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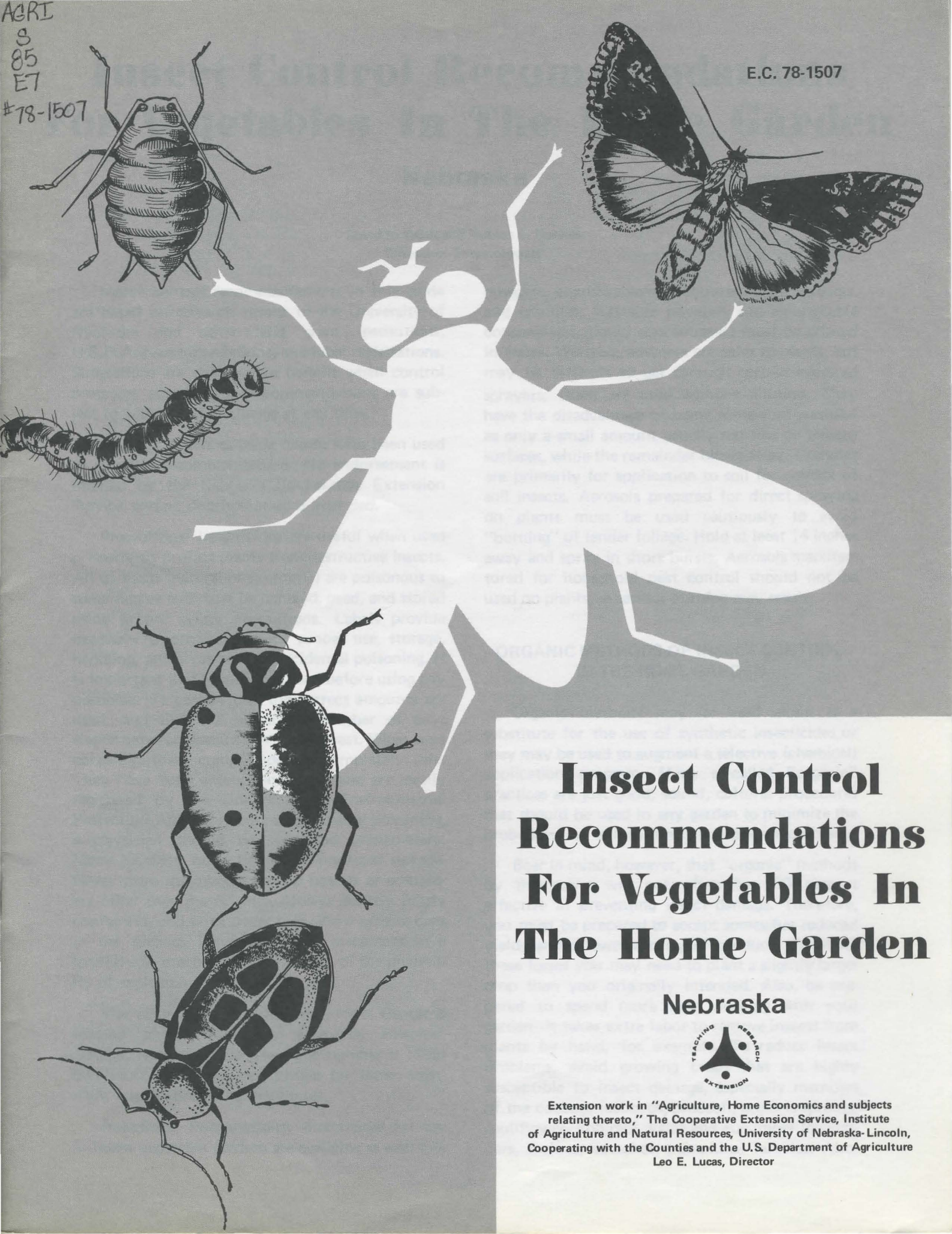


Insect Control Recommendations For Vegetables In The Home Garden

Nebraska

Extension work in "Agriculture, Home Economics and subjects relating thereto," The Cooperative Extension Service, Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln, Cooperating with the Counties and the U.S. Department of Agriculture
Leo E. Lucas, Director

Insect Control Recommendations For Vegetables In The Home Garden

Nebraska

David L. Keith and Robert E. Roselle
Extension Entomologists

Insect control recommendations in this guide are based on research results of the University of Nebraska and other land grant institutions, U.S.D.A. recommendations, and label registrations. Suggestions are designed to benefit when control programs are needed. Recommendations are subject to withdrawal or change at any time.

In some instances trade names have been used to simplify recommendations. No endorsement is implied by the Nebraska Cooperative Extension Service, and no discrimination is intended.

Precautions: Insecticides are useful when used properly to protect plants from destructive insects. All of them (natural or synthetic) are poisonous to some degree and must be handled, used, and stored using proper safety precautions. Labels provide necessary information about proper use, storage, handling, and treatment of accidental poisoning. It is important that labels be studied before using any pesticide. Be certain that the correct amounts are used, and that the prescribed number of days elapse between application and harvest. When used correctly, these compounds are completely safe. They have been extensively tested and are legally registered by the United States Environmental Protection Agency. In case of accidental poisoning, a physician should be contacted immediately. Many accidents occur because of improper storage. **Never** store insecticides in pop bottles or containers other than the original. **Always** destroy empty containers, and burn paper bags. Place aerosol cans in the garbage for removal and placement in a landfill—do not burn them because of the possibility of explosion.

The Nebraska Master Poison Control Center is located at the Childrens Memorial Hospital, Omaha, Nebraska. The telephone number is (402) 553-5400. Physicians can obtain the latest treatment information from this center.

Insecticide Formulations: Insecticides for use in home vegetable gardens are available as wettable powders, emulsifiable concentrates, dusts, aerosols, and granules. Wettable powders and emulsifiable concentrates (liquid concentrates) must be diluted in water. Wettable powders are safer to plants, but may be difficult to get through certain types of sprayers. Dusts are used without dilution. They have the disadvantage of being somewhat wasteful as only a small amount usually remains on treated surfaces, while the remainder blows away. Granules are primarily for application to soil for control of soil insects. Aerosols prepared for direct spraying on plants must be used cautiously to avoid "burning" of tender foliage. Hold at least 14 inches away and spray in short bursts. Aerosols manufactured for household pest control should not be used on plants, as serious burning may result.

ORGANIC METHODS OF INSECT CONTROL IN THE HOME GARDEN

Organic methods may be used alone as a substitute for the use of synthetic insecticides or they may be used to augment a selective (chemical) application program. Many so-called "organic" practices are just good, sound, cultural procedures that should be used in **any** garden to minimize the probability of serious insect and disease problems.

Bear in mind, however, that "organic" methods by themselves will not often be 100 percent effective in preventing insect damage. Therefore, you must be prepared to accept somewhat reduced yields and a lower quality of produce. To offset these losses you may need to plant a slightly larger crop than you originally intended. Also, be prepared to spend more time working with your garden—it takes extra labor to remove insects from plants by hand, for example. To reduce insect problems, avoid growing crops that are highly susceptible to insect damage, especially members of the cabbage (cabbage, broccoli, brussels sprouts, cauliflower, kohlrabi, kale) and cucumber (cucumbers, melons, squashes, pumpkins) families. Also,

ask your seed dealer for varieties that are resistant to insects and plant diseases.

Most organic gardeners have no objection to the use of "natural" insecticides such as rotenone, pyrethrum, and *Bacillus thuringiensis* (Dipel, Thuricide, Biotrol). Two of these are derived from plant materials—pyrethrum from an African chrysanthemum, and rotenone from Derris. All of these compounds control **SOME** insects, but break down rapidly. Therefore, they must be used more often than synthetic materials. Pyrethrum is available in some areas, but is usually expensive and often difficult to get in small quantities. However, if a product is requested by enough people, many dealers will make an effort to locate a supply. It doesn't hurt to ask. Of the materials registered for use in the home garden, nicotine sulfate (Black Leaf 40—a "natural" insecticide derived from tobacco) is the most highly toxic to humans and other warm-blooded animals. **IT IS NOT RECOMMENDED.**

Elemental sulfur, a naturally occurring inorganic material, will provide some control of spider mites on tomatoes. However, if it is used too close to harvest, it may cause "off" flavors in vegetables. Observe the waiting periods on the label.

Soaps and detergents may also be used as sprays to discourage insect pests. These materials would probably be most effective on small bodied insects or mites. Thorough plant coverage with a soap spray would be essential.

CULTURAL PRACTICES TO REDUCE INSECT PROBLEMS

1. Practice thorough sanitation. Many insects hibernate in or under plant debris. Remove as much debris as possible, compost it thoroughly, or turn it under by plowing or tilling. Good sanitation measures also reduce disease problems.

2. Rotate crops. If land is available (such as on a farm), move the garden plot around to reduce soil insect problems. If you are an urban gardener, don't plant the same crop in the same place each year. Avoid growing crops that are susceptible to insects.

3. Remove insect pests by hand. Remove from plants and place in a can half full of kerosene (or oil) and water.

4. Practice clean cultivation. Weeds provide home and protection for certain insect pests (e.g. flea beetles, carrot weevils). If compost is used to control weeds, don't overdo it. Too much organic matter and moisture may create millipede and slug problems. Cultivation exposes soil insects to birds and other predators.

5. Maintain soil fertility and water regularly. Sturdy plants can stand more insect injury.

6. Protect seedling plants. Use hotcaps and cutworm collars. Hotcaps help to conserve heat and provide some protection against insects. Paper collars clipped around transplants and pushed below the soil line are a big help in reducing cutworm damage.

7. Make interplantings. Rather than concentrate on a single plant in a large area, break it up into smaller plantings, separated by other crops. This tends to isolate insect infestations.

8. Utilize natural controls. Lady beetles, green lacewings, syrphid flies, and small wasp parasites feed on many destructive pests. Occasionally, they are abundant enough to hold pest numbers at non-damaging levels. If these insects are common and pests are present, but not causing serious damage, withhold insecticides and give beneficial insects a chance. If they fail to prevent a pest problem, **then** use an insecticide to reduce damage.

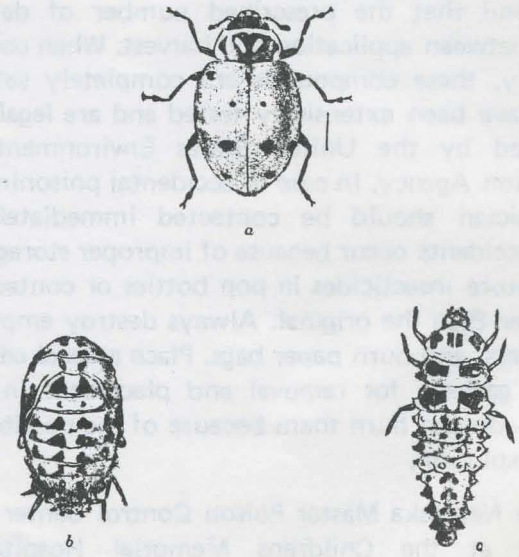


Figure 1. A lady bird: a. beetle; b. pupa; c. young. These beetles and their young eat dozens of aphids each day.

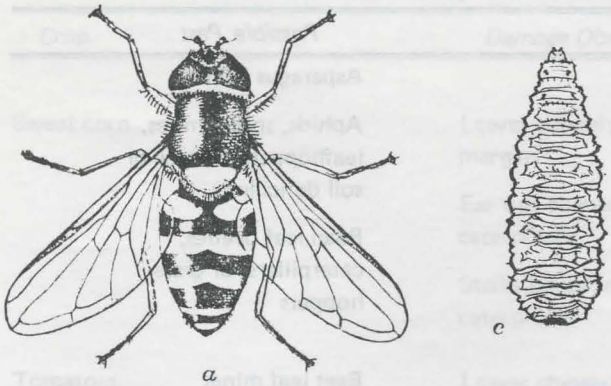


Figure 2. A syrphid fly: a. fly; c. maggot. This fly helps keep down aphids. It is about the size of a common house fly.

Abbreviations Used in This Circular

Tabl . . . . . tablespoon
tea . . . . . teaspoon
WP . . . . . wettable powder
EC . . . . . emulsifiable concentrate
D . . . . . dust
G . . . . . granule

Table of Measures

The following table is useful in preparing small quantities of insecticide for use in home vegetable gardens (Metric equivalents are in parentheses).

3 teaspoons = 1 tablespoon (15 ml)
2 tablespoons = 1 fluid ounce (30 ml)
8 fluid ounces = 1 cup (0.24 l)
2 cups = 1 pint (0.47 l)
2 pints = 1 quart (0.95 l)
4 quarts = 1 gallon (3.78 l)

General purpose insect control mixture: For control of both sucking and chewing insects on many garden vegetables, the following mixtures are suggested. Agitate while spraying to keep wettable powders in suspension. Addition of 1 teaspoon of a mild dishwashing detergent per gallon of spray will increase coverage. Remember, both insecticide labels must state that the crop you wish to spray can be treated.

Material	Amount to 1 gallon water
Methoxychlor 50% wettable powder	2 level tablespoons
or	
Sevin 50% wettable powder	2 level tablespoons
Plus either	
Malathion 57% emulsifiable	2 level teaspoons
or	
Diazinon 25% emulsifiable	2 level teaspoons

PEST IDENTIFICATION

Pest control may be difficult or impossible unless you know exactly what pest you are dealing with. For example, a chemical that controls beetles may not control aphids or other pests. Therefore, proper identification is critical.

The following section will help you to identify your pest problem and select a good control.

Table I will help you find the insect or group of insects most likely to be causing the problem. If no insects or mites are observed on (or near) the plants, they are probably not the cause of your troubles. In that case, be suspicious of plant disease or soil deficiency problems.

For example, if you have a pest problem on leaf lettuce, proceed to "Lettuce" in Table I. What is the damage like? If it consists of leaf yellowing, aphids or leafhoppers are the most likely cause. Proceed to the descriptions of these two kinds of pests (turn to the next section—Pest Identification and Treatment Guidelines) and decide which is responsible for the damage. Do the pests you observed fit the descriptions? If so, and the pests are aphids, for example, go to the last section (Suggestions for the Control of Vegetable Garden Pests) which suggests three materials for aphids on lettuce—Di-Syston (a planting time treatment), diazinon, or malathion. If the lettuce will be ready to use in 8-10 days, you will want to use the material with the shortest waiting period, in this case diazinon 25% EC.

Table I. Pest Identification. How to identify garden vegetable pests and their damage.

Crop	*Damage Observed*	*Possible Pest*
Asparagus	Leaves chewed	Asparagus beetle
Beans	Leaf stippling, yellowing, or browning	Aphids, spider mites, leafhoppers, disease or soil deficiency
	Holes chewed in leaves or beans	Bean leaf beetles, caterpillars, or grasshoppers
Beets	Blotch-like mines in leaves	Beet leaf miner
Carrots	Roots with surface scars	Carrot weevil
	Yellowing	Leafhoppers or disease
Cabbage Family (cabbage, broccoli, brussels sprouts, cauliflower, kale, kohlrabi)	Holes chewed in leaves	Cabbageworms or cabbage loopers
	Leaves yellowing or browning	Aphids, Harlequin bugs, disease or soil deficiency
	Brown, corky ridges and discoloration on inner leaves of cabbage heads	Thrips
Lettuce	Yellowing or browning	Aphids, leafhoppers, disease or soil deficiency
	Holes in leaves	Caterpillars
Cucumber Family (cucumber, melons, pumpkins, squash)	Chewing on cotyledons and leaves of young plants	Striped or spotted cucumber beetles
	Sudden wilting of vines	Disease (especially cucumbers or cantaloups—see cucumber beetles) squash vine borer or squash bug (pumpkin or squash)
Onions	White streaks on leaves, premature death	Onion thrips
	Death of young plants, bacterial soft rot	Onion maggots
Peas	Yellowing of leaves, wilting of plants	Aphids or disease
Potatoes	Holes chewed in leaves	Potato flea beetle, Colorado potato beetle
	Plants wilt and die	European corn borer, aphids, or disease
	Purple areas on leaves, leaf rolling and curling	Leafhoppers
Spinach	Blotch-like mines in leaves	Leaf miners
	Small holes chewed into leaves	Spinach flea beetle

Crop	*Damage Observed*	*Possible Pest*
Sweet corn	Leaves severely chewed at margins	Armyworms or grasshoppers
	Ear tips chewed by caterpillars	Corn earworm
	Stalks bored into by caterpillars	European corn borer
Tomatoes	Leaves chewed	Variegated cutworm or tomato hornworm
	Fruit rotten, holes chewed in side or top, fouled with excrement	Tomato fruitworm (same insect as corn earworm) or slugs
	Plants yellowing or wilting	Mites, aphids, disease, or soil deficiency
	General feeding garden pests	
Most garden crops	Leaf feeding or plants cut off at base	Cutworms, several kinds
Most garden crops	Leaf feeding, especially on plants at edges of gardens	Grasshoppers

PEST IDENTIFICATION AND TREATMENT GUIDELINES

Each pest is shown, descriptions of pest and damage are given under *Description* and control guidelines under *When to Treat.* Consult Suggestions for the Control of Vegetable Garden Pests, for recommended controls.

Asparagus Beetle

Description: Beetles are brightly colored, bluish and red with six rectangular yellow spots. Length 0.25 inch (6.3 mm). The adults (beetles) winter in protected places and emerge in spring to lay eggs on asparagus tips. Greyish slug-like larvae devour asparagus leaves and can destroy newly planted beds. Damage occurs from April-July.

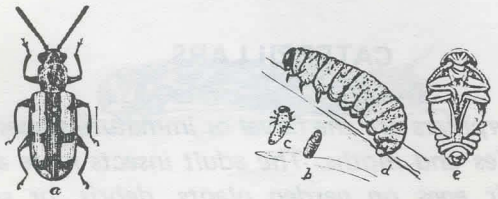


Figure 3. Asparagus beetle: a. adult beetle; b. larva; c. young larva; d. egg; e. pupa.

When to Treat: When beetles are first noted laying eggs on growing asparagus.

Aphid

Description: A large group (several species) which suck the sap from various vegetable garden plants, frequently on the undersides of leaves. Aphids are usually green or yellow and less than 1/8 inch (3.2 mm) long. May be winged or wingless. Leaves of damaged plants become stippled with yellow spots, eventually turning yellow or brown. Leaf curling is common. Some species can transmit plant diseases. Damage occurs from April-September.

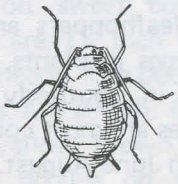


Figure 4. Aphid.

When to Treat: When aphid colonies begin to appear on undersides of leaves, unless lady beetles, green lacewings, and syrphid flies are numerous.

Bean Leaf Beetle

Description: Reddish to light brown or yellowish in color, with six black spots along the middle of the back. Length about 0.25 inch (6.3 mm). This pest hibernates in the adult stage in protected places, emerging in the spring. Beetles feed on leaves and pods of beans, dropping to the ground if disturbed. Eggs are laid in the soil at base of plants and larvae feed on roots. Damage occurs from May-September.

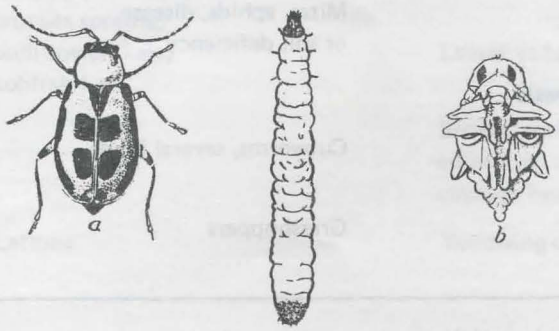


Figure 5. Bean leaf beetle: a. adult larva (left); b. pupa.

When to Treat: When holes are commonly observed in leaves of garden beans. Repeat treatment if damage is observed on new growth several days after initial application. Otherwise, withhold treatment.

Leafhoppers

Description: "Leafhoppers" are a large group of many species, some of which spread plant diseases. Most are green to brown in color, varying in size from 1/8-3/8 inch (3.2-9.6 mm). All are sap-sucking insects which feed on leaves and stems, producing a stippling or yellowing effect. Plants may die if many leafhoppers are present. Many species winter as eggs in plants, while others are carried northward in southerly winds. Carrots, lettuce, and potatoes are most commonly affected. Damage occurs from June-August.

When to Treat: When leafhoppers are common and leaf damage is observed. Pull and destroy plants which appear diseased.

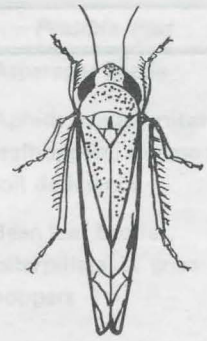


Figure 6. Potato leafhopper.

Red Spider Mite

Description: Mites appear as tiny, yellowish, green or brown moving "spots" on undersides of leaves. Most are 1/32 inch (0.8 mm) long or less. Mites live, feed, and lay eggs in the webbing they produce. They winter as adults which reproduce rapidly under dry conditions the following year. Both immature and adult mites suck sap from leaves, producing stippling and browning. Damage is most serious from mid-July-September.

When to Treat: When stippling appears and mite colonies begin to develop on undersides of leaves. May need to add detergent to increase wetting qualities of spray. Thoroughly spray undersides of leaves

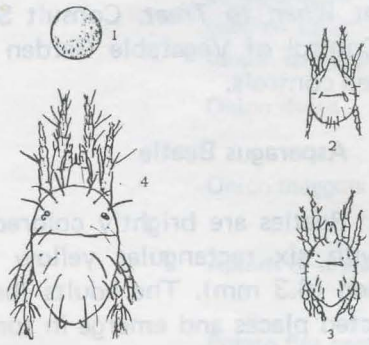


Figure 7. Red spider mite. 1. egg; 2.,3. nymphs; 4. adult.

CATERPILLARS

Caterpillars are the larval or immature stages of butterflies and moths. The adult insects mate and lay their eggs on garden plants, debris, or soil. After the eggs hatch the caterpillars devour leaves, bore in stems or fruit, or cut plants off at ground

level. They are especially destructive and are often a frustrating experience for the home vegetable gardener.

Armyworm

Description: Armyworms are brown caterpillars with orange and yellow stripes. Length may vary from 1/8 - 1½ inches (3.2 mm - 3.8 cm), depending on maturity. Eggs are laid by night-flying moths in grassy weeds bordering the vegetable garden and the worms later move in. Armyworms hide in soil or beneath clods in the daytime, emerging to feed at night. Damage can occur from June through July.

When to Treat: Treat if armyworms are found beneath surface debris and clods, and feeding is evident on grassy weeds and garden vegetables.

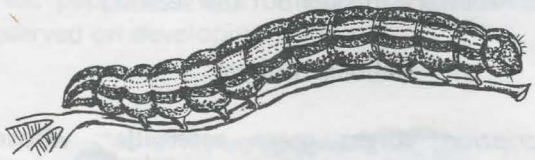


Figure 8. Armyworm.

Hornworms

Description: Two kinds of hornworms (tomato and tobacco) can occasionally be found in the home garden feeding on tomato and potato leaves. Color is green with white chevrons on the side of the body. (The horn at the end of the body probably has a sensory function—it is not a "stinger.") Size may vary from 1/8 - 4 inches (3.2 mm - 10.0 cm). Hornworms winter as pupae in soil with moths emerging in June-July to mate and lay eggs. Individual plants are occasionally stripped of leaves. Look for damage from June-July.

When to Treat: Insecticides rarely necessary. Simply remove the larvae by hand and step on them.

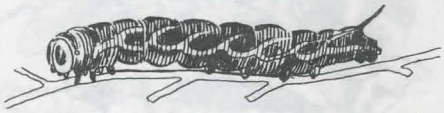


Figure 9. Tomato hornworm.

Squash Vine Borer

Description: White caterpillars with brown heads, varying from 1/8 - 1 inch (3.2 mm - 2.5 cm) in length. These larvae bore in stems (vines) of squash and pumpkins, causing plants to wilt and die. Yellow sawdust-like excrement is pushed outside of the tunnels. Stem swellings (galls) may be produced. This pest winters as pupae in garden soil. Wasp-like red and blackish moths emerge from June-August to lay eggs on the undersides of vines. Damage occurs from July-August.

When to Treat: Very difficult to control. Thorough spray coverage is essential. Cover vines with soil to permit secondary root development at the nodes and water frequently to reduce damage. Poke infested stem galls with a fine wire to kill the borers, or slit stem lengthwise and remove the pests. Acorn and butternut squashes are more resistant while buttercup and Hubbard types are somewhat more susceptible to vine borer damage. Summer squashes are also susceptible to attack but frequently produce in spite of the pest.

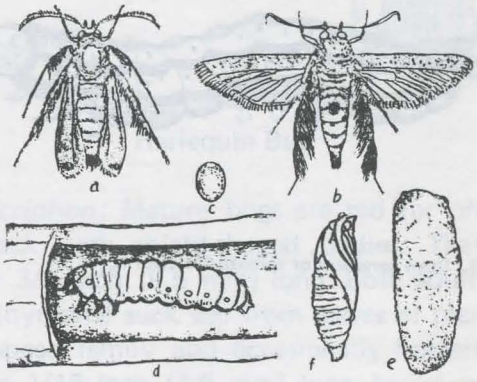


Figure 10. Squash vine borer. a., b. adults; c. egg; d. larva; e. cocoon; f. pupa.

Corn Earworm/Tomato Fruitworm

Description: A common and destructive garden pest, especially on sweet corn and tomatoes. Mature earworms are 1¼ inch (3.2 cm) long and have light brown heads. The body has several black stripes running its full length. General body color may be greenish, yellow, brown, or even pink. Eggs are laid in small groups on the plants by the buff-colored adult earworm moth. Damage to tomatoes occurs when worms bore holes into developing fruit. This results in bacterial contami-

nation and subsequently these tomatoes become rotten. Damage often occurs on the "backside" of the tomato (i.e. the inward side of the fruit cluster), where it is less visible. Damage to sweet corn occurs at the ear tip after the eggs are laid on green silks. Although several eggs may be laid on an ear tip, usually only 1 earworm remains because of cannibalism. Damage may occur early in the season, but is most common after mid-July. Late planted sweet corn is most likely to suffer severe earworm damage.

When to Treat: Tomatoes - Examine green tomatoes for signs of feeding from early July on. Spray at first sign of damage and every 7-10 days if new damage is observed. Observe waiting periods, if any. *Sweet Corn* - Early planted and maturing sweet corn is not likely to need insecticide protection. Watch later plantings closely (examine every 1-2 days) for creamy white eggs scattered among the green silks. If eggs and small worms are found, dust the silks every 2-3 days until they turn brown. When silks are brown, they are no longer attractive to egg laying earworm moths.

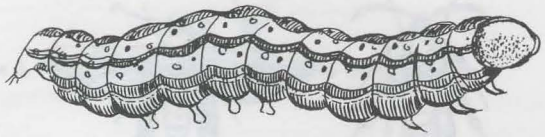


Figure 11. Corn earworm or tomato fruitworm.

Cabbageworm

Description: Mature larvae are dark green caterpillars (1¼ inch (3.2 cm) long) with a rich, velvety appearance. A thin, orange stripe runs down the middle of the back with a broken yellow stripe on each side of the body. These caterpillars can completely destroy young cabbage plants by devouring leaves. The small yellow eggs are laid on the undersides of leaves by white butterflies. Pupae are attached to the plant by silken threads. Early-planted and maturing cabbages sometimes avoid the main attack of this pest, but controls are usually necessary. Damage occurs from May-October.

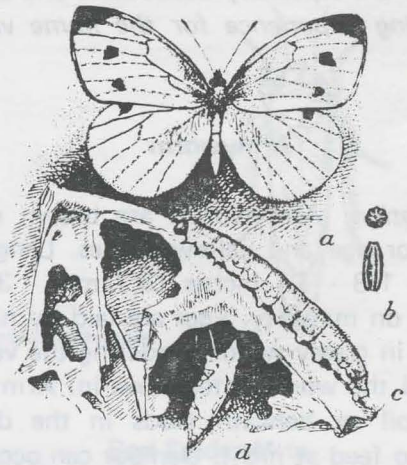


Figure 12. Cabbageworm. a. adult; b. eggs; c. larva feeding on leaf; d. pupa or chrysalis.

When to Treat: When butterflies are laying eggs on cabbages, broccoli, brussels sprouts, cauliflower, or other members of the cabbage family. Should repeat as necessary throughout the season.

Cabbage Looper

Description: Light green caterpillars whose bodies taper toward the head. Body has four white lines, one on each side about midway and two near the midline on top. Mature worms are nearly 1½ inches (3.8 cm) long. Movement is by "looping", as shown in the figure. Eggs are laid on the plants by a drab, brownish, night-flying moth. Pupae are attached to the leaves by silk. Damage consists of severe leaf feeding and boring into the head. All members of the cabbage family are attacked. Damage occurs from mid-July through October, therefore early cabbages are less likely to be damaged.

When to Treat: Treat when evidence of damage occurs or small caterpillars are detected. Repeat as needed, but observe waiting periods before harvest.

Figure 13. Cabbage looper: a. adult; b. eggs; c. looper; d. pupa.

European Corn Borer

Description: A common pest of field and sweet corn, occasionally on potatoes, and rarely (in Nebraska) on peppers. Buff-colored moths lay white eggs on host plants in June and another brood of moths deposits eggs in late July-August, therefore two periods of damage may occur (late June-early July and August-September). Egg masses are white and individual eggs overlap each other like fish scales. They are usually laid on the undersides of leaves. Eggs hatch later into greyish larvae with black spots, which grow to a length of just over 1 inch (2.5 cm). Larvae bore into stalks, stems, ears, ear shanks, and fruit (in the case of peppers).

When to Treat: Treat sweet corn when whorls show shot hole feeding caused by young larvae. Treat peppers if eggs or evidence of chewing are observed on developing fruit.

Figure 14. European Corn Borer

Beet/Spinach Leaf Miner

Description: White to grey maggots, nearly 1/4 inch (6.3 mm) long when full grown, "mine" beet or spinach leaves. Maggots feed on tissue between upper and lower leaf surfaces, producing "blotch-like" brown patterns in leaves. Grey flies, 1/4 inch (6.3 mm) long, are commonly observed resting on leaves. When the eggs hatch, maggots bore into leaves where they remain for 7-10 days. Once inside they cannot be controlled with insecticides.

Figure 15. Beet or spinach leaf miner adult (fly, maggot, and beet leaf with mine.

When to Treat: Watch beet and spinach leaves for fly activity in May, June, and July. Spray when egg clusters appear on undersides of leaves or when some leaves begin to show blotches.

Carrot Weevil

Description: White, legless, curved larvae with brown heads bore into developing carrots, producing surface scars and mines. May also attack dill, parsley, and parsnips. This pest may originate on wild dock, a common weed which grows in lawns, roadside ditches, pastures, or vacant lots near the garden. Control of such weeds and volunteer dill (which often occurs in home gardens) may help reduce the carrot weevil.

When to Treat: Carrots planted into new ground are usually not damaged the first year. In subsequent years, damage is likely to show up and increase.

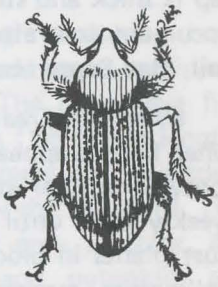


Figure 16. Carrot Weevil

Harlequin Bug

Description: Mature bugs are red (or orange) and black with shield-shaped bodies. They are roughly 3/8 inch (9.5 mm) long. Both adults and young (nymphs) suck sap from leaves of plants of the cabbage family and occasionally horseradish. Eggs are 1/16 inch (1.6 mm) long, barrel-shaped, and white with black wings; they are normally laid in double rows. Harlequin bugs are not common in Nebraska, damage can occur from July-September.

When to Treat: Treatment seldom necessary for this pest.

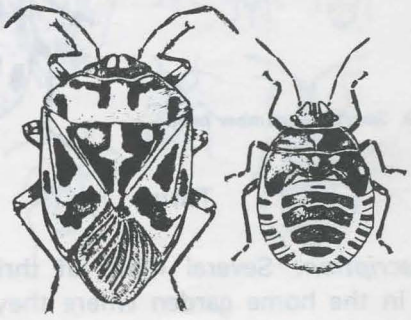


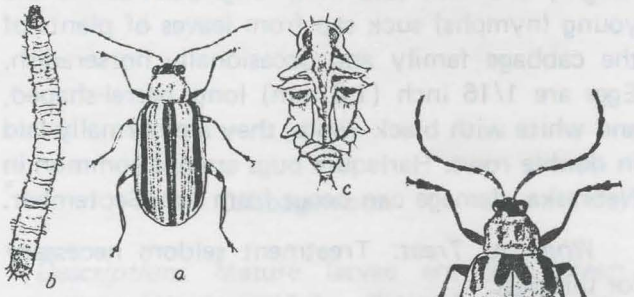
Figure 17. Harlequin bug: a. adult; b. nymph.

Striped/Spotted Cucumber Beetles

Description: Two kinds of cucumber beetles, the striped and spotted, are common in vegetable gardens. They feed on many other plants, but do the most damage to members of the cucumber family—cucumbers, watermelons, cantaloupes, gourds, and squash. Both beetles are yellow and black, and roughly 1/4 inch (6.3 mm) long. The striped species has three black stripes on the wing covers. The spotted beetle has 12 black spots, 6 on each wing cover. Winter is passed in the adult or beetle stage. Both species lay eggs in the ground and the young larvae feed on the roots of the host plant, sometimes causing wilting or death. The adults (beetles) can destroy young plants by direct feeding or by transmitting a bacterial wilt disease. Plants with the disease have very thick, slimy sap which strings out when two pieces of broken vine are touched together. If plants are wilting and the sap is thick and stringy, destroy them. Damage can occur anytime after host plants emerge from the soil, May-September.

When to Treat: Dust or spray young plants when beetles appear or pits are eaten in seed, leaves (cotyledons), or stems. Continue treatments on a weekly basis until plants bloom. Do not spray or dust plants in bloom to avoid damage to essential pollinators, especially honeybees. Immediately remove and destroy wilted vines to prevent spread of the disease to healthy plants.

Figure 18. Striped cucumber beetle: a. adult; b. larva; c. pupa.



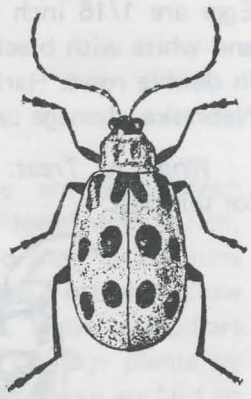


Figure 19. Spotted cucumber beetle.

Thrips

Description: Several kinds of thrips may be found in the home garden where they feed on a variety of plants. Onions, cabbages, and gladiolus are most commonly damaged. Adult thrips are brown or black, minute (1/8 inch (3.2 mm) or less) insects which suck sap from leaves and stems. Eggs are laid in leaves. Feeding results in whitish streaks or brown, corky ridges on leaves. Small, black fecal spots are often observed. Thrips often hide in leaf sheaths or axils and are therefore difficult to see. Look for damage from June-September.

When to Treat: Damage on onions and gladiolus is often more easily seen than the thrips themselves. On onions and gladiolus look for white streaks. Treat when streaking first appears and retreat if damage appears on new growth. Thrips cause brown, corky ridges and discoloration of inner leaves of cabbage. If thrips are observed, treat cabbages just before they head.

Figure 20. Onion Thrips: a. adult; b. antenna; c and d. nymphs.

Onion Maggot

Description: Adult onion maggots are grey flies which do no direct damage themselves. The flies are attacked and killed by a fungus and are often observed clinging to the leaves of many garden plants. Flies lay eggs at the bases of newly set onion plants. Young maggots bore into the onions, producing damage and spreading a bacterial soft rot. Damage occurs from April-July.

When to Treat: Treat furrow before setting plants or bulbs or before sowing seed in the spring.

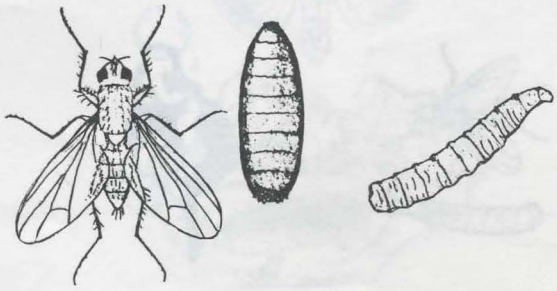


Figure 21. Onion Maggot: adult (left); pupa (right); larva (below).

Colorado Potato Beetle

Description: A pest of members of the nightshade family, principally the potato. It is often found on a common Nebraska pasture weed, the spiny buffalo burr. Beetles are black and yellow striped and about 1/4 inch (6.3 mm) long. The orange-yellow eggs are laid on the undersides of leaves. The larvae have brick red, globular, slug-like bodies and often feed in groups on the uppermost leaves of potato. Damage is most prevalent from June-July.

When to Treat: Spray or dust when larvae and feeding damage appear. One or two treatments should eliminate the problem.

Figure 22. Colorado potato beetle: a. beetle; b. larva; c. pupa.

Flea Beetles

Description: The potato flea beetle is a common garden pest, attacking both potatoes and eggplant. These beetles are black and about 1/8 inch (3.2 mm) long. When disturbed, flea beetles jump off the plants. Eggs of the potato flea beetle are laid in the soil at the bases of plants and small white larvae produce feeding scars on potato tubers. Beetle (adult) damage consists of small "pits" chewed randomly into the leaves of potato and eggplant. The beet (or spinach) flea beetle (adult) is black with a yellow collar and is about 1/4 inch (6.3 mm) long. The hind legs, like those of the potato flea beetle, are enlarged for jumping. Larvae are grey, warty, cylindrical worms that reach 1/4 inch (6.3 mm) in length. Damage consists of irregular holes eaten in spinach leaves by both adults and larvae.

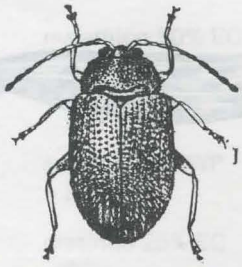


Figure 23. Potato flea beetle.

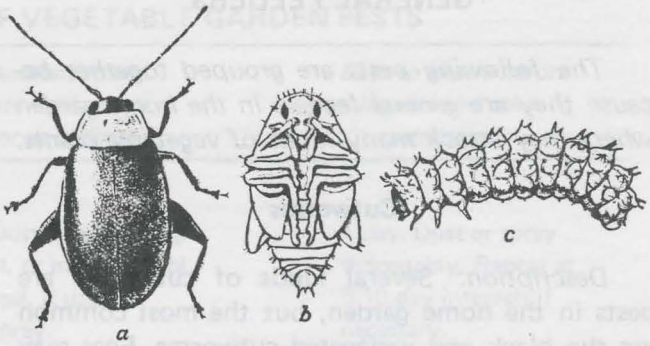


Figure 24. Beet spinach flea beetle: a. beetle; b. pupa; c. full-grown grub.

When to Treat: Treat infested plants when leaves show feeding "pits", scars, or holes. Watch new growth for evidence of damage and retreat if necessary.

Squash Bug

Description: Adults are grey sucking bugs which remove sap from stems and leaves and inject a toxic saliva while feeding. The bugs have flat backs and reach about 5/8 inch (1.6 cm) in length. Eggs are brown and laid in groups on the undersides of leaves in V's formed by the leaf veins. The young nymphs are whitish or grey in color. All cucurbits, especially squash and pumpkin, are severely attacked. Damaged plants wilt and leaves die and turn black. Young fruit may wither, turn brown and die if many bugs are present. Winter squashes are more heavily attacked. Damage most severe from July-September.

When to Treat: When adults, nymphs, egg masses, or damage are evident. Thoroughly cover plants with spray. Add a mild detergent (1 tea. (5 ml) per gallon (3.78 l) of spray) to increase coverage.

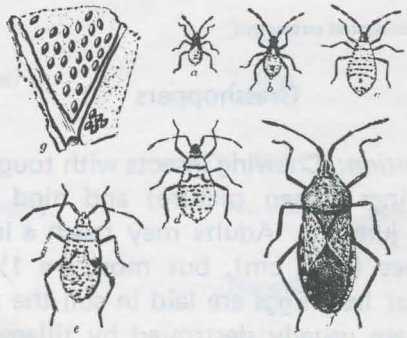


Figure 25. Squash bug: a,b,c,d,e, nymphs; f. adult; g. eggs.

GENERAL FEEDERS

The following pests are grouped together because they are general feeders in the home garden where they attack many kinds of vegetable plants.

Cutworms

Description: Several kinds of cutworms are pests in the home garden, but the most common are the black and variegated cutworms. Eggs may be laid on soil, plant debris, or newly set plants by inconspicuous night-flying moths. Young larvae climb up onto plants and feed on leaves at night and hide under clods or debris by day. When about 3/4 inch (1.9 cm) long, black cutworms remain beneath the soil surface, especially if it is dry and crusted. Here they frequently cut plants off at the base. Watering or rainfall brings them up closer to the surface. Variegated cutworms are grey with an orange stripe on each side and a row of yellow dots down the midline of the back.

When to Treat: When leaves show signs of chewing or stem cutting is observed. Check for cutworms under clods of soil or loose plant debris. Cutworm "collars" made of stiff paper and placed around newly set plants will reduce cutworm damage. In new garden areas that were previously in sod or weeds, it is a good idea to apply a preventive treatment for cutworms. Either sprays, granules, or prepared cutworm baits can be used, but check the label for specific garden crops and use directions.

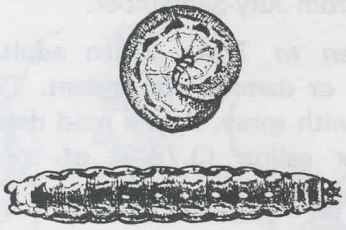


Figure 26. Variegated cutworm.

Grasshoppers

Description: Chewing insects with tough, leathery forewings (when mature) and hind legs enlarged for jumping. Adults may reach a length of three inches (7.62 cm), but most are 1½ inches (3.8 cm) or less. Eggs are laid in soil the previous year and are usually destroyed by tillage. Therefore, hoppers usually originate in grassy or weedy (untilled) areas surrounding the vegetable garden. Young hoppers (nymphs) look like adults and cause similar chewing damage on plant leaves. The worst damage occurs in mid-to-late season (mid-July through September).

When to Treat: Treat border areas when hoppers are small and numerous (six or more per square yard). Controls should be applied before hoppers are half grown to be effective.

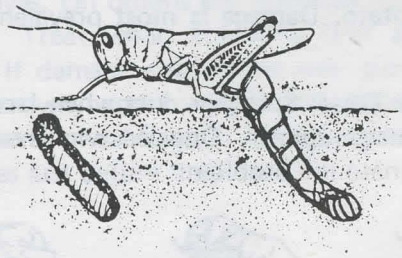


Figure 27. Grasshopper laying eggs.

Slugs

Description: Slugs are terrestrial (land-inhabiting) molluscs and can best be described as "snails without shells." They live in moist places and are especially common in gardens that are overwatered or heavily mulched. Slugs are slow-moving land snails that feed on plants. With their rasping mouthpart (the radula) they produce holes in leaves, stems, and fruit. Slugs leave slick, shiny slime trails (mucous) where they travel. Unstaked or sprawling tomatoes and strawberries are most often attacked by slugs. Damage occurs from mid-to-late summer.

When to Treat: When slugs and evidence of feeding are common. Read the pesticide label carefully. Make sure the slug bait you select is registered on the crop you wish to treat. Do not use baits where small children might find them.

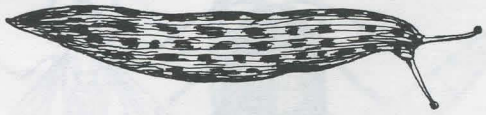


Figure 28. Slugs

SUGGESTIONS FOR THE CONTROL OF VEGETABLE GARDEN PESTS

Crop and Insect	*Insecticide*	*Amount to use per 1 gal. water (or as indicated)*	*Days to expire before harvest and other restrictions*
ASPARAGUS			
Asparagus beetle	rotenone 1% D and WP	Dust 1 lb/1000 sq. ft. or mix 6-8 Tabl. /gal. if used as spray.	1 day. Dust or spray thoroughly. Repeat at 5-10 day intervals if necessary.
	methoxychlor 50% WP	2 Tabl.	3 days.
	malathion 50% EC	2 tea.	1 day.
	carbaryl 50% WP (Sevin)	2 Tabl.	1 day.
BEANS			
Aphids	disulfoton 1% G (Di-Syston)	7 oz. (20 Tabl.) /50 ft. of row.	Band on each side of seed furrow, for 24" row spacing.
	diazinon 25% EC	2 tea.	7 days.
	malathion 50% EC	2 tea.	1 day.
	rotenone 1% D	1 lb/1000 sq. ft.	1 day. Dust thoroughly. Repeat at 5-10 day intervals.
	diazinon 4% D	Dust when air is still	7 days. Dust thoroughly.
Bean leaf beetles	methoxychlor 50% WP	2 Tabl.	7 days.
	diazinon 25% EC	2 tea.	7 days.
	carbaryl 5% D (Sevin)	Dust thoroughly.	No wait.
	carbaryl 50% WP (Sevin)	2 Tabl.	No wait.
	malathion 50% EC	2 tea.	1 day.
Leafhoppers	disulfoton 1% G (Di-Syston)	7 oz. (20 Tabl.) /50 ft. of row	Planting time only. Band on each side of seed furrow for 24" row spacing.
	methoxychlor 50% WP	2 Tabl.	7 days.
	diazinon 4% D	Dust when air is still.	7 days.
	malathion 50% EC	1 Tabl.	1 day.
	carbaryl 5% D (Sevin)	Dust thoroughly	No wait.
	carbaryl 50% WP (Sevin)	2 Tabl.	No wait.
	diazinon 25% EC	2 tea.	7 days.

Crop and Insect	*Insecticide*	*Amount to use per 1 gal. water (or as indicated)*	*Days to expire before harvest and other restrictions*
Spider mites	malathion 50% EC	1 Tabl.	1 day.
	disulfoton 1% G (Di-Syston)	7 oz. (20 Tabl.) /50 ft. of row	Planting time only. Band on each side of seed furrow for 24" row spacing.
	kelthane 18.5% EC	3 Tabl.	7 days.
Caterpillars	methoxychlor 50% WP	2 Tabl.	7 days.
	Bacillus thuringiensis (Dipel, Thuricide, Biotrol)	See Label	No wait.
	diazinon 25% EC	2 tea.	7 days.
	carbaryl 5% D (Sevin)	Dust thoroughly	No wait.
BEETS			
Leaf miners	diazinon 25% EC	2 tea.	14 days.
CARROTS			
Carrot weevil	No insecticide is registered specifically for this pest. Diazinon is registered only for the control of wireworms, root maggots, leafhoppers, and subterranean cutworms on carrots. Look closely for these pests about 4 times at 10 day intervals, beginning when the carrots are 1 inch tall.		
Leafhoppers	carbaryl 5% D (Sevin)	Dust thoroughly	No wait.
	carbaryl 50% WP (Sevin)	2 Tabl.	No wait.
	malathion 50% EC	2 tea.	7 days.
COLE CROPS			
Aphids	disulfoton 1% G (Di-Syston)	5 oz. (14 Tabl.) /50 ft. of row - or 2 tea. in soil of each transplant hole.	Apply at planting time or as side dress treatment after plants are established. Can use twice per season for brussels sprouts or cauliflower; only once for broccoli or cabbage. Wait 42 days for cabbage, 30 for brussels sprouts, 40 for cauliflower, 14 for broccoli.
	diazinon 4% D	Dust when air is still.	Wait 5 days for broccoli, 7 for cabbage, 5 for cauliflower.

Crop and Insect	*Insecticide*	*Amount to use per 1 gal. water (or as indicated)*	*Days to expire before harvest and other restrictions*
	malathion 50% EC	2 tea.	Wait 7 days for cabbage, cauliflower, and brussels sprouts, 3 days for broccoli.
	diazinon 25% EC	2 tea.	Wait 7 days for cabbage and brussels sprouts, 5 days for cauliflower and broccoli.
Cabbageworms	methoxychlor 50% WP	2 Tabl.	Wait 3 days for cabbage, brussels sprouts and broccoli; 7 days for cauliflower, collards, kale, and kohlrabi.
	Bacillus thuringiensis (Dipel, Thuricide, Biotrol)	See label	No wait.
	diazinon 4% D	Dust when air is still.	Wait 7 days for cabbage, 5 days for broccoli & cauliflower.
	carbaryl 50% WP (Sevin)	4 Tabl.	3 days cabbage, cauliflower, brussels sprouts, & broccoli; 14 days chinese cabbage, 3 days kohlrabi.
	carbaryl 5% D (Sevin)	Dust thoroughly	3 days. Use on cabbage, broccoli, brussels sprouts, cauliflower, kohlrabi.
	rotenone 1% D or WP	See Asparagus beetle.	Cabbage only.
Harlequin cabbage bug	carbaryl 5% D (Sevin)	Dust thoroughly	3 days. Use on cabbage, broccoli, brussels sprouts, cauliflower, and kohlrabi.
Thrips	diazinon	Follow label instructions.	
LETTUCE			
Aphids	disulfoton 1% G (Di-Syston)	5 oz. (14 Tabl.) /50 ft. of row.	Planting time. Band on each side of seed furrow. Wait 60 days.
	diazinon 25% EC	2 tea.	10 days leaf.
	malathion 50% EC	2 tea.	7 days head, 14 days leaf.
Leafhoppers	malathion 50% EC	2 tea.	7 days head, 14 days leaf.
	methoxychlor 20% WP	2 Tabl.	14 days leaf lettuce.

Crop and Insect	*Insecticide*	*Amount to use per 1 gal. water (or as indicated)*	*Days to expire before harvest and other restrictions*
	carbaryl 5% D (Sevin)	Dust thoroughly	3 days head, 14 days leaf.
	carbaryl 50% WP (Sevin)	2 Tabl.	3 days head, 14 days leaf.
Caterpillars	*Bacillus thuringiensis* (Dipel, Thuricide, Biotrol)	See label.	No wait.
CUCUMBER			
Aphids	diazinon 4% D	Dust when air is still.	1 day.
	malathion 50% EC	2 tea.	1 day.
	diazinon 25% EC	2 tea.	7 days.
Cucumber beetles	malathion 50% EC	2 tea.	1 day. Do not apply during bloom.
	carbaryl 50% WP (Sevin)	2 Tabl.	No wait. Do not apply during bloom.
	methoxychlor 50% WP	2 Tabl.	7 days.
	carbaryl 5% D (Sevin)	Dust thoroughly.	No wait. May injure foliage if applied when leaves are wet. Do not apply during bloom to avoid damage to pollinators.
	rotenone 1% D or WP	Dust 1 lb/1000 sq. ft. or mix 6-8 Tabl. /gal. if used as spray.	1 day. Do not apply during bloom.
MUSKMELON			
Cucumber beetles	carbaryl 50% WP (Sevin)	2 Tabl.	No wait. May injure vines if applied to wet foliage. Do not apply during bloom.
	malathion 50% EC	2 tea.	1 day. May injure young plants if applied before vining. Do not apply during bloom.
	rotenone 1% D	Dust thoroughly.	1 day.
ONIONS			
Thrips	malathion 50% EC	2 tea.	3 days.
	diazinon 25% EC	2 tea.	10 days.
Onion maggot	diazinon 25% EC	2 tea.	Apply to trench at planting.

Crop and Insect	*Insecticide*	*Amount to use per 1 gal. water (or as indicated)*	*Days to expire before harvest and other restrictions*
	diazinon 4% D	6 Tabl./100 row feet.	In furrow at planting.
	diazinon 5% G	4 oz./500 sq. ft.	In furrow at planting.
PEAS			
Aphids	disulfoton 1% G (Di-Syston)	2.5 oz. (7 Tabl.) /50 ft. of row	Planting time. Band on each side of seed furrow. Do not allow granules to contact seed.
	diazinon 4% D	Dust when air is still.	No wait.
	malathion 50% EC	2 Tabl.	3 days.
	diazinon 25% EC	2 Tabl.	No wait.
	rotenone 1% D	Dust thoroughly.	1 day.
POTATOES			
Colorado potato beetle	methoxychlor 50% WP	2 Tabl.	No wait.
	carbaryl 5% D (Sevin)	Dust thoroughly.	1 day.
	carbaryl 50% WP	2 Tabl.	No wait.
Flea beetles	methoxychlor 50% WP	2 Tabl.	No wait.
	carbaryl 5% D (Sevin)	Dust thoroughly.	1 day. Can also use on eggplant.
	carbaryl 50% WP (Sevin)	2 Tabl.	No wait.
Leafhoppers	methoxychlor 50% WP	2 Tabl.	No wait.
	diazinon 25% EC	1.5 tea.	35 days.
European corn borer	carbaryl 5% D (Sevin)	Dust thoroughly.	1 day. Can also use on peppers.
PUMPKINS AND SQUASH			
Squash bugs	carbaryl 5% D (Sevin)	Dust thoroughly.	No wait. May injure foliage if applied when leaves are wet.
	carbaryl 50% WP (Sevin)	2 Tabl.	No wait.
	rotenone 1% D	Dust thoroughly.	1 day.
Squash vine borers	methoxychlor 50% WP	2 Tabl.	1 day. Pumpkin or squash.
	malathion 50% EC	3 tea.	1 day. Squash.
	rotenone 1% D	Dust thoroughly.	1 day.

Crop and Insect	*Insecticide*	*Amount to use per 1 gal. water (or as indicated)*	*Days to expire before harvest and other restrictions*
SPINACH			
Leaf miner	disulfoton 1% G (Di-Syston)	2.5 oz. (7 Tabl.) /50 ft. of row.	Planting time. Band on each side of seed furrow. See label for waiting period.
	diazinon 25% EC	2 tea.	14 days.
Flea beetle	methoxychlor 50% WP	2 Tabl.	14 days.
	carbaryl 50% WP (Sevin)	2 Tabl.	14 days.
SWEET CORN			
Armyworms	methoxychlor 50% WP	4 Tabl.	7 days.
	malathion 50% EC	2 tea.	5 days.
	carbaryl 50% WP (Sevin)	4 Tabl.	No wait.
Corn earworms	diazinon 4% D	Dust when air is still.	2 days. Repeat every 3 days. Dust green silks. Discontinue if silks have wilted and begin to turn brown.
	carbaryl 5% D (Sevin)	Dust when air is still.	No wait.
	carbaryl 50% WP (Sevin)	4 Tabl.	No wait.
	malathion 50% EC	2 Tabl.	5 days.
European corn borer	carbaryl 50% WP (Sevin)	3 Tabl.	No wait. Spray whorls at 5 day intervals, June 1-July 4 if shot hole injury is observed in 75% of the plants.
	diazinon 5% G (Spectracide 6000)	8-14 oz./1000 sq. ft.	Distribute granules into whorls when 75% show shot holes. Repeat in 7 days only if damage appears on new growth.
TOMATOES			
Aphids	malathion 50% EC	1.5 tea.	1 day.
	diazinon 25% EC	1 tea.	1 day.

Crop and Insect	*Insecticide*	*Amount to use per 1 gal. water (or as indicated)*	*Days to expire before harvest and other restrictions*
	disulfoton 1% G (Di-Syston)	12 oz. (33 Tabl.) /50 ft. of row or 2 tea. in each transplant hole.	Planting time treatment in rows 36" wide. Band on each side of furrow or place in transplant hole. Do not allow granules to contact seed. See label.
	diazinon 4% D	Dust when air is still.	3 days.
	rotenone 1% D	Dust thoroughly.	1 day.
Mites	disulfoton 1% G (Di-Syston)	12 oz. (33 Tabl.) /50 ft. of row or 2 tea. in each transplant hole.	Planting time treatment in rows 36" wide. Band on each side of furrow or place in transplant hole. Do not allow granules to contact seed. See label.
	sulfur 90% D	2½ Tabl/gal. or dust as needed.	40 day wait if to be canned in metal containers.
	kelthane 18.5% EC	4 tea.	2 days.
Hornworms and fruitworms (corn earworms)	*Bacillus thuringiensis* (Dipel HG, Thuricide, Biotrol)	See label.	No wait. Apply every 5-7 days.
	carbaryl 5% D	Dust thoroughly.	See label.
Slugs (On the following plants— asparagus, beans, beets, cabbage, carrots, corn, cucumbers, eggplant, lettuce, melons, onions, peas, peppers, potatoes, radishes, spinach, squash, tomatoes, and turnips)	metaldehyde 3.25% B	1 lb/1000 sq. ft.	No wait. Apply to soil at base of plants in late afternoon. Do not contaminate edible parts. Sprinkle lightly to soften bait.
Cutworms (on the following plants— cucumbers, squash, melons, peas, beans, carrots, eggplant, okra, peppers, tomatoes, potatoes, sweet corn, asparagus, broccoli, brussels sprouts, cabbage, cauliflower, head and leaf lettuce, beets, horseradish, parsnips, radishes, rutabagas, turnips, collards, endive, kale, parsley, spinach, chard)	carbaryl 5% B (Sevin)	0.5-1.0 lb/1000 sq. ft.	0-14 days. See label. Broadcast over vegetables with spreading device.

Crop and Insect	*Insecticide*	*Amount to use per 1 gal. water (or as indicated)*	*Days to expire before harvest and other restrictions*
Grasshoppers	carbaryl 50% WP (Sevin)	2 Tabl.	See label.
(See label for specific crops)	diazinon 25% EC	2 tea.	See label.
Soil Insects (cutworms and wireworms)	diazinon 25% EC	6 fl. oz./15 gal water/1000 sq. ft.	Apply before planting and till into upper 2-6 inches of soil.
(See label for specific crops)			See label for restrictions.
	diazinon 5% G (Spectracide 6000)	14-28 oz./1000 sq. ft.	See Above.

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