



Home Vegetable Garden Insect Pest Control

Jonathan Edelson

Entomology Specialist

Brenda Simons

Assistant Extension Specialist -Horticulture

David Hillock

Assistant Extension Specialist -Horticulture

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What is an Insect Pest?

For purposes of this Fact Sheet, we classify insects and mites as pests based on their ability to damage vegetable plants and reduce your harvest from the home garden. Many insects, and all spiders, found in home vegetable gardens are beneficial and control of these insects is not recommended.

Monitoring Pest Insects in the Home Garden

Insects and mites can move into your garden and then rapidly increase in numbers. You should examine plants in and around the garden throughout the season at least twice weekly. Use magnification to aid in identifying insects and mites. Examine a few plants of each cultivar thoroughly, searching under leaves, inside developing fruit, along stems and at the plant crown. Note feeding damage signs such as insect excrement, holes in leaves or fruit and/or twisted or deformed leaves. Make notes indicating the number or extent of damage from week to week to aid in determining whether insects and/or damage is increasing.

Identify the Insect

Color photos of the most common insect pests and descriptions of others are included in this fact sheet. You should be able to develop a general classification of the pest based on this information. Once you have identified the pest, you should classify the type and amount of damage it is causing.

Identify the Damage

Damage is classified by how the pests feed.

Chewing damage - Insects with 'cutting' mouthparts tear off plant tissue and chew it. Examples include beetles, caterpillars and grasshoppers that feed on fruit or leaves and often leave holes in the plant tissue or foliage. These insects defecate on plants and soil leaving, excrement that may be brown, black or green in color and resemble small flecks or balls.

Piercing, sucking damage - Insects and mites with piercing mouthparts insert their mouthparts into the plant tissue

and 'suck' liquids from the plants. Examples include squash bugs, aphids, stink bugs, thrips and mites. Many of the insects that feed in this manner defecate a sticky liquid (honeydew) that often builds up on leaves or fruit, leaving a shiny residue that may support the growth of a black or gray sooty mold. Damaged foliage often will turn yellow and eventually brown in color or become malformed in shape.

Key Pests

Those pests that feed directly on the harvested portion of the plant are the most destructive, since they compete directly with you for the food you are trying to grow. You will have little tolerance for the key pests. We recommend controlling key pests when found in the garden. Examples include the corn earworm and the tomato fruitworm.

Many insects and mites feed on leaves or on parts of the plants that will NOT be harvested. Most gardeners can tolerate low numbers of these in the garden. They often serve a useful purpose because they attract and help maintain populations of predatory or parasitic insects or mites that also feed on and control the KEY PESTS. You must decide how many of these pests you are willing to tolerate, keeping in mind that large numbers can cause leaf curl and other damage and reduce the vigor of your garden plants. Examples include aphids and spidermites.

Controlling Pests

The best control is prevention. Pest problems can often be prevented by developing and maintaining a healthy crop through soil fertility, proper irrigation, choosing crops suited to the climate and soil, and by removing small infestations before they become a problem. Once you have identified a pest problem based on the type and amount of damage and made a decision to control the pest, you should consider the following. There are numerous methods of controlling pests; the most effective control often is achieved by combining control techniques.

(For more information refer to the following fact sheets: HLA-6007 Improving Garden Soils; HLA-6032 Vegetable Varieties for Oklahoma; and EPP-7652 Non-chemical Methods for Managing Diseases in the Home Landscape and Garden).

Cultural Control

Vigorous, rapidly growing plants often 'outgrow' pest damage. You should plant recommended cultivars, maintain fertile soil with proper pH and moisture providing your garden a means to outgrow pest damage.

Sanitation - dispose of infested plant and trash materials that harbor pests and cultivate the soil to expose and destroy pests in the soil.

Weed control - keep the garden border areas mowed and trimmed and cultivate the garden to control unwanted plants (weeds) that serve as hosts to insects that can move over to your vegetable plants.

Time your plantings - many insect pests, including the corn earworm and squash bug, are less numerous early in the season and an early planting of vegetables will often 'escape' with little to no damage.

Traps are devices that collect or cause insects to congregate, such as flat boards on top of the soil in the garden. Check the traps frequently and collect and destroy the insect pests in the traps.

Barriers serve to exclude pests from the crop and include the use of paper collars around the stem collar of young transplants that prevents cutworms from attacking and destroying plants. Other barriers include row covers made of transparent or translucent covers of woven plastic that allow light to enter, but block insects. Typically, these row covers are supported above the plants with hoop frames although light weight woven covers can rest on the canopy.

Mechanical removal by hand picking or washing with a directed stream of water is effective for large insects or eggs and for small, soft-bodied insects or mites.

Biological Control

Many insects and other arthropods feed on and destroy insects that are pests in gardens. Examples include the lady beetle and spiders that feed on insect eggs, larvae, aphids and mites. These **BENEFICIAL** arthropods are best used by preserving or augmenting their numbers. You can maintain a diverse and healthy garden by NOT spraying the garden unnecessarily with insecticides and by maintaining a diverse planting that provides alternate sources of prey, nectar and pollen. Beneficial insects can be purchased from suppliers and released in mass numbers but this practice has not proven

reliable with the exception of release and management in greenhouses. (Refer to EPP-7307 Beneficial Insects). Many insects are attacked by pathogens that cause diseases that kill the insect pests. Most disease outbreaks occur during periods of wet and humid weather.

Pesticides

Pesticides are materials that are applied directly to pests or in their environment that will kill the pests. Insecticides are specifically designed to kill insects and many other arthropods. Insecticides sold commercially must be registered with the U.S. Environmental Protection Agency and the State of Oklahoma's Department of Agriculture. The label attached to the container with the insecticide provides specific information on proper use of, safety precautions and disposal of the insecticide. Relative toxicity of various insecticides and recommendations for use are listed in Tables 1 and 2. **ALWAYS USE PESTICIDES ACCORDING TO LABEL INSTRUCTIONS** (refer to EPP-7450 Safe Use of Pesticides in the Home and Garden).

Organic Pesticides

Organic gardeners consider insecticides extracted from plants or derived from a 'naturally' occurring source as suitable for 'Organic' production techniques. Examples of botanical insecticides include neem extracts and pyrethrum. Materials derived from other acceptable sources include 'soaps', vegetable and mineral oils, and sulfur dusts. Most of these materials have been evaluated in university trials and have been shown to have short residual activity and are at best, moderately effective in killing insect pests. Most are detrimental to beneficial insects and with exceptions have low toxicity to humans and pets.

Synthetic Pesticides

In contrast to most 'Organic' pesticides, these materials have been synthesized from raw products using industrial technology. All currently labeled and registered pesticides have been determined to be safe based on current regulations from the United States Environmental Protection Agency and the State of Oklahoma when used as specified by the label. Examples of synthetic insecticides labeled for General Use Purposes include: malathion, carbaryl, and diazinon. These materials were evaluated in university trials and were shown to be moderately effective in killing insect pests. Most are

Toxicity of Pesticides Used to Control Common Home Vegetable Garden Pests

The United States Environmental Protection Agency and the State of Oklahoma are charged with regulation of the registration of pesticides. A common terminology is used among regulatory agencies to describe comparative toxicity of the pesticides. Following is a listing of and description of some of the more commonly available insecticides for home garden use. Insecticides labeled as "General Use" can be sold to the public for general unrestricted use. "Restricted Use" pesticides are sold only to and used only by certified applicators.

Categories and Danger Rankings Used in Describing Insecticides

Highly Toxic	Class I	DANGER (ex. endosulfan, nicotine sulfate)
Moderately Toxic	Class II	WARNING (ex. dimethoate)
Slightly Toxic	Class III	CAUTION (ex. malathion)

detrimental to beneficial insects and may have low to moderate toxicity to humans and pets.

Application of Pesticides

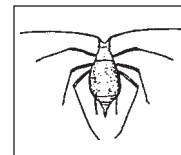
Whether applying synthetic or organic pesticides, the user is responsible for reading the label and making applications in a proper manner including the crop on which sprayed, the interval of time needed prior to harvest after application and proper protection of other people, pets and beneficial organisms including bees, predators, birds, and fish. Both synthetic and organic pesticides can be toxic and/or irritating; therefore, you should wear unlined neoprene gloves and keep materials, dust or mist out of contact with your eyes, mouth or bare skin. Always wash thoroughly after applying pesticides.

Most pesticides approved for use around the home (General Use Purposes) are moderately effective in killing pest insects. To achieve the best control with these materials, it is important for you to direct the spray to the plant surface where the pest is living or feeding. Also, since many pests will continue to hatch from eggs or migrate into the garden, it may be necessary to monitor pest infestations two to three days after the first application and to repeat applications following label directions.

Common Pests of Gardens and Their Management

Aphids

Aphids are small insects, ranging in color from yellow to green to red, which may or may not have wings. Look for these insects on the undersides of the leaves. Aphids feed by inserting needle-like mouthparts in leaves, stems, and fruit to remove plant nutrients. When numerous, aphids generally cause damage; however, they can transmit viruses to your crops even when present in low numbers. Aphids may be controlled by natural factors including rain, wind, parasites (tiny wasps) and predators (lady beetles). Aphids occur on almost all garden crops and are of special concern on tomatoes, peppers, potatoes, squash, melons and cucumbers. They may transmit virus diseases among crops and can be very damaging.



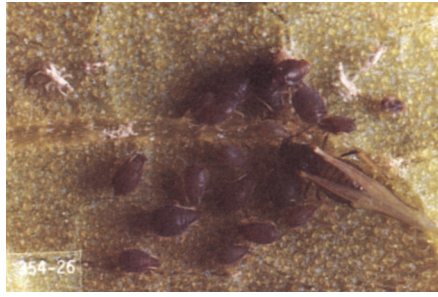
Recommended Control: To prevent virus transmission, place row covers over new plantings and maintain until first flowers are present or use an aluminum mulch. To control large populations on leaves, spray with malathion, dimethoate, endosulfan, diazinon, or neem, making certain to obtain good spray cover under leaves. ORGANIC methods of control include the use of row covers, aluminum mulch, beneficial insects, applications of neem, insecticidal soap or pyrethrum. A fungus based insecticide is available under the Trade name Mycotrol,

Table 1. Commonly available insecticides for home garden use.

Classification	Common Name	Trade Name	Toxicity (see Box Insert)
Synthetic insecticides:			
Organophosphates	malathion	Malathion	Caution
	diazinon	Diazinon	Warning or Caution
	dimethoate	Cygon	Warning
Carbamates	carbaryl	Sevin	Caution, Warning, Danger
Chlorinated hydrocarbons	endosulfan	Thiodan	Danger
	dicofol	Kelthane	Warning or Caution
Pyrethroids	cyfluthrin, esfenvalerate, permethrin	Bayer Advanced Care	Warning or Caution
Botanical insecticides:			
	rotenone		Caution or Danger
	neem		Caution
	pyrethrums		Caution
Biological insecticides:			
	<i>Bacillus Thuringiensis</i>	Dipel, M-Trak	Caution
Others:			
	sulfur		Caution
	horticultural oils		Caution
	vegetable oils		Caution
	diatomaceous earth		Caution
	fatty acid soaps		Caution
	pheromones		Caution



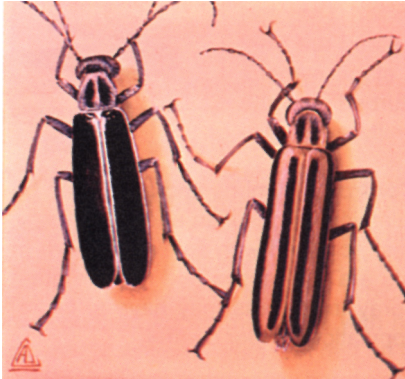
Aphids (note cornicles or 'tail pipes').



Aphids (some occasionally have wings).



Asparagus beetle.



Blister Beetles (two species).



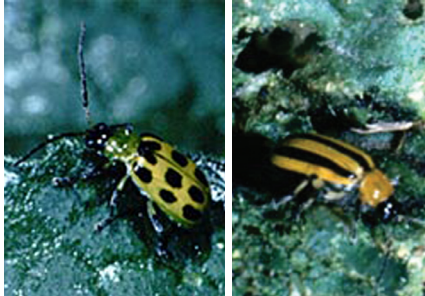
Colorado Potato Beetle (adult and larvae).



Corn Earworm in corn.



Corn Earworm (Tomato fruit worm on tomatoes).



Cucumber Beetles.



Cutworm.



Grub.



Harlequin Bug.



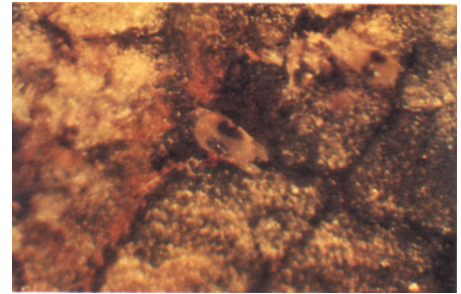
Stink Bug.



Hornworm.



Leafhopper.



Spider Mites.



Squash Bugs.



Squash Bug eggs.

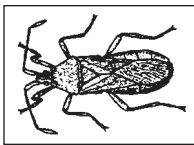


Wireworm (Click Beetle larva).

which is effective when sprayed directly on the aphids under humid conditions. Sprays must be directed at the feeding sites on the undersurface of leaves. You also can thoroughly wash the plants with a directed stream of water early in the morning to allow the leaves to dry before evening.

Bugs

Bugs include stink bugs, leaf-footed bugs, and squash bugs that have piercing mouthparts used to 'suck' nutrients from plant leaves, stems, and fruit. They often are KEY PESTS that feed on tomatoes, beans, and squash causing discolored spotting, pimples or desiccation. The adults are excellent fliers and can move long distances into and among gardens. There are few natural controls limiting their numbers and damaging populations must be treated with insecticides.



Recommended Control: Use row covers to prevent bugs from feeding on young plantings, but remove at first flower. Kill nymphs and adults with cyfluthrin, diazinon, dimethoate, or endosulfan. ORGANIC control methods include the use of row covers, hand picking, traps, and spraying with neem or pyrethrum. Nymphs can be killed with insecticidal soap. Spray applications must be directed towards the feeding sites under the leaves and under the plant canopy. The SQUASH BUG is a perennial pest, primarily of squash and pumpkin, which should be controlled by initiating insecticide applications or hand picking when adults or egg masses are first noted on plants.

Leafhoppers

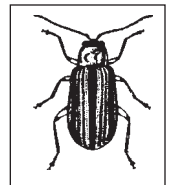
Leafhoppers are closely related to bugs and feed in the same manner. They are generally much smaller and brighter in color. They can become very numerous and are very active. The immature stage nymphs actively run when disturbed and the adults actively 'hop' or fly when disturbed.



Recommended Control: Nymphs and adults can be killed with cyfluthrin, diazinon, malathion, endosulfan, and dimethoate. ORGANIC control is best achieved with sprays of neem or pyrethrum. These pests are very active and migrate great distances; therefore, spray treatments may have to be repeated to bring large populations under control.

Beetles

Beetles are large or small and dark black to metallic green in color. They have hard 'shell-like' bodies, are good fliers, and possess chewing mouth parts. They feed on leaves, stems, and fruit. Common beetles in vegetable gardens include the Colorado potato beetle, blister beetle, bean beetle, and cucumber beetle. Lady beetles are common beneficial beetles that feed on insect eggs, larvae, and aphids.



Recommended Control: Use row covers to protect young plants and remove at first flowering. Larvae and adults can be killed with cyfluthrin, malathion, carbaryl, diazinon, or endosulfan. ORGANIC methods of control include the use of

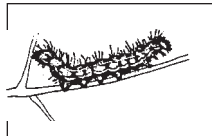
Table 2. Commonly Grown Vegetables and Associated Pests.

Asparagus	Tomatoes (peppers, eggplant, potato)
Asparagus beetle	Tomato fruitworm
Aphid	Hornworms
Beans	Blister beetles
Bean leaf beetles	Flea beetles
Aphids	Colorado potato beetle
European corn borer	Aphids
Leafhoppers	Spider mites
Corn earworm	Stick bugs
Cole crops (broccoli, cauliflower, cabbage, collards, kale, mustard, turnips)	Leaffooted bugs
Diamondback moth	Leafhoppers
Cabbage looper	Cutworms
Aphids	Okra
Cucurbit crops (cucumbers, melons, squash, pumpkins)	Aphids
Cucumber beetles	Onion
Squash bug	Thrips
Aphids	Peas
Spider mites	Aphids
Sweet Corn	Stink bugs
Corn earworm	Loopers
Armyworms	Spinach
Mites	Aphids
Seedcorn maggot	Stink bugs
Flea beetle	Loopers
European corn borer	Lettuce
Cutworms	Aphids
	Spider mites

row covers, hand picking, and spray applications of neem or pyrethrum. Larvae can be killed with insecticidal soap. The larvae or immature forms of the Colorado potato beetle and other beetle species can be killed with the *Bacillus thuringiensis* var *tenebrionis* formulations developed for beetle control (e.g. Trident, M-Trak).

Caterpillars and Cutworms

Caterpillars and Cutworms are 'worm' like larval-stages of insects that will mature into moths or butterflies. They emerge from small eggs laid on plant tissue and can grow to be several inches in length. Caterpillars have chewing mouthparts and feed on leaves, stems, and fruit. Most caterpillars are found feeding on leaves or fruit and are often noted when you observe their excrement on leaves or soil beneath the feeding caterpillar.

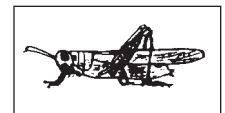


Recommended Control: Young plants and transplants can be protected from cutworms by placing 'collars' around the base of the plant stems. The best method to control caterpillars that feed on leaves and fruit is with applications of pesticides derived from *Bacillus thuringiensis* var *kurstoki* or *aizawai* (e.g. Dipel, Javelin, Xentari). SWEET CORN - the corn earworm is a perennial pest and may best be controlled by directly applying a spray mixture of pyrethrum and/or cy-

fluthrin with an emulsifiable oil in water to the corn silk at 2 day intervals beginning with silk emergence.

Grasshoppers

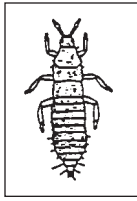
Grasshoppers are fairly large green or brown insects that can jump or fly, are extremely active, and difficult to catch in the act of damaging your garden plants. If you notice them in and around the garden and see ragged feeding holes on the edges of leaves, you can be certain they are causing the damage. They are difficult to control because they can migrate into the garden from areas outside the garden.



Recommended Control: Row covers will protect young plants. Maintain well trimmed borders around the garden to act as a 'barrier' and to prevent their migration into the garden. Several synthetic insecticides (cyfluthrin, carbaryl, endosulfan, diazinon) effectively kill grasshoppers in the garden; however, grasshoppers have a tendency to continuously migrate into gardens and thus repeated applications are often necessary. ORGANIC control may best be achieved using repeated applications of neem or pyrethrum. Insecticide applications, whether synthetic or organic, are most effective when targeted against the small immature nymphs. Larger and adult grasshoppers are more difficult to kill.

Thrips

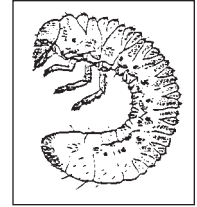
Thrips are very small insects that rasp, tear, and remove nutrients from leaves causing a silver streaking of the leaf tissue and leaf curling. They often are very abundant early in the season and the damage may be very notable on cotyledons and first true leaves. Generally, plants outgrow the damage and control often is not necessary.



Recommended Control: When extremely abundant, or if they are damaging fruit or edible leaves, control may be warranted. Applications of cyfluthrin, dimethoate, or endosulfan are most effective in reducing numbers, but must be repeated because eggs are laid in the plant tissue and are not affected by pesticides. ORGANIC control may be achieved by repeated, direct applications of neem or pyrethrum.

Soil Insects

Soil Insects (wireworms, grubs, cutworms) live in the soil. Those that are pests, feed on roots or other portions of the plant in contact with the soil, including fruit. Healthy, vigorously growing plants can outgrow the damage from a limited number of root feeding insects; however, large numbers can limit your harvest or kill your plants.



Recommended Control: There are few effective methods of killing soil insects once they are damaging the plants, therefore prevention is the best policy. Prevent problems by planting into well cultivated soil that has not been in sod for the previous year. Several granular insecticides (e.g. permethrin, diazinon, chlorpyrifos) are available and application prior to planting will effectively control pest insects.

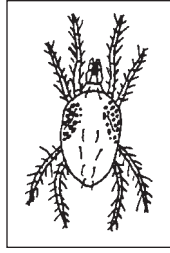
Table 3. Common Pests and Recommended Methods of Control.

Common pests	examples	cultural control	synthetic pesticides	organic pesticides
aphids		row covers high pressure water wash	dimethoate malathion	soap neem pyrethrum Mycotrol
mites		high pressure water wash	dicofol endosulfan dimethoate	soap neem
bugs	squash bug	row covers traps early-plantings handpicking	endosulfan diazinon cyfluthrin	neem pyrethrum
caterpillars	corn earworm tomato fruitworm cabbage looper	row covers early-plantings handpicking	<i>Bacillus thuringiensis</i> products endosulfan cyfluthrin	<i>Bacillus thuringiensis</i> products pyrethrum
beetles	blister beetle bean leaf beetle Colorado potato beetle flea beetle	row covers handpicking	carbaryl diazinon M-Trak (larvae only) cyfluthrin	neem pyrethrum M-Trak (larvae only)
grasshoppers		row covers	carbaryl endosulfan diazinon cyfluthrin	neem pyrethrum
leafhoppers		row covers	diazinon malathion endosulfan dimethoate cyfluthrin	neem pyrethrum
thrips	onion thrips	water spray	endosulfan dimethoate cyfluthrin	soap pyrethrum neem

Spider Mites

Spider Mites are not insects but are closely related arthropods. Look for mites on the underside of leaves. They cause a general yellowing and stippling of the leaf tissue.

Webbing similar to spider webs will be present around colonies on leaves, stems and fruit. Large populations can kill leaves and reduce yield.



Recommended Control: Dicofol is the most effective miticide but is labeled for use only on specific crops and label instructions must be followed. Dimethoate, endosulfan, malathion and diazinon are moderately effective in killing mites, but applications must be directed to the lower surfaces of leaves and repeated applications are necessary. ORGANIC methods of control include applications of neem and insecticidal soap at repeated short intervals.

The pesticide information presented in this publication was current with federal and state regulations at the time of printing. The user is responsible for determining that the intended use is consistent with the label of the product being used. Use pesticides safely. Read and follow label directions. The information given herein is for educational purposes only. Reference to commercial products or trade names is made with the understanding that no discrimination is intended and no endorsement by the Cooperative Extension Service is implied.

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