Virginia Cooperative Extension

PUBLICATION 426-366

Minimum-Chemical Gardening

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Home gardeners often use more pesticides per square foot in their gardens than farmers do in the fields, thinking that if a little is good, more will be better. This is a serious mistake and a serious misuse of pesticides. Overuse of pesticides has a number of adverse effects: it makes food less safe to eat, especially if there are residues at harvest time; it makes handling the plants dangerous; and it may harm or kill beneficial insects, earthworms, birds, and even pets along with harmful insects. Each time gardeners spray, they are exposed to the dangers of inhalation or absorption of the toxin. Pesticides may leach through the soil into the groundwater and contaminate water supplies. Pesticides used near ponds may kill fish. Continuous use of certain pesticides may induce resistance in the pests, thus requiring the use of more toxic substances. Some pesticides break down slowly and can remain in the environment for years.

Concern over the use and misuse of pesticides has led many home gardeners to seek means of natural pest control. There are many cultural practices which will help reduce losses. Because the gardener does not have to live up to perfect market standards, pesticide use may be reduced to a minimum with a little research and effort. If the choice is between minor insect damage and possible pesticide residue, consider accepting the visible blemish that can be removed. Proper soil preparation, careful plant selection, and good garden practices can be combined with biological and mechanical controls to reduce the need for chemical pesticides.

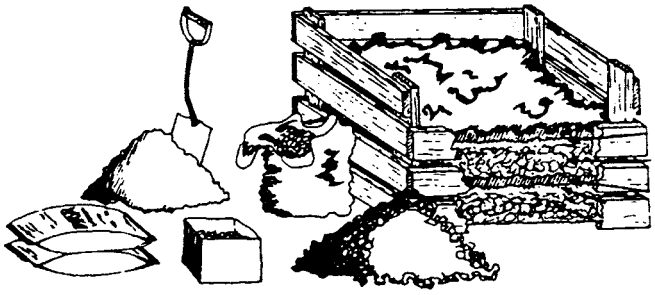
Soil Preparation

Maintain a slightly acidic soil (around pH 6.5). If in doubt, have a soil analysis done through your local Extension office. The appropriate pH allows vegetable plants to have access to all the necessary soil nutrients and provides a suitable environment for earthworms and microorganisms. Follow recommended fertilizer practices. Supplement chemical fertilizers with organic material or compost to help assure that all trace elements and major nutrients are available. Feed the soil, not just the plants; providing an appropriate environment for all soil life will result in healthy plants which can resist pests and diseases.

When using manure and compost, be sure they are worked into the soil. Otherwise, millipedes, white grubs, and other pests may be encouraged. If these insects become a problem, you may be using too much; consider other means of adding organic matter, such as cover-cropping or mulching.

When diseased plant material is added to compost to be used on the garden, delay using the compost until all material has decayed beyond recognition. piles must be hot (160° F) to kill disease organisms, insect eggs, and weed seeds.

Till the soil in the fall to expose those stages of pests which live near the surface of the soil to natural enemies and weather, and to destroy insects in crop residues. If you do not till in the fall, do so early enough in the spring to give remaining vegetation time to degrade before planting time.



Plant Selection

Plant crops that are suited to the soil and climate of your area. If you do plant vegetables or fruits that are not normally grown in your area, do your best to provide necessary conditions. For example, watermelons prefer a light, warm, well-drained soil; don't try to plant in

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Produced by Communications and Marketing, College of Agriculture and Life Sciences, Virginia Polytechnic Institute and State University, 2009

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heavy clay without first adding copious amounts of compost or other soil-lightening material, and allow the soil to warm up before seeding or setting plants out.

Use disease-free, insect-free, certified seed if available. Select disease/insect-resistant or tolerant species and varieties.

Resistance in plants is likely to be interpreted as meaning immune to damage. In reality, it distinguishes plant varieties that exhibit less insect or disease damage when compared with other varieties under similar circumstances. Some varieties may not taste as good to the pest. Some may possess certain physical or chemical properties that repel or discourage insect feeding or egg laying. Some may be able to support insect populations with no appreciable damage or alteration in quality or yield.

Select plants that are sturdy and have well-developed root systems. Diseases and insects in young seedlings may start in greenhouses or plant beds and cause heavy losses in the garden. Buy plants from a reputable grower who can assure you that they are disease/insect-free, or grow your own from seed.

Avoid accepting plants from friends if there is any chance of also getting free insects or diseases!

Cultural Practices

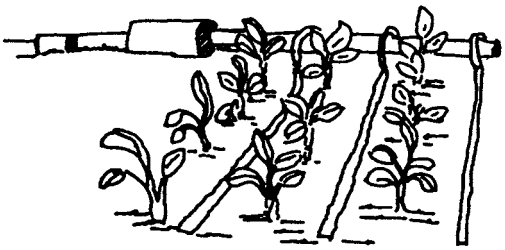
The most effective and most important of all practices is to observe what is going on in the garden. Many serious disease or insect problems can be halted or slowed early by the gardener who knows what to look for and regularly visits the garden for the purpose of trouble-shooting.

Rotation. Do not grow the same kind of produce in the same place each year. Use related crops in one site only once every three or four years. Some related crops are as follows: (a) chives, garlic, leeks, onions, shallots; (b) beets, Swiss chard, spinach; (c) cabbage, cauliflower, kale, collards, Brussels sprouts, broccoli, kohlrabi, turnips, rutabagas, Chinese cabbage, mustard; (d) peas, broad beans, snap beans, lima beans; (e) carrots, parsley, celery, celeriac, parsnips; (f) potatoes, eggplant, tomatoes, peppers; (g) pumpkins, squash, watermelons, cucumbers, muskmelons; (h) endive, salsify, lettuce; (i) corn and sweet corn.

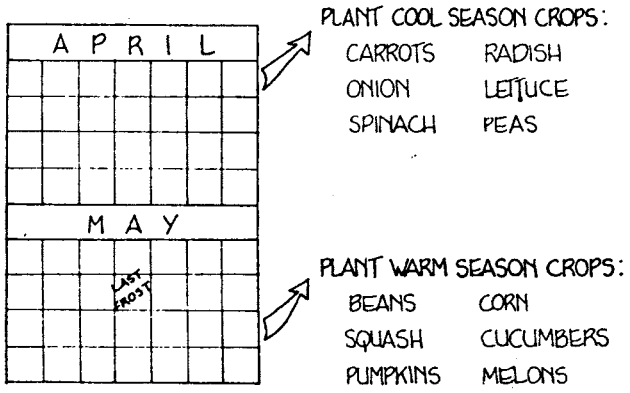
Interplantings. Avoid placing all plants of one kind together; alternate groups of different plants within rows or patches. If an insect lays eggs or otherwise attacks a specific species, the presence of other species in the area can interrupt progress of the attack by diluting the odor of the preferred plants. This can also slow the spread of diseases and pests, giving the gardener more time to deal with them.

Thinning. Thin young plants to a proper stand. Overcrowding causes weak growth and subsequent insect and disease problems.

Watering. Water in the morning so plants have time to dry before the cool evening when fungus infection is most likely. Drip irrigation prevents foliage from getting wet when watering. For plants susceptible to fungus infections, such as tomatoes, leave extra space between plants to allow good air flow and orient rows so that prevailing winds will help foliage dry quickly after a rain or watering. While this may reduce the number of plants per square foot, yields may still be higher due to reduced disease problems. To prevent spread of diseases, stay out of the garden when the plants are wet with rain or dew.



Planting Time. Time plantings in such a way that the majority of the crop will avoid the peak of insect infestations. For example, plant squash as early as possible to avoid borers, which lay eggs in July. Keep a record of the dates insect problems occur. Also, by planting warm-weather crops after the soil has warmed, problems with seed and root rots will be avoided, and growth will be more vigorous.



Sanitation. Clean up crop refuse including stalks, roots, and tubers (potatoes) as soon as harvesting is finished. These act as over-wintering sites for borers and tuber worms. Old sacks, baskets, decaying vegetables, and other rubbish that may harbor insects should be kept out of the garden.

Avoid injury to plants. Cuts, bruises, cracks, and insect damage are often sites for infestation. In cases where fruit is difficult to remove, such as with cucumbers and watermelons, cut them instead of pulling them off the plant. If you cultivate your garden, avoid cutting into the plant roots.

Weed control. Control weeds and grass. They often harbor pests and compete for nutrients and water. They provide an alternate source of food and can be responsible for pest build-up. They also provide cover for cutworms and slugs.

Mechanical Controls

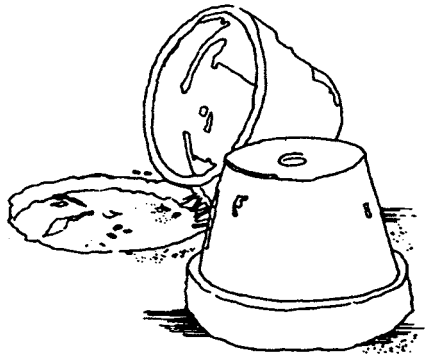
Handpicking. Inspect plants for egg clusters, bean beetles, caterpillars, and other insects as often as possible. Handpick as many as possible. If you don't like squashing the pests, knock the insects and egg clusters into a coffee can or quart jar with a small amount of water, and then pour boiling water over them. Kerosene is often recommended, but poses a disposal problem once you have finished; besides, water is cheaper.

Traps. Use appropriate insect traps to reduce certain insect populations. A simple, effective Japanese beetle trap can be made from two milk jugs or a single milk jug and a plastic bag. The bait used to attract the beetles is available at most farm and garden supply centers. Place traps at least 40 feet away from desirable plants. Remove dead beetles frequently.

Light traps, particularly blacklight or bluelight traps known as "bug zappers" (special bulbs that emit a higher proportion of ultraviolet light that is highly attractive to nocturnal insects), are good insect-monitoring tools but provide little or no protection for the garden. While they usually capture a tremendous number of insects, a close examination of light-trap collections shows that they attract both beneficial and harmful insects that would ordinarily not be found in that area. Those insects attracted but not captured remain in the area, and the destructive ones may cause damage later. Also, some wingless species as well as those species only active during the day (diurnal, as opposed to nocturnal) are not caught in these traps. Consequently, the use of a light trap in protecting the home garden is generally of no benefit and, in some instances, can be detrimental.

Upturned flower pots, boards, newspaper, etc. will trap earwigs, sowbugs, and slugs; collect them every morning and destroy them with boiling water or feed them to pet frogs, toads, turtles, and fish. Indoors, white flies can be caught with yellow sticky traps made with boards painted yellow and lightly coated with oil or grease. There are also commercial sticky traps available through some catalogs.

Baits. Beer placed in a shallow dish sunk so the lid is at ground level will catch and kill many slugs.



Repellents. Aluminum foil and other reflective mulch has been shown to repel aphids. However, the environmental impact and energy consumption involved in making aluminum foil deserves consideration. Crushed eggshells or hydrated lime spread around plants may discourage slugs.

Exclusion or Barriers. Various materials can be used to physically block or repel insects and keep them from damaging plants. Place wood ash, cardboard tubes, or orange juice cans around seedlings to keep cutworms away from plant stems. Use paper bags over ears of corn to keep birds and insects out; do not cover until pollination is complete. Net-covered cages over young seedlings will help prevent insect, bird, and rabbit damage. Cheesecloth screens for cold frames and hot beds will prevent insect egg-laying; sticky barriers on the trunks of trees and woody shrubs will prevent damage by crawling insects. Floating row covers for many vegetable crops are a little more expensive, but their effectiveness in excluding insects is proven by the number of commercial growers that use them, particularly on cole crops and strawberries, cukes, melons, and squash.

Biological Controls

Predators, Parasites, and Pathogens. The garden and its surrounding environment is alive with many beneficial organisms that are present naturally; however, they may not be numerous enough to control a pest before damage is done. Actually, parasites and predators (usually other types of insects) are most effective when pest populations have stabilized or are relatively low. Their influence on increasing pest populations is usually minimal since any increase in parasite and predator numbers depends on an even greater increase in pest numbers. Disease pathogens, however, seem to be most effective when pest populations are large.

Take advantage of the biological control already taking place in your garden by encouraging natural predators such as praying mantises, ladybugs, lacewings, ground beetles, and others. Purchased natural predators are often effective for only a short period, however, since they tend not to remain in the place where they are put. Research the likes and dislikes of these helpers as to foods, habitat, etc. Provide these conditions where possible; some beneficial insect suppliers now offer a formulation for feeding/attracting the beneficials to keep them in the garden longer.

Learn to recognize the eggs and larvae of the beneficial insects, and avoid harming them. You can often find preying mantis egg cases in weedy lots; just bring the twig with the cluster into the garden and

set it in a place where it will not be disturbed. Spiders, toads, and dragonflies are also beneficial, and should not be a source of fright to the gardener; in most cases, they are harmless to people.

Learn to recognize parasites and their egg cases; for example, the tomato hornworm is often seen with a number of white egg cases, a little larger than a grain of rice, on its back. These were laid by a parasitic wasp. The hornworm will die and more wasps will emerge. Obviously, it is to your advantage to leave that worm in the garden.

Pesticides

Nonsynthetic Pesticides

Botanicals. Natural pesticidal products are available as an alternative to synthetic chemical formulations. Some of the botanical pesticides are toxic to humans, fish, and cold-blooded creatures and should be treated with care. Safety clothing should be worn when spraying these, even though their toxicity is low to warm-blooded animals. Botanical insecticides break down readily in soil and are not stored in plant or animal tissue. Often their effects are not as long-lasting as those of synthetic pesticides.

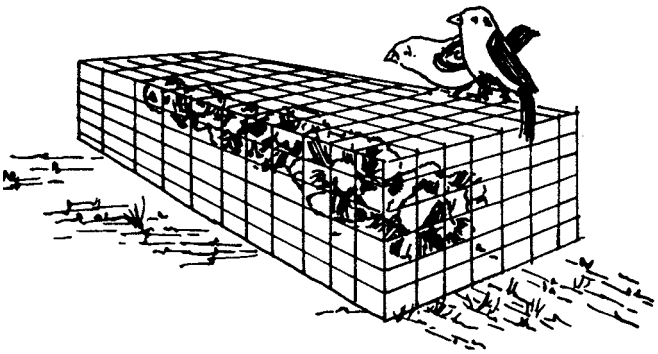
Insecticide	Use Against
Pyrethrum	Pickleworms, aphids, leafhoppers, spider mites, harlequin bugs, cabbageworms.
Rotenone	Spittlebugs, aphids, potato beetles, harlequin bugs, chinch bugs, spider mites, carpenter ants.
Ryania	Codling moths, Japanese beetles, squash bugs, potato aphids, onion thrips, corn earworms, silkworms.
Sabadilla	Grasshoppers, codling moths, moths, armyworms, aphids, cabbage loopers, blister loopers, blister beetles.

Some of these products may be difficult to find.

In addition to botanical insecticides, some biological products can help in the battle against insects. *Bacillus thuringiensis* is an effective product commonly used against moth larvae. B.T., as it is known, is a bacterium that gives the larvae a disease; it is most effective on young larvae. Presently, there is research underway to develop strains that work against other types of insect larvae. Several formulations are available to the gardener under different trade names to provide effective control of several caterpillars without harming man and domestic animals. More than 400 insect species are known to be affected by this important insect pathogen. *Bacillus thuringiensis* is quite slow in its action. For example, caterpillars that consume some of the spores will stop eating within 2 hours, but may continue to live and move around until they die, which may be as long as 72 hours. When this occurs, the untrained gardener may assume the material was ineffective because of the continued pest activity and impatiently apply a chemical pesticide.

Nosema locustae is a disease organism which shows some promise for controlling grasshoppers. There are claims that this parasite may be effective for up to five years after initial application. In some areas, this parasite is available commercially under different trade names. It is still too early to make extensive claims about its effectiveness in home gardens.

Enlist the aid of birds. In rural areas, chickens, guineas, and other domestic fowl can be released in unused areas of the garden to eat grubs and insects. Wild birds will also help, but they aren't as controllable. Provide appropriate conditions (i.e., shelter, nesting material, water) to encourage insect-eating birds.



Soaps. Commercial insecticidal soap (a special formulation of fatty acids) has been proven effective against soft-bodied insects such as aphids, leafhoppers, mealybugs, mites, pear psylla, thrips, and whiteflies.

Synthetic Pesticides

Chemical Control. Pesticides used according to the label can provide a safe and effective control for many pests. Synthetic pesticides, by their simplest definition, are those pesticides made by man in chemical laboratories or factories. Examples of these include malathion, diazinon, and Sevin. The real surge of development of synthetic pesticides began in World War II with the discovery of DDT.

Reviewed by Alan McDaniel, associate professor, Horticulture