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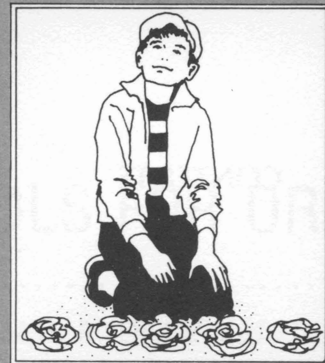
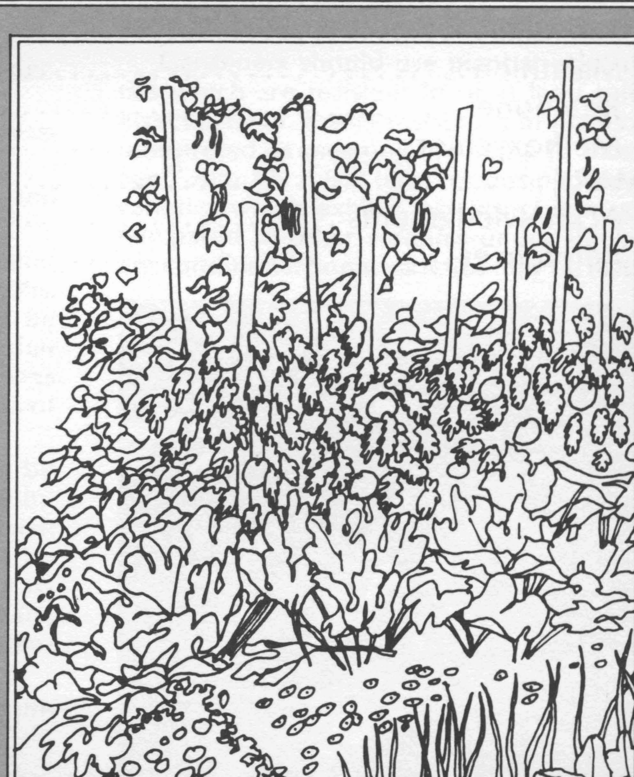
INSECT CONTROLS FOR ORGANIC GARDENERS





TEXAS AGRICULTURAL EXTENSION SERVICE • THE TEXAS A&M UNIVERSITY SYSTEM

DANIEL C. PFANNSTIEL, DIRECTOR • COLLEGE STATION, TEXAS

CONTENTS

INSECT CONTROLS FOR ORGANIC GARDENERS

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Interest in organic gardening has increased in recent years. Organic gardening means enriching the garden soil with natural products (mulches, composts and animal manures) and controlling insects, diseases and weeds with cultural, mechanical and biological methods rather than with pesticides.

This gardening approach has certain limitations:

(1) The organic gardener must give more personal attention to the garden.

(2) Organic gardening is usually more successful on a small plot than on a large one.

(3) Often there will be greater damage to and loss of produce.

Temperature, humidity, precipitation and natural enemies all influence insect populations. In some years troublesome insects may not be numerous enough to significantly damage garden plants. In other years, large insect populations may cause serious damage to or complete loss of the crop.

Effective control of garden insects must be preceded by proper identification of specific insect pests. It is not enough just to distinguish beneficial insects from pest insects. Once an insect's identity is known, you can learn about its life cycle, seasonal cycle, habits and host plants, and thus exercise more effective control measures.

You can obtain assistance with insect identification from your county Extension agent.

*Area Extension entomologists, Texas A&M University Agricultural Research and Extension Centers at Overton and Dallas, respectively, The Texas A&M University System.

A variety of methods often is needed for satisfactory control of the many garden pests. Since insect control methods vary in their effectiveness, you may wish to select alternative methods to correspond with differences in plant growth and productivity, insect damage, weather conditions and cultural practices.

Resistant Plant Varieties

Gardeners should use plant species or varieties which are resistant to or at least tolerant of insect activity. Insect resistance in plants often is interpreted as meaning "immune to insect damage." Actually it is a term for distinguishing plant varieties which exhibit less insect damage when compared to other varieties under similar growing conditions. Some varieties may be less tasty to

Figure 1. Managing and protecting the organic garden can be an enjoyable family project.

insect pests, may possess certain physical or chemical properties which discourage insect feeding or egg-laying, or may be able to support large insect populations without suffering appreciable damage.

Before buying seeds or plants, check seed catalogs for information on resistant varieties which will grow well in your area. Check also with your county Extension agents as well as seed dealers and nurserymen in your area. Vegetable varieties that grow well in Texas and have shown resistance to specific insect pests are listed in Table 1. Some varieties may be resistant to insect attack but subject to certain other restrictions such as soil pH, drainage or temperatures. Your experience with different varieties will indicate the ones best suited for your garden.

Cultural Controls

Many cultural practices can be used to reduce the susceptibility of garden plants to insect attack:

Plowing and cultivating a garden exposes soil insects to adverse weather conditions, birds and other predators. In addition, deep plowing will bury some insects and prevent their emergence.

Crop rotation can be effective against insects that develop on a narrow range of food plants and against insects with short migration ranges. Movement of crops to different sites will isolate such pests from their food source. If an alternate site is not available, then change the sequence of plants grown in the garden plot. Do not plant members of the same plant

Table 1. Vegetable varieties that grow well in Texas and have shown some resistance to specific insect pests.

Vegetable	Variety	Insect resistance
Beans (snap)	Wade	Mexican bean beetles
Broccoli	De Cicco	Striped flea beetle
Cabbage	Early Globe	Cabbage looper, Imported cabbageworm
	Red Acre	Cabbage looper, Imported cabbageworm
	Round Dutch	Cabbage looper, Imported cabbageworm
Cabbage (Chinese)	Michihli	Diamondback moth
Collard	Georgia	Striped flea beetle, Harlequin bug
Corn (sweet)	Golden Security	Corn earworm
Cucumbers	Ashley	Pickleworm, spotted cucumber beetle
	Piccadilly	Pickleworm
	Poinsett	Spotted cucumber beetle
Kale	Vates	Diamondback moth
Mustard	Florida Broadleaf	Diamondback moth, striped flea beetle
Potato (sweet)	Centennial	Sweetpotato flea beetle, Southern potato wireworm
	Jewel	Sweetpotato flea beetle, Southern potato wireworm
Radish	Cherry Belle	Diamondback moth, Harlequin bug
	White Icicle	Harlequin bug
Squash	Early Prolific Straightneck	Pickleworm, striped cucumber beetle
	White Bush Scallop	Pickleworm, striped cucumber beetle
	Zucchini	Striped cucumber beetle
Turnip	Seven Top	Diamondback moth, striped flea beetle
Rutabaga	American Purple Top	Diamondback moth, striped flea beetle
Watermelons	Crimson Sweet	Pickleworm, spotted cucumber beetle

family in the same location in consecutive seasons. For example, do not allow melons, cucumbers and squash to follow each other.

Proper use of fertilizers and water will induce healthy plant growth and increase the capability of plants to tolerate insect damage. However, excessive amounts of compost or manure can encourage millipedes, white grubs and certain other pests.

Changes in planting or harvesting time often will reduce plant damage or keep insect pests separated from susceptible stages of the host plant. Waiting until the soil is warm enough for corn and bean seeds to germinate quickly reduces seed maggot damage. Hot caps (milk cartons, paper sacks or similar materials placed over plants) used during the early season not only will preserve heat, but also will protect plants from damaging wind, hail and insects. In some situations a healthy transplant will more easily overcome insect damage than a small plant developing from seed in the field.

Figure 2. Gallon-sized plastic jugs with bottoms removed serve as mini-greenhouses and insect protectors for young plants.

Removing crop residues and disposing of weeds and other volunteer plants eliminates food and shelter for many insect pests such as cutworms, webworms, aphids, white grubs, millipedes and spider mites. When a garden plant stops producing, spade it into the soil or take it to the compost pile.

"Companion planting," or an orderly mixing of crop plants, is a cultural practice aimed at diversifying insect populations. Numerous claims have been made about the ability of certain plants to protect certain other plants from insect damage. However, *no data* from scientific studies to prove or disprove the value of companion plantings has been found. Following is a partial list of suggested companion plantings which have been recommended at various times:

(1) Interplant beans with marigolds to ward off Mexican bean beetles, although spider mite damage may be increased.

(2) Interplant tomatoes with basil to deter tomato hornworms.

(3) Interplant cucumbers with radishes or nasturtiums to control cucumber beetles.

(4) Interplant eggplants with catnip to repel flea beetles.

(5) Interplant cabbages with thyme to control imported cabbageworms.

(6) Interplant carrots with onions or chives to control rust flies and some nematodes.

(7) Interplant potatoes with deadneetle to repel Colorado potato beetles.

(8) Interplant potatoes with horseradish to control potato bugs.

(9) Interplant roses with chives or marigolds to repel aphids.

Mechanical Control Methods

Mechanical control methods usually are more practical for a small garden than for a large one. They can be used singly or in combinations to obtain desired results.

Preventive devices often are easy to use, although their effectiveness varies. Such devices include: (1) paper collars around the stems of plants to prevent cutworm damage; (2) cheesecloth screens for hot beds and cold frames to prevent insect egg-laying; (3) mesh covers for small fruit trees and berry bushes to keep out larger insects and birds; (4) sticky barriers on the trunks of trees and woody shrubs to prevent damage by crawling insects; and (5) aluminum foil on the soil under plants to repel aphids.

Handpicking of insects and insect egg masses insures quick and positive control. This method is especially effective with foliage-feeding insects such as bean beetles, potato beetles, hornworms and squash bugs.

Simple water sprays or water sprays containing small amounts of soap can dislodge insects such as aphids, mealybugs and spider mites. A stiff stream of water will remove insects without injuring the plants or drenching the soil.

Various types of traps are reportedly successful in reducing garden insect numbers.

For example: (1) earwigs can be trapped in rolled up newspapers placed in the garden or other locations where these insects gather; (2) slugs and pillbugs can be trapped under boards placed on the ground; (3) a small pan placed flush with the soil and filled with beer will attract and kill slugs; and (4) a 2-quart container half-filled with a 10 percent solution of molasses and water will rid the garden of grasshoppers and certain beetles.

Blacklight traps are a reasonably good tool for monitoring insect species in a given area, but usually provide little protection for the garden. Light traps attract both harmful and beneficial insects that ordinarily would not be found in the area. These insects may not be caught in the traps, but may remain in the area, and the harmful ones may cause damage later. Also, some species such as wingless insects and those insects only active in the daytime are not caught in the traps. Consequently, the value of blacklight traps in the home garden is questionable.

Biological Control Methods

Generally, biological control can be defined as the direct or indirect use of parasites, predators or pathogens (bacteria, viruses, fungi, protozoans) to hold pest insect populations at low levels to avoid economic losses. Biological control methods fall into three categories: (1) introduction of natural enemies which are not native to the area (these enemies must then establish and perpetuate themselves); (2) enlarging existing populations of natural enemies by collecting, rearing and releasing additional bio-control agents; and (3) conservation of beneficial organisms by such means as the judicious use of pesticides and the maintenance of alternate host insects so parasites and predators can continue to develop.

It is not yet possible to reliably predict how effective the introduction of a given parasite or predator will be. However, certain factors can indicate the potential value of a natural enemy. The effectiveness of a parasite or predator is usually related to: (1) its ability to find a host when host numbers are small; (2) its ability to survive in all host-inhabited niches; (3) its ability to use alternate hosts when primary hosts are in short supply; (4) its high reproductive capacity and short developmental period; and (5) synchronization of its life cycle with that of the host so that the desirable host stage is available for the developing natural enemy.

Many beneficial organisms occur naturally in the garden, but often they are not numerous enough to control a pest before it inflicts severe damage. In fact, parasites and predators appear to be most effective when a pest population has stabilized or is relatively low. Their influence on an increasing pest population is usually minimal since any increase in parasite and predator numbers depends on an even greater increase in pest numbers. Pathogens, however, seem to be most effective when pest populations are large. Consequently, the nature of the host insect-natural enemy relationship makes it impossible to have an insect-free garden and at the same time maintain sizable populations of beneficial insects.

Numerous bio-control agents are available to organic gardeners. County Extension agents can supply a partial list of sources. Following is a list of some of the more popular bio-control agents:

(1) *Bacillus thuringiensis* — This bacterial insecticide provides effective control of the larvae of several moths and butterflies. The bacterial spores are harmless to warm-blooded animals.

(2) *Bacillus popilliae* (milky disease bacteria) — This bacterial insecticide controls grubs of Japanese beetles in the eastern U.S., and some testing has been done for control of white grubs (*Phyllophaga* spp. and *Cotinis* spp.) in Texas. This insecticide is difficult to obtain because commercial production is restricted by the lack of artificial culture techniques.

(3) *Trichogramma* wasp — Adult wasps are available from selected sources. The tiny wasps attack the eggs of more than 200 pest species, including cutworms, armyworms, fruitworms and many moth and butterfly eggs deposited in orchards and field crops. Wasps should be released when the moths are first seen, but a sequence of releases throughout the season is preferable to a single large release. Results will depend on the timing of the releases, selection of Trichogramma species, and placement of wasps near host egg masses.

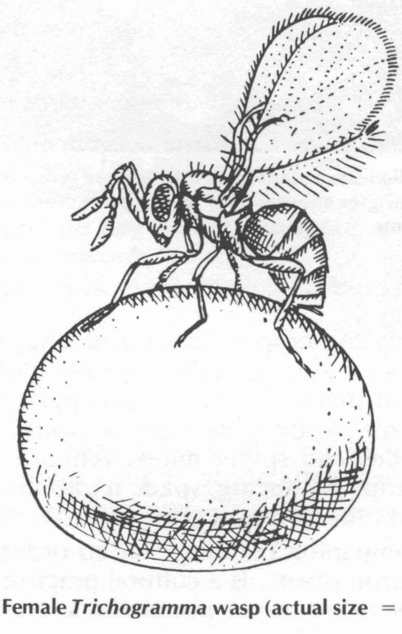

Figure 3. Female *Trichogramma* wasp (actual size = 1/25 inch).

(4) Green lacewings *(Chrysopa)* — Egg masses are sometimes available. The larvae, known as aphid lions, prey on many garden pests including aphids, spider mites, leafhoppers, thrips, moth eggs and small larvae. Adult lacewings feed on honeydew, nectar and pollen. Lacewings introduced into the garden must have a readily available supply of food or they will leave.

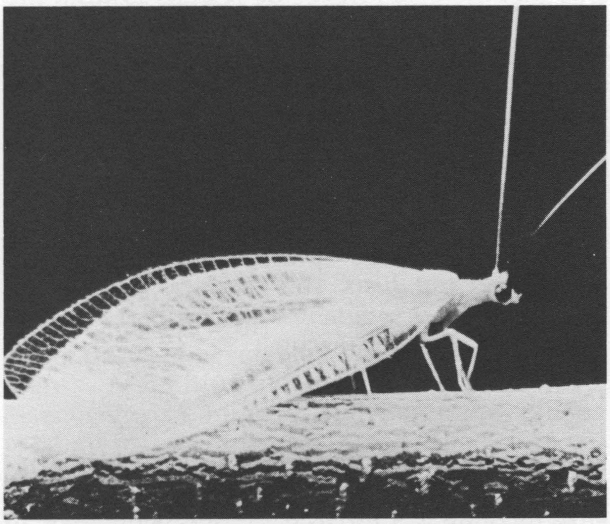

Figure 4. Adult lacewing in search of food (actual size = 1/4 to 3/4 inch).

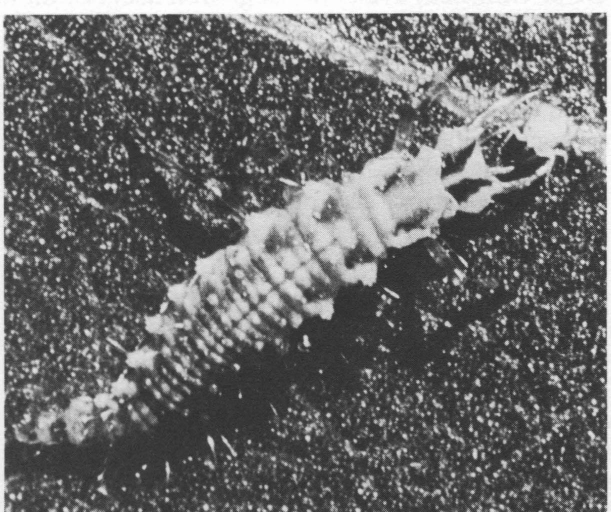

Figure 5. Lacewing larva (antlion) (actual size = 3/8 inch).

(5) Praying Mantids — Egg cases containing about 200 individual eggs are available from a number of sources. The mantid is a voracious predator. In addition, it is cannibalistic immediately after hatching, so few nymphs survive the first week of life. But the mantid is a poor searcher for food and usually waits for prey to come to it. This greatly influences the kinds of insects it captures and kills. Food preferences include grasshoppers, crickets, bees, wasps and flies.

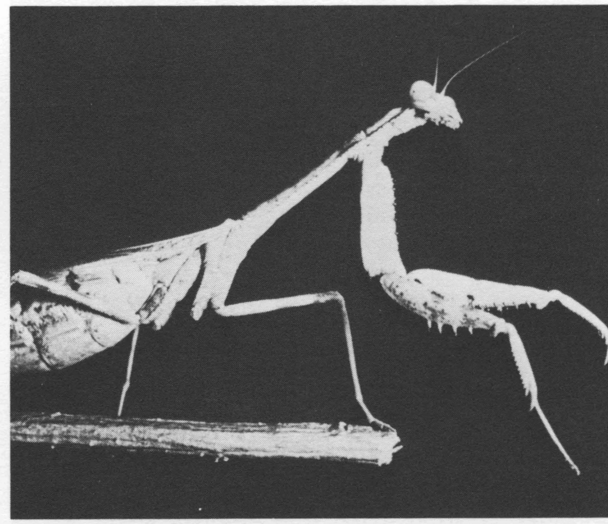

Figure 6. Praying mantid awaiting prey (actual size = 2 to 4 inches).

(6) Lady beetles — Adult beetles are available from several sources. Aphids are the preferred hosts, but lady beetles also will eat mealybugs, spider mites and certain other soft-bodied pests and egg masses. They do not, however, kill grubs, caterpillars and other beetles. If an ample supply of live aphids or other hosts is not available at the release point, they will disperse and leave the area. In some cases, most of the beetles will leave the area regardless of the availability of food.

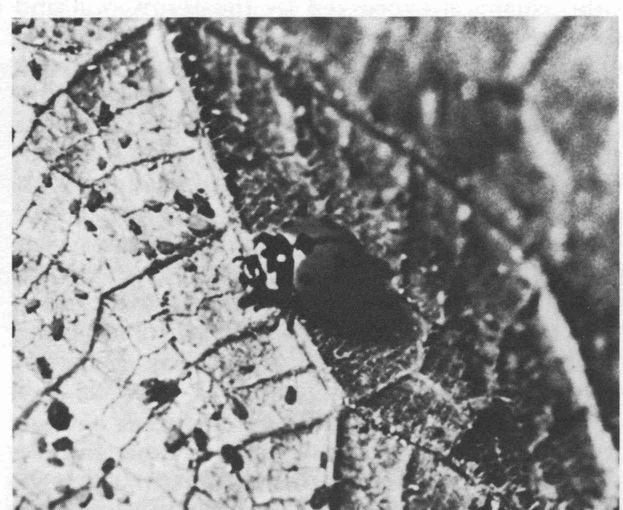

Figure 7. Adult lady beetle searching plant foliage for aphids (actual size = 1/4 inch).

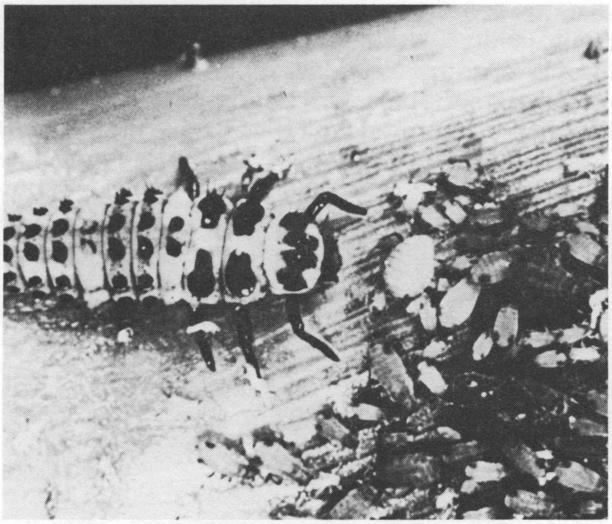

Figure 8. Lady beetle larva approaching colony of aphids (actual size = 3/8 to 1/2 inch).

Chemical Control Methods

Despite all efforts, at times non-chemical methods will fail to prevent excessive insect damage in the garden. At such times, the use of chemical insecticides may be the only alternative to losing the crop. Insecticides chosen should have only moderately low toxicity for humans and other warm-blooded animals. They should be used only when needed and according to label directions. A better understanding of insecticides will enable you to use these chemicals more effectively, and to realize that they can be an aid without harming you or your environment.

All insecticides are poisonous, but some are more toxic than others. The toxicity of an insecticide usually is expressed by the terms oral and dermal LD_{50}. The LD_{50} value is a statistical estimate of the amount of the pure poison that will be lethal to 50 percent of a population of test animals (usually rats or rabbits) within a specified period and under specified test conditions. It is expressed in terms of milligrams of poison per kilogram of bodyweight of test animal (1 milligram = 1/1,000 gram; 454 grams = 1 pound; 1 kilogram = 2.2 pounds). If the toxicant is given by mouth in one dose, the lethal dose is referred to as the acute oral LD_{50}; if applied to the skin in one dose, it is called the acute dermal LD_{50}.

When insect damage becomes great enough to warrant emergency measures, organic gardeners often are encouraged to use natural insecticides and various homemade botanical sprays instead of modern synthetic organic chemicals. However, some synthetic organic materials are actually less toxic and more efficient than some of the natural insecticides.

Following is information about some natural and synthetic insecticides:

(1) *Pyrethrum* — Botanical insecticide. Oral LD_{50} = 1,500 mg/kg
This slightly toxic insecticide is derived from the flowers of a species of *Chrysanthemum* imported mainly from Kenya and Ecuador. The material causes rapid paralysis of most insects, but the insects usually recover unless the pyrethrum is used in combination with a synergist or other poison. Pyrethrum mixed with synergists such as piperonyl butoxide or piperonyl cyclonene to increase toxicity and produce longer residual action is used extensively in space sprays, household sprays, crop sprays and dusts. This chemical is registered for use on most vegetables and fruits at any time during the growing season.

(2) *Nicotine* — Botanical insecticide. Oral LD_{50} = 50-60 mg/kg
Pure nicotine is a tobacco extract highly toxic to warm-blooded animals. The chemical usually is marketed as a 40 percent liquid concentrate of nicotine sulfate, which is diluted in water and applied as a spray. Dusts can irritate the skin and are not normally available for garden use. Nicotine is used primarily for piercing-sucking insects such as aphids, whiteflies, leafhoppers and thrips. Nicotine is more effective when applied during warm weather. It degrades quickly, so can be used on many food plants nearing harvest. It is registered for use on a wide range of vegetable and fruit crops.

(3) *Carbaryl (Sevin®)* — Synthetic organic insecticide. Oral LD_{50} = 500 mg/kg; Dermal LD_{50} = 4,000 mg/kg
This general-purpose carbamate insecticide acts as both a contact and stomach poison for a variety of insect pests of vegetables, fruits and ornamental plants. Carbaryl is moderate in killing speed, and provides control for a period of 1 day to 3 weeks with an average residual effect of 10 days. It is a popular home and garden insecticide and is registered for use on many crops. It is lethal to a variety of insects, including bees, but has low toxicity to humans and pets, and can be used near harvest time on several crops. Dusts, baits, granules, wettable powders and water sprayables are available. Repeated applications may result in increased spider mite populations on some crops.

(4) *Sabadilla* — Botanical insecticide. Oral LD_{50} = 5,000 mg/kg
Sabadilla is obtained from the seeds of a lily-like plant and acts as both a contact and stomach poison for insects. It is not particularly toxic to mammals, but does cause irritation of the eyes and respiratory tract. A mask should be worn when working with this insecticide. This material deteriorates rapidly upon exposure to light and can be used safely on food crops shortly before harvest. Sabadilla generally is used as a 5 to 20 percent dust or as a spray.

(5) *Malathion* — Synthetic organic insecticide. Oral LD_{50} = 1,375 mg/kg; Dermal LD_{50} = 4,444 mg/kg
This organophosphate insecticide controls aphids, spider mites and many other sucking and chewing insect pests of vegetables, fruit and ornamental plants. Malathion is one of the least toxic insecticides to humans and pets, and can be used on many crops near harvest time. It is not particularly hazardous to birds and wildlife. It is available as emulsifiable concentrates, wettable powders and dusts.

(6) *Rotenone* — Botanical insecticide. Oral LD_{50} = 350 mg/kg; Dermal LD_{50} = 2,000 mg/kg
Rotenone is extracted from the roots of *Derris* plants in Asia and cubé plants in South America. This general garden insecticide is harmless to plants, highly toxic to fish and many insects, moderately toxic to mammals, and leaves no harmful residues on vegetable crops. It acts as both a contact and stomach poison to insects. It is slow acting and in the presence of sun and air its effectiveness is lost within a week after application. Wear a mask during application because rotenone can irritate the respiratory tract. Rotenone dusts and sprays have been used for years to control aphids, certain beetles and caterpillars on plants as well as fleas and lice on animals.

(7) *Methoxychlor* — Synthetic organic insecticide. Oral LD_{50} = 6,000 mg/kg; Dermal LD_{50} = 6,000 mg/kg
This chlorinated hydrocarbon insecticide is used for many insect pests of vegetables, fruits and ornamental plants. It has low toxicity to humans and other warm-blooded animals and provides residual action against many insects. This chemical is toxic to fish and bees and can adversely affect populations of beneficial insects. It is available as dusts, wettable powders, emulsifiable concentrates and aerosols.

When it is necessary to use insecticides to protect the garden, use chemicals wisely and safely. Following are some tips to help you make better use of insecticides:

(1) Inspect the entire garden at least weekly to monitor insect numbers and activity. If treatments are applied when an infestation first starts, insect numbers can be maintained at lower levels much more easily, and with smaller amounts of chemicals.

(2) Apply insecticides to all plant surfaces so that an insect anywhere on the plant will be exposed to a lethal amount of the chemical. Do not apply insecticides to wilted plants or during the hottest part of the day. Apply dusts only when the wind is calm, and sprays when the wind is no more than 2 to 3 mph. Retreatment may be necessary after a rain.

(3) Apply chemicals only at recommended dosages; increased amounts can be dangerous, cause plant damage and leave harmful residues without improving insect control.

(4) Insecticides will be effective just so long. The longevity of toxic properties varies primarily with the chemical, formulation, water pH and environmental conditions. Temperature, humidity, wind and sunlight affect insecticides. The greater the extremes, the sooner the insecticides are detoxified.

(5) The time interval required by the Environmental Protection Agency between treating a crop and harvesting that crop varies with the insecticide and the crop. This information is posted on the pesticide label to insure that any residues will be within established tolerances at harvest time.

(6) Always read and follow mixing and application instructions on the insecticide label for safe and effective insect control.

The various non-chemical control practices discussed in this publication are aimed at altering the physical or biological environment in the garden so that it becomes detrimental for insect pests. In many situations it is helpful to use several control techniques to reduce insect pest populations to low enough levels that insecticides are not required, or are needed only sparingly. With reduced insecticide use, biological control agents can become more effective, insecticide cost will be eliminated and you will have the satisfaction of knowing that poisons were not applied to your edible crops.

Acknowledgments

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References

Vegetable insect control using less insecticide. Circular 596, North Carolina Agricultural Extension Service.

A planning guide for your home garden. L-1205, Texas Agricultural Extension Service.

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