# Organic Controls for Insects

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## Table 2.1 - Organic Products and Predators

| Product[1] | Insects Controlled | Remarks |
|---|---|---|
| *Bacillus thuringiensis* | Most caterpillars, loopers, hornworms, bagworms | This product, also known as *Bt*., is sold under many trade names. |
| M-One, M-Track, Foil, Novodor | Colorado potato beetle | Two strains of *Bt* will control potato beetles: *Bacillus thuringiensis* ssp. *san diego* is genetically engineered and therefore is not allowed in certified organic production. On the other hand, *B. thuringiensis* ssp. *tenebrionis*, a form of *Bt* that is not genetically engineered, can be used by organic producers. |
| Insecticidal soap | Works well on soft bodied insects, in particular aphids, mites, mealybugs | This product is sold under many trade names and is a fatty acid soap. |
| Rotenone | Many garden insect pests, including Colorado potato beetle, flea beetles, aphids, weevils, Mexican bean beetles | Usually sold as a dust, but some formulations can be mixed in water. |
| Pyrethrin | Broad spectrum; works on a wide variety of insects | Usually sold mixed with other botanical insecticides such as rotenone. |
| Pyrethrum/Diatomaceous Earth | Whiteflies, fireants | See label for precautions. |
| Neem | Broad spectrum | See label for precautions. |
| Hot Pepper Wax | Aphids, mites, thrips | See label for precautions. |
| Spinosad | Caterpillars, beetles | See label for precautions. |
| **Predators[1]** | **Insects Controlled** | **Remarks** |
| Bean Beetle Parasite (*Pediobius foveolatus*) | Mexican bean beetle | These wasps are shipped to you inside their host—Mexican bean beetle larvae. Once the adults emerge, the females deposit their eggs in the larvae of the Mexican bean beetle. Release rate: timing is critical; release one unit (6 mummies/unit, 20-25 wasps/mummy=120-150 wasps/unit) for every 400 sq ft of beans or 100 units/A when the bean beetle larvae are present. These wasps do not overwinter. |
| Lady beetles | Feed on aphids and other soft bodied insects | Lady beetles may leave the garden to find other prey. |
| Lacewings | Aphids, scales, mealy bugs, other soft bodied insects | Immature lacewings are called aphidlions. Most are *Chrysoperla spp.* |
| Predatory mites | Mostly for control of spider mites | Release approximately 2/square foot. *Phythoseiulus persimilus* will work in most situations. |
| Predatory nematodes | Many ground dwelling and boring insect pests | These nematodes will actively seek host prey and do not harm plants or humans. |
| Parasitic wasps | Many insect pests on the foliage, including caterpillars, whiteflies | *Trichogramma* wasps work well on many caterpillars. *Encarsia formosa* works on whiteflies. |

[1]Botanical insecticides are derived from various plant parts and are commonly used in organic control situations. It is important to read the label and follow all precautions regarding protective clothing, mixing, and labeled plants. Just because they are derived from plants doesn't mean that safety can be disregarded. Biological control is in two major forms. Microbial, which is a formulation containing a microorganism such as *Bacillus thuringiensis*, or the other form, which involves the release of predatory insects or mites, such as lady beetles. Use caution with insecticides when a release of predators is planned. Also see the Organic and Biological Control section of the Insect Identification Laboratory homepage on the World Wide Web: *http://www.ento.vt.edu/bughunt*

# Vegetable Diseases

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## Overview

Home gardeners can avoid many disease problems in their vegetable gardens by practicing cultural and other preventative tactics. If a disorder is found, the first step in controlling the disease is to accurately identify the pathogen. Often abiotic (non-living) problems or insect problems are mistaken for plant diseases and pesticides are used needlessly. Accurate identification of the pathogen ensures that pesticides are used appropriately and only when other control tactics can't control the problem. Accurate identification of the pathogen also allows formulation of an integrated pest management approach to control the disease based on the pathogen's life cycle. Use pesticides in conjunction with cultural and other control tactics.

## General Cultural Controls

- Provide optimal growing conditions: Healthy plants are less likely to become diseased than stressed plants.
  - Provide adequate water and fertilization, but avoid over-fertilization, which creates succulent or compromised tissue that is prone to disease and pest problems. Also avoid placing fertilizer close to tender root and stem tissue, as this injures plants.
  - Ensure soil pH and nutrients are optimal for plant growth by testing the soil when starting a new garden; re-test every two years at least.
  - Plant crops at recommended planting times. Planting too early, in particular, predisposes seedlings and transplants to disease.
  - Space plants adequately to ensure vigor and to promote foliar drying—wet foliage favors most foliar diseases.
  - Check the soil drainage and if drainage is poor, correct before planting. Excessively wet soils can cause soilborne diseases and poor growth even in the absence of a pathogen.
- Irrigation: Most plant diseases favor high humidity and wet foliage. Avoid overhead irrigation when possible, as it creates wet foliage. If irrigating overhead, do so early in the day to promote foliar drying. Also avoid over-irrigation; this can cause root problems and favors the development of certain pathogens.
- Sanitation:
  - Crop rotation: Avoid growing the same crop species AND same crop family (e.g. solanaceous family: potato, tomato, pepper, eggplant) in the same garden location for consecutive years, since this may result in a build-up of pathogen inoculum in the soil.
  - Some plant pathogens can survive on plant debris. Therefore, removing diseased plants and crop debris from the garden reduces inoculum for new infections in the next season's garden. Compost crop debris or till it into the soil at the end of the growing season; however, some pathogens produce survival structures that are not killed by composting or burying in soil.
  - Stakes, rototillers, and gardening tools can be infested with pathogen inoculum; stakes, equipment and tools must be cleaned and disinfected. Also, some pathogens may be present in soil, so avoid any practice that moves infested soil to non-infested areas.
  - Avoid working or harvesting in the garden when plants are wet. This spreads pathogens.
  - Weeds are alternate hosts for many pathogens, so controlling weeds reduces the likelihood of some diseases.
  - Certain pathogens survive in seed, so purchase certified seed and be mindful when saving your own seed, as it may harbor pathogens. Hot water seed treatment reduces seedborne inoculum of some pathogens. Do not save seed from diseased plants.

## General Biological Controls

- Disease-resistant plants: Resistant cultivars are available for some common plant disease problems. For example, tomato varieties designated with the letters "VFN" are resistant to Verticillium and Fusarium species, soil borne fungi with no chemical controls. The 'N' indicates root-knot nematode resistance, another soil-borne pathogen with no available chemical controls.

- Soil amendments: Adding compost or other organic matter to garden soil may increase populations of beneficial microbes in the soil. Some of these microbes may be antagonistic, predatory, or may simply out-compete pathogens, and reduce the likelihood of disease.
- Biological pesticides: Biological pesticides are formulated from living organisms, such as fungi, bacteria, and nematodes that may be antagonistic, predatory, parasitic or may simply out-compete pathogens. The number of biological control products available to homeowners for disease control is growing. These products are safer to handle, break down quickly, and are considered to be environmentally friendly compared to other pesticides. Some biological pesticides are ineffective or less effective compared to other pesticide products for controlling certain plant diseases. However, when biological pesticides are used in conjunction with cultural and other control tactics, or when disease pressure is low, disease may be controlled to an acceptable level with these pesticides.
- Naturally-occurring organisms: Using broad-spectrum pesticides may reduce populations of naturally occurring organisms that are beneficial to crops or have an adverse effect on plant pathogens and other pests. Use these pesticides only when necessary.

## General Mechanical Controls

- Most plant disease problems are made worse by wet foliage. Staking crops, like tomatoes, reduces leaf wetness and promotes foliar drying. Staking also reduces spread of inoculum that may splash onto foliage and fruit from the soil.
- Reflective row covers deter insects that carry plant pathogens.
- Organic and plastic mulches reduce the spread of some soil-borne pathogens and also reduce weeds that may host plant pathogens.

## General Chemical Controls

- Calibrate sprayers and spreaders.
- Wear Personal Protective Equipment (PPE) when applying chemicals, as specified on the pesticide label. Each pesticide product varies in toxicity and must be evaluated individually regarding re-entry and preharvest intervals.
- Most homeowner pesticides are protectants and must be applied preventatively, before infection occurs. It is important to completely cover the plants when using these pesticides. Most homeowner pesticides cannot cure plants that are already diseased and do not have systemic activity.
- Organic pesticides are approved for use in organic production. An example of organic pesticides are copper formulations. Organic pesticides are broad-spectrum pesticides and are toxic or irritants to humans and other non-target organisms. These pesticides can also build up in the soil.
- Each pesticide has different amounts of toxicity and each can have a different negative effect on the environment and other organisms. Pesticides receiving EPA approval today are generally less toxic and have reduced negative impact on the environment than those approved prior to the late 1990s. For general information on pesticides refer to “Pesticide Topics” on the Virginia IPM website (www.vaipm.org )

## Precautions

- Humans: Protect yourself when applying chemicals: read the product label to determine the proper PPE and accessories you need before using any chemicals. Do not assume that because a product is labeled “organic” it is non-toxic to humans. Products vary in human toxicity and each pesticide product must be assessed according to its product label.
- Bees: In general broad-spectrum insecticides are toxic to bees. Read each product label and determine what precautions to take to protect bees and other beneficial insects when applying pesticides.
- Animals (pets, birds, etc.) and water: Read the specific product label to determine what precautions to take to protect the health of other animals and aquatic invertebrates when applying pesticides.
- Pesticide resistance: Over-using pesticides may make pests resistant to the pesticide. Pesticides containing thiophanate-methyl, for example, often develop resistance. Broad-spectrum pesticides have a low risk of developing resistance. Read the pesticide product label to determine if a pesticide is at risk of developing pesticide resistance. To avoid pesticide resistance:
  - Limit applications of the pesticides (the number of allowed applications is usually specified on the label for at-risk pesticides),

- Use pesticide products with different modes of action or use a mix of pesticides with different modes of action
- Use the recommended rate as specified on the product label. For further information refer to the "Pesticide Resistance" and "Pesticide Related Links" section of the Virginia IPM website (www.vaipm.org).

# Guidance on How to Find Specific Recommendations

## *Links to Useful Sources of Information*

- Factsheets
  - IPM in the Department of Plant Pathology, Physiology and Weed Science http://ppwsipm.contentsrvr.net/. This site links to Virginia Cooperative Extension factsheets and other web resources on plant disease and weed pests, sorted by plant type.
  - Virginia Cooperative Extension Plant Disease Factsheets http://pubs.ext.vt.edu/category/plant-diseases.html
- Diagnostic keys or aids
  - Plant Problem Image Gallery http://ppwsidlab.contentsrvr.net/plant.vesh provides images of actual plant disease and abiotic problems diagnosed in the Virginia Tech Plant Disease Clinic and also provides recommendations.
- Virginia Tech Diagnostic and Identification Laboratories
  - Plant Disease Clinic http://www.ppws.vt.edu/~clinic/
  - Insect Identification Lab http://www.idlab.ento.vt.edu/
  - Nematode Assay Lab http://www.ppws.vt.edu/~clinic/nematode.php
  - Soil Testing Lab http://www.soiltest.vt.edu/
  - Weed Identification Lab http://www.ppws.vt.edu/~clinic/weedid.php
- Educational resources
  - The Virginia IPM website www.vaipm.org is a general educational resource on integrated pest management topics, and includes useful links to pesticide resources and sustainable and organic production.

Disease control in home vegetable gardens is important if the gardener is to harvest attractive, nutritious vegetables. It is very important that the home gardener use the following tools, if possible, to reduce plant susceptibility to disease:

1. Use plastic or natural mulch or stake and string vegetables to keep the soil off the harvested portion of the plant.
2. Use disease-free seed or transplants and choose disease resistant varieties.
3. Test soil yearly and apply the needed plant nutrients to maintain optimum plant health.
4. Practice rotation so that the same vegetable or closely related vegetables are not grown in the same location year after year.
5. Plant in areas with good drainage.
6. Avoid planting too close together or thin plants in order to allow air movement around the plants.
7. Control weeds.

If disease occurs it is extremely important to correctly identify the cause of the disease. Removing and destroying diseased portions of the plants may help reduce disease spread. Fungicides can also be used to prevent disease spread as they may help protect the healthy portions of the plants. When using fungicides, it is important that you read and follow the fungicide label. Fungicides listed in the following table are available under many different commercial names and may be found in garden centers or ordered over the Internet. Because different manufacturers' labels vary widely, always check carefully before purchasing a particular brand to make sure it is labeled for both your crop and the disease you are trying to control. For disease problems not covered in the recommendations, contact your local Extension agent or garden center.

**Table 2.2 – Fungicide brands available for Home Vegetable Gardens**

| Chemical Name | Product Name |
|---|---|
| Captan | American Captan Garden Fungicide<br>Bonide Captan 50W<br>Dragon Captan Wettable<br>Hi-Yield Captan Fungicide 50W<br>Orthocide Garden Fungicide<br>Southern Agricultural Home and Garden Captan Fungicide |
| Chlorothalonil | Bonide Fung-onil<br>Dragon Daconil 2787<br>Earl May Fung-onil<br>Ferti-Lome Liquid Fungicide<br>Fung-onil Multipurpose<br>Gordon's Multi-Purpose Fungicide<br>Ortho Daconil 2787<br>Ortho Garden Disease Control<br>Southern Agricultural Lawn, Ornamental, & Vegetable Fungicide |
| Basic copper | Acme Bordeaux Mix<br>Bonide Garden Dust<br>Cooke Copper Fungicide<br>Cooke KopRSpray Conc.<br>Dragon Bordeaux Mix<br>Fertilome Bordeaux Mixture<br>Gordon's Bordeaux Mix<br>Hi-Yield Bordeaux Mix<br>Lilly Miller Microcop Fungicide – Basic $CuSO_4$<br>Southern Agricultural Neutral Copper Fungicide<br>Southern Agricultural Tomato Dust |
| Fixed copper | American Copper Fungicide<br>Bonide Liquid Copper Fungicide<br>Dragon Copper Fungicide<br>Hi-Yield Copper Fungicide<br>Southern Agricultural Liquid Copper Fungicide |
| Mancozeb | Bonide Mancozeb Flowable with Zinc<br>Dragon Mancozeb<br>Green Light Broad Spectrum Mancozeb Fungicide<br>Southern Agricultural Dithane M-45 |
| Maneb | Earl May Tomato Blight Control<br>Earl May Tomato and Vegetable Dust<br>Gordon's Maneb Tomato and Vegetable Fungicide<br>Hi-Yield Maneb Garden Fungicide |
| *Neem oil* | Green light Powdery Mildew Killer<br>Garden Safe Fungicide 3 |
| PNCB (pentachloro-nitrobenzene) | Hi-Yield Terraclor Granule<br>Southern Agriculture Terraclor |
| Potassium bicarbonate | Bonide Remedy<br>Cleary First Step |
| Sulfur | Bonide Liquid Sulfur<br>Bonide Sulfur Fungicide<br>Dragon Garden Sulfur<br>Green Light Wettable Dusting Sulfur<br>Hi-Yield Lime Sulfur<br>Ortho Garden Sulfur Dust<br>Safer Garden Fungicide<br>Southern Agricultural Wettable or Dusting Sulfur |

## Table 2.3 - Disease Management Tools for Specific Crops and Diseases

| Crop Disease | Treatment (PHI)[1] | Rate/Gal. (Unless otherwise Stated) | Remarks |
|---|---|---|---|
| **Asparagus**<br>Rust | Maneb or Mancozeb | 2.0 tbsp | Use resistant varieties or apply 3-4 post-harvest sprays at 7- to 10-day intervals beginning in late June. |
| **Beans (Snaps or Lima)**<br>Anthracnose (Lima bean only) | chlorothalonil 12.5% (7) | 2.0 tbsp | Begin early bloom – reapply every 7 to 10 days. For use only on beans to be harvested dry with pods removed. |
| Bacterial Blights | copper | 1.5 tbsp powder | Use certified western-grown seed. Begin with 4.0 tsp liquid at tri-foliage and reapply every 7 to 10 days. |
| *Botrytis* Blight (Gray mold) | chlorothalonil 12.5% (7)<br>chlorothalonil 30% (7) | 4.0 tbsp<br>1.0 tbsp | Begin at early bloom; apply after extended wet periods. |
| Downy mildew (Lima beans only) | chlorothalonil 12.5% (7) | 2.0 tsp | Begin early bloom – reapply every 7 to 10 days. For use only on beans to be harvested dry with pods removed. |
| Powdery mildew | *Neem oil*<br>Wettable Sulfur or<br>Sulfur dust | 2.0 tbsp<br>2.5 tbsp or<br>6.0 tbsp dust | Spray or dust at first sign and reapply every 7 days. Sulfur may injure blossoms and some varieties of beans. |
| *Rhizoctonia* root and stem rot | PCNB | 4.0 tbsp/gal<br>for 1000 ft row | Apply at planting only. Direct spray in the seed furrow or over the planted row. |
| Rust | chlorothalonil 12.5% (7)<br>chlorothalonil 30% (7)<br>Wettable Sulfur or<br>Sulfur dust | 2.0-4.0 tbsp<br>1.0 tbsp<br>2.5 tbsp<br>6.0 tbsp dust | Spray or dust at first sign and reapply every 7 days. Sulfur may injure blossoms and some varieties of beans. |
| Seed rot and damping off | Captan | 0.5 tsp/1lb seed | Mix thoroughly in paper bag or glass jar. |
| Viruses | No chemicals registered | | Clover control around edge of garden areas is important to reduce spread of virus from clover to beans. Some bean varieties are resistant. Aluminum foil mulch may prevent aphid feeding. |
| **Beets**<br>*Cercospora* | copper<br>leaf spot | 2.0 tbsp | Spray at 7- to 10-day intervals beginning when disease first appears. |
| Seed rot and damping off | Captan | 2.5 tsp/1 lb seed | Mix thoroughly in paper bag or glass jar. |
| **Cabbage, Broccoli, Brussels Sprout, Cauliflower, Turnips, Kale, Collards**<br>Black leg, Black rot | copper | 2.0 tbsp | Use western-grown, hot-water treated seed. Use resistant varieties for black rot control. Apply copper at 7- to 10-day intervals. Copper sprays may reduce spread of blackrot. |
| Club root | PCNB | 1.0 tbsp | Apply in transplant water. Use 0.5 pt per plant. Thoroughly mix with the soil. |
| Downy mildew,<br>*Alternaria* leaf spot | chlorothalonil 12.5%<br>chlorothalonil 30%<br>copper<br>maneb (7) | 2.5 tbsp<br>1.0 tbsp<br>1.0 tsp<br>1.0 tbsp | Begin when disease threatens and reapply every 7 days. Do not spray copper when plants are stressed. |
| Seed rot and damping off | Captan | 0.5 tsp/1 lb seed | Mix thoroughly in paper bag or glass jar. |

[1]PHI = post-harvest interval and indicates the number of days before harvest that the last fungicide application can be made.

## Table 2.3 - Disease Management Tools for Specific Crops and Diseases (cont.)

| Crop Disease | Treatment (PHI)[1] | Rate/Gal. (Unless otherwise Stated) | Remarks |
|---|---|---|---|
| **Carrots**<br>Leaf Blight | chlorothalonil 12.5%<br>chlorothalonil 30%<br>copper | 2.5 tbsp<br>1.0 tbsp<br>2.0 tbsp | Start applications when disease threatens and reapply every 7 to 10 days if needed. |
| **Celery**<br>Bacterial Blight | copper | 2.0 tbsp | Apply at first sign of disease; reapply every 7 to 10 days. |
| Cercospora<br>(Early Blight) | chlorothalonil 12.5% (7)<br>chlorothalonil 30% (7)<br>copper | 3.0-4.0 tbsp<br>1.0 tbsp<br>2.0 tbsp | Apply at first sign of disease; reapply every 7 days. |
| *Septoria* (Late blight) or Stalk rot (*Rhizoctonia*) | chlorothalonil 12.5% (7)<br>chlorothalonil 30% (7) | 3.0 tbsp<br>1.0 tbsp | Apply at first sign of disease; reapply every 7 days. |
| **Cucurbits (Cucumbers, Summer Squash, Cantalopes, Pumpkins)**<br>*Alternaria* leaf spot; Anthracnose; Downy mildew; Gummy stem blight | chlorothalonil 12.5%<br>chlorothalonil 30%<br>mancozeb (5)<br>maneb (5)<br>copper | 2.0-3.0 tbsp<br>1.0 tbsp<br>2.0 tbsp<br>1.0 tbsp<br>2.0 tbsp | Apply at first sign of disease or after runners are formed and reapply every 7 days. Shorten the spray interval to 5 days if disease pressure is high. Some melon varieties may be sensitive to maneb. |
| Angular leaf spot (cucumbers only) | copper | 1.0-2.0 tbsp | Apply at first sign of disease and reapply every 7 days. Copper may injure some young plants. |
| Belly rot (*Rhizoctonia*)-suppression only | chlorothalonil 30% | 1.0 tbsp | Use mulch to keep fruit off soil surface. For plants in bare soil, begin when plants are in first true leaf stage. Apply during wet soil conditions. |
| Powdery mildew | chlorothalonil 12.5%<br>chlorothalonil 30%<br>copper<br>*Neem oil*<br>potassium bicarbonate | 3.0 tbsp<br>1.0 tbsp<br>2.0 tbsp<br>2.0 tbsp<br>2.0 tbsp | Begin at first sign of disease. Reapply every 7 days. Shorten interval if disease is severe. |
| Seed rot and damping off (melons and squash) | Captan | 0.5 tsp/1 lb seed | Mix thoroughly in paper bag or glass jar. |
| **Eggplant**<br>Anthracnose; fruit rot | maneb (5) | 1.0 tbsp | Begin at fruit set. Reapply every 7 days. |
| **Irish Potatoes**<br>Early blight, late blight, and *Botrytis* vine rot | chlorothalonil 12.5%<br>chlorothalonil 30%<br>mancozeb (14)<br>maneb (14)<br>copper | 2.0 tbsp<br>1.5 tbsp<br>2.0 tbsp<br>1.0 tbsp<br>2.5 tbsp | Apply at first sign of disease and reapply every 7 days. |
| **Onion**<br>Bacterial Soft rot | copper | 2.0 tbsp | Apply during extended periods of wet soil. Reapply every 7 days up to harvest. |
| **Onion (dry bulb)**<br>*Botrytis* leaf blight, Downy mildew, Purple blotch | chlorothalonil 12.5% (7)<br>chlorothalonil 30% (7)<br>maneb (7) | 2.0 tbsp<br>1.0 tbsp<br>2.0 tbsp | Apply at first sign of disease and reapply every 7 days. Do not apply to exposed bulbs. |
| **Onion (green bunching), leeks, shallots** | chlorothalonil 12.5% (14)<br>chlorothalonil 30% (14)<br>maneb (7)<br>copper | 2.0-4.0 tbsp<br>1.0 tbsp<br>2.0 tbsp<br>2.0 tbsp | See above. Do not apply chlorothalonil more than 3 times per season and maneb more than 7 times per season. |

[1]PHI = post-harvest interval and indicates the number of days before harvest that the last fungicide application can be made.

## Table 2.3 - Disease Management Tools for Specific Crops and Diseases (cont.)

| Crop Disease | Treatment (PHI)* | Rate/Gal. (Unless otherwise Stated) | Remarks |
|---|---|---|---|
| **Peas**<br>Powdery mildew and Bacterial blight | copper<br>*Neem oil* | 2.0 tbsp<br>2.0 tbsp | Apply at first sign of disease and reapply every 7 days up to harvest. |
| Seed rot and damping off | captan | 0.5 tsp/1 lb seed | Mix thoroughly in paper bag or glass jar. |
| **Peppers**<br>Anthracnose, fruit rot | maneb (7) | 2.0 tbsp | Begin when fruit are half size. Spray on a 7- to 10-day interval. |
| Bacterial spot and *Cercospora* leaf spot | copper | 2.0 tbsp | Apply at first sign of disease and reapply every 7 days up to harvest. |
| Phytophthora blight | No chemicals registered | | Avoid planting in low land. Grow resistant varieties, 'Paladin' or 'Aristotle'. |
| Southern Blight | PCNB | 1.0 tbsp | Apply at transplant. Apply 0.5 pt/plant. |
| **Sweet Corn**<br>Bacterial wilt | No chemicals registered | | Plant resistant varieties. Spray with approved insecticide to control flea beetles. |
| Leaf blight, Rust | chlorothalonil 12.5% (14)<br>chlorothalonil 30% (14)<br>mancozeb (7) | 1.0-2.5 tbsp<br>1.0 tbsp<br>1.5 tbsp | Apply after observing disease and reapply every 7 days. |
| **Tomatoes**<br>Early blight, late blight, *Septoria* leaf spot, gray mold, Anthracnose and *Rhizoctonia* fruit rot | chlorothalonil 12.5%<br>chlorothalonil 30%<br>mancozeb (5)<br>maneb (5)<br>copper | 3.0-4.0 tbsp<br>1.0 tbsp<br>3.0 tbsp<br>2.0 tbsp<br>2.0 tbsp | Repeat at 7- to 10-day intervals throughout the season. Under severe conditions shorten spray intervals. |
| Bacterial spot and speck | copper plus<br>maneb (5) | 2.0 tbsp<br>2.0 tbsp | Apply after observing disease and reapply every 7 days. |
| *Fusarium* wilt and *Verticillium* wilt | | | Use resistant varieties. Maintain soil pH from 6.5-7.0. Rotate out of area. |
| Southern Blight | PCNB | 1.0 tbsp | Apply at transplanting. Apply 0.5 pt/plant |
| **Watermelon**<br>Anthracnose, gummy stem blight, *Alternaria* leaf blight, downy mildew and powdery mildew | chlorothalonil 12.5%<br>chlorothalonil 30%<br>mancozeb (5)<br>maneb (5)<br>copper<br>*Neem oil* (powdery mildew) | 3.0-4.0 tbsp<br>1.0 tbsp<br>2.0 tbsp<br>2.0 tbsp<br>2.0 tbsp<br>2.0 tbsp | Apply at first sign of disease or when runners meet within the row and reapply every 7 days. Shorten interval under severe conditions. |

[1]PHI = post-harvest interval and indicates the number of days before harvest that the last fungicide application can be made.

## Table 2.4 - Nematode Disease Control in Home Vegetables

| Nematode | Remarks |
|---|---|
| root-knot, root lesion, treatment spiral, sting, lance, and various soilborne pathogens | Nematode diseases can cause reduced yield, stunted plants, or weak plants. In areas where nematodes are a problem, rotate with marigolds. |

# Insects

*Eric R. Day, Extension Entomologist, Virginia Tech*

## Table 2.5 - Insecticides

| Vegetable | Insect | Common Name | Wait Period before harvest |
|---|---|---|---|
| Asparagus | Asparagus Beetle | Carbaryl | Do not apply within one day of harvest |
| | | Malathion | Do not apply within one day of harvest |
| | | Permethrin | PHI = 3 days |
| | | *Neem oil* | Can be applied on day of harvest, must be allowed to dry |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Potassium laurate & Pyrethrins* | Can be applied up to the day of harvest |
| | | *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | Grasshopper | Carbaryl | Do not apply within one day of harvest |
| | | Malathion | Do not apply within one day of harvest |
| | | Permethrin | PHI = 3 days |
| | | *Azadirachtin* | Can be applied on day of harvest, must be allowed to dry |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Potassium laurate* | Can be applied up to the day of harvest |
| Beans (snaps and limas) | Aphid | Acephate | PHI = 21 days |
| | | Acetamiprid | PHI = 7 days |
| | | Bifenthrin | See label for instructions |
| | | Imidacloprid | PHI = 21 days |
| | | Malathion | Do not apply within one day of harvest |
| | | *Canola oil* | Can be applied on day of harvest, must be allowed to dry |
| | | *Canola oil & Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | Corn Earworm | Acephate | PHI = 21 days |
| | | Bifenthrin | See label for instructions |
| | | Carbaryl | Do not apply within one day of harvest |
| | | Imidacloprid | PHI = 21 days |
| | | Malathion | Do not apply within one day of harvest |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Spinosad* | PHI = 3 days |

*Italicized pesticides are organic control measures.*

## Table 2.5 - Insecticides (cont.)

| Vegetable | Insect | Common Name | Wait Period before harvest |
|---|---|---|---|
| Beans (snaps and limas) (cont.) | Grasshopper | Acephate | PHI = 21 days |
| | | Bifenthrin | See label for instructions |
| | | Carbaryl | Do not apply within one day of harvest |
| | | Imidacloprid | PHI = 21 days |
| | | Malathion | Do not apply within one day of harvest |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Spinosad* | PHI = 3 days |
| | Mexican bean beetle | Acephate | PHI = 21 days |
| | | Acetamiprid | PHI = 7 days |
| | | Carbaryl | Do not apply within one day of harvest |
| | | Malathion | Do not apply within one day of harvest |
| | | *Canola oil & Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | Spider mite | Bifenthrin | See label for instructions |
| | | Malathion | Do not apply within one day of harvest |
| | | *Canola oil* | Can be applied on day of harvest, must be allowed to dry |
| | | *Canola oil & Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Soybean Oil* | See label for instructions |
| | | *Spinosad* | PHI = 3 days |
| | Stink bug | Acephate | PHI = 21 days |
| | | Acetamiprid | PHI = 7 days |
| | | Bifenthrin | See label for instructions |
| | | Carbaryl | Do not apply within one day of harvest |
| | | Imidacloprid | PHI = 21 days |
| | | Malathion | Do not apply within one day of harvest |
| | | *Canola oil & Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | Thrips | Acephate | PHI = 21 days |
| | | Acetamiprid | PHI = 7 days |

*Italicized pesticides are organic control measures.*

**Table 2.5 - Insecticides (cont.)**

| Vegetable | Insect | Common Name | Wait Period before harvest |
|---|---|---|---|
| Beans (snaps and limas) (cont.) | Thrips (cont.) | Carbaryl | Do not apply within one day of harvest |
| | | Imidacloprid | PHI = 21 days |
| | | Malathion | Do not apply within one day of harvest |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Potassium laurate* | Can be applied up to the day of harvest |
| | | *Spinosad* | PHI = 3 days |
| Beets | Flea beetle | Carbaryl | Do not apply within one day of harvest |
| | | Imidacloprid | PHI = 21 days |
| | | Malathion | Do not apply within one day of harvest |
| | | Thiamethoxam | See label for instructions |
| | | *Azadirachtin* | Can be applied on day of harvest, must be allowed to dry |
| | | *Kaolin clay* | See label for instructions |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| Cabbage (broccoli, cauliflower, brussels sprouts, cabbage etc.) | Aphid (plant lice) | Acetamiprid | PHI = 7 days |
| | | Beauveria bassiana GHA | Can be applied on day of harvest, must be allowed to dry |
| | | Cyfluthrin | See label for instructions |
| | | Esfenvalerate | See label for instructions |
| | | Lambda-Cyhalothrin | Can be applied up to the day of harvest |
| | | Malathion | PHI = 7 days |
| | | Paraffin oil | Can be applied up to the day of harvest |
| | | Permethrin | |
| | | *Azadirachtin* | Can be applied on day of harvest, must be allowed to dry |
| | | *Canola oil & Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Neem oil* | Can be applied on day of harvest, must be allowed to dry |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Potassium laurate* | Can be applied up to the day of harvest |
| | | *Potassium laurate & Pyrethrins* | Can be applied up to the day of harvest |
| | | *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | Cabbage looper, Imported cabbage worm, diamond-back moth larvae | Acetamiprid | PHI = 7 days |
| | | Beauveria bassiana GHA | Can be applied on day of harvest, must be allowed to dry |
| | | Carbaryl | PHI = 3 days |
| | | Esfenvalerate | See label for instructions |
| | | Lambda-Cyhalothrin | Do not apply within one day of harvest |

*Italicized pesticides are organic control measures.*

**Table 2.5 - Insecticides (cont.)**

| Vegetable | Insect | Common Name | Wait Period before harvest |
|---|---|---|---|
| Cabbage (broccoli, cauliflower, brussels sprouts, cabbage etc.) (cont.) | | Malathion | PHI = 7 days |
| | | Permethrin | Do not apply within one day of harvest |
| | | *Azadirachtin* | Can be applied on day of harvest, must be allowed to dry |
| | | Bacillus thuringiensis | Can be applied on day of harvest, must be allowed to dry |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Potassium laurate* | Can be applied on day of harvest, must be allowed to dry |
| | | *Potassium laurate & Pyrethrins* | Can be applied up to the day of harvest |
| | | *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Spinosad* | Do not apply within one day of harvest |
| | Cabbage root maggot | Permethrin | Do not apply within one day of harvest |
| | Flea beetle | Capsaicin & Oil of Mustard | Can be applied on day of harvest, must be allowed to dry |
| | | Esfenvalerate | See label for instructions |
| | | Malathion | PHI = 7 days |
| | | Permethrin | PHI = 1 day |
| | | *Azadirachtin* | Can be applied up to the day of harvest |
| | | *Canola oil & Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Potassium laurate* | Can be applied up to the day of harvest |
| | | *Potassium laurate & Pyrethrins* | Can be applied up to the day of harvest |
| | | *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| Carrots | Aphid | *Beauveria bassiana* | |
| | | Capsaicin & Oil of Mustardaicin & Allyl Isothiocynanate | Can be applied on day of harvest, must be allowed to dry |
| | | Cyfluthrin | Can be applied up to the day of harvest |
| | | Esfenvalerate | See label for instructions |
| | | Imidacloprid | PHI = 7 days |
| | | *Azadirachtin* | Can be applied up to the day of harvest |
| | | *Neem oil* | Can be applied on day of harvest, must be allowed to dry |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Potassium laurate* | Can be applied up to the day of harvest |
| | | *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |

*Italicized pesticides are organic control measures.*

**Table 2.5 - Insecticides (cont.)**

| Vegetable | Insect | Common Name | Wait Period before harvest |
|---|---|---|---|
| Cucurbits (cantaloupes, cucumbers, squash, pumpkins, & watermelons) | Aphid (plant lice) | Acetamiprid | Can be applied up to the day of harvest |
| | | *Beauveria bassiana* | Can be applied up to the day of harvest |
| | | Imidacloprid | PHI = 21 days |
| | | Permethrin | Can be applied up to the day of harvest |
| | | *Azadirachtin* | Can be applied on day of harvest, must be allowed to dry |
| | | *Canola oil* | Can be applied on day of harvest, must be allowed to dry |
| | | *Canola oil & Pyrethrins* | Can be applied up to the day of harvest |
| | | *Neem oil & Azadirachtin* | Can be applied up to the day of harvest |
| | | *Neem oil & Azadirachtin* | Can be applied up to the day of harvest |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Potassium laurate* | Can be applied up to the day of harvest |
| | | *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | Cucumber beetle | Carbaryl | PHI = 3 days |
| | | Imidacloprid | PHI = 21 days |
| | | Permethrin | Can be applied up to the day of harvest |
| | | *Azadirachtin* | Can be applied up to the day of harvest |
| | | *Kaolin clay* | See label for instructions |
| | | *Neem oil* | Can be applied on day of harvest, must be allowed to dry |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | Leafhopper, leafminer | Permethrin | Can be applied up to the day of harvest |
| | | *Azadirachtin* | Can be applied on day of harvest, must be allowed to dry |
| | | *Canola oil* | Can be applied on day of harvest, must be allowed to dry |
| | | *Spinosad* | PHI = 3 days |
| | | *Neem oil & Azadirachtin* | Can be applied up to the day of harvest |
| | | *Neem oil* | Can be applied on day of harvest, must be allowed to dry |
| | | *Canola oil & Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Kaolin clay* | Can be applied up to the day of harvest |
| | Squash bug, Pickleworm, Stink bugs | Permethrin | Can be applied up to the day of harvest |
| | | *Kaolin clay* | See label for instructions |

*Italicized pesticides are organic control measures.*

## Table 2.5 - Insecticides (cont.)

| Vegetable | Insect | Common Name | Wait Period before harvest |
|---|---|---|---|
| Cucurbits (cantaloupes, cucumbers, squash, pumpkins, & watermelons) (cont.) | | *Potassium laurate* | Can be applied up to the day of harvest |
| | | *Pyrethrins* | Can be applied up to the day of harvest |
| | Squash vine borer | Acetamiprid | Can be applied up to the day of harvest |
| | | Permethrin | Can be applied up to the day of harvest |
| | | *Kaolin clay* | Can be applied up to the day of harvest |
| | Spider mite | Permethrin | Can be applied on day of harvest, must be allowed to dry |
| | | *Canola oil* | Can be applied on day of harvest, must be allowed to dry |
| | | *Canola oil & Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Neem oil & Azadirachtin* | Can be applied up to the day of harvest |
| | | *Potassium laurate* | Can be applied up to the day of harvest |
| | | *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Spinosad* | PHI = 3 days |
| | Whitefly | Horticultural oil | See label for instructions |
| | | Imidacloprid | PHI = 21 days |
| | | Permethrin | Can be applied up to the day of harvest |
| | | *Azadirachtin* | Can be applied on day of harvest, must be allowed to dry |
| | | *Canola oil* | Can be applied on day of harvest, must be allowed to dry |
| | | *Neem oil* | Can be applied on day of harvest, must be allowed to dry |
| | | *Potassium laurate* | Can be applied up to the day of harvest |
| | | *Pyrethrins* | Can be applied up to the day of harvest |
| Eggplant | Flea beetle, Colorado potato beetle, grasshopper | Beauveria bassiana | Can be applied up to the day of harvest |
| | | Capsaicin & Oil of Mustard | Can be applied on day of harvest, must be allowed to dry |
| | | Carbaryl | PHI = 3 days |
| | | Esfenvalerate | See label for instructions |
| | | Imidacloprid | PHI = 21 days |
| | | Permethrin | PHI = 3 days |
| | | *Azadirachtin* | Can be applied on day of harvest, must be allowed to dry |
| | | *Canola oil & Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Neem oil & Azadirachtin* | Can be applied up to the day of harvest |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Potassium laurate & Pyrethrins* | Can be applied up to the day of harvest |
| | | *Potassium laurate & Pyrethrins* | Can be applied up to the day of harvest |

*Italicized pesticides are organic control measures.*

## Table 2.5 - Insecticides (cont.)

| Vegetable | Insect | Common Name | Wait Period before harvest |
|---|---|---|---|
| Greens or Leaf Crops (turnips, kale, spinach, collards) | Aphid (plant lice) | *Potassium laurate* | Can be applied up to the day of harvest |
| | | *Neem oil* | Can be applied on day of harvest, must be allowed to dry |
| | | Malathion | PHI = 7 days |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | Acetamiprid | PHI = 7 days |
| | | Imidacloprid | PHI = 21 days |
| | | Beauveria bassiana | Can be applied up to the day of harvest |
| | | Horticultural oil | See label for instructions |
| | | *Canola oil & Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Potassium laurate & Pyrethrins* | Can be applied up to the day of harvest |
| | Caterpillar looper, imported cabbage worm, and diamond-back larva | Acetamiprid | PHI = 7 days |
| | | Beauveria bassiana GHA | Can be applied up to the day of harvest |
| | | Cyfluthrin | See label for instructions |
| | | Malathion | PHI = 7 days |
| | | *Azadirachtin* | Can be applied on day of harvest, must be allowed to dry |
| | | *Neem oil & Azadirachtin* | Can be applied up to the day of harvest |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Potassium laurate* | Can be applied up to the day of harvest |
| | | *Potassium laurate & Pyrethrins* | Can be applied up to the day of harvest |
| | | *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Spinosad* | Can be applied up to the day of harvest |
| | Flea beetle, Harlequin bug | Acetamiprid | PHI = 7 days |
| | | Beauveria bassiana | Can be applied up to the day of harvest |
| | | Capsaicin & Oil of Mustard | Can be applied on day of harvest, must be allowed to dry |
| | | Carbaryl | PHI = 14 days |
| | | Imidacloprid | PHI = 21 days |
| | | *Azadirachtin* | Can be applied on day of harvest, must be allowed to dry |
| | | *Azadirachtin & Pyrethrins* | Can be applied up to the day of harvest |
| | | *Canola oil & Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Neem oil & Azadirachtin* | Can be applied up to the day of harvest |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Potassium laurate* | Can be applied up to the day of harvest |
| | | *Potassium laurate & Pyrethrins* | Can be applied up to the day of harvest |

*Italicized pesticides are organic control measures.*

**Table 2.5 - Insecticides (cont.)**

| Vegetable | Insect | Common Name | Wait Period before harvest |
|---|---|---|---|
| Greens or Leaf Crops (turnips, kale, spinach, collards) cont | Grasshopper | Beauveria bassiana | Can be applied up to the day of harvest |
| | | Capsaicin & Oil of Mustard | Can be applied up to the day of harvest |
| | | Carbaryl | PHI = 14 days |
| | | Cyfluthrin | See label for instructions |
| | | Imidacloprid | PHI = 21 days |
| | | *Azadirachtin* | Can be applied up to the day of harvest |
| | | *Neem oil & Azadirachtin* | Can be applied up to the day of harvest |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Potassium laurate* | Can be applied up to the day of harvest |
| | | *Pyrethrins* | Can be applied up to the day of harvest |
| Lettuce | Aphid (plant lice) | Beauveria bassiana | Can be applied up to the day of harvest |
| | | Capsaicin & Oil of Mustard | Can be applied up to the day of harvest |
| | | Horticultural oil | See label for instructions |
| | | Imidacloprid | PHI = 21 days |
| | | Malathion | PHI = 14 days |
| | | Permethrin | Can be applied up to the day of harvest |
| | | *Azadirachtin* | Can be applied on day of harvest, must be allowed to dry |
| | | *Canola oil* | Can be applied on day of harvest, must be allowed to dry |
| | | *Canola oil & Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Potassium laurate* | Can be applied up to the day of harvest |
| | | *Potassium laurate & Pyrethrins* | Can be applied up to the day of harvest |
| | Flea beetle, harlequin bug, stink bug | Beauveria bassiana | Can be applied up to the day of harvest |
| | | Capsaicin & Oil of Mustard | Can be applied up to the day of harvest |
| | | Malathion | PHI = 14 days |
| | | Permethrin | Can be applied up to the day of harvest |
| | | *Canola oil & Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Neem oil & Potassium laurate & Pyrethrins* | Can be applied up to the day of harvest |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Potassium laurate* | Can be applied up to the day of harvest |
| | | *Potassium laurate & Pyrethrins* | Can be applied up to the day of harvest |
| Mushroom | Gnat, rove beetle | *Azadirachtin* | Can be applied on day of harvest, must be allowed to dry |

*Italicized pesticides are organic control measures.*

**Table 2.5 - Insecticides (cont.)**

| Vegetable | Insect | Common Name | Wait Period before harvest |
|---|---|---|---|
| Okra | Aphid (plant lice) | Beauveria bassiana | Can be applied up to the day of harvest |
| | | Horticultural oil | Can be applied up to the day of harvest |
| | | Imidacloprid | PHI = 21 days |
| | | Malathion | Can be applied up to the day of harvest |
| | | Permethrin | PHI= 3 days |
| | | *Azadirachtin* | Can be applied on day of harvest, must be allowed to dry |
| | | *Neem oil* | Can be applied on day of harvest, must be allowed to dry |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Pyrethrins* | Can be applied up to the day of harvest |
| Onion | Onion Maggot | Malathion | PHI= 3 days |
| | | *Azadirachtin* | Can be applied on day of harvest, must be allowed to dry |
| | | *Neem oil & Azadirachtin* | Can be applied up to the day of harvest |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | Thrips, aphid | Acetamiprid | PHI = 7 days |
| | | Beauveria bassiana | Can be applied up to the day of harvest |
| | | Horticultural oil | See label for instructions |
| | | Malathion | PHI= 3 days |
| | | *Azadirachtin* | Can be applied on day of harvest, must be allowed to dry |
| | | *Kaolin clay* | Can be applied up to the day of harvest |
| | | *Neem oil* | Can be applied on day of harvest, must be allowed to dry |
| | | *Neem oil & Azadirachtin* | Can be applied up to the day of harvest |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Potassium laurate* | Can be applied up to the day of harvest |
| | | *Pyrethrins* | Can be applied up to the day of harvest |
| Pea | Aphid (plant lice) | Acetamiprid | PHI = 7 days |
| | | Imidacloprid | PHI = 21 days |
| | | *Azadirachtin & Pyrethrins* | Can be applied up to the day of harvest |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Pyrethrins* | Can be applied up to the day of harvest |
| | Earworm, cowpea curculio, grasshopper | Carbaryl | PHI = 4 days |
| | | Esfenvalerate | See label for instructions |
| | | *Spinosad* | Can be applied up to the day of harvest |

*Italicized pesticides are organic control measures.*

**Table 2.5 - Insecticides (cont.)**

| Vegetable | Insect | Common Name | Wait Period before harvest |
|---|---|---|---|
| Pepper (bell or hot) | Aphids (plant lice), thrips, stink bugs | Acephate | PHI = 7 days |
| | | Acetamiprid | PHI = 7 days |
| | | Capsaicin & Oil of Mustard | Can be applied up to the day of harvest |
| | | Imidacloprid | See label for instructions |
| | | Malathion | PHI= 3 days |
| | | *Azadirachtin* | Can be applied on day of harvest, must be allowed to dry |
| | | *Azadirachtin* & *Pyrethrins* | Can be applied up to the day of harvest |
| | | *Neem oil* & *Azadirachtin* | Can be applied up to the day of harvest |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Pyrethrins* | Can be applied up to the day of harvest |
| | European corn borer, grasshopper | Acephate | PHI = 7 days |
| | | Acetamiprid | PHI = 7 days |
| | | Carbaryl | PHI = 7 days |
| | | Permethrin | PHI= 3 days |
| | | *Azadirachtin* & *Pyrethrins* | Can be applied up to the day of harvest |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Pyrethrins* | Can be applied up to the day of harvest |
| Potato | Aphids | Horticultural oil | See label for instructions |
| | | Imidacloprid | See label for instructions |
| | | *Azadirachtin* | Can be applied on day of harvest, must be allowed to dry |
| | | *Canola oil* & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Neem oil* | Can be applied on day of harvest, must be allowed to dry |
| | | *Neem oil* & *Azadirachtin* | Can be applied up to the day of harvest |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Potassium laurate* | Can be applied up to the day of harvest |
| | | *Potassium laurate* & *Pyrethrins* | Can be applied up to the day of harvest |
| | | *Pyrethrins* | Can be applied up to the day of harvest |
| | Colorado potato beetle | Carbaryl | PHI = 7 days |
| | | Cryolite | See label for instructions |
| | | Imidacloprid | PHI = 21 days |
| | | Permethrin | PHI = 7 days |
| | | *Azadirachtin* | Can be applied on day of harvest, must be allowed to dry |
| | | *Canola oil*& *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Neem oil* | Can be applied on day of harvest, must be allowed to dry |

*Italicized pesticides are organic control measures.*

**Table 2.5 - Insecticides (cont.)**

| Vegetable | Insect | Common Name | Wait Period before harvest |
|---|---|---|---|
| Potato (cont.) | Colorado potato beetle cont. | *Neem oil* & *Azadirachtin* | Can be applied up to the day of harvest |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Potassium laurate* & *Pyrethrins* | Can be applied up to the day of harvest |
| | | *Pyrethrins* | Can be applied up to the day of harvest |
| | | *Spinosad* | Can be applied up to the day of harvest |
| | European corn borer | Carbaryl | PHI = 7 days |
| | | Esfenvalerate | See label for instructions |
| | | Permethrin | PHI = 7 days |
| | | *Azadirachtin* | Can be applied on day of harvest, must be allowed to dry |
| | | *Azadirachtin* & *Pyrethrins* | Can be applied up to the day of harvest |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Pyrethrins* | Can be applied up to the day of harvest |
| | | *Spinosad* | Can be applied up to the day of harvest |
| | Grasshopper | Capsaicin & Oil of Mustard | Can be applied on day of harvest, must be allowed to dry |
| | | Esfenvalerate | See label for instructions |
| | | Permethrin | PHI = 7 days |
| | | Thiamethoxam | See label for instructions |
| | | *Azadirachtin* | Can be applied on day of harvest, must be allowed to dry |
| | | *Azadirachtin* & *Pyrethrins* | Can be applied up to the day of harvest |
| | | *Kaolin clay* | Can be applied on day of harvest, must be allowed to dry |
| | | *Potassium laurate* | Can be applied up to the day of harvest |
| | Potato leafhopper | Capsaicin & Oil of Mustard | Can be applied on day of harvest, must be allowed to dry |
| | | Malathion | Can be applied up to the day of harvest |
| | | Permethrin | PHI = 7 days |
| | | *Azadirachtin* | Can be applied on day of harvest, must be allowed to dry |
| | | *Canola oil* & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | Carbaryl | PHI = 7 days |
| | | Malathion | Can be applied up to the day of harvest |
| | | *Neem oil* & *Azadirachtin* | Can be applied up to the day of harvest |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Potassium laurate* | Can be applied up to the day of harvest |
| | | *Potassium laurate* & *Pyrethrins* | Can be applied up to the day of harvest |
| | Potato tuberworm | Esfenvalerate | See label for instructions |
| | | Permethrin | PHI = 14 days |

*Italicized pesticides are organic control measures.*

**Table 2.5 - Insecticides (cont.)**

| Vegetable | Insect | Common Name | Wait Period before harvest |
|---|---|---|---|
| Potato (cont.) | Potato tuberworm (cont.) | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Pyrethrins* | Can be applied up to the day of harvest |
| | Whitefly | Capsaicin & Oil of Mustard | Can be applied on day of harvest, must be allowed to dry |
| | | Esfenvalerate | See label for instructions |
| | | Horticultural oil | See label for instructions |
| | | Imidacloprid | See label for instructions |
| | | Malathion | Can be applied up to the day of harvest |
| | | Permethrin | PHI = 7 days |
| | | *Azadirachtin* | Can be applied on day of harvest, must be allowed to dry |
| | | *Canola oil* | Can be applied on day of harvest, must be allowed to dry |
| | | *Canola oil* & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Neem oil* | Can be applied on day of harvest, must be allowed to dry |
| | | *Neem oil* & *Azadirachtin* | Can be applied up to the day of harvest |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Potassium laurate* | Can be applied up to the day of harvest |
| | | *Potassium laurate* & *Pyrethrins* | Can be applied up to the day of harvest |
| | | *Pyrethrins* | Can be applied up to the day of harvest |
| Strawberry | Aphid (plant lice) | Capsaicin & Oil of Mustard | Can be applied on day of harvest, must be allowed to dry |
| | | Imidacloprid | See label for instructions |
| | | Malathion | PHI = 3 days |
| | | Permethrin | PHI = 14 |
| | | *Canola oil* & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Neem oil* | Can be applied on day of harvest, must be allowed to dry |
| | | *Neem oil* & *Azadirachtin* | Can be applied up to the day of harvest |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Potassium laurate* | Can be applied up to the day of harvest |
| | | *Pyrethrins* | Can be applied up to the day of harvest |
| | Cyclamen mite | *Potassium laurate* | Can be applied up to the day of harvest |
| | Leafroller, root lice (root aphid) | Capsaicin & Oil of Mustard | Can be applied on day of harvest, must be allowed to dry |
| | | Carbaryl | PHI = 7 days |

*Italicized pesticides are organic control measures.*

## Table 2.5 - Insecticides (cont.)

| Vegetable | Insect | Common Name | Wait Period before harvest |
|---|---|---|---|
| Strawberry (cont.) | Leafroller, root lice (root aphid) (cont.) | Horticultural oil | See label for instructions |
| | | Malathion | PHI = 3 days |
| | | Permethrin | PHI = 7 days |
| | | *Azadirachtin* | Can be applied up to the day of harvest |
| | | *Canola oil*& *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Neem oil* | Can be applied on day of harvest, must be allowed to dry |
| | | *Neem oil* & *Azadirachtin* | Can be applied up to the day of harvest |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Spinosad* | Can be applied up to the day of harvest |
| | Spider mite | Horticultural oil | See label for instructions |
| | | Malathion | PHI= 3 days |
| | | Permethrin | PHI = 14 |
| | | *Azadirachtin* & *Pyrethrins* | Can be applied up to the day of harvest |
| | | *Canola oil*& *Pyrethrins* | Can be applied up to the day of harvest |
| | | *Neem oil* | Can be applied on day of harvest, must be allowed to dry |
| | | *Neem oil* & *Azadirachtin* | Can be applied up to the day of harvest |
| | | *Potassium laurate* | Can be applied up to the day of harvest |
| | | *Potassium laurate* & *Pyrethrins* | Can be applied up to the day of harvest |
| | | *Pyrethrins* | Can be applied up to the day of harvest |
| | Strawberry weevil "Clipper" & Strawberry rootworms | Carbaryl | PHI = 7 days |
| | | Permethrin | See label for instructions |
| | | *Azadirachtin* | Can be applied up to the day of harvest |
| | | *Pyrethrins* | Can be applied up to the day of harvest |
| Sweet corn | Corn earworm | Capsaicin & Oil of Mustard | Can be applied on day of harvest, must be allowed to dry |
| | | Carbaryl | See label for instructions |
| | | Cyfluthrin | See label for instructions |
| | | Esfenvalerate | PHI = 1 days |
| | | Esfenvalerate | See label for instructions |
| | | Horticultural oil | Can be applied up to the day of harvest |
| | | Permethrin | PHI = 1 days |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied up to the day of harvest |
| | | *Pyrethrins* | Can be applied up to the day of harvest |
| | Corn sap beetle, European corn borer in the ear, Japanese beetle | Carbaryl | PHI= 3 days |
| | | Esfenvalerate | See label for instructions |
| | | Malathion | PHI = 5 days |
| | | Permethrin | PHI = 3 days |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied up to the day of harvest |
| | | *Pyrethrins* | Can be applied up to the day of harvest |

*Italicized pesticides are organic control measures.*

## Table 2.5 - Insecticides (cont.)

| Vegetable | Insect | Common Name | Wait Period before harvest |
|---|---|---|---|
| Sweet corn (cont.) | European corn borer, Stink bugs | Carbaryl | See label for instructions |
| | | Esfenvalerate | PHI = 1 days |
| | | Permethrin | PHI = 3 days |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied up to the day of harvest |
| | | *Pyrethrins* | Can be applied up to the day of harvest |
| | Fall armyworm | Carbaryl | See label for instructions |
| | | Horticultural oil | Can be applied up to the day of harvest |
| | | Permethrin | PHI = 3 days |
| | | *Neem oil* & *Azadirachtin* | Can be applied up to the day of harvest |
| | Flea beetle, grasshoppers | Carbaryl | See label for instructions |
| | | Cyfluthrin | See label for instructions |
| | | Esfenvalerate | PHI = 1 days |
| | | Permethrin | PHI = 3 days |
| | | *Azadirachtin* | Can be applied up to the day of harvest |
| | | *Canola oil* & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Neem oil* & *Azadirachtin* | Can be applied up to the day of harvest |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Potassium laurate* | Can be applied up to the day of harvest |
| | | *Pyrethrins* | Can be applied up to the day of harvest |
| | Seedcorn maggot | Piperonyl butoxide & *Pyrethrins* | Can be applied up to the day of harvest |
| Tomato | Blister beetles, hornworm, tomato russet mite, cabbage looper | Capsaicin & Oil of Mustard | Can be applied on day of harvest, must be allowed to dry |
| | | Carbaryl | PHI = 3 days |
| | | Malathion | PHI = 1 day |
| | | Beauveria bassiana | Can be applied up to the day of harvest |
| | | *Neem oil* & *Azadirachtin* | Can be applied up to the day of harvest |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | Colorado potato beetle | Acetamiprid | See label for instructions |
| | | Carbaryl | PHI = 3 days |
| | | Esfenvalerate | PHI = 1 days |
| | | Imidacloprid | Can be applied up to the day of harvest |
| | | Imidacloprid | See label for instructions |
| | | Permethrin | PHI = 3 days |
| | | Beauveria bassiana | Can be applied up to the day of harvest |
| | | *Canola oil* & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Neem oil* | Can be applied up to the day of harvest |
| | | *Neem oil* & *Azadirachtin* | Can be applied up to the day of harvest |

*Italicized pesticides are organic control measures.*

## Table 2.5 - Insecticides (cont.)

| Vegetable | Insect | Common Name | Wait Period before harvest |
|---|---|---|---|
| Tomato (cont.) | Colorado potato beetle cont. | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Potassium laurate* & *Pyrethrins* | Can be applied up to the day of harvest |
| | | *Pyrethrins* | Can be applied up to the day of harvest |
| | | *Spinosad* | Can be applied up to the day of harvest |
| | Cutworms | Bifenthrin | See label for instructions |
| | | Capsaicin & Oil of Mustard | Can be applied on day of harvest, must be allowed to dry |
| | | Carbaryl | PHI = 3 days |
| | | Cyfluthrin | See label for instructions |
| | | Esfenvalerate | See label for instructions |
| | | Imidacloprid | See label for instructions |
| | | Malathion | PHI = 1 day |
| | | Permethrin | PHI = 3 days |
| | | *Azadirachtin* | Can be applied up to the day of harvest |
| | | *Spinosad* | Can be applied up to the day of harvest |
| | Flea beetle, stink bugs, grasshoppers, leaf-footed bugs | Carbaryl | PHI = 3 days |
| | | Cyfluthrin | See label for instructions |
| | | Esfenvalerate | PHI = 1 days |
| | | Malathion | See label for instructions |
| | | Permethrin | PHI = 3 days |
| | | *Azadirachtin* | Can be applied up to the day of harvest |
| | | *Canola oil* & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Neem oil* & *Azadirachtin* | Can be applied up to the day of harvest |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Potassium laurate* | Can be applied up to the day of harvest |
| | | *Potassium laurate* & *Pyrethrins* | Can be applied up to the day of harvest |
| | Fruitworm | Capsaicin & Oil of Mustard | Can be applied on day of harvest, must be allowed to dry |
| | | Carbaryl | PHI = 3 days |
| | | Esfenvalerate | PHI = 1 days |
| | | Malathion | PHI = 1 day |
| | | *Azadirachtin* | Can be applied up to the day of harvest |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Pyrethrins* | Can be applied up to the day of harvest |
| | | *Spinosad* | Can be applied up to the day of harvest |
| | Spider mites | Horticultural oil | See label for instructions |
| | | Malathion | PHI = 1 day |
| | | Permethrin | Can be applied up to the day of harvest |

*Italicized pesticides are organic control measures.*

## Table 2.5 - Insecticides (cont.)

| Vegetable | Insect | Common Name | Wait Period before harvest |
|---|---|---|---|
| Tomato (cont.) | Spider mites (cont.) | Canola oil | Can be applied on day of harvest, must be allowed to dry |
| | | *Canola oil* & *Pyrethrins* | Can be applied up to the day of harvest |
| | | *Neem oil* | Can be applied on day of harvest, must be allowed to dry |
| | | *Neem oil* & *Azadirachtin* | Can be applied up to the day of harvest |
| | | *Potassium laurate* | Can be applied up to the day of harvest |
| | | *Potassium laurate* & Pyrethrin | Can be applied up to the day of harvest |
| | | *Pyrethrins* | Can be applied up to the day of harvest |
| | | *Spinosad* | Can be applied up to the day of harvest |
| | Thrips, aphids | Acetamiprid | PHI = 7 days |
| | | Capsaicin & Oil of Mustard | Can be applied on day of harvest, must be allowed to dry |
| | | Esfenvalerate | PHI = 1 days |
| | | Imidacloprid | Can be applied up to the day of harvest |
| | | Malathion | Can be applied up to the day of harvest |
| | | Permethrin | PHI = 3 days |
| | | Beauveria bassiana | Can be applied up to the day of harvest |
| | | *Canola oil* & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Neem oil* | Can be applied up to the day of harvest |
| | | *Neem oil* & *Azadirachtin* | Can be applied up to the day of harvest |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Potassium laurate* | Can be applied up to the day of harvest |
| | | *Potassium laurate* & *Pyrethrins* | Can be applied up to the day of harvest |
| | | *Pyrethrins* | Can be applied up to the day of harvest |
| | Whiteflies | *Potassium laurate* | Can be applied up to the day of harvest |
| | | Capsaicin & Oil of Mustard | Can be applied on day of harvest, must be allowed to dry |
| | | Malathion | Can be applied up to the day of harvest |
| | | Piperonyl butoxide & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | *Pyrethrins* | Can be applied up to the day of harvest |
| | | Esfenvalerate | PHI = 1 days |
| | | *Potassium laurate* & *Pyrethrins* | Can be applied up to the day of harvest |
| | | *Neem oil* & *Azadirachtin* | Can be applied up to the day of harvest |
| | | *Canola oil* & *Pyrethrins* | Can be applied on day of harvest, must be allowed to dry |
| | | Imidacloprid | Can be applied up to the day of harvest |
| | | Beauveria bassiana | Can be applied up to the day of harvest |
| | | *Neem oil* | Can be applied up to the day of harvest |
| | | *Pyrethrins* | Can be applied up to the day of harvest |

*Italicized pesticides are organic control measures.*

# Weed Management in Home Vegetable Gardens

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## Overview

Weed management is necessary in vegetable gardens. Weeds compete with vegetable crops for water, nutrients, and light, and can harbor insect and disease pests. Start a weed control program before planting and then continue weeding throughout the growing season. Keeping weeds down early in the season, when they are small, reduces the amount of hand weeding required later in the summer when higher temperatures and humidity make this task more difficult. Weeds are difficult to eradicate. Their seeds can remain dormant but viable for five, 10, 20, or more years in the soil, depending on species. Control weeds in areas near the garden to limit the movement of weed seed or weed propagules into the garden. Prevent weeds from flowering, as this helps reduce the amount of weed seed in the soil over time.

Cultural control of weeds in vegetable gardens is preferred because there are few chemical control options. Not many herbicides can be applied to a wide range of vegetables. For information related to larger areas planted with an individual vegetable species, such as a planting of an acre or more, consult the Commercial Vegetable Production Recommendations guide (Va. Coop Ext. Pub. 456-420).

## General Cultural Controls

**Winter cover crop:** Plant rye, annual ryegrass, or other cover crops in the fall after the final harvest. Till the cover crop into the soil in spring prior to planting vegetables.

**Cultivation/Hoeing/Hand weeding:** Tilling the garden in spring controls winter annual weeds like common chickweed and controls or suppresses perennial weeds. Troublesome perennial weeds like bermudagrass, quackgrass, yellow nutsedge, and other creeping perennials need repeated tilling. Hoe weeds out of the alleyways between vegetable rows. Cut annual weeds at or slightly below the soil surface to minimize soil disturbance. Deeper hoeing brings weed seed from greater depths in the soil to the surface where they can germinate. Controlling weeds prior to flowering reduces weed populations in future years by depleting the weed seed reservoir in the soil.

**Organic mulches:** Pine bark, pine straw, sawdust, and grass clippings are good mulching materials. Do not use grass clippings from a lawn or pasture that has been recently treated with an herbicide, especially herbicides used for controlling broadleaf weeds. Monitor soil fertility, as nitrogen tie-up can occur when using mulches like sawdust. Organic mulches conserve soil moisture and cool the soil. Spread mulch two to four inches deep. Place newspaper on the soil surface prior to applying mulch in order to suppress weeds. Organic mulches suppress or control annual weeds but will not control perennial weeds. Use mulches that are free of weed seed and that do not have a rotten egg or ammonia odor. Improperly composted mulch can have a low pH and contain chemicals that injure crop plants.

**Synthetic mulches:** Using solid black plastic or a landscape fabric improves weed control compared to mulch alone. Solid black plastic is more effective for weed control than the available landscape fabrics but water cannot pass through it. Place drip irrigation under solid black plastic to allow water to reach plant roots. Landscape fabrics allow for air and water movement but weed roots and/or shoots can penetrate through openings in the material. Place plastic or fabric on the soil surface and then cut an X or a hole into the material to transplant plants or vegetable seeds. One can place organic mulch over these materials; however, weeds may germinate in the mulch layer and then send roots through the fabric to the soil below. Black plastic and landscape fabrics control annual weeds and suppress perennial weeds like yellow nutsedge.

## General Biological Controls

There currently are no biological control options for weed control in vegetable gardens.

## General Chemical Controls

### *Organic*

No recommended products at this time.

## *Conventional*

**After final harvest in fall or prior to planting:** Glyphosate (Roundup and other trade names). Apply at least one week before planting. Rinse glyphosate off plastic prior to transplanting vegetables through the black plastic or do not use glyphosate at all when using plastic groundcover. Use glyphosate to control perennial weeds like bermudagrass, quackgrass, and horsenettle. Apply to weed foliage before frost, when the weeds are still actively growing.

**At planting:** Trifluralin (Preen Garden Weed Preventer, Miracle-Gro Garden Weed Preventer, or other labeled formulation). Apply at seeding of broccoli, Brussels sprouts, cabbage, carrots, cauliflower, celery, collards, black-eyed peas, field peas, garden peas, lima beans, mustard greens, snap beans, and turnip greens. Apply before transplanting celery, broccoli, Brussels sprouts, cabbage, cauliflower, eggplant, peppers, onions, and tomatoes. Apply to established cantaloupe, cucumber, and watermelon that have at least four true leaves. Apply to established asparagus prior to spear emergence. Apply after planting potatoes. Trifluralin will not control existing weeds. It does provide pre-emergence control of annual grasses like crabgrass, foxtail, and goosegrass, and small-seeded broadleaf weeds like purslane and pigweed.

### Perennial weeds

Perennial vines and weeds (bermudagrass, poison ivy, dock, honeysuckle, etc.) around the garden borders or in the tilled area may be controlled with a postemergence application of glyphosate (Roundup or other labeled formulations) after completion of the summer vegetable harvest. For small areas or individual weed treatments, the Roundup formulation is packaged in small quantities suitable for home use and does not require special sprayers. Many of the perennial weeds are more effectively controlled when treated in late summer or fall before frost causes the leaves to drop. Since glyphosate is not biologically active in the soil, it cannot result in residue problems.

**Do not spray vegetables with a sprayer that has been used to apply 2,4-D.**

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