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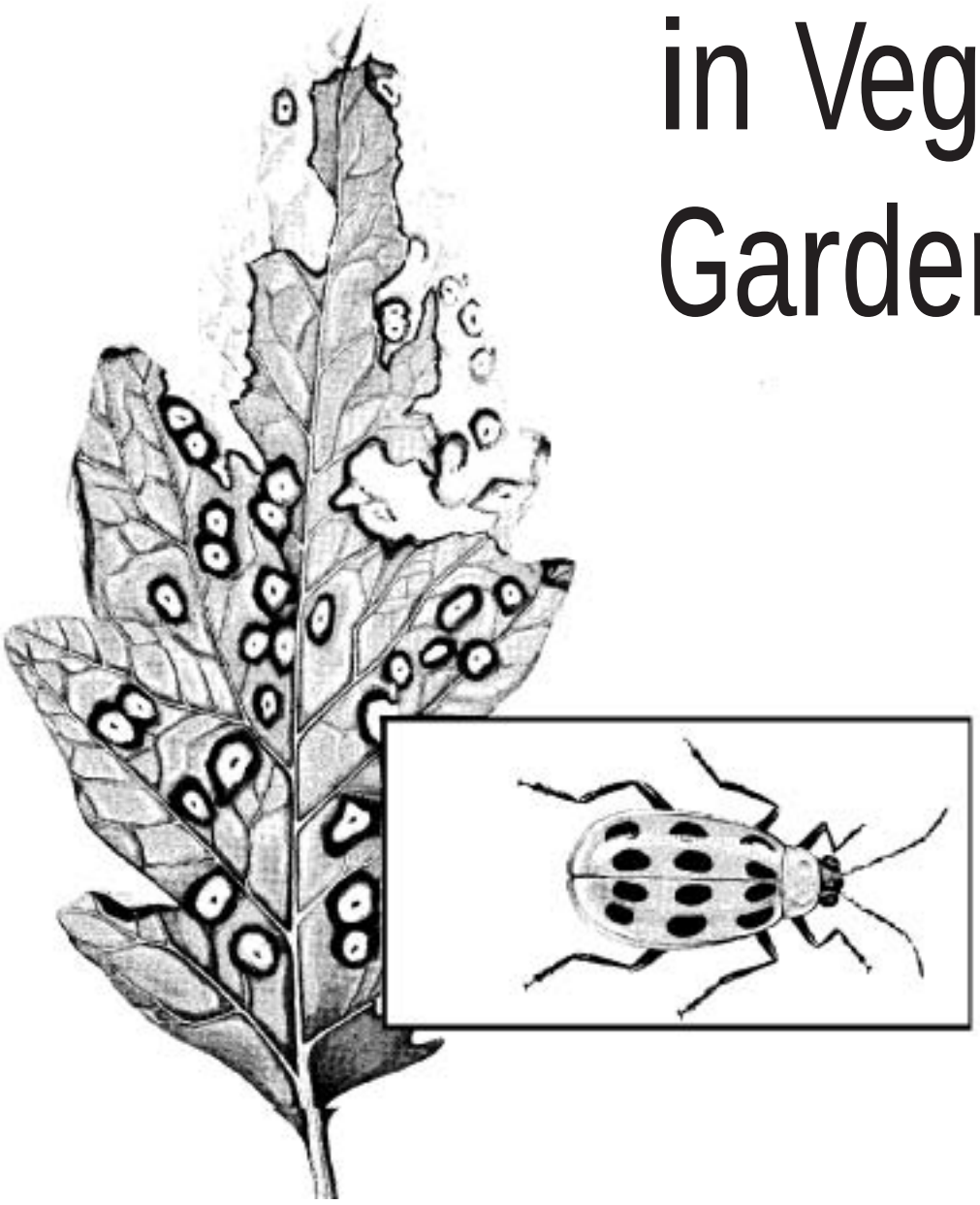
Pest Control in Vegetable Gardens



Pest Control in Vegetable Gardens

Each year pests cause sizeable losses to the Kansas gardener. These losses can be reduced with proper production and pest control practices. Plants that are properly fertilized, watered and cultivated are more tolerant of pests than plants given poor care. Many pests occur year after year, so plan for pest control when you plan the garden.

Gardening with Minimum Pesticides

Chemicals are not the only or best means for controlling garden pests. Gardening without routine use of pesticides has been practiced for centuries. However, one must expect and tolerate some crop losses from pests. Some gardeners accomplish this by planting more garden than needed to insure an adequate supply for both them and the pests. Gardening without pesticides requires more labor and is best suited for small gardens. To control garden pests, remember that damage results from an interaction among:

- The plant (vegetable crop)
- The causal agent (insect, nematode, fungus, etc.)
- The environment (which affects both the plant and causal agent).

The effect of a pest is dependent on this interaction. One year the pest may be an obvious problem, while another year they may disappear due to an unfavorable environment. Other years a small number of pests may appear, but still create a problem because plants are highly susceptible due to certain environmental factors. Environmental factors such as rainfall, humidity and temperature have a great influence on pest populations and plant tolerance. Since pest populations fluctuate, it is important to detect and identify pests early so controls can be selected and implemented. Check plants frequently for evidence of pest problems. Check the underside of leaves, new and old growth, and the root system for changes in plant health. It may be necessary to remove an unhealthy plant to examine the roots to insure soilborne pests are not involved.

Accurate, timely diagnosis is the key to good pest control. If you are unable to identify the problem, consult your local extension office. Retail garden centers, seed stores, nurseries and experienced gardeners may be helpful. Pest control is centered around disrupting the interaction among the plant, causal agent and environment. This can be accomplished by a variety of cultural and chemical practices.

Seed Selection. This is an important first step in planning the garden. Choose varieties that are adapted to your area. Do not save your own seed because many diseases are seed-borne. Instead, buy new seed yearly from dealers with a reputation for selling high-quality, pest-free seed. Certified seed usually costs more, but gives the gardener the best quality assurance. Such seed is grown in Western or arid climates to prevent bacterial and fungal diseases. Seeds may also have been treated to control seed and soilborne pests. If untreated seeds are purchased, consider chemical seed treatment to insure stronger, trouble-free seedlings.

Resistant or Tolerant Varieties. Selecting varieties that are resistant to as many pests as possible is economical in the long run. Resistance is available to most garden diseases, but few insects. Seldom is there a single variety resistant to most garden pests. Consult seed catalogs and the local K-State Research and Extension office for details. The currently recommended varieties for Kansas can be found in the publication L-41, "Recommended Vegetable Varieties for Kansas."

Transplant Selection. Plant strong, healthy seedlings. Plants that are weak, spindly, too young or too old may not survive transplant shock and are more susceptible to certain pests. Avoid purchasing diseased transplants that can introduce a new pest into your garden. Produce your own transplants from clean seed or purchase them from reputable dealers.

Rotation. Rotating vegetables within the garden each year is an effective and economical means of controlling many soilborne diseases. Healthy transplants or clean seed placed in a heavily infested site won't do much good. Move or rotate vegetable crops within the garden or select a new garden site if serious soilborne diseases occur. White grubs, wireworms and cutworms may cause serious damage to crops planted in newly broken sod sites. A soil insecticide may be required. Another effective practice is to alternate corn with other crops. An acceptable four-year rotation would be to follow corn with cole crops (cabbage, broccoli, greens), cole crops with solanaceous crops (tomatoes, potatoes, peppers), solanaceous crops with legumes (peas, beans), and legumes with corn.

Sanitation. Removing volunteer plants, infested crop debris and cull piles are examples of using sanitation for pest control. By reducing pest populations, one reduces the chance for serious outbreaks. Because many pests survive in vegetable plant residues, it is a poor practice to save this residue for mulching. Instead, mulch with straw, leaves or other nongarden materials. Vegetable crop residue should be destroyed by pulling up the entire plant (including roots), chopping it into small pieces, and plowing it under in the fall. Vegetable residue used as compost should not be added back to the garden until it is well decayed.

Sanitation is also important to prevent virus spread. Hands and tools should be washed with soap and water before handling transplants, pruning or close cultivation. This is especially important if you use tobacco products, because tobacco harbors certain plant viruses.

Weed Control. Many garden pests also attack and survive in weeds. Some weeds actually attract certain pests. It is wise to maintain a weed-free garden and a weed-free zone around the garden. Aphids, leafhoppers, beetles, mites, nematodes and other insects transmit plant diseases. Aphids, leafhoppers, and nematodes are the most common carriers of plant viruses. Perennial weeds, such as Johnsongrass and horse nettle, harbor insects and diseases and should be removed from in and around the garden (about a 150-foot perimeter). Weed control will reduce the movement of the insects and plant diseases.

Moisture control. Many pests favor high moisture and humidity. Water gardens early in the day and space plants to obtain good air movement. This will allow leaf surfaces to dry rapidly to reduce many fungal and bacterial diseases, slugs and snails. Stake or cage tomatoes so moisture is not trapped in the foliage and fruit does not touch the soil. During wet periods, slugs and snails may be a severe problem. Their damage can be minimized by reducing moisture-trapping mulches. Generally, plants on wet sites and dry sites are more susceptible to disease and less tolerant of insects.

Physical removal of pests. Picking the insect or its eggs from the plant can be an effective method of controlling a small population. Tomato hornworms, other caterpillars and large beetles can be handpicked from plants. Eggs, often found on the underside of leaves, can be removed and destroyed. Squash vine borer damage can be reduced by slitting the stem lengthwise at the point of attack, killing or removing the borer and covering the stem with moist soil to encourage new root development. The stalk borer in tomatoes can be controlled similarly.

Removing diseased leaves and plants may be helpful in reducing some diseases if only a few plants are attacked and the problem is identified early. Any plants showing virus infection should be removed promptly, and without touching other plants.

Barriers to insects. Transplants can be protected from cutworm attack by wrapping stems with foil or cardboard, or placing the plants inside empty containers opened at both ends. Place protective wrapping in the ground so the container extends 2 inches above and below the soil level. Heavier materials provide better protection.

Traps. Pests such as slugs, snails and squash bugs are attracted to flat boards when they search for moisture, protection and darkness. Slugs can be attracted to and eventually drowned in beer-filled pans partially buried so the pan top is even with the soil surface. Light traps or similar traps are useless to the home gardener. Light traps will attract and collect hundreds of insects, both pest and beneficial. Many insects may not be caught in the traps. Light traps do not catch wingless insects or those active only in the daytime.

Biological controls. Much publicity has been given to the use of predators and parasites for garden pest control. Learn to identify and avoid harming helpful predators such as praying mantids, lady beetles (ladybugs), lacewings, syrphid flies, ground beetles and spiders. Artificial introduction of lady beetles (which can be purchased by the gallon) and praying mantids (purchased by the egg mass) does little good in preventing insect damage. Lady beetles often die from lack of food, or disperse widely soon after they are released. Praying mantids are cannibals, and their first meals are frequently a brother or sister. The best approach is to learn to identify beneficial insects, then avoid destroying them.

Companion planting. This involves using plants that discourage or repel undesirable insects, such as marigolds, petunias and catnip. Companion planting is a somewhat nebulous alternative pest control strategy. Staunch proponents provide testimonials of the effectiveness of companion planting. However, based upon statements from several research-based institutions, it appears companion planting has not shown consistent overall benefits in research conducted under controlled conditions. One citation mentions that research has demonstrated that popular plants such as marigolds, basil and nasturtiums did not provide protection when planted next to most vegetables and, in fact, attracted many common garden insect pests. In another study, cabbages grown with nasturtiums, marigolds, catnip, summer savory and basil as companion plants suffered near-equal damage from cabbageworm feeding as cabbages grown alone. Furthermore, the average head weight of cabbages grown alone (301 grams = .66 pound) was significantly higher than the next best treatment (nasturtium/cabbage = 128 grams = .28 pound/head). Gardeners should not be discouraged from experimenting with companion planting on their own for what might provide acceptable results.

Pesticides. When nonchemical methods fail to prevent pest populations from reaching damaging levels, pesticides should be considered.

Gardening with Chemical Controls

The nonchemical practices described are useful in controlling certain garden pests; however, there are times when these measures are inadequate and chemical pesticides must be considered. Caution: It is a violation of state and federal law for anyone to use a pesticide in a manner inconsistent with its labeling. The user is responsible for reading and following all label directions. Among the items included on the label are the product name, active ingredients, precautionary statements, and directions for use. Some of the mistakes commonly made by home gardeners involve the use of directions. Make sure you understand the label directions before actually making an application. Make sure the crop you plan to treat is listed on the label.

Check the waiting interval. This is the amount of time that must elapse between the time of application and harvest. This may vary from zero to more than 14 days. For example, pretend you have a pesticide you want to apply today on

tomatoes and you anticipate harvesting the tomatoes in the next three to four days. After consulting the label, you find the waiting interval for tomatoes is seven days. This means that you cannot safely harvest the crop in less than seven days if it is treated with this product. If the application was made before reading the label, you should assume that the treated product is unsafe to consume if harvested sooner than the label specifies. By law, the pest or pests that you intend to control must also be listed on the label. Manufacturers may or may not list all the registered uses on the product label. It is not unusual to find that two different brands of the same active ingredient may vary considerably in the number of pests included on the label.

Another safety concern is the dosage and rate of application. Never guess on how much to use. For example, if instructions call for 1 teaspoon per gallon of water to make a spray, and you use 3 tablespoons per gallon, you have prepared a pesticide nine times stronger than intended. You must assume the treated product cannot be safely consumed. The pesticides included in this publication were selected because they are generally available in small package formulations from most local retail dealers. They are listed in this publication by common name. When shopping, you will find a variety of trade, brand, and common names used to identify products. The common or chemical names of these products will be listed under the active ingredient section of the label.

Pesticide Storage. Pesticides should be stored in the original container in a cool (above 32°F), dry place that is secure and away from children. Safely and promptly dispose of empty containers. If accidental ingestion occurs, immediately contact a physician and take the container with you. For the poison control information, call Mid-America Poison Control center at 1-800-322-6633.

Chemicals Used for Disease Control

One difference in disease and insect control programs does exist. Disease control sprays are generally applied at regular intervals to prevent the establishment of plant diseases on economic crops. Insect control sprays can be used to prevent or control an infestation.

Fungicides

Fungicides are chemicals used to control diseases caused by fungi. The chemicals discussed in this section will be helpful in controlling diseases when used at the right time, with the right amount (rate), and in the right manner. Using too much chemical is illegal and often causes plant injury. Many of these chemicals have harvest waiting periods from five to 14 days. These waiting periods must be observed.

Several formulations of copper-based fungicides are available for vegetable disease control. Basic copper sulfate is a fungicide where the copper is fixed chemically so there is less possibility of injury to plants. It gives reasonable control of fungi and provides good control of many bacterial diseases. It is formulated as dust, wettable powder and liquid concentrate and is sold under several names. Cupric hydroxide is also safe for vegetable crops. Copper soaps, which are copper scales of fatty acids, may be used for disease control. Basic copper sulfates should not be confused with common copper sulfate or copper sulfate plus lime (Bordeaux mixture), because the copper is not fixed and will burn many vegetables.

Captan is no longer labeled for control of foliar diseases of vegetables. It is primarily used as a seed treatment and soil drench to control damping-off and other soilborne and seedborne diseases.

Chlorothalonil is an effective fungicide in controlling foliar diseases of tomatoes, melons, cucumbers and other vegetables. It has a limited waiting period. It is sold as Bravo, Daconil 2787, and other trade names.

Mancoteb and Maneb are used to control fungal diseases of cucumber, watermelon, tomato and other vegetable diseases. It may not be applied within five days of harvest.

Potassium bicarbonate is a non-synthetic (organic) fungicide used to suppress certain vegetable diseases.

Sulfur is used mainly to control powdery mildew and rust on vegetables. It may injure plants when applied above 85°F. Several formulations are available, but microfine wettable sulfur is less damaging than dry wettable sulfurs.

Application of Fungicides

Fungicides are most effective when applied before appearance of the disease. Most diseases favor high moisture, so fungicides should be applied soon after rains or irrigation. Repeat applications should be made at regular intervals specified on the label (usually five to 14 days). These chemicals should be applied so the entire upper and lower leaf surfaces are covered with spray.

Spray Additives. It may be best to add a spreader-sticker to spray solutions if recommended on the manufacturer's label. Many emulsifiable or liquid pesticide formulations already contain sufficient spreader-sticker. Spreader-stickers can be purchased at some garden stores. A few drops of household detergent added to cause slight foaming can serve as a spreader. Spreader-stickers are needed when spraying plants with hairy or waxy leaves. Always clean the sprayer with soapy water after each use.

Seed Treatments. Much commercial seed is already treated with fungicides because it improves uniformity of stand and seedling vigor. Untreated seeds can be protected from soilborne and seed-borne diseases. To treat small-seeded vegetables, open the packet and place a small amount of fungicide with the seeds (the amount of fungicide collected twice on the flattened end of a toothpick is usually enough). Next, shake the packet until seeds are coated with the chemical. To treat larger seeds (beans, peas, corn, etc.) place the seed in a jar or similar container, add the amount of fungicide suggested on the label, and shake vigorously. CAUTION: Most seed treatment chemicals are poisonous and should be handled with care. Do not feed or eat treated seed. Most seed treatments discolor the seed and many commercially treated seeds will be a bright color (pink, etc.).

Soil Drenches. Seed treatment is usually not sufficient to control seedling problems when growing transplants in dense stands (window boxes, greenhouse, hotbed). Supplement seed treatments by drenching or sprinkling a fungicide solution over transplants as soon as they emerge. Fungicide labels explain how to make and apply these drenches.

Insecticides, Miticides and Molluscicides

Inorganic insecticides are either elemental or carbon-free compounds.

Sulfur has long been recognized as having insecticidal and acaracidical properties. Sulfur dusts are especially effective against most mite species, as well as acting as an ovicide on mite eggs.

Silicon-based materials act as abrasives and desiccants. Water loss is through abraded cuticular coverings. Dusts also have adsorptive properties to hasten the drying and killing process. Products are marketed as diatomaceous earth.

Iron phosphate is incorporated into a bait that is consumed by slugs and snails. Ingestion of the bait with iron phosphate causes an immediate feeding cessation. Slugs become less active, and die within a week.

Organic insecticides are compunds that contain carbon molecules.

Botanical insecticides are naturally occurring toxicants derived from plants.

- **Pyrethrum** is a mixture of four compounds found in the flowers of certain tropical chrysanthemum species. Upon contact, pyrethrum provides a quick knockdown of targeted insects. However, many insects rapidly recover and continue on. To provide complete control, pyrethrum (marketed as Pyrethrin) is often used in combination with the synergist piperonyl butoxide (pbo). Pbo suppresses the detoxification system, which counteracts the effects of pyrethrum.
- **Rotenone** is made from root extracts of certain tropical plants. Working as a contact and stomach poison, rotenone kills sucking and chewing insects. Being highly sensitive to photodecomposition, the desired degree of insect control may not be achieved with a single rotenone application.
- **NEEM** is a complex of oil extracts from the seeds of the neem tree. One of the extracts (azadirachtin) acts as an insect growth regulator by inhibiting the metabolism of the ecdysome molting hormone. Other extracts, such as lemonoid oils that do not contain the azadirachtin molecules, work as repellents and antifeedants.

Horticultural oils are petroleum or plant based hydrocarbon chains with insecticidal and miticidal properties. Suffocation is the mode of action of horticultural oils. Oils also penetrate egg membranes causing cytoplasmic coagulation, water imbalances or enzymatic and hormonal irregularities. Most current horticultural oils are highly refined, and can be used as dormant and in-season foliar treatments.

Insecticidal soaps are derived from the salts of fatty acids, which are principal components of fats and oils found in plants and animals. Soaps are strictly contact materials to be used against soft-bodied insects and soft-bodied stages of insects that possess hardened and thickened cuticles as adults. Insecticidal soaps can break down soft cuticular tissues. Internally, soaps destroy cell membranes, which disrupts cellular metabolism.

Microbial insecticides are living microscopic organisms or the toxins produced by many types of organisms.

- **Bacteria**. Bacillus thuringiensis (Bt) produces toxic crystalline proteins that actively attach to specific receptor sites on the gut wall when ingested. Destruction of the cellular lining causes cell swelling and eventually lysis, which results in death by septicemia (blood-poisoning). Different Bt strains and substrains produce species-specific endotoxins that must be matched with the appropriate insect.
- **Fungi**. Beauveria bassiana spores germinate and produce hyphal strands. Haustoria penetrate and invade cuticular cells causing rapid water loss and nutrient deprivation, which results in death of the infected insect.
- **Actinomycetes**. Saccharopolyspora spinosa produces substances known as spinosyns. The active ingredient, spinosad, is a naturally occurring mixture of spinosyn A and spinosyn D. Mode of entry is by contact and ingestion. Spinosads prevent acetylcholine from binding to appropriate receptor sites, which causes paralysis and death. Spinosyns are very effective against most caterpillars.
- **Protozoa**. Nosema locustae attacks some grasshopper species. The inactive spore is incorporated into a bait. Once inside the grasshopper, the protozoa become active and consume the body's fat reserves. Remaining reserves are insufficient to nourish grasshopper nymphs during molting periods, which results in their inability to reproduce. Although Nosema locustae has had success in rangeland grasshopper control, results will likely be disappointing in home garden situations.
- **Nematodes**. Although not unicellular organisms, nematodes (multicellular roundworms) are included with microbials due to their small, microscopic sizes. Infective stage nematodes actively enter pests through natural body openings. Bacterial symbionts within the nematodes are released into the infected pests, which eventually succumb to septicemia.

Synthetic insecticides are manmade compounds that do not occur naturally.

- **Organochlorine** chemicals were some of the first synthetic compounds used as insecticides. However, their stability and persistence negatively affected the envi-

ronment, so the manufacture and use of most organochlorine insecticides has been discontinued. The less persistent active ingredient endosulfan has a variety of registered uses, including certain vegetable insect pests. The active ingredient dicofol is marketed Kelthane miticide.

- **Organophosphate** (OP) nerve poisons are relatively nonpersistent compounds, making them ideal organochlorine replacements. Many companies formulate the active ingredients dimethoate, disulfoton, malathion, lambda-cyhalothrin and trichlorfon into their respective product lines. While the names of the active ingredients may or may not be incorporated into product trade names, they always appear on the product label along with the level of their concentration. OPs effectively eliminate a wide variety of vegetable insect pests found in home gardens.
- **Carbamate** insecticides have a mode of action similar to organophosphates — namely as inhibitors of the enzyme acetylcholinesterase. Since its introduction in 1956, carbaryl has been the mainstay of the carbamate insecticides because of its low mammalian toxicity and broad spectrum of insect control.
- **Pyrethroid insecticides** are manmade compounds whose chemical structures are similar to the pyrethrin components of pyrethrum. Pyrethroids are stable when exposed to sunlight, and effective against a wide range of insect pests at very low dosages. Various products containing the active ingredients cyfluthrin, esfenvalerate, lambda-cyhalothrin and permethrin are available for use against vegetable insect pests in home gardens.

Acetaldehyde polymer molluscicides are incorporated into various bait formulations for the control of slugs and snails. The active ingredient metaldehyde interferes with the mucus production systems of organisms.

Protect Beneficial Organisms

Honeybees and other pollinators. Honeybees are the most common pollinators of vegetables crops. They visit plants to collect nectar and pollen. Honeybees work close to their hives, but they also visit plants as far as a mile away. It is a good idea to check for bees before applying insecticides to crops; otherwise, you may damage hives used for pollination. To protect pollinators, the best time to apply insecticides is in the late afternoon or evening. Morning applications should be made with caution because bees visit the flowers early on hot days. Pollinating insects must visit cucumbers, squash, pumpkin, melons, and gourds for them to produce fruit. Lima bean, okra, pepper and eggplant will set fruit without insect visits, but yields increase with pollinators.

Soil organisms. A vast number of organisms live in the soil. Some are pests, but most are beneficial. Organic matter decomposition and transfer, soil aeration and drainage, nutrient availability (especially nitrogen) and control of certain soil pests are influenced by soil organisms. When the soil ecological system is upset these beneficial effects are reduced. Indiscriminate use of pesticides, especially soil pesticides, should be avoided to protect soil organisms.

Equipment Used for Disease and Insect Control

Various spraying and dusting machines that control diseases, insects and weeds are available. Home gardeners will find hand-operated machines or small power-driven machines best suited for their needs. When a person selects dusting or spraying equipment, a number of points should be kept in mind including the following: (1) simplicity of design and ease that adjustments and replacements can be made, (2) quality of material and construction, (3) availability of parts and repair service, and (4) cost.

Sprayers

Sprayers used to apply weed killers like 2,4-D should not be used to apply insecticides and fungicides to garden crops. Herbicide residues often remain in sprayers indefinitely, and use of such a sprayer may result in serious injury to garden crops.

Hose-On Applicators. Several types of applicators designed to fit on the end of a garden hose, are available. As water comes out of the hose, suction mixes the material in the applicator and water. This type of sprayer requires plenty of water and a concentrated solution. This sprayer is more suitable for liquid formulations. However, the sprayer must be attached to a source of water with more than 30 pounds of pressure per square inch in the garden hose. This type of sprayer is inexpensive and readily available. It is good for low-pressure spraying.

Knapsack. This type of sprayer has straps and is carried on the operator's back. The most common is a pump with a large air-chamber and agitator mounted in a 2- to 5-gallon tank. The handle of the pump extends over the shoulder or under the arm, making it possible for the operator to pump with one hand and spray with the other. Knapsack spraying is laborious, which is a disadvantage.

Compression. The compressed-air sprayer consists of an air pump mounted in an air-tight chamber, which is filled approximately three-fourths full with spray materials. The pressure is maintained by pumping the air into the tank, which forces the spray out under pressure. Frequent pumping keeps the pressure up when the tank is nearly full; as the tank empties, the spray effect decreases. The tank must be shaken frequently to keep wettable powder pesticides suspended in the solution. These sprayers are available in 1- to 4-gallon sizes. Those made of plastic or stainless steel are noncorroding and will last for years. The compressed-air sprayer is suitable for the needs of most gardeners.

Power Sprayers. Several types of small, electric and gasoline-powered sprayers are available for home garden use. Sizes range from 3-gallon sprayers or mist-blowers that are backpacked by the operator, to 20-gallon sprayers that are mounted on wheels. Power sprayers are good for pest control

in the garden and for spraying trees. Usually, power sprayers feature automatic agitation that prevents frequent stops and keeps the pesticide properly mixed. Many of these sprayers have an adjustable nozzle attached to the end of a hose. When these sprayers are used for pest control, the nozzle should be adjusted to provide a fine mist. Power sprayers are expensive for home-garden use. However, they should be considered if the garden is large enough to justify the initial investment.

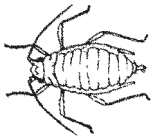
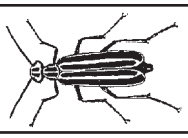
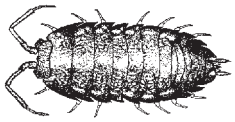
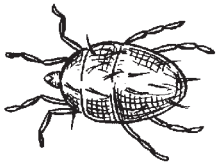
Dusters

In general, a spray is more effective than a dust. The active ingredient in a dust, on the average, is not so finely divided as in a spray, and the dust particles do not adhere to the plant as long as the spray deposit. Furthermore, the smaller the particle size the more toxic the material is to the pest. Dusts are convenient and easy to apply.

Fan Type. The fan-type duster has an enclosed fan with a hand crank and a hopper holding several pounds of dust. Some models are equipped with an agitator to stir the dust so it will flow evenly through the discharge opening. An adjustable device regulates the size of the discharge opening. This type of duster can be fastened to the operator with shoulder straps. The right hand turns the crank and the left hand handles the discharge tube. This type of duster is adequate for use in the home garden.

Plunger Type. The plunger-type hand duster consists of a chamber for the dust and a cylinder with piston or plunger, a rod and a handle. In some models, the dust reservoir is below the cylinder and may be a glass jar, which is screwed onto the cylinder. This type of duster is suitable for dusting a small quantity of plants in the garden. The simplest hand duster is a sack, cheesecloth bag, bucket or can with holes punched in the bottom for the dust to be shaken onto the plants. This method is not very effective for pest control because it gets little or no dust on the lower surface of the leaves. (This section modified from Diseases of Vegetable Crops in Home Garden, North Carolina State Extension Service, Circular 598.)

General Pests

Pest and Damage		Control and Remarks
Aphids. Tiny, soft-bodied, sluggish, winged and wingless insects, may be green, yellow, red, or black. Multiply rapidly. Suck juices from underside of leaves and terminal shoots of many garden plants. Transmit many plant viruses.		Aphids may be present throughout the season. Naturally occurring beneficial insect predators and parasites sometimes suppress aphid populations. If beneficials do not appear to be keeping aphid populations under control, consider applying an insecticide treatment. 2, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16
Blister Beetles. Great numbers of adult beetles may attack many garden plants overnight; feed on leaves. They may be brown, black, gray, or striped brown. One generation per year.		Mostly a problem in late June and July. Apply a foliar insecticide treatment if and when beetles appear. 3, 8
Cutworms. Plump, smooth, greasy-looking, greenish, brownish, or grayish, spotted or striped caterpillars, up to 1-1/2 inches long. Chew through the stems of transplants at the soil surface at night. Hide in soil during the daylight. One to three generations per year, depending on the species.		Mostly a problem in May and June. To prevent cutworm damage, wrap foil around stems of individual plants when transplanting. Or, where stems have just been "cut", cutworms can be found just beneath the soil surface and removed by handpicking. Insecticide applications also may be considered. 3, 4, 5, 8, 9, 14, 17
Flea Beetles. Small, quick-jumping, mostly black; eat small holes in leaves of many garden plants in early spring. There are one to two generations per year, depending on the species.		Overwinter as adults. May be especially damaging to newly emerged seedling plants or small transplants. Apply insecticide at first sign of damage. 3, 4, 5, 8, 9, 13, 15
Grasshoppers. Small nymphs should be killed while in fence rows and non-crop areas in May or June, before they move into the garden. Usually one generation per year.		Insecticide applications may be required to control grasshoppers when they enter gardens. Re-treatments may be necessary if additional grasshoppers move into gardens. 3, 4, 5, 7, 9, 13
Pillbugs or Sowbugs. Many-legged, gray insects that may roll into a ball when disturbed. Found in dark protected areas where there is moisture and decaying organic matter. Feed as scavengers, but may injure plants.		Read specific product labels to ensure that sowbugs appear under the vegetable section of the label. 3
Slugs. Snails without shells. Legless, wormlike, shiny and slimy. Found in dark, damp and protected areas. Feed at night on foliage and fruits.		A general clean-up will eliminate sites where slugs seek refuge. Active ingredients metaldehyde and iron phosphate are registered for slug control. See specific labels for use in and around food crops.
Spider Mites. Tiny webs formed on underside of leaves. Leaves turn off-color. The use of sevin on tomatoes, cucurbits, and beans may cause an increase of spider mites.		Begin mite control program before populations reach damaging levels. Treat the entire plant, giving extra attention to lower leaves. When treating severely infested and damaged plants, a follow-up treatment must be applied two to three days after the initial treatment to kill mites that were in the egg stage during the initial treatment. 5, 6, 7, 10, 11, 12, 13, 15, 16, 18
Stalk Borer. Slender caterpillar, creamy white with purple stripes lengthwise on the body. Brown or purple band behind the head. Bores into stalk of many garden plants, causing them to wither and die.		Usually a problem in June. Overwinter as eggs on grasses and weeds. Destroy fencerow vegetation in late summer or fall. 5,9
White Grubs. Large, white, C-shaped larvae of May/June beetles. Feed underground on tubers and plant roots. Possibly more numerous in new gardens established on previously grassy sites. Damage is attributed to grubs in their second year of development.		No products currently registered for use against white grubs in gardens.

1 - *Bacillus thuringiensis*
2 - *Beauvaria bassiana*
3 - carbaryl
4 - cyfluthrin
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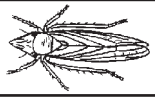
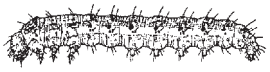
9 - esfenvalerate
10 - horticultural oil
11 - insecticidal soap
12 - malathion
13 - neem
14 - permethrin
15 - rotenone/pyrethrin
16 - rotenone
17 - spinosad
18 - sulfur

Pest and Damage		Control and Remarks
General Pests (cont.)		
Wireworms. Slender, yellow, hard-bodied worms eat holes in roots and stems. Wireworms may be in the soil several years before they mature as click beetles.		No products currently registered for use against wireworms in vegetable gardens.
Moles. Burrowing animals cut roots of plants as they search for insects.		Use traps or flood tunnels with water using garden hose.
Chlorosis. In western and central Kansas, perennial plants often become yellow and stunted if iron is not available for the plants. The leaves become yellow between the veins first causing the veins to appear darker. Well water often has enough minerals to tie up the iron, so this trouble often develops where such water is used in irrigation.		Spray with iron sulfate at 2 teaspoons per gallon of water. Use a spreader-sticker when temperatures are below 85°F. Chelates of iron can also be used. Soil treatments are effective. Repeated applications may be required so spray at two- to four-week intervals until symptoms disappear.
Nematodes. Tiny wormlike animals that feed on roots and lower parts of plant. Gall on roots, stunted growth and poor root development may indicate nematodes. Root Knot nematodes attack a wide variety of vegetables. Some viruses transmitted by nematodes.		Select resistant varieties. Obtain transplants from nematode-free sources. Rotate crops in garden or move garden. No nematicides presently labeled or available locally.
Asparagus		
Asparagus Beetle. ¼ inch long. Red thorax. Bluish wing covered with yellow spots. Larvae and adults feed on emerging spears in early spring, and ferns throughout the remainder of the season. Dark, elongated eggs may be deposited on asparagus heads, rendering them unusable.		Against adults and larvae: 3, 14, 15, 16 Against larvae: 9
Rust. Orange-red pustules on stems and foliage. Spores turn brown with age.		Select resistant varieties. Sulfur sprays. Diseased tops should be cut close to ground and removed or composted each fall.
Crown and Root Rot. Plants die after one or two years. Crowns and roots rotted.		Do not harvest new plantings for three years so adequate food reserves can build up in the crowns. Avoid wet sites.
Beans		
Bean Leaf Beetle. Red to yellow beetles with black spots. Adults feed on undersides of leaves, white larvae feed on roots. There are one to two generations per year.		3, 5, 7, 15, 16
Leafhoppers. Adults are small, green, wedge-shaped flying insects. Nymphs run sideways like crabs. Adults and nymphs suck juice from plants.		3, 5, 9, 10, 11, 12, 13, 15, 16
Mexican Bean Beetle. Copper colored lady beetle with 16 black spots; yellow larvae have black spines. Adults and larvae feed on undersides of leaves. There are two to three generations per year. Only an occasional problem.		7, 8, 9, 15, 16
Spider Mites. See general pests		
Tomato Fruitworm (corn earworm). Green or brown caterpillars with light brown head and light stripe on side and beneath body. Larvae eat leaves and green fruit. There are two to three generations per year.		3, 5, 9, 17

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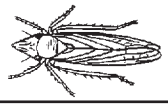
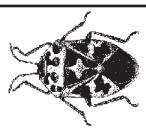
Pest and Damage		Control and Remarks
Beans (cont.)		
Bacterial Blights. First occurs as small, translucent, water-soaked spots on leaves. Later, tissue yellows and dies forming spots of various sizes over the leaves, pods, and stems. Margin of spots often turn reddish with age on pods and stems.		Use disease-free seed and resistant cultivars when available. Avoid saving own seed from season to season. Avoid working in garden when plants are wet and irrigate soil only. Copper fungicides can be helpful (read label). Destroy refuse each fall. Three-year rotation.
Damping Off. Seedlings fall over and are constricted near soil line. Poor stands.		Treat seed with captan prior to planting or buy treated seed. Plant seed on a slight ridge to insure good drainage. Plant in well-drained sites. Do not plant in cold soils.
Root Rots. Plants stunted and wilt during heat of day. Roots and lower stem have large lesions. Plants often show yellowing.		Rotate crops. Plant in well-drained sites. Use seed treated with captan. Plant during ideal germination and growing conditions.
Anthracnose. Elongate, dark red, cankers on stem and leaf veins. Brown sunken spots with pink spores in center on pods.		Rotate beans with corn or cole crops. Do not save seed from year to year. Use chlorothalmil copper based products if severe.
Rust. Powdery red and black pustules on leaves.		Spray with chlorothalonil on a five- to 10-day schedule at first sign of disease. Disease is favored by high humidity so avoid water on foliage.
Mosaic virus diseases. Mottled or variegated foliage (light and dark-green patterns) and curled, stunted leaves.		Grow resistant varieties.
Beets		
Flea Beetles. See general pests.		
Leafhoppers. Adults are small, green, wedge-shaped flying insects. Nymphs run sideways like crabs. Adults and nymphs suck juice from plants.		3, 5, 10, 11, 15, 16
Damping Off. Poor stand and seedlings fall over.		Same as damping off control on beans.
Cercospora Leaf Spot. Spots on leaves. Center of spot is light tan and border is red. Often center of spot has fallen out.		Spray with copper on seven- to 10-day schedule.
Cabbage, Cauliflower, Broccoli, Brussels Sprouts		
Aphids. See general pests.		
Cabbage Looper. Greenish caterpillars that move in a distinctive manner. May be referred to as inchworms. Moths are seldom observed because they are nocturnal. White globular eggs found on undersides of leaves. Caterpillars feed on leaves and in heads.		5, 8, 9, 10, 11, 13, 14, 15, 16, 17
Harlequin Bug. Black stink bug with bright yellow or orange marks. Sucking of sap may cause plants to wilt and die. Also found on horseradish, mustard, and other garden plants. Usually three generations per year.		3, 8, 13, 15, 16
Imported Cabbage Worm. White imported cabbage worm butterflies are in gardens beginning in late March and through the summer and fall. Elongated yellow eggs are mostly on undersides of leaves. Caterpillars are green and fuzzy and feed on leaves and in heads.		1, 3, 5, 8, 9, 12, 13, 14, 15, 16, 17

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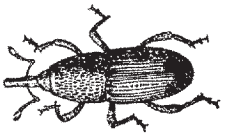
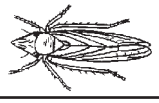
Pest and Damage		Control and Remarks
Cabbage, Cauliflower, Broccoli, Brussels Sprouts (cont.)		
Damping Off. Young plants die in bed by falling over at soil line.		Seed treatment as with bean to aid in prevention. Drench soil with captan. Reseed or reset if necessary.
Black Rot. Large V-shaped lesions at the margin of leaves. Veins are very dark in dead area. Occurs on seedlings and mature plants.		Use disease-free (western grown) seed, disease free seedlings, or disease-resistant cabbage varieties. Hot water treated seeds are safe. Do not work with wet plants. Use a three- to four-year rotation. Destroy refuse.
Blackleg. Small spots on leaves and stems. Spots are well defined with gray centers containing tiny black bodies (fruiting bodies of causal agent). Worse in wet weather.		Same as black rot control.
Downy Mildew. Usually occurs during cool, wet weather. Topside of leaves show yellow spots. Underside has downy bluish fungal growth.		Avoid overhead watering. Use chorothalonil at seven- to 10-day intervals if disease appears. Use resistant broccoli varieties such as Citation, Mariner, and Everest.
Alternaria Leaf Spot. Circular leafspot with concentric rings and yellow border. Usually worse on older leaves.		Same as downy mildew. Spray chlorothalonil on seven- to 10-day interval once disease occurs.
Club Root. Galls or knots on roots. Seldom occurs in basic soil, but common in acid soils. Plants wilt in heat of day.		Make soil basic (pH 7.2 or higher) before planting or setting by adding hydrated lime (1 lb./33 ft. row). Rotate to area where cole crops have not been planted.
Wilt (Yellows). Stunting and slow wilting of plants, especially in wet soils. Leaves (bottom leaves first) are yellowish-green, curl, sapstream is brown. Plants may be affected only on one side.		Grow yellows-resistant varieties.
Soft Rot. Slimy, soft, odorous rot of leaves and heads. Worse in wet weather and after harvest.		Often follows wounds from insects, so control insects and other injury. Store only dry, sound heads.
Carrots		
Carrot Weevil. Beetles lay eggs in carrot tops. When eggs hatch, white legless grubs burrow in roots of carrots. One generation per year.		Remove and destroy plant debris that can provide protection for overwintering adult weevils. A rotenone/pyrethrin mixture is registered for use against "vegetable weevils." 4, 9
Leafhoppers. Adults are small, green, wedge-shaped flying insects. Nymphs run sideways like crabs. Adults and nymphs suck juice from plants.		3, 4, 5, 9, 11, 15, 16
Parsleyworm. Large, green caterpillar with black and yellow bands around the body; eats leaves. Most commonly feeds on dill, also parsley. Two to three generations per year. Adult is the black swallowtail butterfly.		No insecticides specifically registered for use against this lepidopterous species. Caterpillars can be removed by handpicking.
Black and Crown Rot. Lesions on fleshy roots. Plants may wilt and die.		Grow in well-drained area and rotate with corn.
Aster Yellows. Inner leaves stunted and yellow. Outer leaves bronzed to red. Roots stunted, woody and fibrous. Transmitted by leafhoppers.		No practical controls.
Root Knot Nematode. Knots on roots, unthrifty plants.		Rotate with corn on three- to four-year rotation.

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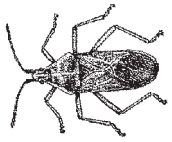
Pest and Damage		Control and Remarks
Corn		
Aphids. See general pests.		
Corn Earworm. Green, brown, yellow or pinkish caterpillars with light stripes. Feed in ear. Moths are attracted to and deposit eggs on green silks. Once silks have browned-off, they are no longer attractive. Several generations per season.		3, 4, 5, 9, 14, 17
Flea Beetles. See general pests. Transmit bacterial wilt disease (see diseases).		
Stalk Borer. See general pests.		
Maize Dwarf Mosaic. Plants stunted, leaves have green and yellow patterns or may be red-purple following cool weather.		Avoid planting near Johnsongrass, because aphids carry virus from grass to corn. Practice good weed control. Choose tolerant varieties.
Bacterial Wilt (Stewart's Disease). Plants wilt. Leaves show large stripes of dead tissue. Sticky ooze often present.		Control flea beetles, which transmit the disease. Use resistant varieties. Plant disease-free seed.
Smut. Large, white to black galls on stalks, tassels and especially ears. Masses of black spores released if galls are opened. May be worse after hail injury.		Spores survive in soil several years. Remove galled tissue early and destroy. Do not use diseased plants in compost. Rotate to areas where corn has not been planted for three to five years. Some partially resistant varieties.
Leaf Spots. Elongate or small spots on leaves. Spots may be so numerous as to cause dead patches.		Plant early. Plow under residue. Spray chlorothalonil once symptoms first appear.
Cucumber, Melons, Squash, Pumpkin, Gourd		
Aphids. See general pests. Transmit mosaic disease (see diseases).		
Cabbage Looper. Greenish inchworm with four white lines down its back. Eats leaves. There are three to four generations per year.		1, 5, 8, 9, 12, 13, 14, 15, 16, 17
Cucumber Beetles, Striped and Spotted. Adults eat leaves when plants come up. Transmit bacterial wilt disease (see diseases). Larvae feed in roots. One to two generations per year.		3, 5, 8, 9, 12, 14, 15, 16
Squash Bug. Large, gray bugs. Suck sap from the plant causing a rapid wilt. Usually hidden about the base of the plant or under leaves. One to two generations per year. See K-State Research and Extension Publication MF-2508, Squash Bugs and Squash Vine Borer.		3, 8, 9, 14, 15, 16
Squash Vine Borer. White worm feeds in stem near base of runner. First sign of presence is sudden wilting, then masses of greenish-yellow excrement protruding from holes in stem. May also enter fruit. Usually one generation per year.		8, 9, 15, 16
Anthracnose. Angular to circular spots on leaves. These spots merge together with time and often blight the whole leaf. Stems also attacked. As fruit approach maturity sunken, water-soaked spots with pink spore masses develop. Entire plant can be killed.		Select resistant varieties. Practice a three-year rotation with crops other than cucurbits. Do not save seed, but use certified seed. Spray at seven- to 10-day intervals with mancoteb, chlorothalonil, maneb, or fixed coppers. Destroy residue. Avoid working with wet plants.

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Pest and Damage	Control and Remarks
Cucumber, Melons, Squash, Pumpkin, Gourd (cont.)	
Alternaria Leaf Spot. Small, zonate or target-shaped spots with yellow halo.	Use same fungicides as listed for anthracnose.
Bacterial Wilt. Plants wilt and die rapidly. Single vines or entire plant may die. Disease can be best diagnosed in the field by cutting a wilted vine in half with a sharp knife or razor. Wait a few minutes and touch cut ends of the vine together again. Clear or white slimly liquid will strand between cut ends as they are put together and pulled apart again.	Disease is transmitted by cucumber beetles, so start cucumber beetle control just as the plants come through the soil.
Damping Off. Young seedlings fall over and die. Poor stand.	Same control as for damping off of bean.
Virus dieseases (mosaic). Green and yellow mottling or variegation on leaves and fruit. Leaves often curled, twisted, or even reduced to almost strings. Fruits may also be warty.	Resistant varieties. Practice good weed control.
Powdery Mildew. White to grayish fungal growth on leaves. Leaves become yellowed, curl and die.	Resistant varieties. Spray with sulfur or chlorothalonil.
Fruit Rots. Fruit rotted, especially where in contact with soil.	Do not plant in poorly drained soils. Grow plants on trellis or straw mulch to keep plants off soil.
Fusarium Wilt. Plants stunted, yellow. Leaves wilt and die. Discolored streaks in vascular system. Roots rotted.	Plant resistant varieties. Fusarium wilt of muskmelons, squash and watermelons are distinct diseases and cross-infection will not occur.
Eggplant	
Flea Beetles. See general pests.	
Damping Off. Young plants die in beds by falling over at soil line.	Soil drenches as with cole crops.
Leaf Blights and Fruit Rots. Brown and sunken spots on stems, leaves and fruit. Blisters may occur on fruit.	Rotate crops in garden.
Leafy Greens: Lettuce, Collards, Kales, Spinach, Mustard	
Leaf Spots. White to brown spots causing spots or blight.	Spray with fixed coppers once sighted. During rainy weather will need to continue at seven- to 10-day intervals. Use spreader-sticker. Read label carefully for waiting period prior to harvest date.
Soft Rot. Soft, slimy, odorous rot of leaves.	Avoid crowding plants. Avoid injury. Rotate on a three- to four-year rotation and avoid wet sites.
Onion	
Onion Thrips. Tiny, sucking insects cause elongated light-colored blotches on leaves. Five to seven generations per year. 	5, 11, 12
Bulb and Neck Rot. Soft, sunken area at top of bulb. This may occur in field or storage. In field, leaves die early.	Harvest only when mature. Hasten maturity by breaking over tops. Cure rapidly after harvest. Rotate crops on a three-year cycle. Store in cool, dry place. Colored varieties are more resistant.

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Pest and Damage	Control and Remarks
Leafy Greens: Lettuce, Collards, Kales, Spinach, Mustard (cont.)	
Smudge. Mostly on white varieties. Dark black to green smudged areas on bulbs. Bulbs often shrivel.	Plant colored varieties and avoid wet sites.
Smut. Elongate, blister-like streaks in seedling leaves that are later filled with black spores. Leaves twisted and stunted.	Use disease-free seed and transplants.
Peas	
Aphids. See general pests.	
Damping Off. Seedlings fall over and die.	Same as for beans. Do not plant in cold, wet soil.
Root Rots. Yellowed, unthrifty plants. Roots rotted.	Rotate crops. Avoid wet soils.
Powdery Mildew. White fungus on leaves. Extensive yellowing and defoliation.	Spray or dust with sulfur.
Downy Mildew. Water-soaked leaves with bluish-gray fungus on lower leaf surface.	Spray with fixed coppers when plants are dry. Ten-day interval is adequate.
Peppers	
European Corn Borer. Larvae feed inside peppers. Moths deposit eggs on fruits. Larvae must bore into fruits. Protective treaments should be applied as fruits form, and thereafter until harvest. 	3, 4, 5, 9, 14, 15, 16, 17
Damping Off. Young seedlings fall over and die.	Seed treatment and soil drenches as with cole crops.
Blossom-end Rot. Shriveled and poorly developed blossom end.	Keep good, balanced nutrition (avoid excessive nitrogen). Uniform water supply. Calcium balance in plant and soil is critical, maintain proper soil pH.
Bacterial Leaf Spot. Circular, yellow-brown spots on leaves and stem. Defoliation can be extensive. Fruit can also be attacked and may sun scald if defoliation is extensive.	Disease-free seed and transplants. Spray with fixed copper every seven to 10 days after disease first appears. Early control is essential. Do not work with wet plants.
Anthracnose Fruit Rots. Sunken spots on fruit with pink spores.	Spray with fixed coppers. Use disease-free seed.
Potatoes	
Aphids. See general pests.	
Blister Beetles.	No registered insecticides for blister beetles on potatoes.
Colorado Potato Beetle. Adult beetles (yellow and black striped) and pink larvae eat leaves. Two generations per year. 	3, 5, 8, 9, 14, 15, 16, 17
White Grubs. See general pests.	
Wireworms. See general pests.	
Scab. Scabby spots on surface of tuber. Disease is worse in dry, nonacid (basic) soils.	Plant scab-free tubers in soils free of scab. Adjust pH to 5.2-5.5. Avoid lime, manure and wood ashes. Use acid-forming fertilizer.

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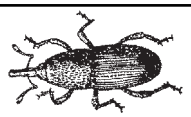
Pest and Damage		Control and Remarks
Potatoes (cont.)		
Early and Late Blight. Early Blight. Spots occur mostly on older leaves as circular spots often with concentric rings typical of a target. This spot is surrounded by a yellow zone that fades into the green leaf. **Late Blight.** Disease occurs mostly during cool, wet weather. Lesions are large, dark to olive-brown. Cottony fungal growth commonly occurs, especially on lower surface. Causes leathery-like rot on tubers, not unlike scalding.		Control of early blight usually not necessary. For late blight, spray fixed coppers, maneb, mancoteb, or chlorothalonil every seven to 10 days. Destroy crop residue, cull piles and volunteer plants.
Seed-piece Decay. Poor stand. Seed-piece rot in hill, especially if soils remain cold. Stunted plants.		Warm tubers for one week to 55° F before cutting and dust cut pieces with captan before planting. Plant in warm soil.
Running-out. Problem when gardener saves his own seed, because viruses attack the plants and are carried over in seed. Plants are stunted, leaves rolled or mottled and yields decline each year.		Use certified seed as indicated by blue tag on bag.
Net Necrosis. Brown or black lines scattered throughout tubers. Can occur in field or storage.		Caused by high temperature injury and/or virus. Difficult to prevent in dry years. Dig before hot weather and store in cool place. Practice good irrigation and water conservation by mulching.
Green Tubers. Tubers are green, similar to leaves. May occur in field or storage.		Potato tubers are modified stem, so they turn green when exposed to light. Store in dark place soon after harvest.
Storage Rots. Tubers decay in storage.		Store in cool, well-ventilated place on racks. Do not pile more than 12 to 14 inches deep. If air movement is blocked and moisture accumulates, potatoes will rot.
Blackleg. Plants yellowed, stunted and wilted with brown to black slimy rot on base of stem, tubers and roots.		Rotate on a three- to four-year basis. Plant certified, disease-free seed. Avoid plant injury and insect damage.
Radish		
Flea Beetles. See general pests.		
Rhubarb		
Rhubarb Curculio. Large (½ inch) weevil. Adult beetles lay eggs in rhubarb stalks, but most larvae feed in roots of dock (Rumex spp.).		Destroy dock plants growing near rhubarb. Handpick beetles and destroy. No insecticides registered for use against this insect.
Crown and Root Rot. Wilting of plant. Brown sunken areas at base of stem. Crowns rotting, especially internally.		Avoid overwatering or drought stress. Remove and destroy diseased plants. Start with disease-free stocks and do not replant in same site. Apply fixed copper or bordeaux in the crown. Fungicides must be applied early to prevent spotting of stalks.
Leaf Spots. Large or small, irregularly shaped spots on leaves. Center of spots often fall out.		Remove and destroy affected leaves. Destroy crop refuse each fall. Captan helpful during wet weather.

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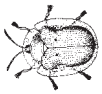
Pest and Damage	Control and Remarks
Sweet Potatoes	
Tortoise Beetles. Adults and larvae feed on leaves. One generation per year. Golden tortoise beetle is most common species. 	3, 15, 16
White Grubs. See general pests.	
Wireworms. See general pests.	
Black Rot. Starts as black spots on base of stems. It can extend up to the soil line causing a shank rot of stems or attacks the storage roots. Here it causes spots that are deep brown to black and nearly circular. The spot has a metallic luster and the flesh under the skin will be green.	Black rot affected roots will usually produce diseased slips. Thus, use only disease-free roots for bedding or buy slips (young plants) produced from clean roots. Rotate to other sites.
Scurf. Brown to black discoloration of roots. The skin is not broken, but appears scaly or russeted.	Same as for black rot.
Storage Rots. Rotting or discoloration of roots. Frequently, damage is not detected until roots are cut.	Do not expose sweet potatoes to temperature below 55°F. They are very susceptible to chill damage. Cure roots immediately after harvest by placing roots at 85°F and high humidity for one week. Never place roots in air-tight bags. Store in areas above 55°F.
Soil Rot or Pox. Roots deformed with pitted, scabby areas. Young roots with girdling lesions.	Plant in acid soil (pH 5.2). Plant disease-free stock. Avoid drought conditions. Rotate every six years.
Tomatoes	
Aphids. See general pests.	
Blister Beetles. See general pests.	
Cutworms. See general pests.	
Hornworms. Large (3 to 4 inches), green caterpillars with a horn (tail) on their rear end; eat leaves. Adult is the large hummingbird moth seen near flowers. 	Handpick, preferably when small and before they have caused extensive defoliation. 1, 3, 4, 5, 8, 9, 14, 16, 17
Stalk Borer. See general pests.	
Stink Bugs. Suck juices, causing white areas beneath skin of ripening fruit.	3, 4, 5, 9, 15, 16
Tomato Fruitworm (corn earworm). See beans.	Problem throughout season. 5, 6, 7, 10, 11, 12, 13, 15, 16, 18
Damping Off. Seedlings fall over at soil line. Mainly a problem in plant beds.	Use treated seed as with bean. Plant seeds in non-soil mix or sterile soil. Drench with captan 50% WP at 2 tablespoons per gallon when first observed. Repeat at 10-day intervals as needed. Avoid wet or poorly drained soil.
Leaf Spots and Blights. Small to large spots on leaves and fruit. Unless a water-soaked ring surrounds the spot the problem is usually due to fungi. **Early Blight and late blight** as described on potatoes. **Septoria** has many small spots with yellow border and black bodies in the center.	Spray with either fixed coppers, maneb, mancoteb or chlorothalonil every seven to 10 days. In wet season, will need to start as soon as plants are transplanted, but in dry seasons only after first symptoms. Stake plants and prune to allow good air movement.

1 - *Bacillus thuringiensis*
2 - *Beauvaria bassiana*
3 - carbaryl
4 - cyfluthrin
5 - lambda-cyhalothrin
6 - dicofol
7 - dimethoate
8 - endosulfan
9 - esfenvalerate
10 - horticultural oil
11 - insecticidal soap
12 - malathion
13 - neem
14 - permethrin
15 - rotenone/pyrethrin
16 - rotenone
17 - spinosad
18 - sulfur

Pest and Damage	Control and Remarks
Tomatoes (cont.)	
Bacterial Spot. Same as peppers.	Same as peppers.
Anthracnose on fruit. Sunken spots on fruit with pink spores.	Use disease-free seed and rotate crops. Spray with chlorothalonil, maneb, mancoteb or fixed coppers.
Fruit Rots. Fruit in contact with soil may rot due to soilborne fungi.	Avoid contact with soil by staking and mulching to prevent splash. Control foliage diseases with program above (see leafspot and blights).
Fusarium Wilt. Wilting of plant and yellowing of lower leaves. Worse during warm weather. Sap streams dark.	Use resistant varieties. Move to soil free of wilt.
Verticillium Wilt. Very slow wilting of plant and slight marginal burn of leaves. Sap stream dark especially near base of plant. Worse during cool weather.	Use resistant varieties. Good fertilization and warm weather will suppress the disease. Plant in disease-free sites.
Virus. Plants appear mottled, rolled, twisted, stunted or even wilted. Several viruses attack tomatoes and cause one or more of these symptoms. This damage can be separated from herbicide injury because virus damage usually first appears on only one or a few plants, while herbicide injury appears to all at about the same time.	Do not use tobacco products while gardening and wash hands with soap and water after handling tobacco. Use resistant varieties to TMV.

1 - *Bacillus thuringiensis*	4 - cyfluthrin	7 - dimethoate	10 - horticultural oil	13 - neem	16 - rotenone
2 - *Beauvaria bassiana*	5 - lambda-cyhalothrin	8 - endosulfan	11 - insecticidal soap	14 - permethrin	17 - spinosad
3 - carbaryl	6 - dicofol	9 - esfenvalerate	12 - malathion	15 - rotenone/pyrethrin	18 - sulfur

Many companies purchase the same active ingredients to incorporate into their respective product lines. Not all companies select the same range of insect pests or use sites to appear on their product labels. Prior to purchase and use, it is the user's responsibility to read product labels to ensure the safe and legal application of that product against the intended pest(s) on the specific crop(s) being grown.

For poison control information call

Mid-America Poison Control Center
Room B-400, 3901 Rainbow Blvd.
Kansas City, KS 66160-7231

1-800-322-6633

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