protecting the crop. Continued observation and sampling are required to assure that taking no action is appropriate. In such cases natural or environmental factors may successfully suppress the pest population.

Reduce Numbers Strategy: Reducing pest numbers to prevent crop damage is the most widely used approach for insect management. This strategy is most often accomplished as a therapeutic measure when the economic threshold has been reached, or for preventative purposes when a history of problems exist.

With the goal of reducing pest numbers, two different situations may need to be addressed. One is the occasional pest whose normal population numbers do not exceed the economic threshold. In this situation the goal is to control population outbreaks during years when it exceeds the economic threshold. This action would not change the normal population levels of the pest, but would prevent economic loss during outbreaks.

The second situation is dealing with pests whose normal population level is at or above the economic threshold every year. These are considered severe pests and require more drastic population reduction measures. In this case the normal population level of the insect has to be reduced to avoid exceeding the economic threshold. This can be done by: •1 altering the environment, making it less favorable for the pest population, or •2 attacking the pest itself by inflicting mortality or inhibiting reproduction.

The first approach can be accomplished in a variety of ways such as crop rotation, tillage, destruction of alternate hosts, altering planting date, or any other action that lowers the general favorableness of the pest's environment.

The second approach deals with characteristics of the pest itself. Methods can be used that inflict mortality or minimize reproductive potential. Tactics utilized in the reduction of numbers strategy are many and varied, including the use of insecticides, natural enemies, pathogens, and insect growth regulators.

Reduce Crop Susceptibility Strategy: Reducing crop susceptibility is often the most effective, economical, and environmentally sound approach to insect pest management. This strategy does not directly modify the insect population, but it is a means by which the crop can repel or tolerate the insect pest.

Reduction of crop susceptibility can sometimes be accomplished by altering the crop environment. Crop vigor, for example, can be increased by timely watering and fertilization. In some cases, plants with high vigor are not as attractive to insect pests as those under stress, or the vigorous crop can compensate for insect damage with no significant yield loss.

Planting resistant crop varieties is another common and effective approach to reducing crop susceptibility to insect pests. These crops either inhibit the survival or reproduction of the insect pest (antibiosis), or are tolerant to the insects feeding and damage (tolerance), resulting in no economic yield loss. Resistant varieties often eliminate the need for pesticide treatments or other management tactics related to a target pest.

Combined Strategies: Dealing with insect pest management in a sustainable manner is not an easy task nor are there any single strategies or tactics that are guaranteed to work in every situation. In fact it is common for tactics that have worked in the past to lose their effectiveness due to the ability of insects to adapt and build up resistance.

The final strategy to discuss is that of combining strategies to develop an effective integrated pest management program. This is an advantageous approach because if one of the tactics fail, other tactics are in place to help manage the pest population. Past experience has demonstrated that extensive use of a single tactic, such as an insecticide over a broad area, can bring about a gradual or abrupt failure of the tactic. The effective life of a control tactic can be increased if it is used in conjunction with other methods. The use of multiple strategies and tactics is a basic principle of integrated pest management programs.

Categories: Tactics, Strategies

Date: 10/20/2003

Western Region IPM Center, EPA Region VIII, National Plant Diagnostic Network, Great Plains Diagnostic Network, USDA CSREES, Colorado State University, Montana State University, South Dakota State University, the University of Nebraska - Lincoln, and the University of Wyoming.