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Managing Insect and Mite Pests in Vegetable Gardens

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Managing Insect and Mite Pests in Vegetable Gardens

Vegetable gardening is an enjoyable pastime. The result of your labors is fresh, home-grown produce. Frequently, growing your own vegetables is even less expensive than buying not-so-fresh produce from the market.

However, producing your own vegetables can be challenging. One of the greatest challenges is to successfully control insect pests. Fortunately, there are numerous management alternatives that vegetable gardeners may consider when dealing with insects and other pests. These include cultural, biological, and management controls and, last but not least, chemical controls.

Understanding insects

There are approximately 30,000 insect species in Texas. Fortunately, fewer than 100 species are routine pests in vegetable gardens. Most insects found in gardens are either incidental or beneficial, contributing to pollination, the balance of nature, or recycling of organic matter. A garden with an abundant supply of insects actually may be quite healthy and productive. However, insect pests can reduce the quantity or quality of the vegetables produced and may transmit plant diseases. Consider using control measures when insects threaten the garden.

Identify the insects in your garden to determine if they are beneficial, incidental, or pests. Learn to recognize the common insects in your area, especially the pests, and learn to recognize the type of damage associated with pests.

Insect pests can enter vegetable gardens by walking or flying. Flight allows many insects to have great mobility and their movement in large numbers is possible. Also, certain pests, like aphids and mites, reproduce about once a week under good conditions and their populations can increase rapidly. When pests seem to appear in large numbers almost overnight, they have either moved in or are rapidly reproducing.

As insects grow, they change in size and shape. This process is called metamorphosis. Some insects damage plants in both the immature and adult stages. Because insects change, they may be difficult to identify and the type of damage they cause also may change. Young caterpillars may barely scrape

the surface of a leaf when feeding, while the same caterpillar may eat great chunks of leaves when mature.

An insect's mouthparts can be a key to understanding the type of damage caused by a pest. Insects with sucking mouthparts feed by piercing leaves or fruit. Damage appears as pock marks or mottled leaves. Insects with chewing mouthparts chew holes in plants. If you can recognize the type of feeding, you can select the proper insecticides (i.e., stomach poisons for chewing insects).

Plan ahead

When planning a vegetable garden, anticipate the pests that may occur during the year. Consider all management practices that will help deal with the pests before they become problems. Then, develop a management plan and put it into use before problems occur. Use your past experience as a guide in anticipating pests for the upcoming season.

Integrated Pest Management

Integrated pest management, IPM, is a philosophy of managing pests using multiple control techniques. IPM balances the goals of economic production and environmental stewardship when implementing control practices. IPM is the overriding strategy for most of production agriculture today and is rapidly being adopted in home gardening as well.

Monitoring or scouting crops for the presence and abundance of pests is an important part of IPM. Most IPM programs reserve the use of insecticides for situations when the pest is present in large numbers and the cost of return on the investment in control practices can be justified.

Many specific insect control practices can be implemented as part of an IPM program; generally the use of insecticides is included as a control option. When alternate control practices are substituted for insecticides, the IPM approach is similar to organic gardening.

Many of the insect management practices available to home vegetable gardeners are categorized in the following sections.

Cultural control

Cultural controls that can reduce pest populations consist of a variety of management practices such as crop rotation, cultivation, weed management, water management, and proper fertilizer use. Use fallow periods and crop rotation to interrupt the life cycles of pests whenever possible. Always destroy plant debris that can harbor pests and control weeds because they attract insects that may feed on vegetables.

Host plant resistance

Vegetable varieties differ in susceptibility to insect pests. This response is called host plant resistance (HPR). Resistance can be expressed as tolerance, non-preference, or antibiosis. Tolerance is the ability of the plant to continue to develop and produce even with insect feeding. Non-preference is exhibited when an insect prefers to feed on or lay eggs on alternative varieties or host plants. Antibiosis is the ability of a plant to kill or slow the development of a pest, usually with chemicals that occur naturally in the plant. Extensive variety trials are needed to determine the HPR of vegetables. Most variety selection emphasizes factors like appearance, taste and production volume, not insect resistance.

Recently, transgenic plants have been developed for field crops and some vegetables including tomatoes, potatoes and corn. Transgenic plants have had their genetic material altered. Dramatic results have been achieved when genes for resistance to insects are incorporated into plants. Most of the resistant transgenic vegetable varieties have genes of the bacteria *Bacillus thuringiensis* and are resistant through antibiosis to caterpillars or beetles. Resistant transgenic vegetable varieties are expected to become increasingly available to home gardeners in time.

Biological control

Biological control is the use of one organism to control another. Three approaches to biological control have been successfully implemented: importation, conservation and augmentation.

Importation is the introduction of a parasite or predator from another country into our country to control a pest species. Importation is highly regulated and is beyond the scope of home vegetable gardeners. We do benefit, however, from successful importation programs completed by various research groups.

The conservation approach to biological control is the perpetuation or encouragement of natural enemies already present in the area. Conservation methods in home gardens include providing nectar-producing flowers as food for insect parasites and avoiding unnecessary pesticide applications.

Augmentation is the release of additional predators and parasites that add to the natural populations of biological control organisms. Releases of ladybird beetles, praying mantises, parasitic wasps, and other organisms contribute to biological control. However, because many of these organisms occur naturally in the environment, the additional benefit contributed by releases may be marginal. There are many commercial sources of biological control agents.

Biological control should not be considered as an instant solution to pest problems. Generally, a sound biological control program needs to be supported by careful study and increased knowledge. Proper identification of pests, careful selection of beneficial organisms, and increased monitoring are all necessary for success. Biological control solutions cannot be implemented for all pest situations because biological control agents are not available for every pest.

Mechanical control

Mechanical control is the use of physical means to reduce the number of insects or insect damage or to exclude pests from the garden. Mechanical methods include the use of barriers, covers, high pressure water sprays, and hand picking of pests.

Barriers come in many shapes and sizes. They prevent the movement of pests onto the plants. Cardboard or plastic cylinders around the base of transplants are an example of a barrier that discourages cutworms and other soil-inhabiting pests from attacking transplants.

Cloth or plastic row covers can serve as a cover to keep out pests in a newly planted garden. Screening may increase the temperature of a planting bed, so additional benefits of temperature management may be achieved. Screening is useful for young plants and seedlings that are the most susceptible to pest attack.

High pressure water sprays are also a mechanical control method. Sprays are most effective against small, soft-bodied pests like aphids. High pressure water sprays may help remove webbing, dissolve droppings, and quickly reduce the number of pests.

This is one of the few options available for use when vegetables are near harvest because of safety restrictions.

Hand picking and destruction of some pests may be feasible in small gardens. If persistently done, hand picking can be successful in controlling tomato hornworms and squash bugs. Obviously, hand picking is more feasible for larger insects than for small insects.

Chemical control

Pesticides come in many forms and provide a wide array of pest management options. Pesticides are regulated for safety by the Environmental Protection Agency (EPA), and the sale and use of these products are regulated by the Texas Department of Agriculture. These agencies do not consider efficacy, or "how well it works," in the registration process but concentrate on safety issues instead. The number of products available for use in home vegetable gardens and the rapid changes in product availability make it difficult to determine product efficacy. The response of pests also can change as resistance develops over time or as environmental factors interact with the chemical treatment.

The USER is always responsible for the proper use of any pesticide. It is illegal to use a product in a manner or situation that is not defined on a pesticide label. Therefore, the user must read the product label thoroughly and follow directions specifically.

Insecticides are approved or registered by the EPA for use on particular crops. Registration should be the primary consideration in using pesticides safely. Table 1 lists chemicals registered for use on specific vegetables. There are several products with more than one active ingredient; only a few of them have been reviewed and included here.

Product labels may carry a number of restrictions that must be considered before using an insecticide. There are limits on the rate of application, the number of applications per season, specific crops, the method of application, and the days from last application to harvest. Be sure to read the label for additional restrictions and carefully follow the directions.

Product labels also have a suggested list of target pests on the label. A summary of the target pests also is included in Table 1. This list was prepared from product labels and not all product labels have been examined by the Texas Agricultural Extension

Service. Results from efficacy trials were not considered in preparation of this guide. Control results may vary depending on the environmental conditions, method of application, and other factors.

Table 2 lists product label names of insecticides available for use in home gardens. It is not an exhaustive list but includes most of the common active ingredients currently available. Use this list as a guide when purchasing products for use in home vegetable gardens.

There are numerous trade names for some generic insecticides and special restrictions may be present on the labels. Read the labels carefully.

Pesticides vary widely in their danger to humans and the environment. The label's key words, CAUTION, WARNING or DANGER, indicate product toxicity. Use product label information as a guide to product use and potential hazard. Also, Material Safety Data Sheets (MSDS), which provide further safety information, are available from chemical manufacturers upon request.

Insecticide products can be further categorized by their compound class (Table 3). Insecticide classes provide a key to understanding the mode of action of the product and, thus, the pests that are most likely controlled by that product. When insect control is unsatisfactory, change to a product in a different compound class.

Less Toxic Approaches

Many gardeners prefer to use less toxic approaches, rather than standard insecticides, to manage insects. Less toxic approaches range from selecting "soft" insecticides to that of natural control with no action. These "soft" insecticides generally carry the CAUTION signal word on the label. They are sold and may be purchased in the same manner as the more traditional pesticide products that also carry the CAUTION word on the label. Several of the products considered less toxic that are registered and sold as pesticides are included in this guide.

Some less toxic chemicals are available under different legal registrations. The EPA has listed chemicals under Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) Section 125.25 that are considered "minimum risk pesticides" and are exempt from FIFRA registrations. This list includes: cedar oil, citric acid, citronella, cloves, garlic, lemongrass oil, mint, peppermint, rosemary, thyme, white pepper, and several other products. Many of these products (e.g., Garlic Barrier[®], Hot Pepper Spray[®])

may be sold as repellents. This registration category was created for products considered to be "safe"; it does not imply product effectiveness.

Put It All Into Practice When Planning and Planting a Garden

1. **Plant a Garden of Manageable Size** – Garden size directly affects control methods that work for individual plants or small gardens. Hand removal of pests and swabbing pests with insecticidal soap may not be feasible in larger gardens. The larger the garden, the greater the need for insecticides.
2. **Leave the Garden Fallow Before Planting** – Insect pests such as white grubs, wireworms and cutworms overwinter in the soil and feed on abandoned plants or weeds. Remove these food sources during the off-season to reduce pest numbers before spring planting.
3. **Good Sanitation** – Remove dead leaf piles, boards, landscape timbers and other objects where pests such as cutworms, slugs, snails, pillbugs and sowbugs congregate. Mulches often are used to maintain moisture and provide shelter for spiders and predatory insects. However, mulches also provide shelter for pests.
4. **Select Pest-free Transplants** – Inspect plants at the store to be sure they have no pests. Many common insects and mites can be found on the under surfaces of leaves. Purchase only healthy, pest-free transplants.
5. **Select Pest-resistant Vegetable Varieties** – Some vegetable varieties are unattractive to or resistant to certain pests. Planting resistant varieties adapted to your area can dramatically reduce the need for insecticides. For example, the sweet corn variety 'Seneca Sentry' is resistant to corn earworms and is adapted to central Texas. Unfortunately, the pest resistance status of only a few vegetable varieties is known.
6. **Practice Good Horticultural Methods** –
 - *Properly prepare the soil before planting.* Thorough tilling of the soil will kill many soil insects and provide good growing conditions for seedlings and transplants. Healthy plants will be less susceptible to severe pest damage. The composition of the soil and spring growing conditions (weather) also affect pest populations. Soils with

high organic matter are more likely to support white grubs, root maggots, pillbugs and sowbugs, even though these soils may promote better plant growth.

- *Plant at the proper time.* Cold wet soils can slow germination and promote disease.
 - *Keep a weed-free garden.* Weeds supply food for insect pests. Weeds also compete with vegetable plants for soil nutrients and water, and can drastically decrease vegetable yields. Keep weeds out of the garden and keep grass around the garden mowed short to discourage insects such as grasshoppers and armyworms from moving in.
 - *Fertilize properly.* Plants need adequate nutrients to grow well. Without them, plants may be slow growing, stunted and more susceptible to pest damage. However, too much fertilizer can produce lush green plants that attract insects such as aphids.
 - *Water properly.* Either too much or too little water can be unhealthy for plants. Drought-stressed plants are likely to attract spider mites.
7. **Inspect Plants for Pests and Properly Identify Them** – Learn to identify the various insects and other creatures encountered in the garden. Many of them are actually beneficial. County Extension agents can be helpful in identifying plant pest problems. Avoid treating undiagnosed problems. Pests attack garden plants from seed to maturity. Inspecting plants weekly or more often helps you detect pest infestations early, monitor natural enemies and evaluate the effects of control tactics. Check the undersides of leaves for aphids, whiteflies and spider mites, and for egg clusters of armyworms, Colorado potato beetles, and squash bugs. To detect low populations of spider mites and thrips, beat plants on a piece of off-white paper. The pests can be seen and easily identified on the paper. Although yellow sticky cards are occasionally promoted as insect control devices, they are best used to monitor pest activity. These cards attract the winged adult stages of aphids, leafminers, thrips, whiteflies and a variety of flies. Cards should be inspected and replaced regularly so pests can be detected early and their numbers monitored. Sex attractant chemicals called pheromones also are available commercially for use in monitoring many insect pests.

8. Consider All Pest Suppression Methods –

When a pest outbreak occurs, consider how it might have been prevented and what the best method of control might be. Control means reducing the pest numbers to a tolerable level, not eliminating 100 percent of the pests.

- *Reflective mulches.* Highly reflective mulches like foil paper can slow infestation by pests such as aphids.
- *Barriers.* Young plants or transplants are vulnerable to attack by cutworms, sowbugs or pillbugs. Plants can be protected by placing a barrier around the base of each one. Barriers can be made of cardboard, plastic or metal containers with the bottoms cut out.
- *Row covers over the garden.* Fine mesh screens or fabrics provide a barrier through which even tiny insects such as thrips cannot cross. Several products are used to cover and protect crops. This method works best in early spring or fall because it also serves to protect against frost damage. When barriers are properly maintained, insects can be excluded. However, plants should still be monitored regularly and this requires removing the barrier. The row covers, which come in several weights, also may need to be removed to prevent damage to plants from elevated soil temperatures.
- *Cages and trellises.* Plants growing on the ground are susceptible to soil pests. Vine plants, such as cucumbers, and tomatoes are easier to manage when grown in trellises or cages. It is easier to monitor pests and spray plants thoroughly when they are held off the ground.
- *High pressure water sprays.* Small pests such as aphids, spider mites and others can be dislodged from plants with high pressure water sprays directed to the undersides of leaves. Commercial spray devices are available (Water Wand® and Jet-All Water Wand®), but these devices also can be homemade. Be careful not to harm the plant or to distribute pests around the garden. Repeated treatments may be necessary to keep pest numbers low.

9. Conserve Natural Enemies and Protect Bees –

The first line of defense against insect pests is their natural enemies. Spiders, praying mantises, lady beetles, ground beetles, green

lacewings, ambush bugs, assassin bugs, minute pirate bugs and even some wasp species prey upon insects. However, the most effective natural enemies are the tiny parasitic wasps and flies, together with bacteria, fungi and viruses that are rarely observed. Whether naturally occurring or released into the garden, these organisms should be preserved and encouraged to thrive. Do not use pesticides except as a last resort; allow natural enemies an opportunity to suppress the pest infestation. Should pesticides be required, select the least toxic, most target-specific pesticides that decompose quickly in the environment.

Natural enemies can be released in the garden to control pests. Lady beetles and green lacewing larvae eat aphids and whiteflies; predaceous mites eat two-spotted spider mites; and certain wasps parasitize certain insect pests (*Trichogramma* species develop inside caterpillar eggs and *Encarsia* species develop inside immature whiteflies). Parasitic nematodes (*Steinernema carpocapsae* and *Heterorhabditis bacteriophora*) control a wide variety of vegetable garden soil pests. Companies that sell these natural enemies do not guarantee the results, particularly in outdoor sites. Factors such as the number of pests present, the environment, timing of releases, prior pesticide use and the presence of ants can affect results.

Bees pollinate vegetables such as cucumbers, pumpkins, squash and melons and should be protected. Don't apply pesticides while bees are active during the day. Instead, treat plants early in the morning or late in the afternoon. Avoid using products or formulations highly toxic to bees. If a bee hive is located nearby, cover it during pesticide application or arrange to have the hive protected from pesticide drift.

10. **Apply Pesticides Only When Justified** – If a pest population becomes too damaging and other control measures have failed, a pesticide may be required. Pesticides are regulated by law and must be applied strictly according to label directions. Pesticides can be toxic, and must be used carefully to reduce risk of negative side effects.

To effectively control leaf-feeding insects, the pesticide must thoroughly cover the undersides of leaves. This is difficult to do with dust-formulated products. When using liquids

(emulsifiable concentrates, wettable powders), mix the directed amount with water and spray immediately. Alkaline water will decompose the active ingredients of some products if the solution is allowed to stand. Agitate the mixture while treating. If spray droplets bead up and roll off the treated foliage, a spreader-sticker may be necessary. After treatment, clean the sprayer thoroughly, store pesticides properly and wash protective clothing separately from other laundry.

Some pesticides, especially those of biological origin, have short shelf lives. Do not store for long periods.

11. Follow Instructions – The user is always responsible for the effects of pesticide residues and problems that could arise from drift or movement of the pesticide to neighboring areas. **Always read and carefully follow the instructions on the container label.** Proper disposal of leftover pesticides and “empty” or used containers is an essential step in safe pesticide use.

Additional information on pest biology, identification and control may be obtained via the Web at <http://entowww.tamu.edu/>.

POLICY STATEMENT FOR MAKING CHEMICAL CONTROL SUGGESTIONS

The Texas Agricultural Extension Service bases its suggestions for pesticide use on:

- product registration status;
- avoidance of residues in excess of allowable tolerances;
- avoidance of toxicity to desirable vegetation and animals, and to humans; and
- avoidance of adverse side effects upon beneficial predators and parasites, honeybees, fish and other wildlife, plants, animals and humans.

Suggested pesticides must be registered and labeled for use by both the Environmental Protection Agency and the Texas Department of Agriculture. The status of pesticide label clearances is subject to change and may have changed since this publication was printed. County Extension agents and appropriate specialists are advised of changes as they occur.

Natural Enemies of Common Garden Pests



Trichogramma wasp



Syrphid fly



Pirate bug



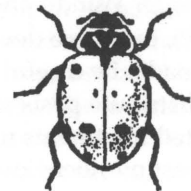
Big-eyed bug



Damsel bug



Green lacewing



Convergent ladybeetle

Table 1. Common garden vegetables, their registered pesticides and common insect pests.

NA – no specific pre-harvest interval information was found on the label.

P – a pre-plant soil application, generally used for pests in the soil.

S – allowed on the soil only and not on the vegetable plants directly; usually indicates baits.

Only some of the more common pests and vegetables are listed.

Product labels found in trade channels were the primary source of information. This includes many, but not all, of the products available to the home vegetable grower. A list of the products reviewed during preparation of the guide are included in Table 2. Only a few products with a mixture of two or more active ingredients were reviewed for this guide. Multiple active ingredients complicate the summary so these were not included in the listing in this table.

The column "Registered Pesticides" lists the common name of chemicals that have that particular vegetable listed on the label. "Pesticides Registered by Pest" is similarly the pesticides that have that pest on the label. The user should be aware that the pesticide may not specifically state the combination of commodity and pest on a particular label. The user is responsible for reading the label and following directions on the label.

Pests sometimes have several common names. Additional common names for the same pest are given in parentheses. Some labels have a general common name for a pest group. This group is listed under the pest name and specific examples are listed after the colon. In a few cases the adult and immature form have different common names and control measures. The control measures for each stage are indicated in the table or both names are listed separately with

different control measures. An example is cucumber beetles; immature ones are called rootworms. This example includes several species having adults that feed on flowers and foliage and larvae that feed on roots.

Common insect names follow the common names list of the Entomological Society of America wherever possible.

Additional pests

Ants – Several ant species can be found in vegetable gardens. Fire ants and Texas leafcutting ants are the most severe pests. Ants should be controlled outside the garden if possible. Bait formulations or individual mound treatments are preferred. Inside the garden, use a mound drench of boiling water if possible.

Snails and slugs – Products containing metaldehyde are the primary control measures for snails and slugs. These products are typically granular baits or pastes.

Grasshoppers and crickets – Grasshoppers and crickets may move into gardens rapidly, especially when winged. When these pests are abundant, protecting foliage with an insecticide may not be very successful. Insecticides like carbaryl are generally preferred. Bait formulations with carbaryl and metaldehyde are available for this situation. Treating the premises outside of the garden may help. Use barriers to protect the most valuable plants.

Sowbugs, pillbugs, millipedes, centipedes, mole crickets, cutworms and earwigs are considered soil insects. These pests are typically controlled with preplant treatments of insecticides incorporated into the soil. Typical treatments are granular formulations of diazinon or chlorpyrifos watered into the soil.

Vegetable	Registered Pesticides	Days Between Last Application and Harvest	Common Insect Pests	Pesticides Registered by Pest
Asparagus	azadirachtin	NA	asparagus beetles	carbaryl chlorpyrifos pyrethrins rotenone
	<i>Bacillus thuringiensis</i>	0		
	carbaryl	1		
	chlorpyrifos	1		
	insecticidal soap	0		
	metaldehyde	S	cutworms	azadirachtin carbaryl chlorpyrifos pyrethrins
	neem oil	NA		
	paraffinic oil	0		
	pyrethrins	0		
	rotenone	1		
Beans Comments: Special restrictions apply to lima beans in some cases. Dry beans are specifically mentioned on the labels for carbaryl, dicofol and dimethoate only.	azadirachtin	NA	aphids: pea aphid	azadirachtin diazinon dimethoate disulfoton endosulfan insecticidal soap malathion neem oil paraffinic oil pyrethrins rotenone
	<i>Bacillus thuringiensis</i>	0		
	carbaryl	0		
	diazinon	P-7		
	dicofol	7		
	dimethoate	0		
	disulfoton	P		
	endosulfan	P		
	insecticidal soap	0		
	malathion	1-3		
	metaldehyde	5		
	methoxychlor	3		
	neem oil	NA		
	paraffinic oil	0		
	pyrethrins	0	blister beetles	carbaryl endosulfan malathion methoxychlor pyrethrins
	rotenone	1		
	sulfur	NA		

Table 1. Common garden vegetables, their registered pesticides and common insect pests. (continued)

Vegetable	Registered Pesticides	Days Between Last Application and Harvest	Common Insect Pests	Pesticides Registered by Pest
Beans (continued)			cabbage looper	<i>Bacillus thuringiensis</i> carbaryl endosulfan malathion pyrethrins rotenone
			corn earworm (tomato fruitworm, bollworm, soybean podworm)	azadirachtin <i>Bacillus thuringiensis</i> carbaryl diazinon endosulfan methoxychlor
			cucumber beetles	azadirachtin carbaryl diazinon endosulfan malathion pyrethrins rotenone
			cutworms: black cutworm	azadirachtin carbaryl diazinon endosulfan pyrethrins
			European corn borer	azadirachtin carbaryl endosulfan
			flea beetles	carbaryl chlorpyrifos diazinon endosulfan malathion pyrethrins rotenone
			leafhoppers	carbaryl diazinon disulfoton endosulfan insecticidal soap malathion methoxychlor pyrethrins rotenone
			leafminers: serpentine leafminer	azadirachtin diazinon dimethoate disulfoton malathion paraffinic oil

Table 1. Common garden vegetables, their registered pesticides and common insect pests. (continued)

Vegetable	Registered Pesticides	Days Between Last Application and Harvest	Common Insect Pests	Pesticides Registered by Pest
Beans (continued)			Mexican bean beetle	azadirachtin carbaryl diazinon endosulfan malathion methoxychlor neem oil pyrethrins rotenone
			mites: spider mites	azadirachtin diazinon dimethoate disulfoton insecticidal soap paraffinic oil pyrethrins
			plant bugs	insecticidal soap
			saltmarsh caterpillar	<i>Bacillus thuringiensis</i> carbaryl
			stink bugs	carbaryl endosulfan insecticidal soap pyrethrins rotenone
			thrips: western flower thrips	azadirachtin carbaryl diazinon dimethoate disulfoton insecticidal soap malathion paraffinic oil pyrethrins rotenone
			wireworms	diazinon
Beets (roots and tops)	azadirachtin <i>Bacillus thuringiensis</i> carbaryl diazinon insecticidal soap malathion metaldehyde neem oil paraffinic oil pyrethrins rotenone	NA 0 3 (roots); 14 (tops) P 0 7 P NA 0 0 1	aphids	azadirachtin diazinon insecticidal soap malathion neem oil pyrethrins rotenone
			armyworms: beet armyworm	azadirachtin <i>Bacillus thuringiensis</i> carbaryl diazinon
			flea beetles	carbaryl diazinon insecticidal soap malathion pyrethrins rotenone

Table 1. Common garden vegetables, their registered pesticides and common insect pests. (continued)

Vegetable	Registered Pesticides	Days Between Last Application and Harvest	Common Insect Pests	Pesticides Registered by Pest
Beets (roots and tops) (continued)			stink bugs	carbaryl insecticidal soap pyrethrins rotenone
			webworms: beet webworm, garden webworm	<i>Bacillus thuringiensis</i> carbaryl pyrethrins
Bok choy	azadirachtin	NA	(see Lettuce)	
Broccoli (see cole crops)				
Brussels sprouts (see cole crops)				
Cabbage (see cole crops)				
Cantaloupe (see melons)				
Carrots	azadirachtin	NA	cutworms: black cutworm	azadirachtin carbaryl diazinon pyrethrins
	<i>Bacillus thuringiensis</i>	0		
	carbaryl	0		
	diazinon	P-14		
	insecticidal soap	0		
	metaldehyde	S	flea beetles	carbaryl diazinon insecticidal soap pyrethrins rotenone
	neem oil	NA		
paraffinic oil	0			
pyrethrins	0			
rotenone	1			
			leafhoppers	carbaryl diazinon insecticidal soap pyrethrins rotenone
			mites: spider mites	azadirachtin diazinon insecticidal soap paraffinic oil pyrethrins
			wireworms	diazinon
			weevils: carrot weevil	azadirachtin
Cauliflower (see cole crops)				
Celery	azadirachtin	NA	aphids	azadirachtin diazinon insecticidal soap malathion pyrethrins rotenone
	<i>Bacillus thuringiensis</i>	0		
	carbaryl	14		
	diazinon	P-7		
	insecticidal soap	0		
	malathion	7		
	pyrethrins	0		
	rotenone	1	armyworms: beet armyworm	azadirachtin <i>Bacillus thuringiensis</i> carbaryl diazinon

Table 1. Common garden vegetables, their registered pesticides and common insect pests. (continued)

Vegetable	Registered Pesticides	Days Between Last Application and Harvest	Common Insect Pests	Pesticides Registered by Pest
Celery (continued)			cabbage looper	<i>Bacillus thuringiensis</i> carbaryl malathion pyrethrins rotenone
			corn earworm (tomato fruitworm, bollworm, soybean podworm)	azadirachtin <i>Bacillus thuringiensis</i> carbaryl diazinon
			cutworms: black cutworm	azadirachtin carbaryl diazinon pyrethrins
			leafhoppers	azadirachtin carbaryl diazinon insecticidal soap malathion pyrethrins rotenone
			leafminers: serpentine leafminer	azadirachtin diazinon malathion
			mites: spider mites	azadirachtin diazinon insecticidal soaps pyrethrins
			weevils: carrot weevil	azadirachtin
Chives	azadirachtin	NA		
Cole Crops: Broccoli, Brussels sprouts, Cabbage, Cauliflower	azadirachtin <i>Bacillus thuringiensis</i> carbaryl chlorpyrifos diazinon dimethoate disulfoton endosulfan insecticidal soap malathion metaldehyde methoxychlor neem oil paraffinic oil pyrethrins rotenone	NA 0 3-14 P-30 P-21 7 5 7-14 0 3-7 S 3-7 NA 0 0 1	aphids: cabbage aphid, poplar-petiole gall aphid	azadirachtin diazinon dimethoate disulfoton endosulfan insecticidal soap malathion neem oil pyrethrins rotenone
			armyworms: beet armyworm	azadirachtin <i>Bacillus thuringiensis</i> carbaryl chlorpyrifos diazinon endosulfan
			cabbage looper	<i>Bacillus thuringiensis</i> carbaryl endosulfan malathion pyrethrins rotenone

Table 1. Common garden vegetables, their registered pesticides and common insect pests. (continued)

Vegetable	Registered Pesticides	Days Between Last Application and Harvest	Common Insect Pests	Pesticides Registered by Pest
Cole Crops: Broccoli, Brussels sprouts, Cabbage, Cauliflower (continued)			corn earworm (tomato fruitworm, bollworm, soybean podworm)	azadirachtin <i>Bacillus thuringiensis</i> carbaryl chlorpyrifos diazinon endosulfan methoxychlor
			cutworms: black cutworm	azadirachtin carbaryl chlorpyrifos diazinon endosulfan pyrethrins
			diamondbacked moth	azadirachtin <i>Bacillus thuringiensis</i> diazinon endosulfan pyrethrins rotenone
			flea beetles	carbaryl chlorpyrifos diazinon endosulfan insecticidal soap malathion methoxychlor pyrethrins rotenone
			imported cabbageworm	azadirachtin <i>Bacillus thuringiensis</i> carbaryl diazinon endosulfan malathion methoxychlor pyrethrins rotenone
			harlequin bug	carbaryl endosulfan insecticidal soap malathion pyrethrins rotenone
			root maggots: cabbage maggot	chlorpyrifos diazinon
			thrips: western flower thrips	azadirachtin carbaryl diazinon dimethoate disulfoton insecticidal soap malathion paraffinic oil pyrethrins rotenone

Table 1. Common garden vegetables, their registered pesticides and common insect pests. (continued)

Vegetable	Registered Pesticides	Days Between Last Application and Harvest	Common Insect Pests	Pesticides Registered by Pest
Cole Crops: Broccoli, Brussels sprouts, Cauliflower, Cabbage, (continued)			weevils: vegetable weevil	azadirachtin
			whiteflies: sweetpotato whitefly	azadirachtin diazinon endosulfan insecticidal soap malathion paraffinic oil pyrethrins rotenone
Collards (see greens)				
Corn (sweet)	azadirachtin	NA	aphids	azadirachtin
	<i>Bacillus thuringiensis</i>	0		diazinon
	carbaryl	0	endosulfan	
	chlorpyrifos	P-35	insecticidal soap	
	diazinon	P-7	neem oil	
	endosulfan	0	pyrethrins	
	insecticidal soap	0	rotenone	
	metaldehyde	S	armyworms: fall armyworm	azadirachtin
	neem oil	NA		<i>Bacillus thuringiensis</i>
paraffinic oil	0	carbaryl		
pyrethrins	0	chinch bug	chlorpyrifos	
rotenone	1		corn earworm (tomato fruitworm, bollworm, soybean podworm)	azadirachtin <i>Bacillus thuringiensis</i> carbaryl chlorpyrifos diazinon endosulfan
			cucumber beetles	azadirachtin carbaryl chlorpyrifos diazinon endosulfan pyrethrins rotenone
			European corn borer	azadirachtin carbaryl chlorpyrifos endosulfan pyrethrins rotenone
			flea beetles	carbaryl chlorpyrifos diazinon endosulfan insecticidal soap
			grubs: white grub	chlorpyrifos

Table 1. Common garden vegetables, their registered pesticides and common insect pests. (continued)

Vegetable	Registered Pesticides	Days Between Last Application and Harvest	Common Insect Pests	Pesticides Registered by Pest
Corn (sweet) (continued)			rootworms: southern corn rootworm, spotted corn rootworm, twelve-spotted cucumber beetle	azadirachtin carbaryl chlorpyrifos diazinon endosulfan pyrethrins rotenone
			root maggots: seedcorn maggot	chlorpyrifos diazinon
			stalk borers: lesser cornstalk borer, southwestern corn borer	chlorpyrifos
			stink bugs	carbaryl endosulfan insecticidal soap pyrethrins rotenone
			wireworms	chlorpyrifos diazinon
Cowpeas (see peas, southern)				
Cucumbers	azadirachtin <i>Bacillus thuringiensis</i> carbaryl diazinon endosulfan insecticidal soap malathion metaldehyde neem oil pyrethrins rotenone	NA 0 0 P-7 0-5 0 1-3 S NA 0 1	aphids: melon aphid or cotton aphid	azadirachtin diazinon endosulfan insecticidal soap malathion neem oil pyrethrins rotenone
			cabbage looper	<i>Bacillus thuringiensis</i> carbaryl endosulfan malathion pyrethrins rotenone
			cucumber beetles: southern corn rootworm	azadirachtin carbaryl diazinon endosulfan malathion pyrethrins rotenone
			cutworms: black cutworm	azadirachtin carbaryl chlorpyrifos diazinon endosulfan pyrethrins
			leafminers: serpentine leafminer	azadirachtin diazinon malathion

Table 1. Common garden vegetables, their registered pesticides and common insect pests. (continued)

Vegetable	Registered Pesticides	Days Between Last Application and Harvest	Common Insect Pests	Pesticides Registered by Pest
Cucumbers (continued)			melonworm	azadirachtin <i>Bacillus thuringiensis</i> carbaryl endosulfan rotenone
			mites: spider mite	azadirachtin diazinon insecticidal soap pyrethrins
			pickleworm	azadirachtin carbaryl endosulfan malathion rotenone
			squash bug	azadirachtin carbaryl endosulfan insecticidal soap neem oil rotenone
			squash vine borer	endosulfan malathion
			stink bugs	carbaryl endosulfan insecticidal soap pyrethrins rotenone
			thrips: western flower thrips	azadirachtin carbaryl diazinon insecticidal soap malathion pyrethrins rotenone
			whiteflies: sweetpotato whitefly	azadirachtin diazinon endosulfan insecticidal soap malathion pyrethrins rotenone
Eggplant	azadirachtin <i>Bacillus thuringiensis</i> carbaryl insecticidal soap malathion metaldehyde methoxychlor neem oil paraffinic oil pyrethrins rotenone	NA 0 0 0 3 S 1 NA 0 0 1	aphids	azadirachtin insecticidal soap malathion neem oil pyrethrins rotenone
			Colorado potato beetle	azadirachtin <i>Bacillus thuringiensis</i> carbaryl methoxychlor neem oil pyrethrins rotenone
			Comments: Certain <i>Bacillus thuringiensis</i> formulations are specific for beetles.	

Table 1. Common garden vegetables, their registered pesticides and common insect pests. (continued)

Vegetable	Registered Pesticides	Days Between Last Application and Harvest	Common Insect Pests	Pesticides Registered by Pest
Eggplant (continued)			cucumber beetles	azadirachtin carbaryl malathion pyrethrins rotenone
			flea beetles	carbaryl insecticidal soap malathion methoxychlor pyrethrins rotenone
			lacebugs: eggplant lacebug	carbaryl insecticidal soap paraffinic oil pyrethrins
			leafminers: serpentine leafminer	azadirachtin malathion paraffinic oil
			mites: broad mite, spider mite	azadirachtin insecticidal soap paraffinic oil pyrethrins
			whiteflies: sweetpotato whitefly	azadirachtin insecticidal soap malathion paraffinic oil pyrethrins rotenone
Greens: Chinese cabbage, Collards, Kale, Mustard greens, Turnip greens Comments: Registration for specific crops varies between product labels. Check the label for specifics. Chinese cabbage is listed only on the labels of carbaryl, chlorpyrifos, diazinon and insecticidal soap. Turnip greens is listed only on the labels of azadirachtin, <i>Bacillus thuringiensis</i> , carbaryl and diazinon. Chlorpyrifos does not have mustard greens on the label.	azadirachtin <i>Bacillus thuringiensis</i> carbaryl chlorpyrifos diazinon dimethoate endosulfan insecticidal soap malathion neem oil paraffinic oil pyrethrins rotenone	NA 0 14 P-30 P-10 14 21 0 7 NA 0 0 1	aphids	azadirachtin diazinon dimethoate endosulfan insecticidal soap malathion neem oil pyrethrins rotenone
			armyworms: beet armyworm	azadirachtin <i>Bacillus thuringiensis</i> carbaryl chlorpyrifos diazinon endosulfan
			beetles: yellowmargin- ed leaf beetle	azadirachtin
			<i>cabbage looper</i>	<i>Bacillus thuringiensis</i> carbaryl endosulfan malathion pyrethrins rotenone

Table 1. Common garden vegetables, their registered pesticides and common insect pests. (continued)

Vegetable	Registered Pesticides	Days Between Last Application and Harvest	Common Insect Pests	Pesticides Registered by Pest
<p>Greens: Chinese cabbage, Collards, Kale, Mustard greens, Turnip greens (continued)</p> <p>Diazinon is labeled only for preplant treatment on mustard greens.</p> <p>Dimethoate does not have kale on the label.</p> <p>Insecticidal soap and malathion do not have mustard greens on the labels.</p> <p>Neem oil and paraffinic oil do not have kale or mustard greens on the labels.</p>			diamondbacked moth	azadirachtin <i>Bacillus thuringiensis</i> diazinon endosulfan pyrethrins rotenone
			flea beetles	carbaryl chlorpyrifos diazinon endosulfan insecticidal soap malathion pyrethrins rotenone
			imported cabbageworm	azadirachtin <i>Bacillus thuringiensis</i> carbaryl diazinon endosulfan malathion pyrethrins rotenone
			leafhoppers	carbaryl diazinon dimethoate endosulfan insecticidal soap malathion pyrethrins rotenone
			mites: spider mite	azadirachtin diazinon dimethoate insecticidal soap paraffinic oil pyrethrins
Herbs	insecticidal soap pyrethrins	0 0		
Kale (see greens)				
Kohlrabi (see cole crops)				
<p>Lettuce</p> <p>Comments: Registration status may be for head or leaf lettuce. Be sure to check the label for specifics.</p> <p>Days from last application to harvest is less on leaf lettuce than head lettuce for several chemicals.</p>	azadirachtin <i>Bacillus thuringiensis</i> carbaryl diazinon dimethoate disulfoton endosulfan insecticidal soap malathion metaldehyde neem oil paraffinic oil pyrethrins rotenone	NA 0 3-14 P-14 7-14 P 14 0 7-14 S NA 0 0 1	aphids: red lettuce aphid	azadirachtin diazinon dimethoate disulfoton insecticidal soap malathion neem oil rotenone
			armyworms: beet armyworm	azadirachtin <i>Bacillus thuringiensis</i> carbaryl diazinon endosulfan

Table 1. Common garden vegetables, their registered pesticides and common insect pests. (continued)

Vegetable	Registered Pesticides	Days Between Last Application and Harvest	Common Insect Pests	Pesticides Registered by Pest
Lettuce (continued)			beetles: yellowmargined leaf beetle	azadirachtin
			cabbage looper	<i>Bacillus thuringiensis</i> carbaryl malathion rotenone
			corn earworm (bollworm, tomato fruitworm, soybean podworm)	azadirachtin <i>Bacillus thuringiensis</i> carbaryl diazinon endosulfan
			cutworms: black cutworm	azadirachtin carbaryl diazinon pyrethrins
			diamondbacked moth	azadirachtin <i>Bacillus thuringiensis</i> diazinon rotenone
			flea beetles	carbaryl diazinon insecticidal soap malathion rotenone
			imported cabbageworm	azadirachtin <i>Bacillus thuringiensis</i> carbaryl diazinon malathion rotenone
			leafhoppers	carbaryl diazinon dimethoate disulfoton insecticidal soap malathion rotenone
			leafminers: serpentine leafminer	azadirachtin diazinon dimethoate disulfoton malathion paraffinic oil
			thrips: western flower thrips	azadirachtin carbaryl diazinon dimethoate disulfoton insecticidal soap malathion paraffinic oil pyrethrins rotenone

Table 1. Common garden vegetables, their registered pesticides and common insect pests. (continued)

Vegetable	Registered Pesticides	Days Between Last Application and Harvest	Common Insect Pests	Pesticides Registered by Pest
Melons Comments: Specific melon types may be listed on some of the labels. Be sure to check product labels for specific restrictions.	azadirachtin <i>Bacillus thuringiensis</i> carbaryl diazinon dimethoate endosulfan insecticidal soap malathion metaldehyde neem oil rotenone	NA	aphids: melon aphid or cotton aphid	azadirachtin diazinon dimethoate endosulfan insecticidal soap malathion neem oil rotenone
		0	cabbage looper	<i>Bacillus thuringiensis</i> carbaryl endosulfan malathion rotenone
		0	cucumber beetles: southern corn rootworm	azadirachtin carbaryl diazinon endosulfan malathion rotenone
		P-3	cutworms: black cutworm	azadirachtin carbaryl diazinon endosulfan
		3	leafminers: serpentine leafminer	azadirachtin diazinon dimethoate malathion paraffinic oil
		0-5	melonworm	azadirachtin <i>Bacillus thuringiensis</i> carbaryl endosulfan rotenone
		0	mites: spider mite	azadirachtin diazinon dimethoate disulfoton insecticidal soap paraffinic oil pyrethrins
		1-7	pickleworm	azadirachtin carbaryl endosulfan malathion rotenone
		S	squash bug	azadirachtin carbaryl endosulfan insecticidal soap neem oil rotenone
		NA	squash vine borer	endosulfan malathion

Table 1. Common garden vegetables, their registered pesticides and common insect pests. (continued)

Vegetable	Registered Pesticides	Days Between Last Application and Harvest	Common Insect Pests	Pesticides Registered by Pest
Melons (continued)			stink bugs	carbaryl endosulfan insecticidal soap rotenone
			thrips: western flower thrips	azadirachtin carbaryl diazinon dimethoate insecticidal soap malathion paraffinic oil pyrethrins rotenone
			whiteflies: sweetpotato whitefly	azadirachtin diazinon endosulfan insecticidal soap malathion paraffinic oil pyrethrins rotenone
Muskmelon (see melons)				
Mustard greens (see greens)				
Okra	<i>Bacillus thuringiensis</i> carbaryl insecticidal soap malathion neem oil paraffinic oil rotenone	0 0 0 1 NA 0 1	aphids	insecticidal soap malathion neem oil rotenone
			corn earworm (bollworm), tomato fruitworm, soybean podworm)	<i>Bacillus thuringiensis</i> carbaryl
			stink bugs	carbaryl insecticidal soap rotenone
Onions Comments: Dry onions are sometimes on the label as a separate site.	azadirachtin <i>Bacillus thuringiensis</i> diazinon insecticidal soap malathion metaldehyde neem oil paraffinic oil pyrethrins rotenone	NA 0 P-14 0 3 5 NA 0 NA 1	armyworms: beet armyworm	azadirachtin <i>Bacillus thuringiensis</i> diazinon
			cutworms: black cutworm	azadirachtin diazinon pyrethrins
			root maggots: onion maggot Comments: Diazinon granules are for soil treatments for maggots. Other treatments are meant for adult flies.	diazinon malathion

Table 1. Common garden vegetables, their registered pesticides and common insect pests. (continued)

Vegetable	Registered Pesticides	Days Between Last Application and Harvest	Common Insect Pests	Pesticides Registered by Pest
Onions (continued)			thrips: onion thrips, western flower thrips	azadirachtin diazinon insecticidal soap malathion paraffinic oil pyrethrins rotenone
			wireworms	diazinon
Parsley	azadirachtin carbaryl diazinon	NA 14 P	aphids	azadirachtin diazinon
			armyworms	azadirachtin carbaryl diazinon
			flea beetles	carbaryl diazinon
			weevils: carrot weevil	azadirachtin
Peas (English)	<i>Bacillus thuringiensis</i> carbaryl diazinon disulfoton insecticidal soap malathion metaldehyde methoxychlor neem oil paraffinic oil pyrethrins rotenone sulfur	0 0-3 P-7 P 0 3 S 7 NA 0 0 1 NA	aphids: pea aphid	diazinon disulfoton insecticidal soap malathion neem oil pyrethrins rotenone
			armyworms	<i>Bacillus thuringiensis</i> carbaryl diazinon
			cutworms: black cutworm	carbaryl diazinon pyrethrins
			leafhoppers	carbaryl diazinon disulfoton insecticidal soap malathion methoxychlor pyrethrins rotenone
			leafminers	diazinon disulfoton malathion neem oil
			loopers: alfalfa looper	<i>Bacillus thuringiensis</i> pyrethrins rotenone
			stink bugs	carbaryl insecticidal soap pyrethrins rotenone
			wireworms	diazinon

Table 1. Common garden vegetables, their registered pesticides and common insect pests. (continued)

Vegetable	Registered Pesticides	Days Between Last Application and Harvest	Common Insect Pests	Pesticides Registered by Pest
Peas (southern, black-eyed, crowder)	azadirachtin	NA	aphids: cowpea aphid	azadirachtin
	<i>Bacillus thuringiensis</i>	0		endosulfan
	carbaryl	0-3	cowpea curculio	insecticidal soap
	endosulfan	3		neem oil
	insecticidal soap	0		rotenone
	neem oil	NA		
	paraffinic oil	0		
	rotenone	1		
Peppers	azadirachtin	NA	aphids: green peach aphid, melon aphid or cotton aphid	azadirachtin
	<i>Bacillus thuringiensis</i>	0		diazinon
	carbaryl	0		dimethoate
	diazinon	P-5		endosulfan
	dicofol	2		insecticidal soap
	dimethoate	0		malathion
	endosulfan	4-7		neem oil
	insecticidal soap	0		pyrethrins
	malathion	3		rotenone
	metaldehyde	5		
	methoxychlor	7	armyworms: beet armyworm	azadirachtin
	neem oil	NA		<i>Bacillus thuringiensis</i>
	paraffinic oil	0		carbaryl
	pyrethrins	0		diazinon
rotenone	1		endosulfan	
			cutworms: black cutworm	azadirachtin
				carbaryl
				diazinon
				endosulfan
				pyrethrins
			corn earworm (tomato fruitworm, bollworm, soybean podworm)	azadirachtin
				<i>Bacillus thuringiensis</i>
				carbaryl
				diazinon
				endosulfan
				methoxychlor
			flea beetles	carbaryl
				diazinon
				endosulfan
				insecticidal soap
				pyrethrins
				rotenone
			leafminers: serpentine leafminer	azadirachtin
				diazinon
				dimethoate
				malathion
				neem oil
			mites: broad mite, spider mite	azadirachtin
				diazinon
				dimethoate
				insecticidal soap
				paraffinic oil
				pyrethrins
			psyllids	insecticidal soap
				neem oil

Table 1. Common garden vegetables, their registered pesticides and common insect pests. (continued)

Vegetable	Registered Pesticides	Days Between Last Application and Harvest	Common Insect Pests	Pesticides Registered by Pest
Peppers (continued)			thrips: western flower thrips	azadirachtin carbaryl diazinon dimethoate insecticidal soap malathion paraffinic oil pyrethrins rotenone
			weevils: pepper weevil	azadirachtin
Potatoes (Irish)	azadirachtin	NA	aphids: green peach aphid, melon aphid or cotton aphid	azadirachtin diazinon dimethoate disulfoton endosulfan insecticidal soap malathion neem oil pyrethrins rotenone
	<i>Bacillus thuringiensis</i>	0		
	carbaryl	0	Colorado potato beetle	azadirachtin <i>Bacillus thuringiensis</i> carbaryl diazinon endosulfan methoxychlor neem oil pyrethrins rotenone
	diazinon	P-35		
	dimethoate	0		
	disulfoton	S		
	endosulfan	0-14		
insecticidal soap	0			
malathion	0-3	cutworms: black cutworm	azadirachtin carbaryl diazinon endosulfan pyrethrins	
metaldehyde	S			
methoxychlor	0	cucumber beetles	azadirachtin carbaryl diazinon endosulfan malathion pyrethrins rotenone	
neem oil	NA			
paraffinic oil	0			
pyrethrins	0	flea beetles	carbaryl diazinon endosulfan insecticidal soap malathion methoxychlor pyrethrins rotenone	
rotenone	1			
sulfur	NA	leaffooted bug	endosulfan	

Table 1. Common garden vegetables, their registered pesticides and common insect pests. (continued)

Vegetable	Registered Pesticides	Days Between Last Application and Harvest	Common Insect Pests	Pesticides Registered by Pest
Potatoes (Irish) (continued)			leafhoppers	carbaryl diazinon dimethoate disulfoton endosulfan insecticidal soap malathion methoxychlor pyrethrins rotenone
			plant bugs	insecticidal soap
			psyllids Comments: Disulfoton is labeled for use for potato psyllid as a preplant treatment.	insecticidal soap neem oil
			wireworms	diazinon
Pumpkin (see squash)				
Radishes	azadirachtin <i>Bacillus thuringiensis</i> carbaryl chlorpyrifos diazinon insecticidal soap malathion metaldehyde neem oil paraffinic oil pyrethrins rotenone	NA 0 3 P P-14 0 7 S NA 0 0 1	aphids	azadirachtin diazinon insecticidal soap malathion neem oil pyrethrins rotenone
			beetles: yellowmargined leaf beetle	azadirachtin
			cabbage looper	<i>Bacillus thuringiensis</i> carbaryl malathion pyrethrins rotenone
			flea beetles	carbaryl chlorpyrifos diazinon insecticidal soap malathion pyrethrins rotenone
Spinach	azadirachtin <i>Bacillus thuringiensis</i> carbaryl diazinon dimethoate disulfoton endosulfan insecticidal soap malathion metaldehyde neem oil paraffinic oil pyrethrins rotenone	NA 0 14 P-14 14 P 21 0 7 S NA 0 0 1	aphids	azadirachtin diazinon dimethoate disulfoton endosulfan insecticidal soap malathion neem oil pyrethrins rotenone

Table 1. Common garden vegetables, their registered pesticides and common insect pests. (continued)

Vegetable	Registered Pesticides	Days Between Last Application and Harvest	Common Insect Pests	Pesticides Registered by Pest
Spinach (continued)			armyworms: beet armyworm	azadirachtin <i>Bacillus thuringiensis</i> carbaryl diazinon endosulfan
			cabbage looper	<i>Bacillus thuringiensis</i> carbaryl endosulfan malathion pyrethrins rotenone
			cutworms: black cutworm	azadirachtin carbaryl diazinon endosulfan pyrethrins
			flea beetles	carbaryl diazinon disulfoton endosulfan insecticidal soap malathion pyrethrins rotenone
			webworms: garden webworm	<i>Bacillus thuringiensis</i> carbaryl pyrethrins
Squash Comments: Product labels differ in the statements regarding winter squash, summer squash and pumpkin. The pest complex and management are similar for pumpkins. Be sure to read the product labels for specifics. Pumpkin is mentioned specifically only on product labels for azadirachtin, <i>Bacillus thuringiensis</i> , carbaryl, endosulfan, malathion and rotenone.	azadirachtin <i>Bacillus thuringiensis</i> carbaryl diazinon dimethoate endosulfan insecticidal soap malathion metaldehyde neem oil paraffinic oil pyrethrins rotenone	NA 0 0 P-7 3 0-5 0 1-7 S NA 0 0 1	aphids: melon aphid or cotton aphid	azadirachtin diazinon dimethoate endosulfan insecticidal soap malathion neem oil pyrethrins rotenone
			cabbage looper	<i>Bacillus thuringiensis</i> carbaryl endosulfan malathion pyrethrins rotenone
			cucumber beetles: southern corn rootworm	azadirachtin carbaryl diazinon endosulfan malathion pyrethrins rotenone
			cutworms: black cutworm	azadirachtin carbaryl diazinon endosulfan pyrethrins

Table 1. Common garden vegetables, their registered pesticides and common insect pests. (continued)

Vegetable	Registered Pesticides	Days Between Last Application and Harvest	Common Insect Pests	Pesticides Registered by Pest
Squash (continued)			leafminers: serpentine leafhopper	azadirachtin diazinon dimethoate malathion paraffinic oil
			melonworm	azadirachtin <i>Bacillus thuringiensis</i> carbaryl endosulfan rotenone
			mites: spider mite	azadirachtin diazinon dimethoate insecticidal soap paraffinic oil pyrethrins
			pickleworm	azadirachtin carbaryl endosulfan malathion rotenone
			squash bug	azadirachtin carbaryl endosulfan insecticidal soap neem oil rotenone
			squash vine borer	endosulfan malathion
			stink bugs	carbaryl endosulfan insecticidal soap pyrethrins rotenone
			thrips: western flower thrips	azadirachtin carbaryl diazinon dimethoate insecticidal soap malathion paraffinic oil pyrethrins rotenone
			whiteflies: sweetpotato whitefly	azadirachtin diazinon endosulfan insecticidal soap malathion paraffinic oil pyrethrins rotenone

Table 1. Common garden vegetables, their registered pesticides and common insect pests. (continued)

Vegetable	Registered Pesticides	Days Between Last Application and Harvest	Common Insect Pests	Pesticides Registered by Pest
Strawberries	diazinon dimethoate neem oil pyrethrins sulfur	P 2 NA 0 NA		
Sweet corn (see corn)				
Sweet potatoes	azadirachtin <i>Bacillus thuringiensis</i> chlorpyrifos insecticidal soap malathion neem oil paraffinic oil rotenone	NA 0 P-125 0 3 NA 0 1	beetles: golden tortoise beetle	azadirachtin
			cutworms: black cutworm	azadirachtin chlorpyrifos
			flea beetles	chlorpyrifos insecticidal soap malathion rotenone
			sweetpotato weevil	chlorpyrifos
			wireworms	chlorpyrifos
Swiss chard	azadirachtin <i>Bacillus thuringiensis</i> carbaryl diazinon dimethoate insecticidal soap malathion neem oil paraffinic oil pyrethrins	NA 0 14 P 14 0 7 NA 0 0-1	aphids	azadirachtin diazinon insecticidal soap malathion neem oil pyrethrins rotenone
			armyworms: beet armyworm	azadirachtin <i>Bacillus thuringiensis</i> carbaryl diazinon
			flea beetles	carbaryl diazinon insecticidal soap malathion pyrethrins rotenone
			stink bugs	carbaryl insecticidal soap pyrethrins rotenone
			webworms: beet webworm, garden webworm	<i>Bacillus thuringiensis</i> carbaryl pyrethrins

Table 1. Common garden vegetables, their registered pesticides and common insect pests. (continued)

Vegetable	Registered Pesticides	Days Between Last Application and Harvest	Common Insect Pests	Pesticides Registered by Pest
Tomatoes	azadirachtin	NA	aphids	azadirachtin
	<i>Bacillus thuringiensis</i>	0		diazinon
	carbaryl	0		dimethoate
	diazinon	P-3		disulfoton
	dicofol	2		endosulfan
	dimethoate	7		insecticidal soap
	disulfoton	P		malathion
	endosulfan	1-7		neem oil
	insecticidal soap	0		pyrethrins
	malathion	1-7		rotenone
metaldehyde	S	armyworms: beet armyworm, fall armyworm	azadirachtin	
methoxychlor	1		<i>Bacillus thuringiensis</i>	
neem oil	NA		carbaryl	
paraffinic oil	0		diazinon	
pyrethrins	0		endosulfan	
rotenone	1		cabbage looper	<i>Bacillus thuringiensis</i>
sulfur	NA			carbaryl
				endosulfan
				malathion
				pyrethrins
		rotenone		
		cutworms: black cutworm		azadirachtin
				carbaryl
		flea beetles		diazinon
				endosulfan
			insecticidal soap	
			malathion	
			methoxychlor	
			pyrethrins	
			rotenone	
		leaffooted bug	endosulfan	
		leafminers: serpentine leafminer	azadirachtin	
			diazinon	
			dimethoate	
			disulfoton	
			malathion	
		neem oil		
		plant bugs	insecticidal soap	
		stink bugs	carbaryl	
			endosulfan	
			insecticidal soap	
			pyrethrins	
			rotenone	

Table 1. Common garden vegetables, their registered pesticides and common insect pests. (continued)

Vegetable	Registered Pesticides	Days Between Last Application and Harvest	Common Insect Pests	Pesticides Registered by Pest
Tomatoes (continued)			thrips: western flower thrips	azadirachtin carbaryl diazinon dimethoate disulfoton insecticidal soap malathion paraffinic oil pyrethrins rotenone
			tomato pinworm	azadirachtin carbaryl rotenone
			tomato russet mite	dicofol endosulfan sulfur
			tomato hornworm (tobacco hornworm is a close relative)	<i>Bacillus thuringiensis</i> carbaryl endosulfan malathion metaldehyde methoxychlor rotenone
			tomato fruitworm (corn earworm, bollworm, soybean podworm)	azadirachtin <i>Bacillus thuringiensis</i> carbaryl chlorpyrifos diazinon endosulfan methoxychlor
			whiteflies: sweetpotato whitefly	azadirachtin diazinon endosulfan insecticidal soap malathion paraffinic oil pyrethrins rotenone
Turnips Comments: The site generally refers to roots. Also see greens (turnip).	azadirachtin <i>Bacillus thuringiensis</i> carbaryl chlorpyrifos diazinon dimethoate insecticidal soap malathion metaldehyde neem oil paraffinic oil pyrethrins rotenone	NA 0 3 (roots) P-30 P-14 14 0 7 5 NA 0 0 1	aphids	azadirachtin diazinon dimethoate insecticidal soap malathion neem oil pyrethrins rotenone
			blister beetles	carbaryl malathion pyrethrins
			weevils: vegetable weevil	azadirachtin

Table 1. Common garden vegetables, their registered pesticides and common insect pests. (continued)

Vegetable	Registered Pesticides	Days Between Last Application and Harvest	Common Insect Pests	Pesticides Registered by Pest
Watermelon Comments: Also see melons.	azadirachtin <i>Bacillus thuringiensis</i> diazinon insecticidal soap paraffinic oil	NA 0 P-3 0 0	aphids: melon aphid or cotton aphid	azadirachtin diazinon insecticidal soap paraffinic oil
			armyworms: beet armyworm	azadirachtin <i>Bacillus thuringiensis</i> diazinon
			cabbage looper	azadirachtin <i>Bacillus thuringiensis</i> diazinon insecticidal soap paraffinic oil
			cucumber beetle	azadirachtin diazinon
			cutworms: black cutworm	azadirachtin diazinon paraffinic oil
			leafminers: serpentine leafminer	azadirachtin diazinon paraffinic oil
			mites: spider mite	azadirachtin diazinon insecticidal soap paraffinic oil
			squash bug	azadirachtin insecticidal soap
			thrips: western flower thrips	azadirachtin diazinon insecticidal soap paraffinic oil
			webworms: garden webworm	<i>Bacillus thuringiensis</i>
whiteflies: sweetpotato whitefly	azadirachtin diazinon insecticidal soap paraffinic oil			

Table 2. Insecticides, their relative toxicity and example product names.

Insecticide	Oral LD 50 mg/kg ¹	Example Product Names ²
azadirachtin	5,000	Bio Neem
B.t., <i>Bacillus thuringiensis</i> var. <i>kurstaki</i>	considered non-toxic	American Brand Thuricide Concentrate Bonide Dipel .86% WP Green Light BT Worm Killer <i>Bacillus thuringiensis</i> ME Green Light Dipel Dust Martin's Dipel Dust Safer Caterpillar Killer Science Thuricide
B.t., <i>Bacillus thuringiensis</i> var. <i>san diego</i>	considered non-toxic	Bonide Colorado Potato Beetle Beater
carbaryl	850	Eliminator Liquid Sevin Insect Spray Eliminator Sevin 10% Dust Green Light Liquid Flowable Sevin Carbaryl Insecticide Green Light Sevin 5% Dust Green Light Sevin 10% Dust Hi-Yield 5% Sevin Garden & Pet Dust Hi-Yield 10% Sevin Dust Hi-Yield Sevin Spray Ortho Sevin Brand Carbaryl Insecticide 5 Dust Ortho Sevin Brand Carbaryl Insecticide 10 Dust Ortho Sevin Brand Carbaryl Insecticide Garden Dust Ortho Sevin Brand Liquid Carbaryl Insecticide
carbaryl + metaldehyde	not available	Bonide Slug, Snail & Sowbug Bait Ortho Bug-Geta Plus Snail, Slug & Insect Killer
chlorpyrifos	135	Green Light Liquid Double Dursban Granules Green Light Many Purpose Dursban Concentrate II Ortho Dursban Lawn & Garden Insect Control Spectracide Dursban Multiple Purpose Insect Spray Concentrate
diazinon	66	Green Light Diazinon 5 Granules Green Light Diazinon Insect Spray Martin's 5% Diazinon Granules Martin's Diazinon Garden Dust Ortho Bug-B-Gon Multipurpose Insect Killer Ortho Bug-B-Gon Insect Killer Ortho Bug-B-Gon Ready Spray Ortho Diazinon Ultra Insect Spray Ortho Soil & Turf Insect Control Spectracide Diazinon Multi-Purpose Insect Spray Concentrate
dicofol	575	Green Light Red Spider Spray
dimethoate	250	Hi-Yield Cygon 2-E
disulfoton	4	Bonide Systemic Granules 1% Bonide Systemic Granules 2%
endosulfan	18	Bonide Tomato-Potato Vegetable Insecticide-Fungicide Dust w/Maneb 5.6 Thiodan 3 Lilly/Miller Thiodan Insect Spray Rigo's Best Thiodan Insecticide Concentrate Security Thiogard 3 Thiodan Insect Spray
insecticidal soap	16,500	Concern Insect Killing Soap Concentrate Safer Insecticidal Soap
malathion	1,842	Green Light 50% Malathion Martin's 5% Malathion Dust Martin's 50% Malathion Concentrate Ortho Malathion 50 Plus Insect Spray Spectracide Malathion Insect Spray Concentrate

Table 2. Insecticides and example product names. (continued)

Insecticide	Oral LD 50 mg/kg¹	Example Product Names²
metaldehyde	283	Corry's Liquid Bonide Last Slime Slug-N-Snail Beater Ortho Bug-Geta Snail & Slug Killer
methoxychlor	5,000	Bonide Methoxychlor 25% E Insecticide
neem oil	considered non-toxic	Green Light Fruit, Nut & Vegetable Spray Green Light Red Spider Mite Spray Green Light Tomato & Vegetable Spray
paraffinic oil	considered non-toxic	SunSpray Ultra-Fine Year-round Pesticidal Oil
pyrethrins	1,350	Concern Multi-purpose Insect Killer Concentrate Concern Tomato & Vegetable Insect Killer Ortho Tomato & Vegetable Insect Killer Safer Tomato & Vegetable Insect Killer Schultz Houseplant & Gardens Insect Spray Schultz Fruits & Vegetables Insect Spray
pyrethrins + insecticidal soap	not available	Safer Yard & Garden Insect Killer
rotenone	60	Bonide Cuke & Melon Dust Bonide Rotenone 5% Organic Insecticide Green Light Rotenone Insect Dust Martin's Cube Powder
rotenone + pyrethrins	not available	Science Red Arrow Insect Spray Bonide Liquid Rotenone/Pyrethrins Spray
sulfur	>5,000	Bonide Liquid Sulfur Green Light Wettable Dusting Sulfur

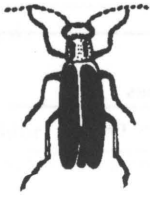
¹Acute (short-term) toxicity is measured as the amount of toxin that kills 50 percent of laboratory rats in a test. Smaller values indicate a more toxic product. As comparison, table salt has an Oral LD 50 of 3,000 mg/kg and DDT has an Oral LD 50 of 87mg/kg.

²All product names are registered (®).

Table 3. Chemical classes and modes of action.

Insecticide Class	Examples	Mode of Action
Botanical	azadirachtin	Insect growth regulator that inhibits molting
	pyrethrins	Derived from a dried pyrethrum daisy flower head Provides quick "knockdown" by destabilizing nerve cell membranes
	rotenone	Derived from several tropical legume roots such as derris and cube root Inhibits cellular respiration primarily in nerve and muscle cells causing death to occur hours or days after exposure
Carbamate	carbaryl dicofol metaldehyde	Inhibits cholinesterase, preventing the termination of nervous impulses
Chlorinated hydrocarbon	endosulfan methoxychlor	Destabilizes nerve cell membranes, preventing them from transmitting nervous impulses
Inorganic	sulfur	Elemental sulfur when ingested causes dehydration and electrolyte depletion
Microbial	<i>Bacillus thuringiensis</i>	Bacteria produced spores and delta endotoxin cause disruption of the stomach lining of certain leaf feeding caterpillars and beetles
Organophosphate	diazinon dimethoate disulfoton chlorpyrifos malathion	Inhibits cholinesterase, preventing the termination of nervous impulses
Insecticidal soaps and oils	insecticidal soap neem oil paraffinic oil	Derived from animal byproducts (fat) or plant oils Causes physical disruption of the insect cuticle, resulting in water imbalance and desiccation

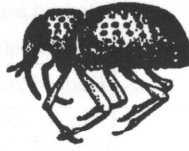
Common Vegetable Garden Pests



Blister beetle



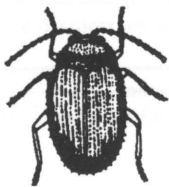
Colorado potato beetle



Cowpea curculio



Spotted cucumber beetle



Flea beetle



White grub



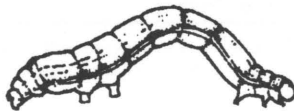
Leaf beetle



Wireworm



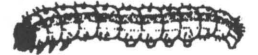
Armyworm



Cabbage looper



Cutworm



Corn earworm



Melonworm



Saltmarsh caterpillar



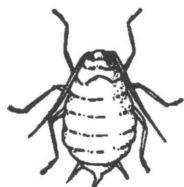
Squash vine borer



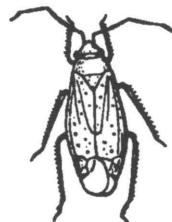
Tomato hornworm



Mole cricket



Aphid



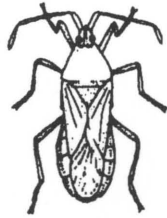
Fleahopper



Leafhopper



Plant bug



Squash bug



Stink bug



Whitefly



Fungus gnat



Leaf miner



Maggot



Thrips



Spider mite



Millipede



Slug



Sowbug

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10M, Revision

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