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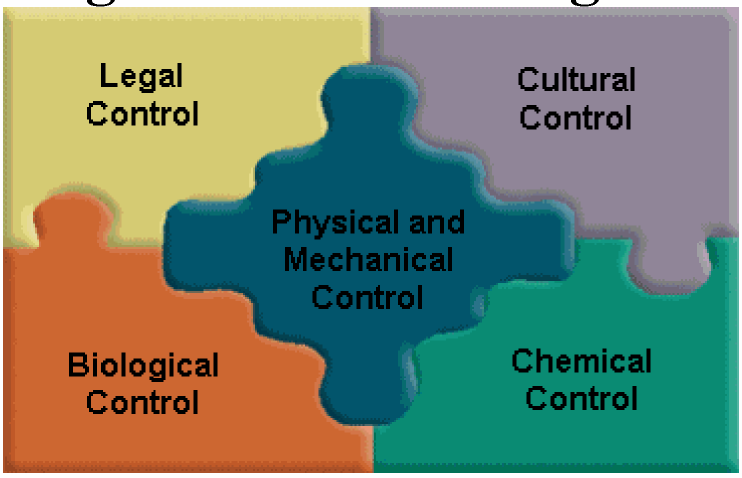
Integrated Pest Management



Pest management is the science of preventing, suppressing, or eradicating biological organisms that are causing a problem. Today the term "pest management" is often used in place of such terms as "pest control," "plant protection," or other equivalent expressions. The term "pest" is often used to refer to invertebrate (arthropods, slugs, etc.) as a group in contrast to plant diseases and weeds. However, the term "pest" should apply to any unwanted biological organisms - especially when the problem is associated with agriculture or environmental issues.

Pest management practices may be classified according to the *approach* or the *method* used to deal with a pest problem. In terms of approach, pest management practices may be designed to (1) prevent a problem, (2) suppress a problem, or (3) eradicate a problem. In regard to method, pest management practices may be classified in a number of categories of which the most common are (1) chemical, (2) cultural and mechanical, (3) biological, and (4) legal.

The term "*Integrated Pest Management*" (IPM), implies integration of approaches and methods into a pest management system, which takes into consideration the ecology of the environment and all relevant interactions that pest management practices may have upon the environment in which one or more pest problems may exist. When IPM principles are applied to a given pest problem, it is generally assumed that environmental impact and economic risks have been minimized. Since IPM considers all applicable methods, it is also assumed that emphasis on chemical methods may be reduced when effective non-chemical alternative methods are available. As a result, implementation of IPM principles and practices is advocated in various federal and state regulations affecting pesticides. Section 11(c) of FIFRA specifically advocates that IPM techniques be included in training of certified applicators of restricted use pesticides.

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Approaches to Pest Management

Prevention - When a pest problem is anticipated and action is taken to prevent a significant problem from occurring, the approach is termed prevention. The action taken may include any applicable method proven to prevent or reduce the probability of a significant pest problem from occurring. The prevention approach may include either chemical or non-chemical methods.

When a corn grower applies a granular soil insecticide at planting time, it is assumed that the treatment will prevent a significant loss in yield due to the presence of soil insect or nematode pests. When a grain manager cleans and treats an empty bin to eliminate sources of insect infestation, it is assumed that the action will reduce the probability of serious insect infestations at a later point in grain storage. When a grower applies a preemergent herbicide before any weeds appear, it is assumed that weed seeds are present and the treatment will prevent emergence of the weeds as the season progresses.

Suppression - After a pest problem has been detected, any action taken to suppress the pest population is termed a suppression approach. In practice, few treatments totally eliminate a pest problem, but the pest population is reduced to a point at which it is no longer perceived as a problem. Thus, any action ranging from treatment of a corn borer infestation on corn to treating the family pet for fleas may be regarded as suppression. Post emergence application of herbicides to reduce emerging weed populations is regarded as suppression. The use of chemical methods is generally associated with suppression practices, but non-chemical methods may also be employed to suppress a pest problem. For example, a grain manager may alter the temperature of a grain mass and significantly reduce insect infestations.

Eradication - When a pest problem must be totally eliminated from a designated area, the approach is termed eradication. If a new pest such as the Mediterranean fruit fly is detected in a fruit growing area, regulatory agencies may implement widespread actions to totally eliminate the pest problem before it becomes established to a point that it can no longer be eradicated. When a serious insect pest problem is detected in a commodity of foreign origin, fumigation tactics may be employed to totally eliminate the presence of the unwanted pest from stock identified as infested. If a pest population of public health importance is detected in a hospital or food establishment, efforts may be taken to totally eradicate the pest population. In general, the eradication approach does not apply to elimination of an established pest population from a large area.

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Pest Management Methods

Pest management practices are grouped under various method categories including (1) biological, (2) chemical, (3) cultural and mechanical, and (4) legal. Additional categories may be defined, but we will attempt to group most practices under the four mentioned.

Biological Control - Biological control generally includes the manipulation of one biological organism to control another organism classified as a pest. In the web of nature, the combination of biological control techniques is extensive. Insect pests may be preyed upon or parasitized by other insects. Most insect pests are attacked by bacterial, fungal or viral pathogens. Specific weeds may be controlled by insects with specialized feeding habits.
The implementation of biological control methods has been categorized into three basic approaches, namely: (1) classical, (2) augmentation, and (3) natural.

When a pest is found to not be native to a given area, it may be assumed that the biological organisms that regulated its population dynamics in its native environment are lacking. In such a situation, the classical approach of biological control is employed to (1) determined the pest's native home, (2) locate beneficial organisms that naturally control the pest organism in its native area, and (3) if feasible, import, multiply, release and establish the beneficial organisms in the problem area to facilitate biological regulation of the pest problem. If successful, the importation and establishment of the beneficial organisms will result in a long term reduction of the pest problem and repeated releases of the beneficial organisms will not be required. Key examples of such accomplishments classical biological control applicable to Ohio include the control of the Cereal leaf beetle on oats and the alfalfa blotch leafminer on alfalfa by the release and establishment of beneficial parasitic wasps. The process of importing and releasing beneficial organisms is complex, since many precautions must be taken to prevent the introduction of organisms that may have adverse effects.

When beneficial biological organisms are mass reared and released periodically to supplement the natural enemy complex and achieve reduction of a pest problem, the approach is called **augmentation**. This approach may be applied to pest populations that are either native to the area or of foreign origin. In general, augmentation may be considered when it is economic and feasible to rear, multiple, and release a natural enemy of a pest to the point that reduction of the pest problem is achieved. Successful augmentation efforts have been developed for greenhouse environments where altering the balance between a pest and its natural enemy is feasible. A number of corporations are currently investigating techniques of applying parasitic nematodes to turf for control of soil pests. Application of the augmentation approach to field crops is limited, but a major effort is underway in South Africa to control the Eldana borer on sugarcane via augmentative releases of parasites.

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Most pest populations are maintained by a number of natural predators, parasites and diseases, which represents **natural** biological control. If such forces were not in effect, we would be overrun by pest populations. The balance of crop pest populations and their natural enemies can be significantly influenced by cultural practices and the use of chemicals. Populations of natural enemies can be enhanced by selective use of cultural practices or decimated by indiscriminate use of pesticides. In some cases, pesticides have been developed that effectively control a pest population without having a significant effect on beneficial species. A new pesticide for control of alfalfa weevil is currently approaching registration that effectively kills weevils without harming beneficial parasitic wasps and pollinating bees. An example of natural control research in Ohio includes studies on the impact of predatory ground beetles on early pests of corn such as cutworms and armyworms. One study suggested that the efficacy of a given soil insecticide to reduce cutworm damage may be related to the lack of toxicity of the compound to the ground beetles that prey upon cutworms.

The potential for development of biological controls for a wide range of pest problems is significant. However, development of successful biological control technologies often requires significant investments into research that may or may not readily produce satisfactory results. To date, biological control has not been a marketable product like chemical controls and research efforts into the field have been limited. Furthermore, implementation and evaluation of biological controls are often more complex than that of chemical methods.

In summary, classical and augmentative biological controls are not available for very many pest problems - especially severe pest problems that demand immediate attention. However, natural biological control is in effect in most situations, and it is important that every effort be implemented to enhance such biological activity wherever it exists.

Chemical - Pesticides are the most readily recognized method of pest management. The institution of the pesticide industry is a relatively recent development of the last half of the 20th century. The evolution of pesticide products changes significantly with each decade. Advancements in the development of biological pesticides may alter the field significantly. The range of risks and benefits attributed to pesticides will remain a key issue of society. The use of pesticides will remain as a dominant method to be incorporated in future pest management programs.

Cultural & Mechanical - Prior to the advent of chemical pesticides, humanity relied primarily on cultural and mechanical methods of pest management. With the development of pesticides, the relative impact of various cultural and mechanical practices on pest populations was often overlooked. As public interest in environmental issues expands, the impact of cultural and mechanical pest management practices is receiving greater attention. Crop rotation, tillage practices, barriers, hedge rows, traps, and other forms of environmental modifications all influence the incidence of pest problems. Crop host resistance to pests - which may be considered a cultural practice - remains a key factor in many pest management programs. Sanitation is the basis for pest management in most livestock, public health and food establishment pest management programs. Sanitation is also applied to

crop production when removal of sources of pest populations is a critical factor.

Examples of cultural and mechanical practices in pest management are abundant. Every time a grower rotates a crop or tills the land, weed, insect, nematode, slug and disease pest problems are affected.

Legal - Regulatory actions are often employed to prevent immigration of foreign pests or to prevent the dispersal of established pests. Such actions are termed legal methods of pest management. Fruit and other perishable products being carried in to the USA by travellers are confiscated to prevent entry of pests. California prohibits transport of apples from northwest counties into the remainder of the state by posting quarantine signs to prevent the spread of apple maggot. New York prohibits movement of gravel from counties bordering the eastern shore of Lake Ontario to prevent the spread of the alfalfa snout beetle. Imported animals are often held in quarantine for a period of time to allow inspection for pests and diseases. Such legal actions are not always effective, but they enable interceptions of many pests that could add to the pest problems already present in the county.