Pest Management Strategies

A “pest” is an organism which has characteristics that are regarded as injurious or unwanted. The term pest often refers to harmful animals, insects, weeds, mites, fungi and viruses. Use of the word “pest” troubles some people because it implies a negative value on the organism in question regardless of the context. For example, we have native Arizona cockroaches. Are these cockroaches “pests” when they live outdoors, subsist on native foods and are part of a local food web? Regardless, the word “pest” persists in the literature and it is often difficult to avoid its use. This publication will focus on insect, animal and disease management with cultural, ultrasonic, farmscaping, biological and pheromone techniques.

Cultural control methods include a broad range of normal management practices that can be modified or manipulated to manage one or more pest problems. Cultural control techniques may include crop rotation, tillage, timing of planting and harvesting, cover crops, choice of plant cultivar, competition, fertilizer or irrigation practices, sanitation, and soil solarization. Cultural controls are often most effective when used in conjunction with other pest management strategies (i.e. mechanical, biological, and chemical control methods) and should be part of every gardener’s integrated pest management (IPM) strategy.

Many disease resistant plant varieties and rootstocks are available. Plant diseases are often difficult to control once they appear, but some cultural practices can be used effectively to control some plant diseases. In vegetable gardens and annual flower beds, crop rotation and sanitation are easy and effective: don’t plant the same species (or plant family) in successive years and remove diseased plants as soon as symptoms appear. Never compost diseased plant material.

Many insects can also be controlled using cultural methods. For instance, aphid populations can be reduced by controlling weeds where they take refuge, controlling ants (they protect aphids to harvest the honeydew), and by not applying excessive amounts of nitrogen fertilizer which can create very succulent foliage. Spider mite populations can be reduced by taking steps to reduce dust and washing plant foliage during the growing season. Thrips can be managed by knocking them off plants with a spray of water and by reducing weeds where they may find refuge. Whitefly populations can be reduced early in the growing season by using reflective mulches such as aluminum foil or plastic sprayed with silver paint. These should be removed before summer temperatures peak to avoid damaging the crop. Traps are also available for many insects.

Birds are protected by law and it is illegal to harass, trap, or kill them without first consulting the Arizona Game and Fish Department. The only exceptions are starlings, English sparrows, and pigeons (rock doves). Exclusion (bird netting, caging, etc.) is the best solution to prevent bird damage. Frightening (owl decoys, Mylar streamers, etc.) will sometimes repel birds for a few days, but they often habituate to these devices over time.

Cultural controls are not very effective in controlling animal pest populations. Exclusion (fencing/blockage) is probably the best control method for deer, rabbits, skunks, raccoons, and javelinas. Gophers, packrats, and rock squirrels are best controlled by trapping and removing the attractant(s). All animal species except gophers, packrats, and rock squirrels are also protected and may not be harassed, trapped, or killed without consulting Arizona Game and Fish Department.

Ultrasonic pest control devices are commonly marketed as an alternative to pesticides. The word “ultrasonic” is defined as sound waves higher in frequency than human hearing. These devices claim to use ultra-high frequency sound waves to chase away birds, bats, rodents and arthropod pests like fleas, cockroaches, silverfish and even spiders. Most of them are designed to plug into an electrical outlet. The devices are usually a little plastic box with a handy LED light to tell the owner it is on and working. Some ultrasonic devices are battery-operated for such applications as a flea-repellent collar and pocket-sized cards for outdoor enthusiasts to repel mosquitoes.

Several researchers have concluded that ultrasonic devices do not effectively repel or eliminate pests from homes and/or gardens. Most insects and animals hear or feel the same range of frequencies that humans do. If a sound or frequency doesn't bother us, it is doubtful that it will bother pests. Animals placed in cages next to these devices continue to live normal lives. If they are paired with the opposite sex, the animals continue to reproduce. Others have placed ultrasonic devices in rat and bat infested attics and found that pest populations continue to live and reproduce in those spaces.

“New and improved” subsonic devices produce a low frequency sound or vibration. Some producers of subsonic devices say they use the electrical wiring in a house or structure to form a protective shield around the inhabitants and the things they want to protect. The box, plugged into a common outlet, supposedly sets up low frequency vibrations through the electrical wires that pests can’t stand. Again, researchers have proven subsonic devices are ineffective.

People are usually purchasing these devices to discourage small rodents, bats, insects, or spiders. There are several strategies that do work on these and other pest species. For any pest, try to remove any attractant (food, water, nesting material, etc.) and keep areas as clean as possible. In addition, seal cracks and crevices around doors, windows, and utilities; eliminate weedy growth or vegetation near the house; use traps and/or glue boards inside the house; seal food (including pet food) in pest-proof containers; and monitor closely to determine if additional measures are warranted.

Some sonic and ultrasonic devices have been shown to be effective on specific pests. Researchers at Northern Arizona University showed that colonization of ponderosa pine logs by southern pine beetles was reduced by 72% when biologically relevant sounds were played back. The particular sound in this case was the insect’s stress call. Some have used recorded predator calls (hawks and falcons) to discourage woodpeckers from causing damage to stucco and siding. They used these sounds in conjunction with other methods (bird netting and sheet metal) and had limited success. In general, ultrasonic pest control devices are not effective and time and resources are better directed at prevention, direct control, and exclusion.

Farmscaping is a whole-farm, ecological approach to pest management and uses non-crop plants interplanted with crop plants to support populations of beneficial insects. Farmscaping includes insectary plants (plants that attract and feed beneficial insects) and cover crops to provide habitat elements (food, water, shelter, and space) for beneficial insects.

Farmscapers enlist native populations of beneficial insects to assist them by creating prime habitat for them right in the fields. The beneficial insects will be healthier, reproduce more readily, and be more effective at biocontrol when provided habitat with an adequate and easily available diet of nectar, pollen, and herbivorous insects and mites as food to sustain and increase their populations. Flowering plants are particularly important to adults of the wasp and fly families, which require nectar and pollen sources in order to reproduce the immature larval stages that parasitize or prey on insect pests.

Farmscaping requires some thought and planning. Selecting a random group of plants could result in a situation that favors pest species, so it is important to identify those plants, planting situations, and management practices that best support populations of beneficial insects. Farmscaping requires greater knowledge and management skill than conventional pest management. The farmscaper’s payoffs are reduced pesticide use and associated costs, reduced pesticide residues on crops, and an overall safer farm environment with increased biodiversity.

Guidelines usually suggest planting 1 to 5% of the total field area with “farmscaping plants” in rows between crop plants or along windbreaks and borders. Data suggest that planting permanent insectary rows is superior to planting them annually. Depending on the plant species, these “perennial islands” provide food resources for beneficial insects as well as overwintering sites. During the year, beneficial insects can colonize the crop plants directly from the adjacent farmscape.

Many gardening catalogs sell seed mixes for farmscaping applications (often called “beneficial blends” or “insectary blends”). These mixes will usually contain plants in the carrot, sunflower, and mint families. Seed mixes may or may not contain cover crops (legumes and other soil building species). Cover crops that are good insectary plants include buckwheat, sweet clover, fava beans, vetch, clover, mustards, and cowpeas.

Some farmscape plants that would do well in our area are sweet clover, alfalfa, gypsophila, alyssum, yarrow, black-eyed Susan, evening primrose, cowpeas, basil, carrot, dill, parsley, buckwheat, and fennel. London rocket, a naturalized species of mustard, will no doubt be in the area already. If you decide to try farmscaping, plan carefully, record what you planted and when, observe the results, and share your findings with others. Natives and landscape plants can also contribute to the farmscaping potential of your garden or orchard.

Biological pest control differs from chemical, cultural, and mechanical controls in that it requires maintenance of some level of food supply (e.g., pest) in order for the biocontrol agent to survive and flourish. Therefore, biological control alone will only manage any pest species under the best circumstances. Pest eradication is never the goal of biological control practices.

Classical biological control has been used most for introduced or “exotic” pests. The origin of the pest is determined and then a search for natural enemies in its native habitat is conducted. Here, potential biocontrol agents are imported to the new location of the pest and evaluated under controlled conditions. In particular, the biocontrol agent is monitored to ensure that it does not feed on organisms other than the pest species (this is called host specificity). It is also evaluated to see whether it can survive the environmental conditions where it may be introduced.

Conservation biocontrol is based on controlling what usually are native pests with the natural enemies or predators that should already be out there doing the work. One reason they're not out there working is that broad-spectrum pesticides applications may have killed them. In the United States, the use of broad-spectrum pesticides appears to be declining. This is good news for growers that place a greater reliance on natural control agents.

In the world of insect biocontrol, predators and parasites that feed on the pest are often present in the area and populations increase in response to increased food (pests). Major types of insects that are predaceous: dragonflies and damselflies, mantids, true bugs, some thrips, lacewings and relatives, beetles, some wasps and ants, and some flies. Spiders and some mites are also important predators of insects. In the world of insect biocontrol, parasites are actually called parasitoids because what they kill are parasitic in their immature stages and free-living as adults. Some examples of these include wasps, flies, some beetles, and mantisflies.

Microbial pathogens can also reduce insect populations and these organisms have become very popular for insect biocontrol. Major pathogens used in biological control of insects are:

Bacteria— Bacillus thuringiensis = Bt (many caterpillar pests, beetles, mosquitoes, others).
Viruses— Nucleopolyhedrosis viruses (Gypsy moth, European corn borer), granulosis viruses (Codling moth).
Fungi— Metarhizium (cockroach motels), Beauveria bassiana (Colorado potato beetle, Corn rootworms).
Protozoa— Nosema locustae (grasshoppers).
Nematodes— Steinernema and Heterorhabditis spp. (Soil weevils, Stem-boring caterpillars).

Keep in mind that insect biocontrol never provides complete pest control and minimizing the use of broad spectrum insecticides will enhance the probability that predators and parasitoids will be present in your garden.

Pheromones can be effective. Insects communicate by sound, chemicals, and some even use flashes of light. They do this for several reasons: to find a mate; to direct others to food and other resources; to regulate their distribution; to warn others of danger; to mimic or deceive, and probably for some reasons we have yet to discover. Chemical signals have been studied by entomologists and chemists and are often used in the management of insects we consider pests.

Chemical compounds insects use to communicate are called pheromones. Pheromone use in insect management is environmentally friendly and widely used in organic crop production, forestry, structural and stored food, and exotic pest management. They are non-toxic, biodegradable chemicals that are used to change behavior of specific insects and have no effect on other insects and non-target organisms.

The use of pheromones in insect management begins with the discovery of a pheromone that alters feeding or mating behavior. Entomologists working with other scientists isolate specific pheromones and chemists determine how to replicate and commercially produce them.

Insect antennae are receptors that sense the presence of pheromones in the environment. The persistence of individual pheromone signals varies from a very short time to several days. Long-lasting pheromones are used by insects to mark territorial boundaries or food sources. Short-lived pheromones provide an immediate message, such as a short-term warning of danger or a brief period of reproductive readiness.

An example of a pheromone induced behavior you may have observed is the aggregation of ladybird beetles on mountaintops during the summer months. They are responding to an aggregation pheromone and do this to escape the heat and stay together. Ants also use pheromones to trail each other. The next time you see an ant trail in your kitchen, take a damp, soapy sponge, wipe it across the ant trail and observe them as they try to reestablish their bearings.

There are three main uses of pheromones in insect management. The most common application is for monitoring insect populations to determine if they are present or absent in an area or to determine if enough insects are present to warrant an insecticide treatment. This monitoring function is the keystone of integrated pest management (IPM). Monitoring is used extensively in urban pest control of cockroaches, in the management of stored grain pests in warehouses or distribution centers, and to track the worldwide spread of exotic pests such as the medfly, Asian longhorn beetle, emerald ash borer, and others. Pheromone traps are currently used to monitor the movement of exotic insect pests in most major North American ports of entry.

A second major use of pheromones is to mass trap insects with the intent to remove large numbers of insects from the breeding and feeding population. Massive reductions in the population density of pest insects ultimately help to protect resources such as food or fiber for human use. Mass trapping has been explored with pine bark beetles and has resulted in millions of insects attracted specifically into traps and away from trees. Pheromone trapping has been somewhat successful in controlling codling moths in apples and pears.

The third method seeks to confuse the insects during mating to reduce future populations and is called mating disruption. This is commonly used for codling moth management and is applied through small coated wire "twist ties" or a gel impregnated with the pheromone in strategic locations throughout apple and pear orchards. A newer technology uses spray cans that are timed to go off at dawn and dusk, the time of peak activity for codling moths. Each puff of spray releases the equivalent of 10,000 female moths causing the male moths to frantically fly every which way thinking they’ve located a receptive female.

The ultimate benefit of using pheromones in insect management is that they are non-toxic to the insects, non-target organisms, and environment. This makes them safe to use and helps growers to better time the use of other pesticides thereby reducing the amounts of pesticides applied.

For reliable pest management, learn and follow integrated pest management (IPM) guidelines. These are: correctly identify the pest species, learn about that organism’s behavior and biology, employ preventative strategies, apply direct control strategies if necessary (traps, baits, pesticides), and finally, monitor the effectiveness of your efforts and revise as necessary.

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