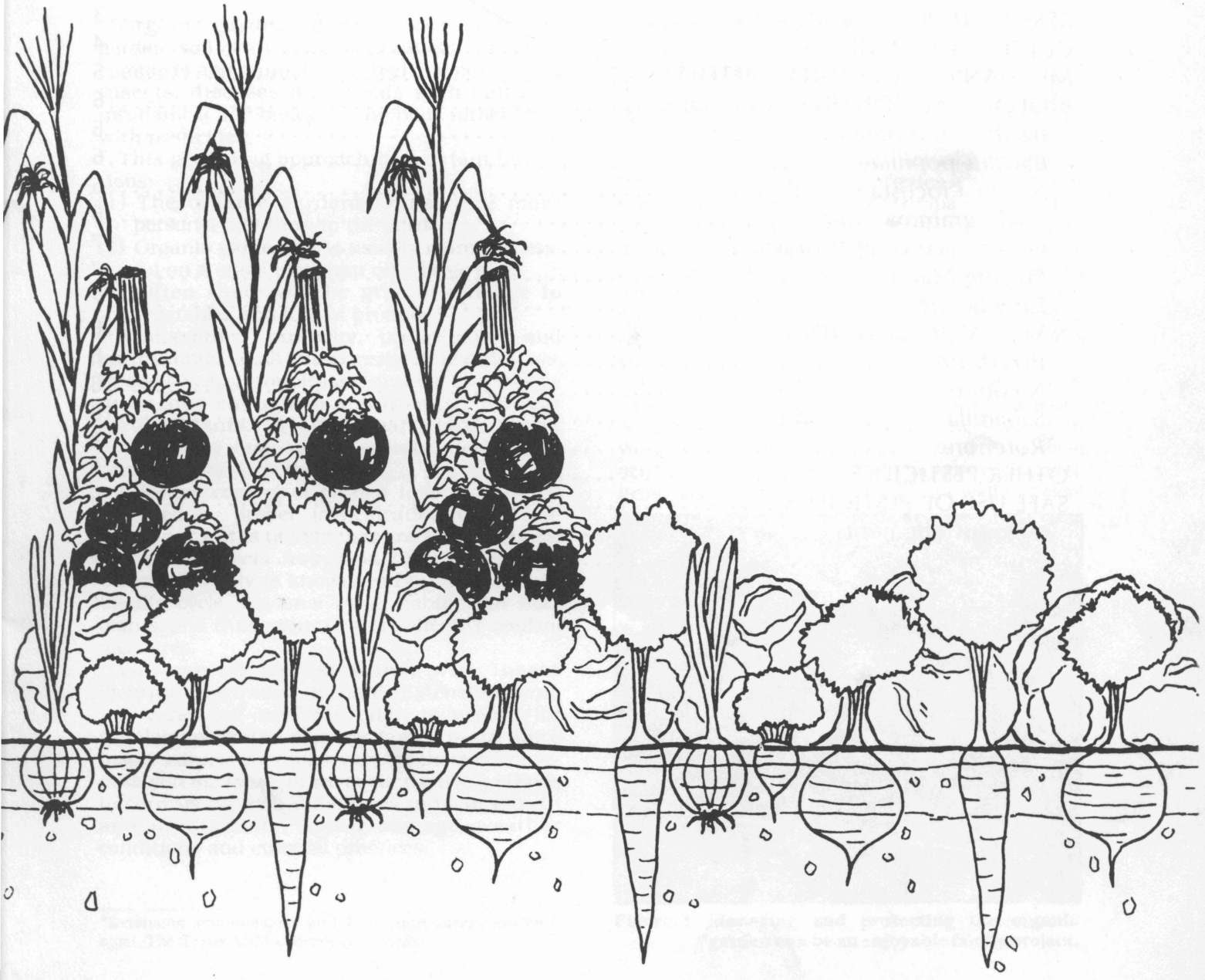
INSECT CONTROL GUIDE FOR ORGANIC GARDENERS



Texas Agricultural Extension Service • The Texas A&M University System • Zerle L. Carpenter, Director • College Station, Texas

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INSECT CONTROL GUIDE FOR ORGANIC GARDENERS

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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 vegetables 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 or completely destroy 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.

A variety of methods often is needed for satisfactory control of 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.

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Resistant Plant Varieties

Gardeners should use available plant species or varieties which are resistant to or at least tolerant of insect activity. Insect resistance in plants frequently 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 and pest population conditions. Some varieties may be less "tasty" to insect pests, or 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 local seed dealers and nurserymen for best varieties to grow. Vegetable varieties that grow well in Texas

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

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 temperature. 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 potential for or actual damage of garden plants caused by insects:

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 family in the same location in consecutive seasons. For example, do not follow melons with cucumbers or squash.

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, pillbugs, 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. Delayed planting 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 overcome insect damage more easily than a small plant developing from seed in the field.

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

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 garden plants stop producing, spade them into the soil or take them to the compost pile.

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

"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 are available to prove the value of companion plantings. Following is a partial list of suggested companion plantings which have been recommended at various times:

- Interplant tomatoes with basil to deter tomato hornworms.

- Interplant cucumbers with radishes or nasturtiums to control cucumber beetles.

- Interplant eggplants with catnip to repel flea beetles.

- Interplant cabbages with thyme to control imported cabbageworms.

- Interplant carrots with onions or chives to control rust flies and some nematodes.

- Interplant potatoes with deadneetle to repel Colorado potato beetles.

- Interplant potatoes with horseradish to control potato bugs.

- 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 combination 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, berry bushes, tomatoes and other plants to keep out large 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.

There may be times when gardeners can use a fine stream of water under pressure to dislodge insects from plant stems and leaves. Control spider mites by physically washing them off of the leaves. This also increases humidity around the leaves which may help to bring spider mite infestations under control. The stream of water can physically remove some insects, especially aphids, and when dislodged they fail to return to the plant. Care should be taken to use water pressure only on sturdy plants to avoid plant damage.

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 stale beer will attract and kill slugs and snails; and (4) a 2-quart container, half-filled with a 10 percent solution of molasses and water will attract and trap 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. Where blacklights are used, it is recommended that they be placed 50 to 75 feet away from the area which is to be protected.

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 places where the host insect lives; (3) its ability to use alternate hosts when primary hosts are in short supply; (4) its high reproductive ability to reproduce rapidly over a short period of time; and (5) its ability to adapt its life cycle with that of the host so that the desirable host stage is available for development.

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 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 and beneficial insects.

(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. It has not been effective against the principal white grub species in Texas.

(3) *Nosema locustae* - is a spore (Protozoan) used to control grasshoppers. The material is sprayed on the plants which grasshoppers ingest. The spores germinate inside the grasshopper, causing death. Control is extremely slow and homeowners may not be satisfied with results. Baits have proven more effective.

(4) *Trichogramma* wasp (Fig. 3) - Adult wasps are available from several 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

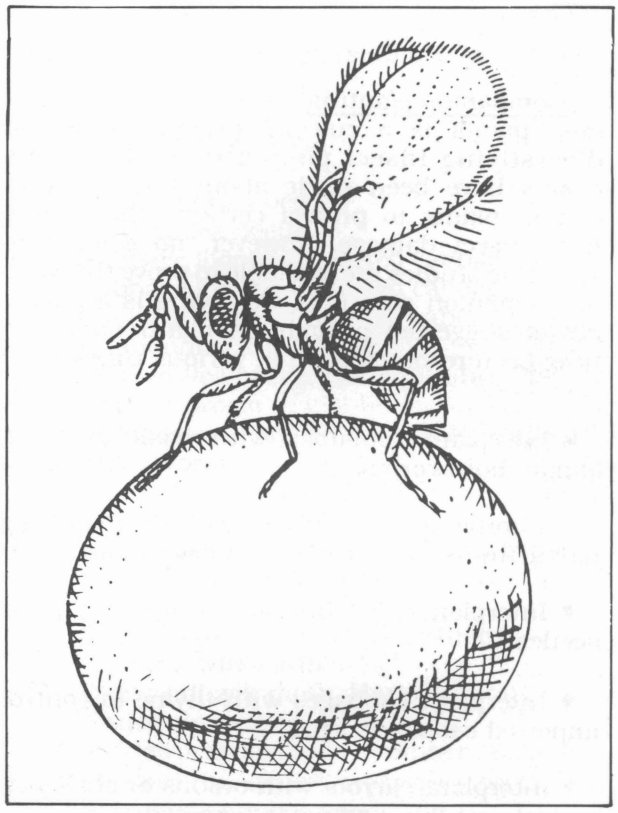

Figure 3. Female Trichogramma wasp (actual size = 1/25 inch).

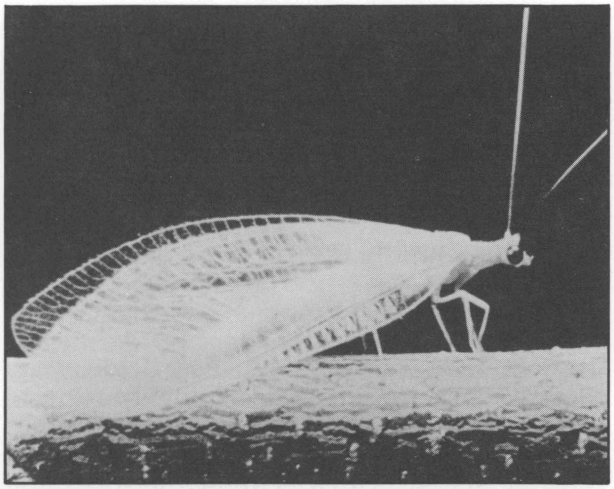

Figure 4. Adult lacewing in search of food (actual size = 1/4 to 3/4 inch).

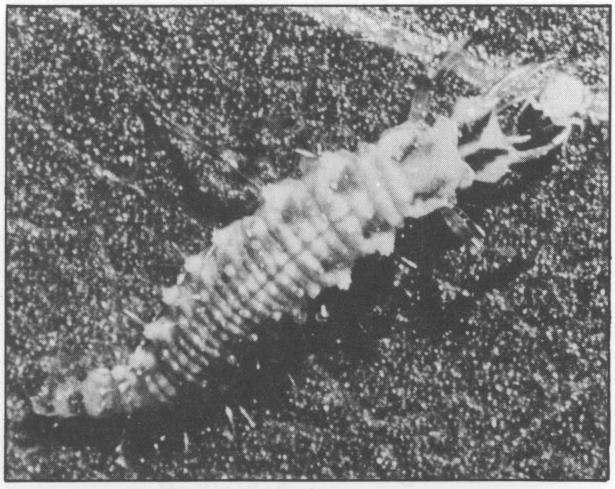

Figure 5. Lacewing larva (antlion—actual size = 3/8 inch).

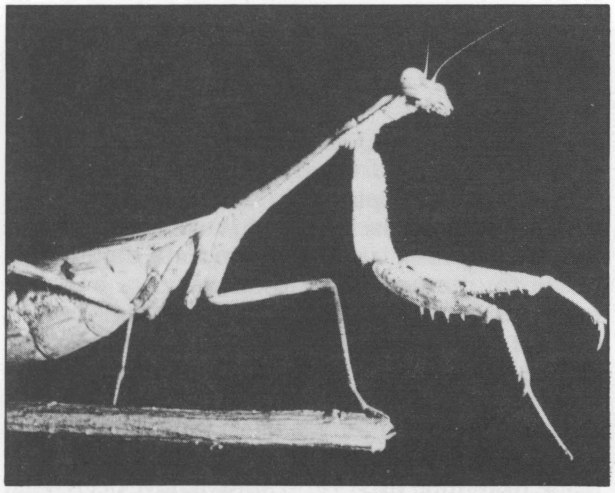

Figure 6. Praying mantid awaiting prey (actual size = 2 to 4 inches.).

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.

(5) Green lacewings (*Chrysopa*—Fig. 4 & 5) Eggs 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.

(6) *Praying Mantid* (Fig. 6) - 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.

(7) *Lady beetles* (Fig. 7 & 8) - Adult beetles are available from several sources. Aphids are the preferred hosts, but lady beetles will eat mealybugs, spider mites and certain other soft-bodied pests and eggs. They do not, however, kill grubs, caterpillars and other beetles. Unless an ample supply of live aphids or other hosts are available at the release point, lady beetles will disperse and leave the area. In some cases, most of the beetles will leave the area regardless of the availability of food. Lady beetles can be encour-

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

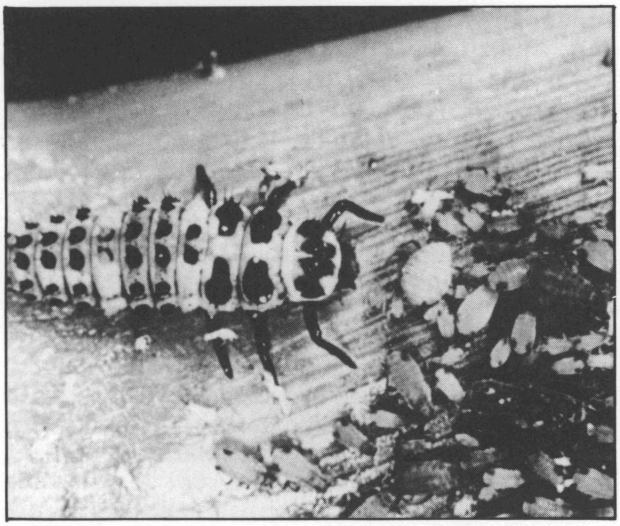

Figure 8. Lady beetle larva approaching colony of aphids (actual size = 3/8 to 1/2 inch).

aged to remain on a plant by using small meshed screen cages. Remove cages before they devour all of their food supply. In hot dry weather these beetles enter a nonactive (aestivation) state. Feeding and reproduction cease. Little control from lady beetles can be expected during this time.

Natural Insecticides

Despite all efforts, at times non-insecticidal methods will fail to prevent excessive insect damage in the garden. At such times, the use of insecticides may be the only alternative left to save the crop. Insecticides chosen should have only 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 materials more effectively, and to realize that they can be an aid without harming you or the environment.

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 insecticides:

(1) *Pyrethrum* - Botanical insecticide. 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. Pure nicotine is a tobacco extract highly toxic to warm-blooded animals. The insecticide 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 quicky, 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) *Sabadilla* - Botanical insecticide. 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.

(4) *Rotenone* - Botanical insecticide. Rotenone is extracted from the roots of *Derris* plants in Asia and cube 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.

Other Pesticides

Gardeners have been using soap to control insects since the early 1800's. During the first half of the 19th Century, whale oil soap, and more commonly, fish oil soaps were an important part of insect control. Recent tests indicate that Ivory® liquid dishwashing detergent, diluted with water to a 1 to 2 percent solution, provides the most consistent control and is easy to mix. There are also soaps available which are specifically formulated for use on plants to control insects. Thorough coverage of the plant and repeated applications may be necessary to bring insect populations under control. High rates of soaps and detergents may produce plant damage to some varieties of plants. The most effective soaps have carbon chains of C-12 or C-18. Laurate (C-12) is the main component of most dishwashing liquids and various other products in common usage. The richest natural source of this is coconut oil.

Organic garderners have been using a spray mixture containing onions, garlic and pepper mixed together to control insects for many years. Recent scientific research indicates that the use of the combination of these materials have been erratic and in many cases ineffective for insect control. Sprays of food-derived substances do not appear to be good choices as a pesticide. However, some success may be achieved with them, but it is likely to be sporadic. Spraying several times a week might help to bring infestations under control. Control with one application should not be expected.

Safe Use of Pesticides

When it is necessary to use insecticides to protect the garden, use them wisely and safely. The following tips will help you make better use of insecticides:

(1) Inspect the entire garden at least weekly to monitor insect numbers and activity. Pay particular attention to underside of leaves where mites, whiteflies, aphids and insect eggs occur. 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 plants are dry. Sprays should be applied when the wind is no more than 5 to 10 mph. Retreatment may be necessary after a rain.

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

(4) The length of effective control of insecticides varies widely. The longevity of toxic properties varies primarily with the product, 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-insecticidal 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 costs will be saved, and you will have the satisfaction of knowing that few, if any poisons were applied to your edible crops.

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