



Minimum Chemical Gardening

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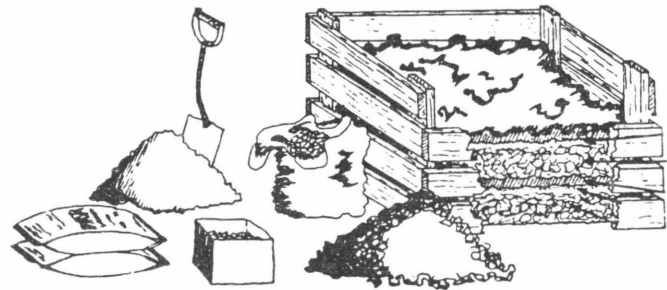
Home gardeners often use more pesticides per square foot in their gardens than farmers do in the fields, thinking that if a little is good, more will be better. This is a serious mistake, and a *misuse of pesticides*. Over-use of pesticides has a number of adverse effects: it makes your food less safe to eat, especially if there are residues at harvest time; it makes handling the plants more dangerous; beneficial insects, earthworms, birds, even pets may be harmed or killed along with the "bad guys;" each time the gardener sprays, she or he is exposed to the dangers of inhalation or absorption of the toxin; pesticides used near water may contaminate the water supply; continuous use of certain pesticides may induce resistance in the pests, thus requiring the gardener to switch to more toxic substances; some pesticides do not break down easily and can remain in the environment for years.

The growing public concern over the use and misuse of pesticides has led increasing numbers of home gardeners to seek means of "natural" pest control. Although some people do not have the time or knowledge to practice all the available alternative methods for controlling pests, 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. And, if the choice is between minor insect damage and a possible pesticide residue, consider accepting the visible blemish you can cut out.

Soil Preparation

- Maintain a slightly acid soil (around pH 6.5). If in doubt, have an analysis done of your soil through your local Extension Office, by a private lab, or with a soil test kit. The appropriate pH allows vegetable plants to have access to all the necessary soil nutrients and provides a suitable environment for earthworms and microorganisms.
- Build a biologically active, healthy soil through regular addition of organic matter. Compost and manure can be incorporated into the soil and various mulches such as leaves and grass clippings can be applied on the surface. Organic matter is essential for providing good soil structure, moisture infiltration and retention, and gradual release of plant nutrients. Regular addition of organic matter to garden soil can totally eliminate the need for chemical fertilizers, although moderate use of chemical fertilizers is helpful during a transition period until sufficient soil organic

matter content has been obtained. Addition of organic matter has also been shown to be effective in suppressing many soil-borne plant pathogens by encouraging beneficial microorganisms. By improving the general conditions for plant growth (i.e., moisture retention, improved soil aeration, and soil fertility), the addition of organic matter helps reduce various stresses on plants which make them susceptible to pathogens and insect pests.



- Grow winter annual cover crops to provide additional organic matter without the effort of hauling, fix free nitrogen from the air, reduce loss of soluble plant growth nutrients through leaching, and provide a bright patch of greenery during the winter months. A mixture of rye grain and hairy vetch makes a good winter annual cover crop if seeded at a rate of 2 lbs rye and 1 lb of hairy vetch per 1,000 sq ft of garden. After the summer garden crops have been harvested, stalks and vines should be removed and composted, and the garden lightly tilled to prepare a seedbed. The cover crop seed can be broadcast and raked lightly with a leaf rake to cover the seed. If possible, irrigate after planting and then every 4-7 days until the crop has emerged. Be sure to inoculate the hairy vetch seed with *Rhizobium* bacteria to enable the vetch to fix nitrogen. Pour the seed into a bucket with a small amount of vetch inoculant (available in garden stores) and add enough water to dampen the seed. Mix thoroughly and plant. Winter annual cover crops can be planted as late as Oct. 15-25. In the spring, mow the cover crop with a lawn mower set at the highest setting prior to tilling. Till in the cover crop at least two weeks prior to planting garden crops. During spring and summer, as areas of the garden are harvested, plant a summer cover crop of buckwheat. This crop grows quickly, maturing in less than thirty days. Let the buckwheat flower, but incorporate prior to seed set.

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- When diseased plant material is added to compost to be used on your garden, delay using the compost until all has decayed beyond recognition. Compost piles should be hot (140°F.) to kill disease organisms, insect eggs, and weed seeds.
- Till 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. Plant winter annual cover crops whenever possible.
- 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. If you do plant vegetables or fruits that are not normally grown in your area, do your best to provide necessary conditions. For example, watermelon prefers a light, warm, well-drained soil; don't try to plant in 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, certified seed, if available.
- Select disease-resistant vegetable and fruit varieties.
- 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- and insect-free, or grow your own from seed.

Cultural Practices

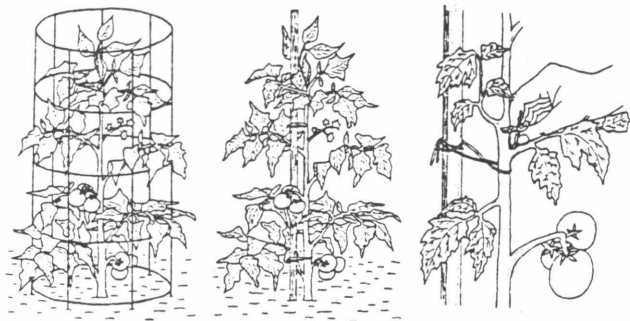
- The most effective and most important of all practices is to observe what is going on in the garden! Many serious disease or insect problems can be halted or slowed down early by the gardener who knows what to look for and regularly visits the garden for the purpose of trouble-shooting.



- Water in the morning so that plants have time to dry before the cool evening. Drip irrigation prevents

foliage from getting wet at all when watering. For plants susceptible to fungus infections, such as late blight on tomatoes, leave extra space between them to allow good air flow; 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, you may still get higher yields because of reduced disease problems.

- Use interplantings as opposed to solid plantings of a crop. This can slow the spread of diseases and pests, giving you more time to deal with them.
- Thin young plants to a proper stand. Overcrowding causes weak growth and subsequent insect and disease problems.
- Keep down weeds and grass. They often harbor pests and compete for nutrients and water. Leaf mulches are extremely effective for weed control.
- Use a mulch to reduce soil splash, which brings soil-borne diseases into contact with lower leaves.
- Rotate your garden plot, if you can. 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; and (h) endive, salsify, lettuce.
- Avoid injury to vegetable plants. Cuts, bruises, cracks and insect damage are often the site for infection by disease-causing organisms. In cases where fruits are difficult to remove (such as cucumbers and watermelons), cut them off instead of pulling them off the plant. If you cultivate your garden, avoid cutting into the plant roots.
- Stay out of the garden when the plants are wet with rain or dew to prevent spreading diseases.
- Do not use tobacco products such as cigarettes or cigars when working in the garden. Tomatoes, pepper, and eggplant are susceptible to a mosaic virus disease common in tobacco and may be spread by your hands.
- Remove infected leaves from diseased plants as soon as you observe them. Dispose of severely diseased plants before they contaminate others.
- Clean up crop refuse as soon as you are finished harvesting if possible.
- Keep old sacks, baskets, decaying vegetables, and other rubbish which may harbor insects and diseases out of the garden.



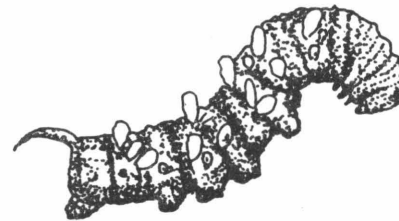
- Staking plants or planting them in wire cages prevents the fruit from coming in contact with the soil. This also helps prevent fruit rots. Caging helps reduce sun scald often seen in staked tomatoes, since caged plants do not require as much pruning, leaving a heavier foliage cover. Place boards or a light, open mulch such as straw beneath melons lying on the ground to prevent rotting.
- Time plantings in such a way that the majority of your 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, you will avoid problems with seed and root rots; growth will be more vigorous, as well.

A P R I L							PLANT COOL SEASON CROPS:	
						CARROTS		RADISH
						ONION		LETTUCE
						SPINACH		PEAS
M A Y							PLANT WARM SEASON CROPS:	
						BEANS		CORN
						SQUASH		CUCUMBERS
						PUMPKINS		MELONS

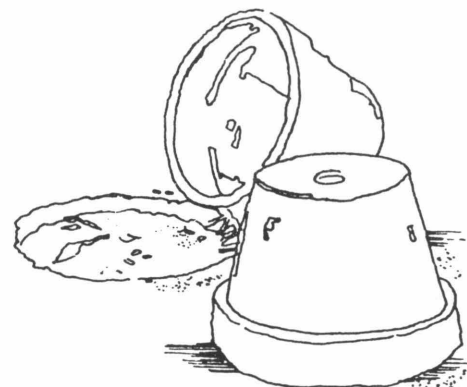
- Inspect plants for egg clusters, bean beetles, and caterpillars and other insects as often as possible. Hand-pick as many as you can. Knocking insects and egg clusters into a coffee can with a small amount of water in it and then pouring boiling water over them is a way to kill insects if you don't like squashing them. Kerosene is often recommended, but there is a disposal problem once you have finished; besides, water is cheaper.

Alternatives

- Take advantage of the biological control already taking place in your garden by encouraging natural predators, such as preying mantises, ladybugs, lacewings, ground beetles, and others. Purchased natural predators are often ineffective, 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. Learn to recognize the eggs and larvae of the beneficial insects and avoid harming them. 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 the worm in the garden, moving it to another place if it is doing a lot of damage. Spiders, toads, and dragonflies are beneficial and should not be a source of fright to the gardener; in most cases they are harmless to people.



- Use various insect traps to reduce the insect population levels. Upturned flower pots, bamboo lengths, boards, etc. will trap earwigs and sowbugs; collect them every morning and feed to pet frogs, toads, turtles, and fish, or destroy with boiling water. Slugs can also be caught by these means and can be killed. Indoors, white flies can be caught with sticky yellow traps, made with boards painted yellow and lightly coated with oil or grease. There are also commercial sticky traps available through some catalogs. Although several Japanese beetle traps are on the market which are effective at attracting beetles, use of these traps has not been shown to be effective in preventing Japanese beetle injury to garden plants, since the traps attract beetles from a wide area. Similarly, light traps and electric "zapper" traps operated at night can capture or kill a large number of insects; however, these devices are indiscriminant -- they kill beneficial as well as pest insects -- and will not aid in control of insect pests.



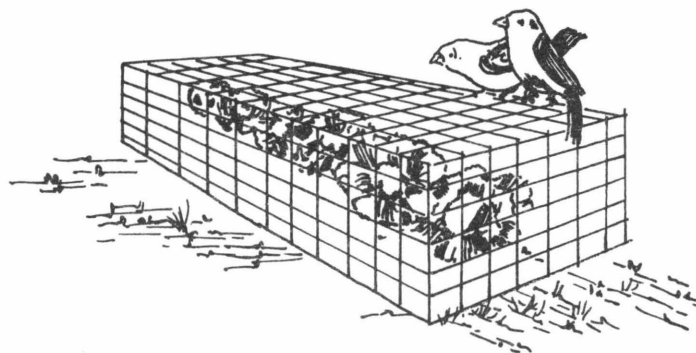
- Natural pesticidal products are available as an alternative to synthetic chemical formulations. Some of the botanical pesticides are fairly toxic to fish and other cold-blooded creatures and should be treated with care. Safety clothing should be worn when spraying these even though their toxicity is low to warm-blooded animals. The 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. Apply insecticides locally, to take care of a specific pest problem, instead of blanketing the entire garden.

Insecticide	Use Against
Pyrethrum	Pickleworms, aphids, leafhoppers, spider mites, harlequin bugs, cabbageworms, Mexican bean beetles, flea beetles, flies, squash bugs
Rotenone	Colorado potato beetle, Mexican bean beetle, Japanese beetle, flea beetles, cucumber beetles, spittlebugs, aphids, potato beetles, mites, carpenter ants, cabbage worms, loopers, fleas
Ryania	Codling moths, corn earworm, Oriental fruit moth, potato aphids, onion, thrips, corn earworms,
Sabadilla	Armyworms, Harlequin bugs, stink bugs, cucumber beetles, leafhoppers, cabbage loopers, blister beetles

Some of these products may be very difficult to find.

- In addition to the 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 bacteria that produces a toxin quite lethal to caterpillars, but nontoxic to beneficial insects and mammals. B.t. is most effective on young larvae. Presently, there is research underway to develop strains that work against other types of insect larvae. Another biocontrol product which is just becoming available to gardeners is grasshopper spore; it is not proven for small-scale use, but may help gardeners reduce damage by grasshoppers.
- Commercial insecticidal soap, a special formulation of fatty acids, has been proven effective against aphids, leafhoppers, mealybugs, mites, pear psylla, thrips, and whiteflies. Homemade soap sprays also work to some extent: use three tablespoons of soap flakes (not detergent) per gallon of water and spray on plants till dripping. Repellent sprays, such as

garlic sprays and bug sprays (made from a puree of bugs), have been found useful by some gardeners, but their effectiveness is questionable. Some researchers believe that bug sprays may work if a disease is present in the insect, which is spread through the spray to other insects.



- Various materials can be used to physically block or repel insects and keep them from damaging the 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.
- Where slugs are a problem, use methods described under trapping above, and try to create drier conditions. Heavy mulches may sometimes encourage slugs. Spread crushed eggshells or hydrated lime around affected plants.
- Enlist the aid of birds in your garden. In rural areas, chickens, guineas, and other domestic fowl are released in unused areas of the garden to eat grubs and insects. Wild birds will also help, but aren't as controllable. If you encourage wild birds you will have to protect ripening fruit (and even some vegetables); use bird netting or scare devices (aluminum pans banging in the breeze are fairly effective). Overall, birds do more good than harm. Consider planting shrubs and trees with fruits that attract them.

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