Organic Controls for Insects

Eric R. Day, Extension Entomologist, Virginia Tech

Table 2.1 - Organic Products and Predators

Product[1]	**Insects Controlled**	**Remarks**
Bacillus thuringiensis	Most caterpillars, loopers, hornworms, bagworms	This product, also known as B.t., is sold under many trade names.
M-One, M-Track, Foil, Novodor	Colorado potato beetle	This is a new strain of *Bacillus thuringiensis,* variety: *san diego,* which is particularly effective against beetle larvae.
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
Spinosan	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 larvae are present. These wasps do not overwinter.
Lady beetles	Feed on aphids and other soft	Lady beetles may leave the garden to find bodied insects 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 safely 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 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

Steven L. Rideout, Vegetable Plant Pathologist, Easern Shore, AREC
Christine Waldenmaier, Plant Pathology Research Specialist Senior, Eastern Shore AREC
Elizabeth Bush, Research Associate, Department of Plant Pathology, Physiology, and Weed Science

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 Bonide Captan 50W Dragon Captan Wettable Hi-Yield Captan Fungicide 50W Orthocide Garden Fungicide Southern Agricultural Home and Garden Captan Fungicide
Chlorothalonil	Bonide Fung-onil Dragon Daconil 2787 Earl May Fung-onil Ferti-Lome Liquid Fungicide Fung-onil Multipurpose Gordon's Multi-Purpose Fungicide Ortho Daconil 2787 Ortho Garden Disease Control Southern Agricultural Lawn, Ornamental, & Vegetable Fungicide
Basic copper	Acme Bordeaux Mix Bonide Garden Dust Cooke Copper Fungicide Cooke KopRSpray Conc. Dragon Bordeaux Mix Fertilome Bordeaux Mixture Gordon's Bordeaux Mix Hi-Yield Bordeaux Mix Lilly Miller Microcop Fungicide – Basic $CuSO_4$ Southern Agricultural Neutral Copper Fungicide Southern Agricultural Tomato Dust
Fixed copper	American Copper Fungicide Bonide Liquid Copper Fungicide Dragon Copper Fungicide Hi-Yield Copper Fungicide Southern Agricultural Liquid Copper Fungicide
Mancozeb	Bonide Mancozeb Flowable with Zinc Dragon Mancozeb Green Light Broad Spectrum Mancozeb Fungicide Southern Agricultural Dithane M-45
Maneb	Earl May Tomato Blight Control Earl May Tomato and Vegetable Dust Gordon's Maneb Tomato and Vegetable Fungicide Hi-Yield Maneb Garden Fungicide
Neem oil	Green light Powdery Mildew Killer Garden Safe Fungicide 3
PNCB (pentachloro-nitrobenzene)	Hi-Yield Terraclor Granule Southern Agriculture Terraclor
Potassium bicarbonate	Bonide Remedy Cleary First Step
Sulfur	Bonide Liquid Sulfur Bonide Sulfur Fungicide Dragon Garden Sulfur Green Light Wettable Dusting Sulfur Hi-Yield Lime Sulfur Ortho Garden Sulfur Dust Safer Garden Fungicide 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 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) 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 or 4.0 tsp liquid at tri-foliage and reapply every 7 to 10 days.
Botrytis Blight (Gray mold)	chlorothalonil 12.5% (7) chlorothalonil 30% (7)	4.0 tbsp 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 Wettable Sulfur or Sulfur dust	2.0 tbsp 2.5 tbsp or 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 for 1000 ft row	Apply at planting only. Direct spray in the seed furrow or over the planted row.
Rust	chlorothalonil 12.5% (7) chlorothalonil 30% (7) Wettable Sulfur or Sulfur dust	2.0-4.0 tbsp 1.0 tbsp 2.5 tbsp 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 *Cercospora*	copper 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 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, *Alternaria* leaf spot	chlorothalonil 12.5% chlorothalonil 30% copper maneb (7)	2.5 tbsp 1.0 tbsp 1.0 tsp 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 Leaf Blight	chlorothalonil 12.5% chlorothalonil 30% copper	2.5 tbsp 1.0 tbsp 2.0 tbsp	Start applications when disease threatens and reapply every 7 to 10 days if needed.
Celery Bacterial Blight	copper	2.0 tbsp	Apply at first sign of disease; reapply every 7 to10 days.
Cercospora (Early Blight)	chlorothalonil 12.5% (7) chlorothalonil 30% (7) copper	3.0-4.0 tbsp 1.0 tbsp 2.0 tbsp	Apply at first sign of disease; reapply every 7 days.
Septoria (Late blight) or Stalk rot (*Rhizoctonia*)	chlorothalonil 12.5% (7) chlorothalonil 30% (7)	3.0 tbsp 1.0 tbsp	Apply at first sign of disease; reapply every 7 days.
Cucurbits (Cucumbers, Summer Squash, Cantalopes, Pumpkins) *Alternaria* leaf spot; Anthracnose; Downy mildew; Gummy stem blight	chlorothalonil 12.5% chlorothalonil 30% mancozeb (5) maneb (5) copper	2.0-3.0 tbsp 1.0 tbsp 2.0 tbsp 1.0 tbsp 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% chlorothalonil 30% copper neem oil potassium bicarbonate	3.0 tbsp 1.0 tbsp 2.0 tbsp 2.0 tbsp 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 Anthracnose; fruit rot	maneb (5)	1.0 tbsp	Begin at fruit set. Reapply every 7 days.
Irish Potatoes Early blight, late blight, and *Botrytis* vine rot	chlorothalonil 12.5% chlorothalonil 30% mancozeb (14) maneb (14) copper	2.0 tbsp 1.5 tbsp 2.0 tbsp 1.0 tbsp 2.5 tbsp	Apply at first sign of disease and reapply every 7 days.
Onion Bacterial Soft rot	copper	2.0 tbsp	Apply during extended periods of wet soil. Reapply every 7 days up to harvest.
Onion (dry bulb) *Botrytis* leaf blight, Downy mildew, Purple blotch	chlorothalonil 12.5% (7) chlorothalonil 30% (7) maneb (7)	2.0 tbsp 1.0 tbsp 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) chlorothalonil 30% (14) maneb (7) copper	2.0-4.0 tbsp 1.0 tbsp 2.0 tbsp 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 Powdery mildew and Bacterial blight	copper neem oil	2.0 tbsp 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 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 Bacterial wilt	No chemicals registered		Plant resistant varieties. Spray with approved insecticide to control flea beetles.
Leaf blight, Rust	chlorothalonil 12.5% (14) chlorothalonil 30% (14) mancozeb (7)	1.0-2.5 tbsp 1.0 tbsp 1.5 tbsp	Apply after observing disease and reapply every 7 days.
Tomatoes Early blight, late blight, *Septoria* leaf spot, gray mold, Anthracnose and *Rhizoctonia* fruit rot	chlorothalonil 12.5% chlorothalonil 30% mancozeb (5) maneb (5) copper	3.0-4.0 tbsp 1.0 tbsp 3.0 tbsp 2.0 tbsp 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 maneb (5)	2.0 tbsp 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 Anthracnose, gummy stem blight, *Alternaria* leaf blight, downy mildew and powdery mildew	chlorothalonil 12.5% chlorothalonil 30% mancozeb (5) maneb (5) copper neem oil (powdery mildew)	3.0-4.0 tbsp 1.0 tbsp 2.0 tbsp 2.0 tbsp 2.0 tbsp 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 soil-bourne 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

Crop	Insect	Treatment and Amount to Mix with 1 Gallon of Water or as Indicated Otherwise	Remarks and Days Between Last Application and Harvest
Asparagus	Asparagus beetle, Grasshopper	Carbaryl (Sevin) 50% WP, 2.0 tbsp OR 5% dust.	1-day wait. Treat spears during harvest. Do not repeat a carbaryl (Sevin) application within 3 days.
Beans (snaps and limas)	Aphid	Malathion 57% EC, 1.0 tbsp or Esfenvalerate, 2.0 tsp Thiodan[1]	Treat when first seen. esfenvalerate : 3-day wait. Malathion : 3-day wait. Thiodan : 3-day wait. Do not exceed 7 applications.
	Thrips	Insecticidal soap or Esfenvalerate	Treat when damage is first observed.
	Mexican bean beetle	Carbaryl (Sevin) 50% WP, 2.0 tbsp OR 5% dust OR Esfenvalerate	carbaryl (Sevin) : 3-day wait. esfenvalerate : 3-day wait. Treat when damage appears.
	Grasshopper	Carbaryl (Sevin) or Esfenvalerate	See label for carbaryl (Sevin) esfenvalerate : 3-day wait.
	Stinkbug	Esfenvalerate OR Sevin 5% dust	See label for carbaryl (Sevin) esfenvalerate : 3-day wait.
	Corn earworm	Esfenvalerate OR Carbaryl (Sevin) 50% WP, 3.0 tbsp OR 5% dust.	Treat when first pods are 1 inch long and weekly or as needed thereafter. esfenvalerate : 3-day wait. carbaryl (Sevin) : 0-day wait.
	Spider Mite	insecticidal soap	Treat when damage appears.

[1]Three percent Thiogard is a low-concentrate formulation of Thiodan for homeowner and home garden use. It may be available under other trade names.

[2]Loopers are hard to kill. *Bacillus thuringiensis* (*B.t.*) will work well but is not fast. *B.t.* is safe. Loopers and other worms get sick the first day and die later. Loopers become a problem in Virginia in late July or early August. They will remain a problem until a killing frost or light freeze occurs.

[3]**Special note for all cucurbits:** Row covers, in place from seedling stage until plants push out from the underside, will provide control for many of the pests including Cucumber beetles and Squash vine borer. Row covers are either fine mesh or loose spun fiber cloth that lets air, sun, and rain in, but excludes pests.

[4]Keeping seedbeds free of vegetation for 3 weeks prior to planting time will aid in control of cutworms. For more details on cutworm control see text about soil insects and cutworms-wireworms.
The three formulations of Diazinon are now sold for home and garden use under the Spectracide label, the Ortho label, and several others. For this reason we urge home gardeners to **read the label** and act accordingly.

Dusts should always be applied as a “fog” to cover leaf surfaces with a very light but visible film of insecticide. A hand-operated crank duster is in most cases the only hand equipment that is really acceptable for applying dusts. However, a puff duster is adequate for small plants such as young cucumbers and for treating silking ears of corn.

Sprays should be applied to the point of runoff. An effort should be made to spray undersides of leaves, especially for effective spider mite, aphid, and whitefly control.

Wettable powders are omitted in some cases to conserve space. They are generally as effective at comparable rates, but usually require more agitation. Read labels for amount per gallon of water.

Table 2.5 - Insecticides (cont.)

Crop	Insect	Treatment and Amount to Mix with 1 Gallon of Water or as Indicated Otherwise	Remarks and Days Between Last Application and Harvest
Beets	Flea beetle	Carbaryl (Sevin) 50% WP, 2.0 tbsp OR 5% dust.	Treat when insects appear in damaging numbers. Repeat as needed. carbaryl (Sevin) : 0-day wait.
Cabbage (broccoli, cauliflower, brussels sprouts, cabbage)	Caterpillars[2] looper, imported cabbageworm, and diamondback moth larvae	*Bacillus thuringiensis (Bt),* 2.0-3.0 tbsp (Bactur, Dipel, SOK-BT, Thuricide). Esfenvalerate Permethrin	*(Bt)* : 0-day wait. May be applied as a bait. Follow directions on label. Treat every 4 days after first true leaves appear until harvest if worms are present. esfenvalerate : 3-day wait. permethrin : See label.
	Aphid (plant lice), flea beetle	Permethrin (not for brussels sprouts), OR Carbaryl (Sevin). Esfenvalerate	Treat when insects appear in damaging numbers. Cauliflower 5 days, cabbage 7 days, broccoli 5 days for Diazinon. See label for carbaryl (Sevin). esfenvalerate : 3-day wait.
	Cabbage root maggot	See text about maggots and soil Insects.	
	Flea beetle	Carbaryl (Sevin) 50% WP, 2.0 tbsp OR 5% dust, Permethrin Esfenvalerate	carbaryl (Sevin) : 3 day wait. Repeat treatment at 7- to 14-day intervals as needed. permethrin : See label. esfenvalerate : 3-day wait.
Carrots	Aphid	Cyfluthrin, Thiodan insecticidal soap	Thiodan : 7-day wait, do not exceed 2 applications. soap : 0-day wait. cyfluthrin : 0-day wait.

[1]Three percent Thiogard is a low-concentrate formulation of Thiodan for homeowner and home garden use. It may be available under other trade names.

[2]Loopers are hard to kill. *Bacillus thuringiensis* (*B.t.*) will work well but is not fast. *B.t.* is safe. Loopers and other worms get sick the first day and die later. Loopers become a problem in Virginia in late July or early August. They will remain a problem until a killing frost or light freeze occurs.

[3]**Special note for all cucurbits:** Row covers, in place from seedling stage until plants push out from the underside, will provide control for many of the pests including Cucumber beetles and Squash vine borer. Row covers are either fine mesh or loose spun fiber cloth that lets air, sun, and rain in, but excludes pests.

[4]Keeping seedbeds free of vegetation for 3 weeks prior to planting time will aid in control of cutworms. For more details on cutworm control see text about soil insects and cutworms-wireworms.
The three formulations of Diazinon are now sold for home and garden use under the Spectracide label, the Ortho label, and several others. For this reason we urge home gardeners to **read the label** and act accordingly.

Dusts should always be applied as a “fog” to cover leaf surfaces with a very light but visible film of insecticide. A hand-operated crank duster is in most cases the only hand equipment that is really acceptable for applying dusts. However, a puff duster is adequate for small plants such as young cucumbers and for treating silking ears of corn.

Sprays should be applied to the point of runoff. An effort should be made to spray undersides of leaves, especially for effective spider mite, aphid, and whitefly control.

Wettable powders are omitted in some cases to conserve space. They are generally as effective at comparable rates, but usually require more agitation. Read labels for amount per gallon of water.

Table 2.5 - Insecticides (cont.)

Crop	Insect	Treatment and Amount to Mix with 1 Gallon of Water or as Indicated Otherwise	Remarks and Days Between Last Application and Harvest
Cucurbits[3] (cantaloupes, cucumbers, squash, pumpkins, and watermelons)	Cucumber beetle	Carbaryl (Sevin) 50% WP, 1.0 tbsp OR 5% dust. Permethrin 25% EC, Thiodan. Esfenvalerate	Treat when seedlings emerge from soil if damage appears. Repeat at 5-day intervals as needed. Make application in late afternoon. esfenvalerate : 3-day wait. Esfenvalerate is not labeled for cantaloupe or watermelon. Carbaryl (Sevin) may kill bees when applied between 10 a.m. and 2 p.m. To avoid injury to tender foliage, do not apply when rain or humidity is expected during the next 2 days. Repeat as needed. See label for carbaryl (Sevin). permethrin : 3-day wait. Thiodan : 0-day wait.
	Squash bug Pickleworm	Carbaryl (Sevin) 50% WP, 1.0 tbsp OR 5% dust. Esfenvalerate	Treat when damage appears. Treat when seedlings emerge. carbaryl (Sevin) : See label. permethrin : 3-day wait. esfenvalerate : 3-day wait. Esfenvalerate is not labeled for cantaloupe or watermelon.
	Squash vine borer	Permethrin 25% EC OR 2.0-3.0 tbsp Thiodan. Esfenvalerate	Treat when vines begin to run, apply to bases of plants four times at 7-day intervals. Honeybees are necessary for good fruit set. Insecticides are toxic to bees. Apply in evening when fewer bees are working. Treat flower buds, stems, and vines weekly. permethrin : 3-day wait. Thiodan : 0-day wait. esfenvalerate - 3-day wait. Esfenvalerate is not labeled for cantaloupe or watermelon.

[1]Three percent Thiogard is a low-concentrate formulation of Thiodan for homeowner and home garden use. It may be available under other trade names.

[2]Loopers are hard to kill. *Bacillus thuringiensis* (*B.t.*) will work well but is not fast. *B.t.* is safe. Loopers and other worms get sick the first day and die later. Loopers become a problem in Virginia in late July or early August. They will remain a problem until a killing frost or light freeze occurs.

[3]**Special note for all cucurbits:** Row covers, in place from seedling stage until plants push out from the underside, will provide control for many of the pests including Cucumber beetles and Squash vine borer. Row covers are either fine mesh or loose spun fiber cloth that lets air, sun, and rain in, but excludes pests.

[4]Keeping seedbeds free of vegetation for 3 weeks prior to planting time will aid in control of cutworms. For more details on cutworm control see text about soil insects and cutworms-wireworms.
The three formulations of Diazinon are now sold for home and garden use under the Spectracide label, the Ortho label, and several others. For this reason we urge home gardeners to **read the label** and act accordingly.

Dusts should always be applied as a “fog” to cover leaf surfaces with a very light but visible film of insecticide. A hand-operated crank duster is in most cases the only hand equipment that is really acceptable for applying dusts. However, a puff duster is adequate for small plants such as young cucumbers and for treating silking ears of corn.

Sprays should be applied to the point of runoff. An effort should be made to spray undersides of leaves, especially for effective spider mite, aphid, and whitefly control.

Wettable powders are omitted in some cases to conserve space. They are generally as effective at comparable rates, but usually require more agitation. Read labels for amount per gallon of water.

Table 2.5 - Insecticides (cont.)

Crop	Insect	Treatment and Amount to Mix with 1 Gallon of Water or as Indicated Otherwise	Remarks and Days Between Last Application and Harvest
Cucurbits[3] (cantaloupes, cucumbers, squash, pumpkins, and watermelons) (cont.)	Aphid (plant lice)	Permethrin 25% EC, Thiodan, Esfenvalerate	Treat when seedlings emerge. CARBARYL (SEVIN) WILL NOT CONTROL APHIDS. Treat when insects appear in damaging numbers. Repeat as needed. permethrin : 3-day wait. Thiodan : 0-day wait. esfenvalerate : 3-day wait. Esfenvalerate is not labeled for cantaloupe or watermelon.
	Spider mite	Insecticidal soap,	Treat when damage appears. Kelthane : 2-day wait. Repeat as needed. esfenvalerate : 3-day wait. Esfenvalerate is not labeled for cantaloupe or watermelon.
	Leafhopper, leafminer	Permethrin 25% EC. Esfenvalerate	Treat when damage appears. permethrin : 3-day wait, repeat as needed. Pick and destroy infested leaves. esfenvalerate : 3-day wait. Esfenvalerate is not labeled for cantaloupe or watermelon.
	Whitefly	See text about Whiteflies. Esfenvalerate	esfenvalerate : 3-day wait. Esfenvalerate is not labeled for cantaloupe or watermelon.
Eggplant	Flea beetle, Colorado potato beetle, grasshopper	Carbaryl (Sevin) 50% WP, 2.0 tbsp OR 5% dust. Thiodan Esfenvalerate	carbaryl (Sevin) : 0-day wait. Treat when damage appears. Repeat as needed. Thiodan : 1-day wait. Do not exceed 0.5 lb of active ingredient/A. esfenvalerate : 7-day wait.
Greens or Leaf Crops (turnips, kale, spinach, collards)	Caterpillars[2] looper, imported cabbageworm, and diamondback larva	*Bacillus thuringiensis*, for spinach and turnips. Esfenvalerate	*Bacillus thuringiensis :* 0-day wait.. Treat every 4 days after first true leaves appear until harvest, if worms are present. Esfenvalerate not labeled for turnips, kale, or spinach.

[1]Three percent Thiogard is a low-concentrate formulation of Thiodan for homeowner and home garden use. It may be available under other trade names.

[2]Loopers are hard to kill. *Bacillus thuringiensis* (*B.t.*) will work well but is not fast. *B.t.* is safe. Loopers and other worms get sick the first day and die later. Loopers become a problem in Virginia in late July or early August. They will remain a problem until a killing frost or light freeze occurs.

[3]**Special note for all cucurbits:** Row covers, in place from seedling stage until plants push out from the underside, will provide control for many of the pests including Cucumber beetles and Squash vine borer. Row covers are either fine mesh or loose spun fiber cloth that lets air, sun, and rain in, but excludes pests.

[4]Keeping seedbeds free of vegetation for 3 weeks prior to planting time will aid in control of cutworms. For more details on cutworm control see text about soil insects and cutworms-wireworms.
The three formulations of Diazinon are now sold for home and garden use under the Spectracide label, the Ortho label, and several others. For this reason we urge home gardeners to **read the label** and act accordingly.

Dusts should always be applied as a “fog” to cover leaf surfaces with a very light but visible film of insecticide. A hand-operated crank duster is in most cases the only hand equipment that is really acceptable for applying dusts. However, a puff duster is adequate for small plants such as young cucumbers and for treating silking ears of corn.

Sprays should be applied to the point of runoff. An effort should be made to spray undersides of leaves, especially for effective spider mite, aphid, and whitefly control.

Wettable powders are omitted in some cases to conserve space. They are generally as effective at comparable rates, but usually require more agitation. Read labels for amount per gallon of water.

Table 2.5 - Insecticides (cont.)

Crop	Insect	Treatment and Amount to Mix with 1 Gallon of Water or as Indicated Otherwise	Remarks and Days Between Last Application and Harvest
	Flea beetle, Harlequin bug	Carbaryl (Sevin) 50% WP, 2.0 tbsp. Esfenvalerate	carbaryl (Sevin) : 14-day wait. esfenvalerate : 7-day wait. Esfenvalerate not labeled for turnips, kale, or spinach.
Greens or Leaf Crops (turnips, kale, spinach, collards) (cont.)	Grasshopper	Carbaryl (Sevin), Esfenvalerate	Treat when insects appear in damaging numbers. Repeat as needed. See label for carbaryl (Sevin). esfenvalerate : 7-day wait. Esfenvalerate not labeled for turnips, kale, or spinach.
	Aphid (plant lice)	Rotenone 1% dust. Insecticidal soap, Esfenvalerate	See label for Rotenone. Treat when insects appear in damaging numbers. esfenvalerate : 7-day wait. Esfenvalerate not labeled for turnips, kale, or spinach. Insecticidal soap : Use up to the day before harvest.
Lettuce	Aphid (plant lice)	Permethrin OR insecticidal soap, OR Malathion 4% dust OR 57% EC, 1.0 tsp.	Treat when insects appear in damaging numbers. Malathion : 14-day wait for leaf lettuce, 7-day wait for head lettuce. permethrin : 1-day wait. soap : 0-day wait.
	Flea beetle, harlequin bug, stink bug	Carbaryl (Sevin) 5% dust Permethrin	carbaryl (Sevin) : 3-day wait for head lettuce, 14-day wait for leaf lettuce. permethrin : 1-day wait.
Mushroom	Gnat, rove beetle	Pyrethrins, Malathion	See label. Only certain specific brands have mushrooms on the label. Make sure the brand you use is registered for mushrooms.
Okra	Aphid (plant lice)	Rotenone 1% dust	See label. Treat when insects appear in damaging numbers.
Onion	Thrips, Aphid	Malathion 4% dust OR 57% EC, Insecticidal soap	Malathion : Three days green onion. 1.0 tbsp For onion, treat when thrips appear in damaging numbers.

[1]Three percent Thiogard is a low-concentrate formulation of Thiodan for homeowner and home garden use. It may be available under other trade names.

[2]Loopers are hard to kill. *Bacillus thuringiensis* (*B.t.*) will work well but is not fast. *B.t.* is safe. Loopers and other worms get sick the first day and die later. Loopers become a problem in Virginia in late July or early August. They will remain a problem until a killing frost or light freeze occurs.

[3]**Special note for all cucurbits:** Row covers, in place from seedling stage until plants push out from the underside, will provide control for many of the pests including Cucumber beetles and Squash vine borer. Row covers are either fine mesh or loose spun fiber cloth that lets air, sun, and rain in, but excludes pests.

[4]Keeping seedbeds free of vegetation for 3 weeks prior to planting time will aid in control of cutworms. For more details on cutworm control see text about soil insects and cutworms-wireworms.

The three formulations of Diazinon are now sold for home and garden use under the Spectracide label, the Ortho label, and several others. For this reason we urge home gardeners to **read the label** and act accordingly.

Dusts should always be applied as a “fog” to cover leaf surfaces with a very light but visible film of insecticide. A hand-operated crank duster is in most cases the only hand equipment that is really acceptable for applying dusts. However, a puff duster is adequate for small plants such as young cucumbers and for treating silking ears of corn.

Sprays should be applied to the point of runoff. An effort should be made to spray undersides of leaves, especially for effective spider mite, aphid, and whitefly control.

Wettable powders are omitted in some cases to conserve space. They are generally as effective at comparable rates, but usually require more agitation. Read labels for amount per gallon of water.

Table 2.5 - Insecticides (cont.)

Crop	Insect	Treatment and Amount to Mix with 1 Gallon of Water or as Indicated Otherwise	Remarks and Days Between Last Application and Harvest
	Onion Maggot		Maggot control, see section on wireworms and maggots under soil insect control.
Pea	Aphid (plant lice)	Insecticidal soap. Esfenvalerate	Treat when insects appear in damaging numbers. esfenvalerate : 3-day wait. Insecticidal soap : Use up to the day before harvest.
	Earworm, cowpea curculio, grasshopper	Carbaryl (Sevin) 50% WP, 2.0 tbsp OR 5% dust OR Esfenvalerate	Treat for cowpea curculio when pods begin to form. esfenvalerate : 3-day wait.
Pepper (bell or hot)	European corn borer, grasshopper	Carbaryl (Sevin) 50% WP, 1.0 tbsp OR 5% dust	carbaryl (Sevin) : 0-day wait. Use at 4- to 5-day intervals as long as needed.
	Aphid (plant lice)	Esfenvalerate Cyfluthrin	Treat when insects appear in damaging numbers. esfenvalerate : 7-day wait. cyfluthrin : 7-day wait.
Potato	Colorado potato beetle,	Thiodan (Thiogard) Carbaryl (Sevin) *Bacillus thuringiensis* var. tenebrionis	Try planting potatoes as far from last year's crop as possible. Short-season varieties such as Superior can withstand late-season damage. Hand picking will work as a last resort. Sevin: 0-day wait Thiodan: see label Bt: 0-day wait Bacillus thuringiensis var. tenebrionis is sold under the trade names: M-Trak, Foil and Novodor

[1]Three percent Thiogard is a low-concentrate formulation of Thiodan for homeowner and home garden use. It may be available under other trade names.

[2]Loopers are hard to kill. *Bacillus thuringiensis* (*B.t.*) will work well but is not fast. *B.t.* is safe. Loopers and other worms get sick the first day and die later. Loopers become a problem in Virginia in late July or early August. They will remain a problem until a killing frost or light freeze occurs.

[3]**Special note for all cucurbits:** Row covers, in place from seedling stage until plants push out from the underside, will provide control for many of the pests including Cucumber beetles and Squash vine borer. Row covers are either fine mesh or loose spun fiber cloth that lets air, sun, and rain in, but excludes pests.

[4]Keeping seedbeds free of vegetation for 3 weeks prior to planting time will aid in control of cutworms. For more details on cutworm control see text about soil insects and cutworms-wireworms.
The three formulations of Diazinon are now sold for home and garden use under the Spectracide label, the Ortho label, and several others. For this reason we urge home gardeners to **read the label** and act accordingly.

Dusts should always be applied as a "fog" to cover leaf surfaces with a very light but visible film of insecticide. A hand-operated crank duster is in most cases the only hand equipment that is really acceptable for applying dusts. However, a puff duster is adequate for small plants such as young cucumbers and for treating silking ears of corn.

Sprays should be applied to the point of runoff. An effort should be made to spray undersides of leaves, especially for effective spider mite, aphid, and whitefly control.

Wettable powders are omitted in some cases to conserve space. They are generally as effective at comparable rates, but usually require more agitation. Read labels for amount per gallon of water.

Table 2.5 - Insecticides (cont.)

Crop	Insect	Treatment and Amount to Mix with 1 Gallon of Water or as Indicated Otherwise	Remarks and Days Between Last Application and Harvest
	European corn borer	Carbaryl (Sevin) Thiodan (Thiogard) *Bacillus thuringiensis*	To control ECB, make 3 applications at 7-day intervals, starting in mid-May. Treat when insect and/or damage first appear. Sevin: 0-day wait Thiodan: see label Bt: 0-day wait
Potato (cont.)	Grasshopper	Carbaryl (Sevin) (Thiogard)	Treat when insect and/or damage first appears. Sevin: 0-day wait
	Whitefly	Thiodan (Thiogard)	Purchase pest-free plants. Treat when insect and/or damage first appears. Thiodan: see label
	Potato leafhopper	Carbaryl (Sevin) Thiodan (Thiogard)	Treat in mid-June or when insects and/or damage first appear. Sevin: 0-day wait Thiodan: see label
	Aphids	Insecticidal soap Malathion Thiodan (Thiogard)	Treat when insect and/or damage first appear. Sevin: 0-day wait Thiodan: see label
	Potato tuberworm	Thiodan (Thiogard) Esfenvalerate	Keep potatoes hilled properly to avoid infestation and store potatoes at a temperature below 50ºF. If insecticide is needed, treat 10 days before harvest.
Strawberry	Spider mite	Insecticidal soap	Treat when damage appears. Damage usually occurs in hot, dry seasons, and it may be severe.
	Cyclamen mite	Thiogard 3, 1.67 tbsp[1]	Four days. Do not reapply within 15 days or more than twice within a 35- day period when fruit is present.
	Leafroller, root lice (root aphid)	Malathion 5% dust OR 57% EC, 2 tsp	Malathion : 3-day wait. Treat when damage appears or insects appear in damaging numbers.

[1]Three percent Thiogard is a low-concentrate formulation of Thiodan for homeowner and home garden use. It may be available under other trade names.

[2]Loopers are hard to kill. *Bacillus thuringiensis* (*B.t.*) will work well but is not fast. *B.t.* is safe. Loopers and other worms get sick the first day and die later. Loopers become a problem in Virginia in late July or early August. They will remain a problem until a killing frost or light freeze occurs.

[3]**Special note for all cucurbits:** Row covers, in place from seedling stage until plants push out from the underside, will provide control for many of the pests including Cucumber beetles and Squash vine borer. Row covers are either fine mesh or loose spun fiber cloth that lets air, sun, and rain in, but excludes pests.

[4]Keeping seedbeds free of vegetation for 3 weeks prior to planting time will aid in control of cutworms. For more details on cutworm control see text about soil insects and cutworms-wireworms.
The three formulations of Diazinon are now sold for home and garden use under the Spectracide label, the Ortho label, and several others. For this reason we urge home gardeners to **read the label** and act accordingly.

Dusts should always be applied as a “fog” to cover leaf surfaces with a very light but visible film of insecticide. A hand-operated crank duster is in most cases the only hand equipment that is really acceptable for applying dusts. However, a puff duster is adequate for small plants such as young cucumbers and for treating silking ears of corn.

Sprays should be applied to the point of runoff. An effort should be made to spray undersides of leaves, especially for effective spider mite, aphid, and whitefly control.

Wettable powders are omitted in some cases to conserve space. They are generally as effective at comparable rates, but usually require more agitation. Read labels for amount per gallon of water.

Table 2.5 - Insecticides (cont.)

Crop	Insect	Treatment and Amount to Mix with 1 Gallon of Water or as Indicated Otherwise	Remarks and Days Between Last Application and Harvest
	Aphid (plant lice)	Insecticidal soap	Treat when insects appear in damaging numbers.
Strawberry (cont.)	Strawberry weevil "Clipper" and Strawberry rootworms	Carbaryl (Sevin) 50% WP, 2.0 tbsp OR 5 % dust Malathion 5% dust OR 57% EC, 1.0 tbsp	carbaryl (Sevin) : 1-day wait. Malathion : 3-day wait. Start treatment when cut buds or leaf holes are seen. This is usually just after beginning of bloom (late March or early April). Treat at weekly intervals as needed. Rotate strawberries to a part of the garden that has not had strawberries in the last year.
Sweet Corn[4]	Flea beetle, grasshoppers	Carbaryl (Sevin) 50% WP, 2.0 tbsp Cyfluthrin Esfenvalerate Permethrin	carbaryl (Sevin) : 0-day wait. Treat when insects and damage appear on young plants. Application of carbaryl (Sevin) to the tassel region of corn during the pollen shedding period will seriously reduce the bee population. cyfluthrin : 0-day wait. esfenvalerate : 1-day wait. permethrin : 1-day wait.
	Fall armyworm	Carbaryl (Sevin) 50% WP, 2.0 tbsp OR 5% dust Cyfluthrin Esfenvalerate Permethrin	Treat when "window pane" feeding damage appears on leaves of young corn or in whorls of older corn. cyfluthrin : 0-day wait. esfenvalerate : 1-day wait. permethrin : 1-day wait.
	European corn borer	Carbaryl (Sevin) 50% WP, 2.0 tbsp OR 5% dust Cyfluthrin Esfenvalerate Permethrin	Treat when 50% of plants show tiny pin holes in leaves. cyfluthrin : 0-day wait. esfenvalerate : 1-day wait. permethrin : 1-day wait.

[1]Three percent Thiogard is a low-concentrate formulation of Thiodan for homeowner and home garden use. It may be available under other trade names.

[2]Loopers are hard to kill. *Bacillus thuringiensis* (*B.t.*) will work well but is not fast. *B.t.* is safe. Loopers and other worms get sick the first day and die later. Loopers become a problem in Virginia in late July or early August. They will remain a problem until a killing frost or light freeze occurs.

[3]**Special note for all cucurbits:** Row covers, in place from seedling stage until plants push out from the underside, will provide control for many of the pests including Cucumber beetles and Squash vine borer. Row covers are either fine mesh or loose spun fiber cloth that lets air, sun, and rain in, but excludes pests.

[4]Keeping seedbeds free of vegetation for 3 weeks prior to planting time will aid in control of cutworms. For more details on cutworm control see text about soil insects and cutworms-wireworms.
The three formulations of Diazinon are now sold for home and garden use under the Spectracide label, the Ortho label, and several others. For this reason we urge home gardeners to **read the label** and act accordingly.

Dusts should always be applied as a "fog" to cover leaf surfaces with a very light but visible film of insecticide. A hand-operated crank duster is in most cases the only hand equipment that is really acceptable for applying dusts. However, a puff duster is adequate for small plants such as young cucumbers and for treating silking ears of corn.

Sprays should be applied to the point of runoff. An effort should be made to spray undersides of leaves, especially for effective spider mite, aphid, and whitefly control.

Wettable powders are omitted in some cases to conserve space. They are generally as effective at comparable rates, but usually require more agitation. Read labels for amount per gallon of water.

Table 2.5 - Insecticides (cont.)

Crop	Insect	Treatment and Amount to Mix with 1 Gallon of Water or as Indicated Otherwise	Remarks and Days Between Last Application and Harvest
	Corn sap beetle, European corn borer in the ear, corn earworm, Japanese beetle	Carbaryl (Sevin) 50% WP, 2.0 tbsp OR 5% dust Thiodan Cyfluthrin Esfenvalerate Permethrin	Apply to silks every other day begin- ning at 10% silking and continuing until 90% of silks have wilted and turned brown. cyfluthrin : 0-day wait. esfenvalerate : 1-day wait. permethrin : 1-day wait.
Sweet Corn[4] (cont.)	Corn earworm	Carbaryl (Sevin) Cyfluthrin, Esfenvalerate, Permethrin	Carbaryl (Sevin) : 1-day wait. Apply at 2- to 3-day intervals when silking. cyfluthrin : 0-day wait. esfenvalerate : 1-day wait. permethrin : 1-day wait.
	Seedcorn maggot	Soil insecticide labeled for vegetables	For fields with a history of seedcorn mag- got problems or when a cool, wet spring is expected.
Tomatoes[4]	Flea beetle, stink bugs, grasshoppers, leaf- footed bugs	Carbaryl (Sevin) 50% WP, 2.0 tbsp OR 5% dust Thiodan Cyfluthrin, Esfenvalerate	carbaryl (Sevin) : 0-day wait. Thiodan : 1-day wait. Treat when damage appears or when insects appear in damaging numbers. cyfluthrin : 0-day wait. esfenvalerate : 1-day wait.
	Colorado potato beetle	Thiodan Cyfluthrin, Esfenvalerate	Thiodan : 1-day wait. Treat when damage appears or when insects appear in damaging numbers. cyfluthrin : 0-day wait. esfenvalerate : 1-day wait.
	Blister beetles, horn- worm, tomato russet mite, cabbage looper	Carbaryl (Sevin) Thiodan, Cyfluthrin, Esfenvalerate	Thiodan : 1-day wait. Repeat as needed. Follow directions on label. cyfluthrin : 0-day wait. esfenvalerate : 1-day wait.

[1]Three percent Thiogard is a low-concentrate formulation of Thiodan for homeowner and home garden use. It may be avail- able under other trade names.

[2]Loopers are hard to kill. *Bacillus thuringiensis* (*B.t.*) will work well but is not fast. *B.t.* is safe. Loopers and other worms get sick the first day and die later. Loopers become a problem in Virginia in late July or early August. They will remain a problem until a killing frost or light freeze occurs.

[3]**Special note for all cucurbits:** Row covers, in place from seedling stage until plants push out from the underside, will pro- vide control for many of the pests including Cucumber beetles and Squash vine borer. Row covers are either fine mesh or loose spun fiber cloth that lets air, sun, and rain in, but excludes pests.

[4]Keeping seedbeds free of vegetation for 3 weeks prior to planting time will aid in control of cutworms. For more details on cutworm control see text about soil insects and cutworms-wireworms.
The three formulations of Diazinon are now sold for home and garden use under the Spectracide label, the Ortho label, and several others. For this reason we urge home gardeners to **read the label** and act accordingly.

Dusts should always be applied as a “fog” to cover leaf surfaces with a very light but visible film of insecticide. A hand-oper- ated crank duster is in most cases the only hand equipment that is really acceptable for applying dusts. However, a puff duster is adequate for small plants such as young cucumbers and for treating silking ears of corn.

Sprays should be applied to the point of runoff. An effort should be made to spray undersides of leaves, especially for effec- tive spider mite, aphid, and whitefly control.

Wettable powders are omitted in some cases to conserve space. They are generally as effective at comparable rates, but usually require more agitation. Read labels for amount per gallon of water.

Table 2.5 - Insecticides (cont.)

Crop	Insect	Treatment and Amount to Mix with 1 Gallon of Water or as Indicated Otherwise	Remarks and Days Between Last Application and Harvest
	Fruitworm	Carbaryl (Sevin) 50% WP, 2.0 tbsp OR 5% dust. Cyfluthrin, Esfenvalerate	carbaryl (Sevin) : 0-day wait. Treat every 5- to 7-days when fruit begins to set. Continue as long as fruit is present if needed. cyfluthrin : 0-day wait. esfenvalerate : 1-day wait.
Tomatoes[4] (cont.)	Thrips, Aphids	Insecticidal soap OR Malathion 5% dust OR 57% EC, 1.0 tbsp. Esfenvalerate, Cyfluthrin	Malathion : 1-day wait. Treat when insects appear in damaging numbers. esfenvalerate : 1-day wait. cyfluthrin : 0-day wait.
	Spider mites	Insecticidal soap	Treat when mites appear in damaging numbers.
	Cutworms	See text about Cutworms and Wireworms and soil insects.	
	Whiteflies	Esfenvalerate	esfenvalerate : 1-day wait.

[1]Three percent Thiogard is a low-concentrate formulation of Thiodan for homeowner and home garden use. It may be available under other trade names.

[2]Loopers are hard to kill. *Bacillus thuringiensis* (*B.t.*) will work well but is not fast. *B.t.* is safe. Loopers and other worms get sick the first day and die later. Loopers become a problem in Virginia in late July or early August. They will remain a problem until a killing frost or light freeze occurs.

[3]**Special note for all cucurbits:** Row covers, in place from seedling stage until plants push out from the underside, will provide control for many of the pests including Cucumber beetles and Squash vine borer. Row covers are either fine mesh or loose spun fiber cloth that lets air, sun, and rain in, but excludes pests.

[4]Keeping seedbeds free of vegetation for 3 weeks prior to planting time will aid in control of cutworms. For more details on cutworm control see text about soil insects and cutworms-wireworms.
The three formulations of Diazinon are now sold for home and garden use under the Spectracide label, the Ortho label, and several others. For this reason we urge home gardeners to **read the label** and act accordingly.

Dusts should always be applied as a “fog” to cover leaf surfaces with a very light but visible film of insecticide. A hand-operated crank duster is in most cases the only hand equipment that is really acceptable for applying dusts. However, a puff duster is adequate for small plants such as young cucumbers and for treating silking ears of corn.

Sprays should be applied to the point of runoff. An effort should be made to spray undersides of leaves, especially for effective spider mite, aphid, and whitefly control.

Wettable powders are omitted in some cases to conserve space. They are generally as effective at comparable rates, but usually require more agitation. Read labels for amount per gallon of water.

The Potato Tuberworm

Each year, Virginia home gardeners are plagued by injury to their white potatoes by the potato tuberworm.

The injury shows up in stored potatoes as unsightly feeding tunnels filled with excrement throughout the flesh of the tubers and, consequently, the tubers become unfit for food. Each year, many people ask how these pests get in the stored potatoes and how they can be controlled.

The potato tuberworm is the larva or immature stage of a gray moth not over one-fourth inch long. It has small, dark brown or black markings on the wings. The female moth lays her pearly-white eggs on the leaves and stems of the plants or in the eyes of exposed tubers in the field or in storage. The moths are seldom seen because they hide during the daytime but are active at night. The female usually lays from 150 to 200 eggs. In warm storage places, the tuberworm may continue to reproduce and be a pest throughout the winter. In the field, it overwinters as a larva or pupa in the soil. The life cycle may be as short as 2 weeks in the summer or as long as 7 months in the winter. In the field, there are five or six generations in the South, but probably not more than three or four in Virginia.

The full-grown larva of the potato tuberworm is about one-half inch long. Its head is brown and its pinkish green or white body sometimes has a reddish-purple band down the back. CONTROL MEASURES: Protective measures for controlling the potato

tuberworm include the following: 1) plant only seed pieces that are not infested, 2) cultivate so as to hill the soil against the plants - keeping at least 2 inches of soil over the developing tubers, 3) harvest as soon as the crop is mature. During harvest, do not leave the dug potatoes in the field overnight, and do not cover piles of potatoes with potato tops, 4) destroy all culled or infected potatoes as soon as possible, 5) store tubers at temperatures below 52° F if possible and practical. Use either new or thoroughly cleaned bags or baskets when storing. The storage area should be screened or enclosed in such a way that moths cannot get in. Without such an enclosed storage area, the moths can still fly in and still become a problem even though the storage area was clean and the potatoes insect-free when stored.

There is no legal chemical control for this insect in stored potatoes. However, an approved household insecticide may be used at regular intervals to control tuberworm moths. Potatoes should be covered while these sprays are being applied. Consider a weekly spray application as long as the problem persists.

Slugs

Slug populations are the result of favorable environmental conditions for slug reproduction and survival. Any type of mulch may give rise to greater problems with slugs. Young seedlings and the more succulent parts of plants and even some entire plants are devoured by these pests. They leave a trail of mucus on the surfaces on which they crawl, and, on drying, silvery marks result. Moist, humid environments favor slug development. Slugs generally spend the winter in sheltered situations outdoors. Eggs are usually deposited in moist habitats and maturity requires a year or more. Many different modern-day insecticides have been tested against slugs and very few show any promise at all. The following are suggestions for minimizing slug damage to either vegetable or flower gardens:

1. Spade or rototill the garden area in the fall.
2. Spade or rototill the garden again around April 1.
3. Maintain a system of clean cultivation by hoeing so that the surface of the soil is dry and crumbly.
4. Where heavy infestations of slugs cause serious damage, hand-picking will reduce slug populations. Use a flashlight to check infestation. About 10:00 p.m., inspect garden for active slugs. Those detected can be picked up with an old teaspoon. Place captured slugs in a container of salt, which will kill them. If this activity is continued for 3 or 4 nights in a row, damage can be greatly reduced.
5. In order to increase organic material in the soil, it is best to compost materials such as grass clippings, leaves and other plant debris for at least one year. At the end of this time the compost should be black and crumbly. This then should be spread over the garden and spaded into the soil.
6. Gardeners have reported some success with stale beer placed in small cups or pans sunken in the soil so the lip of the container is slightly below the level of the ground. Slugs are attracted to the containers; once inside they drown. The beer needs to be replaced about every three days for best results. However, stale beer must be used. Slug populations can be greatly reduced if this method is started early in the spring and enough of the containers are set out.
7. Slug baits are available and effective against this pest if applied exactly as directed on the label. None of these commercial baits are to be used directly on food crops.
8. Crushed oyster shells (a chicken feed supplement) placed around the base of the plant may also deter slugs.

Cutworm, Wireworm, and Root Maggots

Several companies produce granular insecticides that are labeled for use in vegetable gardens. In general, diazinon has been replaced by carbaryl and permethrin, but other active ingredients may also be labeled and appropriate.

Check insecticide label to make sure it is labeled for your specific crop and for rates and other instructions.

For cutworms, apply on soil surface.

For wireworms and root maggots apply in planting furrow.

Whiteflies

During the past several years, whiteflies have become a serious problem in home gardens. They are very small non-mobile insects with sucking mouthparts. They are closely related to aphids. They are likely to be found on several garden crops such as tomatoes, beans, squash, etc. The problem may arise from transplants that become infested in greenhouses. This insect is almost totally resistant to any of the insecticides commonly used in the home garden. In a nutshell, this insect is not only extremely hard to kill, there is nothing legal to recommend for its control in the home garden that will kill all stages.

We have suggested repeated applications of malathion, esfenvalerate, or Thiogard 3 (which may be the most effective). Use in accordance with label for other garden pests. Observe dosage and waiting period recommendations. Make at least three applications at four day intervals. Thorough coverage is a must, especially on undersides of leaves.

Yellow Sticky Boards should be considered as a means of mechanical control. They may be constructed as follows: (1) Cut standard (22˝ X 28˝), bright yellow posterboard into 7˝ X 7˝ squares, (2) fasten squares of posterboard to stakes and drive into the ground, (3) with small paint brush, spread 90-weight gear oil or vegetable shortening onto both sides of posterboard squares; repeat as necessary. Makes 12 squares of Yellow Sticky Board; one board to be used for six plants.

Consider bright yellow empty containers in lieu of poster board, such as plastic motor oil, antifreeze, or tennis ball containers. Invert them over bamboo stakes and treat the outsides of the empty yellow containers with 90-weight gear oil or vegetable shortening.

Cabbage Maggot

Cabbage maggot feeding usually shows no effect until late in the spring. The first outward sign is a slight drooping of the leaves of a few plants, which later wilt and die. Such plants have had their root systems entirely destroyed, and some may have their tap roots entirely cut off, leaving only a stub. In small plants, the maggots sometimes burrow up into the stems and cause quick wilting. Usually, they destroy the branch roots and make furrows in the sides of the tap roots, sometimes completely girdling them.

Weeds

Jeffrey F. Derr, Extension Weed Scientist, Hampton Roads AREC
Henry P. Wilson, Plant Physiologist, Eastern Shore AREC

Home Vegetable Production

Nonchemical Control

In most home garden situations, it is more practical to use cultural methods of weed control rather than chemical. A hoe and rototiller are very effective if weeds are not allowed to get ahead. Mulching is also very practical in a home garden situation. The mulch could be several layers of newspaper, black plastic, or sawdust. **Caution**: Do not mulch with grass clippings from a lawn that has been sprayed to control broadleaf weeds. See VCE Publication 427-035, *Weed Control in the Vegetable Garden*, for additional information on ways to control weeds in home vegetable gardens.

In areas infected with nutsedge, bermudagrass, or similar troublesome weeds, black plastic mulch can be placed over tilled soil and then plants such as tomatoes or peppers can be planted by punching holes in the plastic. During the growing season, the weeds will starve beneath the black plastic. The next year, this process can be repeated in an adjacent area and row crops planted in the area where the plastic was the previous year. Perennial weeds such as nutsedge and bermudagrass may, however, break through black plastic in places.

Sanitation is another important aspect of home gardening. If you allow weeds to mature and seed, you create more severe weed problems for the years ahead. When a crop is harvested, cultivate the area to prevent weeds from maturing and seeding.

Chemical Control

There are many herbicides cleared for use in vegetable crops. However, most of these are designed for commercial vegetable production rather than the home garden. They are formulated in large packages, require precise rates of application, and may leave residues in the soil that would interfere with growing other plants in the area the next growing season.

Trifluralin (Preen Garden Weed Preventer) is cleared on a wide variety of vegetables, has good crop tolerance, is readily available in small quantities, and is available to gardeners. It is a preemergent herbicide and kills weeds as they germinate. It remains active in the soil about 8 weeks during the growing season Application rate ranges from 1 lb per 640 sq feet to 1 lb per 1,280 sq ft depending upon soil type. Rake into the top 1 to 3 inches of soil immediately after application.

Table 2.6 - Preen Garden Weed Preventer Use

Vegetable	Time of Application
Vegetables Cleared for Preen Garden Weed Preventer[1] (trifluralin) application	
broccoli, brussels sprouts, cabbage, carrots, cauliflower, celery, collard, black eyed peas, field peas, green peas, lima beans, mustard greens, snap beans, turnip greens	From seed
celery, broccoli, brussels sprouts, cabbage, cauliflower, eggplant, peppers, onions, tomatoes	Before transplanting
asparagus	Established plants only, apply prior to spear emergence
potatoes	After planting
Weeds Controlled at Time of Germination Only	
Annual bluegrass, Barnyardgrass, Carpetweed, Common chickweed, Fall panicum, Goosegrass, Green foxtail, Large crabgrass, Johnsongrass from seed, Common lambsquarters, Purslane, Prostrate spurge, Redroot pigweed, Smooth crabgrass, Spiny pigweed, Spotted spurge, Stinkgrass, Witchgrass, Yellow foxtail	
Weeds Not Controlled	
Velvetleaf, Common ragweed, Mustards, Jimsonweed, Galinsoga (Quickweed), Yellow nutsedge	

[1]No established perennial weeds or emerged annual weeds are controlled by Preen Garden Weed Preventer.

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