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EC96-1555 Insect Pest Management Strategies for Yards and Gardens

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A growing awareness of problems associated with overusing pesticides has prompted many home gardeners and landscape managers to seek alternative methods of insect control. Integrated pest management (IPM) uses suitable methods in a compatible manner to maintain pest densities below levels of unacceptable injury. IPM principles can be applied to all pest groups (insects, mites, weeds, plant diseases and vertebrates), and urban as well as agricultural settings. This publication will discuss how integrated pest management can be applied to insect and mite management in yards and gardens.

IPM requires taking a longterm view and planning to avoid or reduce pest problems as much as possible. Various decisions made when you establish and maintain your yard or garden can influence pest development. These include selection of plant species and variety, site selection, and irrigation and fertility programs. Plants stressed by various means (too much or too little water, fertilizer, sunlight, or winter injury) are often more easily damaged by pests. Maintaining healthy, vigorous plants is a good preventive insect management strategy. Also, naturally occurring biological control agents often help keep pest populations in check, and prevent many pests from reaching damaging levels. Avoid unnecessary use of pesticides which may interfere with these natural controls.

Despite use of appropriate measures to avoid or reduce pest problems, populations may increase under certain conditions. In an IPM system, control measures, including conventional pesticides, are employed only when pest numbers reach or threaten to reach predetermined damage thresholds. These thresholds are based on several factors including the target pest and plant species, time of year, value, growth stage and vigor of the plant. Inherent in the IPM concept is the recognition that for most pests, population levels exist that can be tolerated without significant plant injury or yield loss. The IPM practitioner does not attempt to eradicate a pest since moderate pest levels help maintain natural enemies and chemical overuse can lead to pesticide resistance. The overall objective of IPM is to optimize rather than maximize pest control.

Establishing a Pest Management Program

Establishing an IPM program requires an understanding of the growth habits of the plant and its cropping system, knowledge of the biology, behavior, life history and type of damage caused by potential pests, and information regarding the plant growth stage or environmental conditions under which pest damage is most likely to occur. Accurate pest identification also is important.

All yards and gardens are inhabited by a diverse array of organisms including insects, spiders, mites and small animals. Most of these cause little or no damage and are generally considered non-pests. Others are beneficial and aid in the breakdown of organic matter, pollination of crops, or serve as natural enemies of pests. Only a

few of the insects and mites present are actually plant-feeding pests. Because of the wide diversity of species present and the many similarities between pests and non-pests, it is important to be able to distinguish incidental and beneficial species from target pests.

In a successful IPM program, pests are detected before they reach damaging levels. This can be accomplished through frequent inspections. When examining plants, look for natural enemies of pests, such as lady beetles, lacewings, spiders, or parasitic wasps that may be reducing pest populations. Insect monitoring aids include magnifiers, drop cloths, sweep nets, sticky traps, and light and pheromone traps.

Inspect plants for pest problems regularly during the growing season. Depending on the size of the planting, inspect all plants or a subsample of plants of each species. Plants of different varieties or growth stages may have different pest levels and should be inspected separately. Carefully search for pests and pest damage to detect them before they cause extensive damage. Depending on the particular plant and pest involved, certain parts of a plant should be checked first. For example, in sweet corn, corn earworm eggs tend to be found on the silks and spider mites tend to be found on the undersides of the lower leaves. In some situations, drop cloths or sweep nets can be used as collecting devices to aid in pest monitoring. Use sticky traps or light and pheromone traps to monitor the seasonal occurrence of insects and alert you to when to begin inspections for a particular pest.

Good record-keeping is essential to make maximum use of information obtained during plant inspections. Record the information in a quantitative fashion. For example, record the number of insects found per plant or leaf, rather than recording "many" or "few". After the growing season, review this information and plan to improve your pest management next year. You may detect certain patterns, such as more damage or pests on certain varieties or certain planting dates. Use this information next year to minimize pest problems. Good record-keeping allows you to know when to expect certain pest problems and plan to deal with them. Also, information from regular inspections will allow you to evaluate which control practices are effective and which need to be modified.

Pest Management Alternatives

As previously stated, IPM combines complementary strategies to effectively manage pest populations. Descriptions of many of these pest management strategies follow.

Cultural Methods

Cultural methods involve manipulating the environment to make it less suitable for pest survival. Use of cultural measures requires a thorough understanding of the life history and habits of the pest. The most vulnerable stages in the pest's life history must be identified, with cultural practices altered to minimize attack by the pest, slow its rate of increase, or destroy it.

Selection of Plant Materials. When selecting landscape plants, turfgrasses or garden crops, choose plant materials that are well adapted to local soil and environmental conditions. The University of Nebraska-Lincoln Department of Horticulture, most nurseries, garden centers and UNL Cooperative Extension offices can provide information on plant varieties best adapted to local environments.

Planting insect resistant varieties is another valuable IPM tool. Many plants have been found to have some natural resistance to insect pests, although the degree of resistance may vary considerably from one species or cultivar to another. One problem associated with the widespread use of resistant varieties is the possible development of insect biotypes. Biotypes are insect populations that have undergone genetic changes which allow them to survive on a host plant that was previously resistant to them. Fortunately, biotype development has not been widespread with yard and garden insect pests. Successful examples of plant resistance include grape resistance to grape phylloxera, muskmelon resistance to cucumber beetles, strawberry and tomato resistance to twospotted spider mites and resistance of certain apple varieties to the woolly apple aphid.

Crop Rotation. Rotating the location of garden crops will not affect the incidence of foliar-feeding insects, but may reduce damage caused by soil-inhabiting pests such as wireworms, white grubs, seedcorn beetles, corn rootworms, millipedes and some cutworms. Avoid planting root crops into areas recently infested with soil insects or into plots that were not cultivated or were in sod the previous year.

Sanitation. Many insect and mite pests seek shelter or attempt to overwinter in plant residues. Overwintering forms include eggs on dead leaves, adults in plant stems or under crop residues, and larvae or pupae in plant stems or in the soil. Removing dead branches or canes from trees and shrubs and raking and composting leaves, grasses and other plant debris helps eliminate many overwintering sites. In the garden, remove plants at the end of the production season or after they have been destroyed by frost. Plant residues can be composted or deeply tilled into the soil.

Sanitation during the growing season also can be important. Harvest fruits and vegetables as they ripen. Over-ripe fruit or vegetables may serve as breeding sites for fruit flies, picnic beetles, or apple maggots and may attract yellowjackets, houseflies, honeybees or other insects.

Cultivation. Keep crop areas weed-free. Many weeds serve as a reservoir for insects such as flea beetles, grasshoppers, leafminers and aphids which may later move to garden crops. Use fall and spring cultivation to incorporate compost or crop residues and expose soil-dwelling insects to natural enemies and the weather.

Variation in Time of Planting or Harvest. This strategy involves growing the crop when the pest is in a growth stage where it can do the least harm or planting the crop so that the most susceptible stage of crop occurs when the pest is least abundant. A good example of this technique is the early planting of sweet corn to escape damage from corn earworms. Similar reductions in pest problems can be achieved by carefully timing harvest. For example, harvesting cabbage as soon as heads are mature may reduce the incidence of cabbage worms and cabbage loopers. Reduce picnic beetle damage to strawberries by harvesting the berries when they are still firm.

Intercropping and Companion Planting. Intercropping refers to planting two or more crops in adjacent plots to slow the spread of pests and to provide habitat for natural enemies. This practice provides some isolation of pest infestations and can reduce the spread of damaging pest populations. Also, isolated pest infestations are generally easier to manage. Companion planting involves growing certain types of plants to protect neighboring crops by repelling or confusing insect pests. Scientific research in this area is limited, but when evaluated under controlled conditions, companion planting does not appear to consistently repel insects or provide other benefits.

Planting patterns and the diversity of plant species in a yard and garden may influence natural enemies of various insect pests. A diversity of plants increases the likelihood that some of them will harbor low levels of pest insects, which allows predatory and parasitic insects to survive periods of low pest populations on other plants. Many predatory and parasitic insects feed on pollen, nectar or plant sap either as an essential part of their nutrition or as an alternative food source in the absence of prey insects. Having a diversity of flowering plants with different blooming periods can increase survival of many beneficial insects. Some cultivated plants that provide food resources include alfalfa, buckwheat, faba bean, Phacelia, sweet alyssum, and many composite plants, such as tansy. Umbelliferous plants, such as caraway, dill, fennel and yarrow, also are very attractive nectar sources to several groups of natural enemies.

Mulches. Exercise caution in the use of heavy mulches during the growing season. Thick mulches of plant material will encourage the development of potentially damaging pests such as white grubs, millipedes, sowbugs and cutworms. However, a light mulch of straw or shredded plant material will conserve moisture. Apply plant residues and compost in the fall and deeply till into the soil. Increasing the organic content of soils helps retain moisture and improve fertility.

Water and Fertilizer Management. Adequate fertilization and watering encourages healthy, vigorous plant

growth. For example, deep watering of turf as needed is better than more frequent shallow watering. Although these practices do not prevent insect infestations, they tend to promote healthier growth and a more vigorous plant that is better able to tolerate pest damage.

Mechanical/Physical Methods

Mechanical/physical pest control methods include hand removal; use of screens, barriers, or trapping devices; freezing; crushing; and grinding. They are the oldest, and in some cases, the simplest of all insect control methods. These tactics differ from cultural control measures because they are directed against the pest itself rather than the pest's environment. Mechanical methods are not widely used in commercial settings because they are often expensive and labor intensive, however, they may be more suitable for small gardens or yards.

Hand Removal. Remove large or readily visible insects by hand and destroy, or dislodge pests into a can containing a small amount of water and detergent. The egg masses of many insects can be scraped off or smashed. In tomatoes, for example, hornworms can be located by their damage or fecal pellets, picked off and crushed. During winter, removing bagworm cases from juniper and witches' brooms from honeysuckle will help reduce infestations the next spring. Hand removal requires considerable time, however, and may not be feasible for heavy infestations or larger landscapes or gardens.

Exclusion Using Screens and Barriers. Cardboard or metal collars placed around garden transplants or bedding plants will reduce the risk of cutworm and millipede damage. Metal screens or cold frames covering high-value crops also can be used to exclude larger insects, birds and rabbits. Sticky bands placed around tree trunks will reduce infestations of spring cankerworm and elm leaf beetles.

Floating row covers, consisting of lightweight, fine-meshed fabric, can be draped loosely over crop rows and anchored to the soil at the edges. The small mesh size excludes nearly all insects the size of aphids or larger. These row covers also extend the growing season and moderate harsh summer temperatures. As row covers are put in place, carefully inspect plants to be sure there are no existing pest infestations. Row covers exclude the natural enemies of insects, and any existing pests may flourish within the covered planting. Also, be aware that insects which overwinter in the soil may emerge from the ground after row covers are in place and damage plants. Examine plants periodically to check for this. For garden crops that require insect pollination, remove row covers when flowering begins.

Trapping. Various kinds of traps can be used to monitor insect abundance, and in some cases, help reduce pest numbers. Yellow sticky traps are highly attractive to whiteflies, aphids, thrips, leafhoppers and other small flying insects, and are used by some commercial greenhouses for insect control. In outdoor settings, traps placed near susceptible plants may capture some invading insects before they can damage the plant. Other trapping devices, used largely against fruit flies and caterpillars, use pheromones or attractive scents to lure flying adult stages to their sticky surfaces. They are better used as monitoring tools than control measures.

Syringing. A vigorous stream of cold water from a hose can be used to dislodge aphids, other small insects and spider mites from turfgrasses, landscape plants and garden crops. Syringing must be carried out frequently, however, as it has little effect on eggs, and will not prevent some insects and mites from crawling back onto plants.

Biological Methods

This important IPM strategy uses beneficial organisms including predators, parasites or insect pathogens to reduce pest populations. It can be implemented by releasing beneficial organisms into the landscape or garden, or by modifying cultural, chemical and other control practices to conserve existing natural enemies.

Beneficial Insects and Mites. Natural populations of predators (e.g., lady beetles, lacewings, syrphid flies,

praying mantis, wasps, and predaceous mites) and parasites (e.g., parasitoid wasps and tachinid flies) are valuable in reducing infestations of insect and mite pests. If these or other beneficial organisms are observed near the yard or garden, take care to insure their survival. If pest suppression becomes necessary, select control measures which minimize injury to beneficial organisms, while still providing satisfactory control of the target pest. Remember that a low level of pest infestation may need to be tolerated to attract and maintain natural enemy populations.

Several species of beneficial insects are now being mass-reared and can be purchased from commercial suppliers. In general, this approach is risky because success requires a detailed knowledge of predator/prey or parasite/host biology, accurate timing, and careful management. For example, if lady beetles are released to control cabbage aphids and insufficient aphids are present at the time of release, most of the beetles will simply fly elsewhere. In the long run it is generally more practical to conserve naturally-existing enemy populations through wise pest management practices.

Birds. Attract insect-eating birds and small mammals to yards and gardens by planting trees and shrubs that provide cover and furnish berries for food. Birds also can be encouraged by providing water or nesting sites. Remember, however, that some bird species are destructive to crops and may do more harm than good.

Disease-Causing Microorganisms. Disease-causing organisms or their products also can be used to suppress insect populations. Among the microorganisms known to attack insects are bacteria, fungi, viruses and protozoans. Generally, sustained warm and humid conditions favor the development and effectiveness of these organisms as pathogens. Most home gardeners are familiar with the microbial-based insecticide "B.t.". Other microbial-based insecticides may be available in the future.

Nematodes. Certain species of nematodes (microscopic worms) that only attack insects are available commercially. Because of their origin as soil organisms they are most suitable for use against soil insect pests (cutworms, white grubs, etc.). Nematodes are living organisms; extremes of temperature, moisture, or exposure to ultraviolet light can greatly decrease their survival. Survival is increased (and thus control is increased) if nematodes are applied to moist soil late in the day and irrigation is applied after nematode application. Maintaining adequate soil moisture after application also will improve nematode survival. Efficacy against different pest insects may vary widely with different nematode species and strains. New species and strains continue to be isolated from the soil.

Chemical Methods

Many important chemical control methods are available, including attractants, repellents, sterilants and growth regulators for pest suppression. Insecticides and acaricides are probably the most powerful tools available for insect and mite control. In many cases, they are the only practical method of reducing insect populations that have already reached threshold levels. Insecticides have rapid curative action in preventing pest damage and offer a wide range of properties, uses and application methods. They are relatively inexpensive, and may provide substantial financial or aesthetic benefits. Potential problems associated with insecticide use include the development of pest resistance, outbreaks of secondary pests, adverse effects on nontarget organisms including humans and beneficial insects, hazardous residues in our food supply, and ground water contamination.

Insecticides are classified according to their origin. Among the more common classes of insecticide are the inorganic compounds, plant-derived botanicals, microbial-based insecticides, petroleum oils, insecticidal soaps and the synthetic organic compounds. Included among the synthetic insecticides are the chlorinated hydrocarbons (Kelthane, lindane, methoxychlor), organophosphates (diazinon, Dursban, malathion), carbamates (Sevin) and synthetic pyrethroids (permethrin, resmethrin).

When insecticides are used in an IPM program, they should be carefully selected and their application timed with respect to the developmental stages of both target pest and crop. Proper selection and timing of pesticide

applications are extremely important in obtaining the best possible control with the least effect on the environment. Always carefully measure pesticides and follow all label instructions.

Many compounds with insecticidal properties can be derived from natural products. Because these materials are not "man-made", many advocates of an "organic" approach find them acceptable for pest control. The following are some of the more commonly used non-synthetic materials. Most of these products have some level of toxicity to humans and can be highly destructive to beneficial insects.

Bacillus thuringiensis, commonly called "Bt", is marketed under a number of trade names including Dipel, MVP and Steward. When certain species of insects ingest the spores of this common soil-inhabiting bacterium, the action of a bacterial toxin on the digestive tract causes the insect to stop feeding, sicken and die within four to seven days. Until recently, control with this microbial insecticide has been limited to caterpillars of certain butterflies and moths, and to mosquito larvae, but strains of Bt are now available for control of some leaf-feeding beetles such as Colorado potato beetle and elm leaf beetle.

Pyrethrins. Pyrethrins are refined from natural pyrethrum, which is extracted from a species of chrysanthemum grown primarily in Kenya. Synthetic pyrethrins, called pyrethroids, are based on the chemical structure of natural pyrethrins, but are much more stable and do not break down as rapidly. Many formulations of pyrethrins have a synergist (such as piperonyl butoxide) added to increase their efficacy. Pyrethrins provide rapid knock-down, but residual activity is brief. They must be used often if insects persist. These chemicals are effective against many insect pests, especially soft-bodied forms, since they kill by absorption through the insect's skin. Pyrethrins generally are not effective against spider mites.

Rotenone. Rotenone is produced from the roots of two legumes, derris and cube, which grow in Asia and South America, respectively. The product is highly toxic to cold-blooded animals (especially fish), but only slightly toxic to most warm-blooded animals. Rotenone is the most effective and readily available of the non-synthetic insecticides and can be applied as a dust or a spray. Rotenone is effective against many insects, but not spider mites. The residual activity of this product is very short.

Nicotine Sulfate. This "natural" insecticide is derived from the tobacco plant and is highly toxic to humans and other warm-blooded animals. It is only suggested for commercial application.

Sulfur. Finely-ground sulfur can be applied as a dust or a spray. If sprays are preferred, be certain the formulation is intended as a foliar application. Sulfur is moderately effective for controlling spider mites and some fungal diseases. It may cause a chemical "burn" on tender foliage, however, if the air temperature is 90oF or higher. It also may cause a sulfur taste if used on fruits or vegetables shortly before harvest.

Insecticidal Soaps. Certain commercially-produced detergent or soap formulations are effective in reducing populations of soft-bodied pests such as aphids, mites, leafhoppers, scale crawlers, plant bugs and thrips when used as sprays. Insecticidal soaps kill insects and mites by disrupting cell membranes, causing cells to burst. For acceptable control, these products usually require thorough coverage and multiple applications. Use insecticidal soaps with caution because they can injure the leaves of certain plants.

Horticultural Oils. Horticultural oil sprays are highly refined petroleum oils used to control insects and mites on selected fruits and vegetables, shade trees, shrubs, flowers and other foliage plants. Spray oils often are used as dormant treatments to control overwintering pests such as aphids, mites and scale insects. In many cases, they can also be used after leaves are present. Examples of insects controlled while plants are actively growing are scale crawlers, aphids, leafhoppers, sawfly larvae, mealybugs, caterpillars and some beetle immatures. Under certain conditions, spray oils can cause plant damage, so care must be taken when using these products. Before using spray oils, consider refinement classification (dormant, summer, superior), dosage, growth stage of the plant, climatic conditions and the sensitivity of the plant species to be treated. Plants showing stress because of low moisture conditions should not be sprayed with a horticultural oil.

Summary

Establishing an integrated pest management program will require time, effort and careful planning. The potential rewards, however, are substantial in terms of improved pest control, higher crop yields and reduced reliance on pesticides for insect and mite control.

Additional sources of information

Identification

Peterson Field Guides:
- Insects
- Eastern Moths
- Western Butterflies
- Eastern Butterflies
- Beetles

Houghton Mifflin Co., Boston.

Golden Guides:
- Butterflies and Moths
- Insects
- Insect Pests
- Spiders and Their Kin

Golden Press, Western Publishing Co., Racine, Wis.

Simon and Schuster Field Guides:
- Insects
- Butterflies and Moths

Simon and Schuster, New York.

Audubon Society Field Guides:
- Insects
- Spiders
- Butterflies

Alfred A. Knopf, New York.

Biology and Management

Alternatives in Insect Management: Biological and Biorational Approaches. R. Weinzierl & T. Henn. 1991. North Central Regional Extension Publication 401. Univ. of Illinois Cooperative Extension. 73 pp. Available from: Univ. of Illinois, 69 Mumford Hall, 1301 W. Gregory Dr., Urbana, IL, 61801. (217) 333-2007.

Biological Control of Insect Pests of Cabbage and Other Crucifers. S. Mahr, D. Mahr & J. Wyman. 1993. North Central Regional Extension Publication 471. 54 pp. Available from: UNL Extension Division.

Biological Control of Insects and Mites: An Introduction to Beneficial Natural Enemies and Their Use in Pest Management. D.L. Mahr & N.M. Ridgway. 1993. North Central Regional Extension Publication 481. 91 pp. Available from: UNL Extension Division.

Common Insect Pests of Trees in the Great Plains. (1986). Dix, M. E., J. E. Pasek, M. O. Harrell, and F.

P. Baxendale. University of Nebraska Cooperative Extension, EC86-1548. Cost: $3.

Insect Pests of Farm, Garden and Orchard, (1987), 8th Edition, Davidson and Lyon. Wiley & Sons, New York.

Nebraska Insects, Johnson, S.V., 2nd Ed., (1988). Nebraska Dept. of Agriculture, Lincoln, NE.

Pests of the Garden and Small Farm, (1990), Pub. No. 3322, Mary Louise Flint. (Includes insects, diseases, nematodes and weeds.) University of California, Oakland, CA.

Newsletters

Midwest Biological Control News, a monthly 8-page newsletter ($12/year; make check payable to University of Wisconsin). Send subscriptions to: Midwest Biological Control News, Dept. of Entomology, University of Wisconsin, 1630 Linden Drive, Madison, WI 53706. Visit the MBCN Home Page at: http://www.wisc.edu/entomologymbcn/mbcn.html.

Entomological Supplies

BioQuip Products
17803 LaSalle Ave.
Gardena, CA 90248
(213) 324-0620

Carolina Biological Supply Co.
2700 York Road
Burlington, NC 27215
(800) 334-5551

Edmund Scientific
101 E. Gloucester Pike
Barrington, NJ 08007-1380
(609) 547-8880

Fisher Scientific
711 Forbes Avenue
Pittsburgh, PA 15219
(800) 325-4075

Forestry Supplies, Inc.
205 W. Rankin St.
P.O. Box 8397
Jackson, MS 39284-8397
(800) 647-5368

Ward's Natural Science Establishment, Inc.
5100 West Henrietta Road
P.O. Box 92912
Rochester, NY 14692-9012
(800) 962-2660

Insect Monitoring Devices, Other Supplies

A.H. Hummert Seed Co., 2746 Chonteau Ave., St. Louis, MO 63107. 800-325-3055.

Ecogen, Inc., Sentry Division, 2005 Cabot Blvd. West, Langhorne, PA 19047. 800-220-3326.

Great Lakes IPM, 10220 Church Road NE, Vestaburg, MI 48891. (517) 268-5693.

Pest Management Supply Co., Inc., P.O. Box 938, Amherst, MA 01004. (413) 243-3747.

Trece, Inc., P.O. Box 6278, 1143 Madison Lane, Salinas, CA 93912. (408) 758-0204.

Retail Suppliers of Beneficial Organisms. R.J. Wright. 1994. NebFact 94-182. 4 pp. Available from: UNL Extension Division.

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