Managing Yard Pests

NC Cooperative Extension
Forsyth County Center

1450 Fairchild Road
Winston-Salem NC 27105

Phone: 336-703-2850
Website: www.forsyth.cc/ces

NC State University
A&T State University
COOPERATIVE EXTENSION
Empowering People · Providing Solutions

Managing Yard Pests Contents

All of the information in this booklet can be found via the internet. The link for each leaflet is listed beside the title. There are many more leaflets and useful information found on our State Urban Horticulture Site at: http://www.ces.ncsu.edu/depts/hort/consumer/
and on our local county websites at:
http://www.forsyth.cc/ces or http://forsyth.ces.ncsu.edu.

NC STATE UNIVERSITY

Encourage Existing Beneficial Insects

NC State University | College of Ag & Life Sciences | Cooperative Extension | Horticultural Science

Take advantage of biological controls in your garden by encouraging natural predators, such as praying mantids, ladybugs, lacewings, and ground beetles. Increase their populations by providing shelter, food, moisture, and overwintering sites. Some beneficial insect suppliers offer a formulation for feeding/attracting the beneficials to keep them in the garden longer.

Learn to recognize the eggs and larvae of the beneficial insects, and avoid harming them. You can often find praying mantis egg cases in weedy lots. Carry the twig with the cluster attached into the garden and set it in a place where it will not be disturbed. Learn to recognize parasites and their egg cases. For example, the tomato hornworm is often seen with a number of white cocoons, a little larger than a grain of rice on its back. These are from a parasitic wasp. The hornworm will die and more wasps will emerge. Obviously, it is to your advantage to leave that caterpillar in the garden.

Another possibility is to increase the type and number of plants in your landscape that will attract beneficial insects. Most composite and umbel plants attract beneficial insects by providing nectar and pollen that prolongs the insects life. Cosmos and marigolds will attract a few beneficial insects, while tansy will attract large numbers. Best results come from planting the attractant plants on the edges of the area instead of interplanted in the garden.

Beneficial insects are often killed when insecticides are applied. A selective insecticide has less adverse effect than a broad spectrum insecticide. Stomach poison insecticides, are less likely to harm beneficial insects.

Consumer Horticulture | Quick Reference

Plant	Insects
Black locust	Lady beetles
Caraway	Lacewings, hover flies, insidious flower bugs, spiders, parasitic wasps
Common knotweed	Big-eyed bugs, hover flies, parasitic wasps, soft-winged flower beetles
Cowpea	Parasitic wasps
Crimson clover	Minute pirate bugs, big-eyed bugs, lady beetles
Flowering buckwheat	Hoverflies, minute pirate bugs, predatory wasps, tachinid flies, lacewings, lady beetles
Hairy vetch	Lady beetles, minute pirate bugs, predatory wasps
Queen Anne's lace	Lacewings, predatory wasps, minute pirate bugs, tachinid flies
Spearment	Predatory wasps
Sweet alyssum	Tachinid flies, hoverflies, chalcids
Subterranean clover	Big-eyed bugs
Sweet fennel	Parasitic wasps, predatory wasps
Tansy	Parasitic wasps, lady beetles, insidious flower bugs, lacewings
White sweet clover	Tachinid flies, bees, predatory flies
Wild buckwheat	Hoverflies, minute pirate bugs, tachinid flies
Yarrow	Lady beetles, parasitic wasps, bees

Other plants include: sage, wallflower, salvia, nasturtium, poppy, zinnia, dill, anise, fennel, coriander, parsley, marigold, aster, daisies, coneflower, bee balm, basil, oregano, mints, cosmo, lovage, wild mustard, canola.

Assassin Bugs - Assassin bugs are 1/2 inch long, black or brown, have large eyes on a narrow head, and have large front legs with spines for grabbing prey. The giant wheel bug is one well known example. They overwinter in different stages. They prey on aphids, caterpillars, Colorado potato beetles, Japanese beetles, leafhoppers, and other insects. They also do not like to be handled.

Bigeyed bugs - Bigeyed bugs are long grey-tan insects with huge eyes and tiny black spots on the head and thorax. They hibernate in garden matter and like carrot family plants and goldenrod. Their prey include aphids, leafhoppers, chinch bugs, spider mites, and insect eggs.

Damsel Bugs - Damsel bugs resembles assassin bugs. They are pale gray, about 3/8 inches long. The damsel bug feeds on aphids, leafhoppers, mites, and caterpillars.

Green lacewings - Adults are pale green or brown, 1/2 to 3/4 inch long, with a slender body and large, clear, highly veined wings that are held over the body when at rest. They lay eggs with stalks. Larvae are yellowish-grey, mottled, spiny, and have long thin jaws which curve like pinchers. They are attracted to yarrow and wild carrot. Larvae, (called antlions or aphid lions) eat aphids, mealy bugs, mites, scale insects, white flies, thrips, and insect eggs.

Ground beetles - Adults are 1 inch or less, fast moving, iridescent bluish-black in color. They hide under rocks and other objects during the day. Larvae are elongated and dark brown-black with large heads. They eat a variety of insects they find on the ground.

Lady beetles (Ladybird beetles, lady bugs) - These well known beetles are reddish, orange, or black with spots. Color and spots vary with species. Larvae are elongated, 1/4 to 1/2 inch long, covered with tiny spines, and are grey or black with blue and orange markings. Adults are attracted to pollen and nectar plants. Both adults and larvae consume aphids, thrips, mealy bugs, scale insects, mites, and whiteflies.

Minute pirate bugs - These tiny bugs are smaller than 1/8 inch long and are generally black. Nymphs resemble adults but are orange and do not have wings. They eat aphids, scale insects, and other tiny insect pests. The insidious flower bug is an important enemy of thrips.

Parasitic wasps - These wasps are common in several different families. They can range in size from 1/16 to 2 inches, though most are tiny. Coloration is often black to brown. The wasps are slender, have a pinched waist and clear wings. Examples include chalcids, braconids, ichnecmonids, and trichogramma. Trichogramma wasp attacks eggs of more than 200 species, including cutworms, corn borers, corn earworms, armyworms, codling moths, and cabbage moths. Adults use their stinger to attack larvae and lay eggs in their prey; trichogramma attacks the legs of its host. They can be encouraged by planting wildflowers in the daisy and carrot families. They can attack many caterpillars, beetle larvae, flies, aphids, and other soft bodied insects.

Praying mantids - Large (2 1/2 to 4 inches long) green or brown with long bodies, large

eyes and papery wings. These slow moving insects have modified long front legs for grabbing prey. Immatures resemble adults but are smaller and wingless. Mantids overwinter as eggs deposited in a paper mache-like egg case. They are nonselective feeders of insects including other praying mantids.

Predacious stink bugs - Adults have a shield shaped body and overlapping wing tips. They emit a strong odor when disturbed. Nymphs are more rounded and colored red and black when young. The older nymphs are red, black, yellow-orange, and cream colored in bands and blotches. Many stink bugs are insect pests, but the spined soldier bug and twospotted stink bugs are beneficial. Predacious stink bugs feed on Colorado potato beetles, Mexican bean beetles, and various caterpillar larvae.

Predatory mites - They are the same size or larger than spider mites but move more rapidly. The color can be white, tan, orange, or reddish. These mites feed on many mite pests, including the two spotted spider mite.

Soldier beetles - Adults resemble fireflies, but do not light up. They overwinter as mature larvae and are attracted to wild lettuce, milkweed, hydrangea, and goldenrod. They eat aphids, small beetles, caterpillars, grasshopper eggs, and spider mites.

Syrphid flies (Hover flies, Flower flies) - Adults are 1/8 to 5/8 inch long with short antennae, one pair of wings, and the ability to hover and turn like a humming bird. The adults resemble bees, come in many colorations (yellow, orange, black), and feed on nectar and pollen. The larvae are tapered, legless, tan or green maggots. They are attracted by coreopsis, candytuft, morninglory, and nemophila. Larvae have a voracious appetite for aphids, scale, thrips, mealybugs, and leafhoppers.

Tachinid flies - Adults resemble houseflies, but are larger, and are covered with bristles. They parasitize adults and larvae of beetles, grasshoppers, and caterpillars such as sawflies, armyworms, and gypsy moth.

Trichogrammatid wasps - Very minute wasps that parasitize insect eggs. Some species are host and habitat specific. Timing of release is critical since these parasitic wasps only attack the egg stage of insect pests. Host examples: cabbage lopper, tomato hornworm.

Paper wasps, Hornets - Though more often considered pests, paper wasps consume many caterpillars while raising their young during the summer months. Hornets catch many soft bodied flying insects to feed their larvae.

Consumer Horticulture | Quick Reference

Botanical Insecticides

Botanical insecticides are naturally occurring chemicals extracted from plants. Natural pesticidal products are available as an alternative to synthetic chemical formulations but they are not necessarily less toxic to humans. Some of the most deadly, fast acting toxins and potent carcinogens occur naturally. Some of the botanical pesticides are very toxic to fish and other cold-blooded creatures and should be treated with care. Protective clothing should be worn when spraying, even though their toxicity is normally low to warm-blooded animals. Botanical insecticides break down readily in soil and are not stored in plant or animal tissue. Often their effects are not as long lasting as those of synthetic pesticides and some of these products may be very difficult to find.

Citrus oil (limonene, linalool) are extracts from citrus peels primarily used as flea dips, but have been combined with soaps as contact poisons against aphids and mites. They evaporate quickly after application and provide no residual control.

Nicotine concentrate is very poisonous if inhaled. It is derived from tobacco and is commonly sold as a 40 percent nicotine sulfate concentrate. Nicotine is a fast acting contact killer for soft bodied insects, but does not kill most chewing insects. It is less effective when applied during cool weather. Do not spray within 7 days of harvest.

Pyrethrin is a fast acting contact poison derived from the pyrethrum daisy. It is very toxic to cold blooded animals. Some people and most cats have allergic reactions to it. Pyrethrin is effective on most insects, but does not control mites. It rapidly breaks down in sunlight, air and water.

Rotenone is derived from the roots of over 68 plant species, and is very toxic to fish, pigs, and cool-blooded animals. It has a short residual. Rotenone is a broad spectrum poison mainly used to control leaf-eating caterpillars and beetles. Direct contact may cause skin and mucous membrane irritation. It is more toxic when inhaled.

Ryania is a slow acting stomach poison. It has a longer residual than most botanicals. Toxicity to mammals is moderate.

Sabadilla is derived from the seeds of South American lilies. It is a broad spectrum contact poison, but has some activity as a stomach poison. It is most effective against true bugs such as harlequin bugs and squash bugs. Sabadilla degrades rapidly in air and sunlight, and has little residual toxicity. It is very toxic to honey bees. The least toxic botanical to humans.

Neem is a relatively new product on the market. It is derived from the neem tree that grows in arid tropical regions. Extracts from the neem tree have been reported to control over 200 types of insects, mites, and nematodes. The neem spray solution should not be exposed to sunlight and must be prepared with water having a temperature between 50 and 90°F. The solution is effective for only 8 hours after mixing. Neem is most effective under humid conditions or when the insect and plants are damp. It has a low toxicity to mammals.

Insecticide	Use Against
Pyrethrum	Pickleworms, aphids, leafhoppers, spider mites, harlequin bugs, cabbage worms.
Neem	Cutworms, armyworms, sodworms.
Rotenone	Spittlebugs, aphids, potato beetles, harlequin bugs, chinch bugs, spider mites, carpenter ants.
Ryania	Codling moths, Japanese beetles, squash bugs, potato aphids, onion thrips, corn earworms, silkworms.
Sabadilla	Grasshoppers, codling moths, moths, armyworms, aphids, cabbage loopers, blister beetles, squash bugs, harlequin bugs.
Nicotine	Aphids, thrips, caterpillars.

Consumer Horticulture | Quick Reference

Soaps
Commercial insecticidal soap (a special formulation of fatty acids) has been proven effective against aphids, leafhoppers, mealybugs, mites, pear psylla, thrips, and whiteflies. Soaps and oils seem to disrupt cell membranes and must have direct contact with soft-bodied insects to be effective. Soaps are not very effective against insects with heavy cuticles or those that are highly mobile. Most adult beneficial insects are not harmed by soap sprays, but the immature stages can be since they often have soft bodies and have limited mobility. Soaps can also aid in the passage of insecticides through the waxy insect cuticle. Some plants can be damaged by soap sprays because they break down the waxy protective outer layer on the plant surface.

Homemade soap sprays also work to some extent: mix 3 tablespoons of soap flakes (not detergent) per gallon of water and spray on plants until dripping. Dishwashing detergents and laundry products may damage plants. Some home "recipes" call for cleaning agents, fuel oils, polishes, solvents, and other materials that may be very toxic to plants and animals (including humans). Commercial products deliver a more consistant result.

Homemade repellents - Repellent sprays, such as garlic sprays and bug sprays (made from a puree of bugs), have been found useful by some gardeners, but their effectiveness is short lived and poorly documented. Some researchers believe that bug sprays may work if a disease is present in the insect, which is spread through the spray to other insects.

Consumer Horticulture | Quick Reference

Home Vegetable Garden Insect Control

VEGETABLE/INSECT	INSECTICIDE & FORMULATION L=liquid, D=Dust, G=granular	AMOUNT OF FORMULATION PER GALLON OF SPRAY (or as otherwise noted)*	MIN. INTERVAL (DAYS) BETWEEN LAST APPLICATION AND HARVEST	REMARKS AND PRECAUTIONS
ASPARAGUS asparagus beetle Japanese beetle	carbaryl 22.5% L	3 - 6 Tbsp	1	Treat fern and brush growth as beetles appear. Repeat applications as necessary up to 3 times prior to harvest or 5 times per crop but not more often than once every 7 days.
	permethrin 2.5% L 0.25%D	3 Tbsp Apply according to label	3 1	Do not apply L more than 4 times per crop. Do not apply D more than 4 times per season.
BEANS - check product for specific beans				When available, insecticide-treated seeds should be used to avoid problems with seed corn maggots and other soil insect pests.
aphids	malathion 50% L (Spectracide)	1 ½ to 2 tsp	1	Apply when necessary, waiting at least 7 days between applications.
	bifenthrin 0.3% L	1 1/2 fl. oz.	3	Wait at least 7 days between each application.
	Safer Brand Insect Killing Soap Concentrate II 49.52% L	5Tbsp	0	Repeat applications may be needed. Repeat at weekly to biweekly intervals up to 3 times. Do not make more than 3 sequential applications over a 2 week period. Do not apply during heat of day or when temps exceed 90F.
bean beetles (Mexican bean beetle, bean leaf beetle)	carbaryl 22.5% L	1 1/2-3 Tbsp	3 (fresh beans) 21 (dried beans)	Repeat as necessary up to 4 times, but not more than once every 7 days.
	5D	1/2 to 1oz./ 50 ft. row	0	When Mexican bean beetle the only pest, use ½ oz per 50 ft. row
	bifenthrin 0.3% L	1 1/2 fl. oz.	3	Wait at least 7 days between each application.
	gamma cyhalothrin 0.25% L	1 Tbsp	7	Wait at least 7 days between each application. Do not apply more than 9 times per growing season.
corn earworm	carbaryl 22.5% L	1 1/2-4 1/2 Tbsp	3 (fresh beans) 21 (dried beans	Repeat treatments at 7 day intervals may be needed on late beans. Do not treat more than 4 times.
	5D	1oz./ 50 ft. row	0	
	bifenthrin 0.3% L	1 1/2 fl. oz.	3	Wait at least 7 days between each application.
	gamma cyhalothrin 0.25% L	1 Tbsp	7	
	permethrin 2.5%L	4 Tbsp	3	Do not apply more than 8 times per season.

VEGETABLE/INSECT	INSECTICIDE & FORMULATION L=liquid, D=Dust, G=granular	AMOUNT OF FORMULATION PER GALLON OF SPRAY (or as otherwise noted)*	MIN. INTERVAL (DAYS) BETWEEN LAST APPLICATION AND HARVEST	REMARKS AND PRECAUTIONS
BEANS (Cont'd)				
corn earworm	spinosad 0.5% L	4 Tbsp	3	Maximum of 6 applications per year. Wait 5 days before reapplying.
cowpea curculio	See peas.			
spider mites	Safer Brand Insect Killing Soap Concentrate II 49.52%	5 Tbsp	0	Begin at first signs of mites and off-color. Repeat applications may be needed, especially during hot weather. Repeat at weekly to biweekly intervals up to 3 times. Do not make more than 3 sequential applications over a 2 week period. Do not apply during heat of day or when temps exceed 90F.
	malathion 50% L (Spectracide)	1 Tbsp	1	Apply when necessary, waiting at least 7 days between applications.
thrips, lima bean borer	spinosad 0.5%	4 Tbsp	3	Maximum of 6 applications per season; Wait 5 days before reapplying.
whitefly	bifenthrin 0.3% L	1 1/2 fl. oz.	3	Wait at least 7 days between each application.
	Safer Brand Insect Killing Soap Concentrate II 49.52% L	5Tbsp	0	Repeat applications may be needed. Repeat at weekly to biweekly intervals up to 3 times. Do not make more than 3 sequential applications over a 2 week period. Do not apply during heat of day or when temps exceed 90F.
BEETS, GARDEN				
flea beetles	(Sevin) 22.5 % L	1 ½-3 Tbsp	7	Repeat up to 6 times but not more often then once every 7 days.
BROCCOLI	malathion 50% L (Spectracide)	1 ½ to 2 tsp	3	On foliage as aphids appear. Wait at least 7 days between applications.
aphid	bifenthrin 0.3% L	1 1/2 fl. oz.	7	Wait at least 7 days between each application.
	Safer Brand Insect Killing Soap Concentrate II 49.52% L	5Tbsp	0	For suppression. Repeat applications may be needed. Repeat at weekly to biweekly intervals up to 3 times. Do not make more than 3 sequential applications over a 2 week period. Do not apply during heat of day or when temps exceed 90F.
cabbageworms	Bacillus thuringiensis subsp. kurstaki (Dipel, Thuricide and other formulations)	As recommended on the label.	0	Treat as soon as damage is found and repeat weekly.
	esfenvalerate 0.425% L	2 Tbsp	3	Wait at least 7 days between each application.

VEGETABLE/INSECT	INSECTICIDE & FORMULATION L=liquid, D=Dust, G=granular	AMOUNT OF FORMULATION PER GALLON OF SPRAY (or as otherwise noted)*	MIN. INTERVAL (DAYS) BETWEEN LAST APPLICATION AND HARVEST	REMARKS AND PRECAUTIONS
BROCCOLI (Cont'd) cabbageworms	permethrin 2.5% L 0.25%D	2 Tbsp Apply according to label.	1	Do not apply more than 8 applications of L and not more often than every 5 days. Do not apply D more than 8 times per season.
	spinosad 0.5% L	4 Tbsp	1	Maximum of 6 applications per season. Wait 4 days before reapplying.
stink bugs	carbaryl 22.5 % L	3-6 Tbsp	3	Repeat as necessary up to 4 times, but not more than once every 7 days.
	bifenthrin 0.3% L	1 1/2 fl. oz.	7	Wait at least 7 days between each application.
BRUSSELS SPROUTS aphid	malathion 50% L (Spectracide)	1 ½ to 2 tsp	7	Apply when necessary, waiting at least 7 days between applications.
	Safer Brand Insect Killing Soap Concentrate II 49.52% L	5Tbsp	0	For suppression. Repeat applications may be needed. Repeat at weekly to biweekly intervals up to 3 times. Do not make more than 3 sequential applications over a 2 week period. Do not apply during heat of day or when temps exceed 90F.
cabbageworms	Bacillus thuringiensis subsp. kurstaki (Dipel, Thuricide and other formulations)	As recommended on the label.	0	Begin treatment when first noted and repeat weekly until harvest.
	permethrin 2.5% L 0.25%D	2 Tbsp Apply according to label.	1	Do not apply more than 8 applications of L and not more often than every 5 days. Do not apply D more than 8 times per season.
	spinosad 0.5% L	4 Tbsp	1	Maximum of 6 applications per season. Wait 4 days before reapplying.
CABBAGE aphid	bifenthrin 0.3% L	1 1/2 fl. oz.	7	Wait at least 7 days between each application.
	Safer Brand Insect Killing Soap Concentrate II 49.52% L	5Tbsp	0	Repeat applications may be needed. Repeat at weekly to biweekly intervals up to 3 times. Do not make more than 3 sequential applications over a 2 week period. Do not apply during heat of day or when temps exceed 90F.
cutworm	permethrin 0.25%D	Apply according to label.	1	Do not apply more than 5 times per season.
	bifenthrin 0.3% L	1 1/2 fl. oz.	7	Wait at least 7 days between each application.

VEGETABLE/INSECT	INSECTICIDE & FORMULATION L=liquid, D=Dust, G=granular	AMOUNT OF FORMULATION PER GALLON OF SPRAY (or as otherwise noted)*	MIN. INTERVAL (DAYS) BETWEEN LAST APPLICATION AND HARVEST	REMARKS AND PRECAUTIONS
CABBAGE (Cont'd) cabbageworms	Bacillus thuringiensis subsp. kurstaki (Dipel, Thuricide and other formulations)	As recommended on the label.	0	Good coverage is essential. Upper and lower leaves. Treat as soon as damage is found and repeat weekly until harvest.
	permethrin 2.5% L 0.25%D	2 Tbsp Apply according to label.	1	Do not apply L formulation more than 10 times. Do not apply D formulation more than 5 times per season for tight-heading varieties.
	esfenvalerate 0.425% L	2 Tbsp	3	Wait at least 7 days between each application.
	spinosad 0.5% L	4 Tbsp	1	Maximum of 6 applications per season. Wait 4 days before reapplying.
flea beetles	carbaryl 22.5% L	1 1/2-3 Tbsp	3	On foliage, as needed Repeat as necessary up to 4 times, but not more than once every 7 days.
	permethrin 0.25%D	Apply according to label.	1	Do not apply more than 5 times per season.
harlequin bug	carbaryl 22.5% L	1.5-3 Tbsp	3	Apply when necessary but not more than 4 times; wait at least 7 days between applications.
	bifenthrin 0.3% L	1 1/2 fl. oz.	7	Wait at least 7 days between each application.
CANTALOUPE aphid	bifenthrin 0.3% L	1 1/2 fl. oz.	3	Wait at least 7 days between each application.
	Safer Brand Insect Killing Soap Concentrate II 49.52% L	5Tbsp	0	Repeat applications may be needed. Repeat at weekly to biweekly intervals up to 3 times. Do not make more than 3 sequential applications over a 2 week period. Do not apply during heat of day or when temps exceed 90F.
cucumber beetles	carbaryl 22.5% L	3 Tbsp	3	Repeat as necessary up to 6 times, but not more than once every 7 days.
	bifenthrin 0.3% L	1 1/2 fl. oz.	3	Wait at least 7 days between each application.
	esfenvalerate 0.425% L	2 Tbsp	3	For use on adult beetles. Wait at least 7 days between each application.
	permethrin 2.5% L 0.25%D	As recommended on the label	0	Do not apply L more than 8 times per year. Do not apply D formulation more than 8 times per season. For use on adult beetles.

VEGETABLE/INSECT	INSECTICIDE & FORMULATION L=liquid, D=Dust, G=granular	AMOUNT OF FORMULATION PER GALLON OF SPRAY (or as otherwise noted)*	MIN. INTERVAL (DAYS) BETWEEN LAST APPLICATION AND HARVEST	REMARKS AND PRECAUTIONS
CANTALOUPE (Cont'd) leafminer	spinosad 0.5% L	4 Tbsp	3	Maximum of 6 applications per season. Wait 5 days before reapplying.
pickleworm	carbaryl 22.5 % L	1 1/2-3 Tbsp	3	Late-planted cantaloupes are heavily attacked. Begin treatments at first bloom; repeat as necessary up to 6 times, but not more than once every 7 days.
	bifenthrin 0.3% L	1 1/2 fl. oz.	3	Wait at least 7 days between each application.
	esfenvalerate 0.425% L	2 Tbsp	3	Wait at least 7 days between each application.
	permethrin 2.5% L 0.25%D	As recommended on the label	0	Do not apply L formulation more than 8 times per year. Do not apply D formulation more than 8 times per season.
	spinosad 0.5% L	4 Tbsp	3	Maximum of 6 applications per season; Wait 5 days before reapplying.
spider mite	Safer Brand Insect Killing Soap Concentrate II 49.52% L	5Tbsp	0	Repeat applications may be needed. Repeat at weekly to biweekly intervals up to 3 times. Do not make more than 3 sequential applications over a 2 week period. Do not apply during heat of day or when temps exceed 90F.
COLLARDS aphid	malathion 50% L (Bonide)	3 tsp	7	Make 2 or more applications as needed. Apply when necessary, waiting at least 7 days between applications.
cabbageworms	Bacillus thuringiensis subsp. kurstaki (Dipel, Thuricide and other formulations)	As recommended on the label	0	Begin treatments as soon as damage is found and repeat weekly until harvest
	esfenvalerate 0.425% L	2 Tbsp	7	Wait at least 7 days between each application.
	spinosad 0.5%	4 Tbsp	1	Maximum of 6 applications per season. Wait 4 days before reapplying.
flea beetles	carbaryl 22.5 % L	1 1/2-3 Tbsp	14	On foliage as needed. Repeat as necessary up to4 times, but not more than once every 7 days.

VEGETABLE/INSECT	INSECTICIDE & FORMULATION L=liquid, D=Dust, G=granular	AMOUNT OF FORMULATION PER GALLON OF SPRAY (or as otherwise noted)*	MIN. INTERVAL (DAYS) BETWEEN LAST APPLICATION AND HARVEST	REMARKS AND PRECAUTIONS
COLLARDS (Cont'd) flea beetles	esfenvalerate 0.425% L	2 Tbsp	7	Wait at least 7 days between each application.
harlequin bug	malathion 50% L (Bonide)	1 Tbsp	7	On foliage as needed. Wait at least 7 days between applications.
	esfenvalerate 0.425% L	2 tsp	7	Wait at least 7 days between each application.
	carbaryl 22.5% L	1 1/2-3 Tbsp	14	Repeat as necessary up to 4 times, but not more than once every 7 days.
CORN, SWEET corn earworm, fall armyworm, European corn borer	bifenthrin 0.3%L	1 1/2 fl. oz.	1	Wait at least 7 days between each application.
	carbaryl 22.5% L	3 - 6 Tbsp	2	Begin treating when silks appear. Repeat with sprays directed at ears as necessary up to 8 times, but not more than once every 7 days.
	cyfluthrin 0.75%L cyfluthrin 0.75%L	Ready-to-spray formula 1 Tbsp	0 0	Apply to flowering plants during early morning or late evening, when bees are not present. Do not apply more than 5 times per season.
	esfenvalerate 0.425% L	2 Tbsp	1	Wait at least 7 days between each application.
	permethrin 2.5% L 0.25%D	 3 Tbsp Apply according to label	1	Apply as needed every 5 days, but do not apply more than 6 times per season.
	spinosad 0.5% L	4 Tbsp	1	Maximum of 6 applications per season. Wait 3 days before reapplying.
flea beetle	bifenthrin 0.3% L	1 1/2 fl. oz.	1	Wait at least 7 days between each application.
	carbaryl 22.5% L	3-6 Tbsp	2	Early application on seedling corn is usually necessary. Repeat up to 8 times, but not more than once every 7 days. Application during pollen shed will seriously reduce bee populations.
	cyfluthrin 0.75% L cyfluthrin 0.75% L	Ready-to-spray formula 1 Tbsp	0 0	Apply to flowering plants during early morning or late evening, when bees are not present. Do not apply more than 5 times per season.

VEGETABLE/INSECT	INSECTICIDE & FORMULATION L=liquid, D=Dust, G=granular	AMOUNT OF FORMULATION PER GALLON OF SPRAY (or as otherwise noted)*	MIN. INTERVAL (DAYS) BETWEEN LAST APPLICATION AND HARVEST	REMARKS AND PRECAUTIONS
CUCUMBER aphid	Safer Brand Insect Killing Soap Concentrate II 49.52% L	5Tbsp	0	For suppression. Repeat applications may be needed. Repeat at weekly to biweekly intervals up to 3 times. Do not make more than 3 sequential applications over a 2 week period. Do not apply during heat of day or when temps exceed 90F. Apply to cucumbers at night or during coolest part of day.
aphid	bifenthrin 0.3% L	1 1/2 fl. oz.	3	Wait at least 7 days between each application.
cucumber beetle, squash bug	carbaryl 22.5% L	3 Tbsp	3	Apply Sevin late in the day to minimize killing pollinating insects. Repeat L up to 6 times, but not more than once every 7 days.
	5D	1oz./50ft. Row	0	
	bifenthrin 0.3% L	1 1/2 fl. oz.	3	Wait at least 7 days between each application.
	esfenvalerate 0.425% L	2 Tbsp	3	For use on cucumber beetle adults. Wait at least 7 days between each application.
	malathion 50% L (Bonide)	3 tsp or 1 Tbsp	1	Apply when necessary, waiting at least 7 days between applications. Do not apply unless plants are dry.
	permethrin 2.5% L 0.25%D	As recommended on the label	0	For use on cucumber beetle adults. Do not apply more than 8 times per year.
spider mites	Safer Brand Insect Killing Soap Concentrate II 49.52% L	5Tbsp	0	For suppression. Repeat applications may be needed. Repeat at weekly to biweekly intervals up to 3 times. Do not make more than 3 sequential applications over a 2 week period. Do not apply during heat of day or when temps exceed 90F. Apply to cucumbers at night or during coolest part of day.
EGGPLANT aphids	bifenthrin 0.3% L	1 1/2 fl. oz.	7	Wait at least 7 days between each application.
	malathion 50% L (Bonide)	4 tsp	3	Apply treatment when aphids present and repeat when needed. Make 2 or more applications. Wait at least 7 days between each application
	Safer Brand Insect Killing Soap Concentrate II 49.52% L	5Tbsp	0	For suppression. Repeat applications may be needed. Repeat at weekly to biweekly intervals up to 3 times. Do not make more than 3 sequential applications over a 2 week period. Do not apply during heat of day or when temps exceed 90F.

VEGETABLE/INSECT	INSECTICIDE & FORMULATION L=liquid, D=Dust, G=granular	AMOUNT OF FORMULATION PER GALLON OF SPRAY (or as otherwise noted)*	MIN. INTERVAL (DAYS) BETWEEN LAST APPLICATION AND HARVEST	REMARKS AND PRECAUTIONS
EGGPLANT (Cont'd) Colorado potato beetle	carbaryl 22.5% L	3-6 Tbsp	3	On foliage as needed. Repeat up to 7 times, but not more than once every 7 days.
	bifenthrin 0.3% L	1 1/2 fl. oz.	7	Wait at least 7 days between each application.
	esfenvalerate 0.425% L	2 Tbsp	7	Wait at least 7 days between each application.
	permethrin 2.5% L 0.25%D	6 Tbsp Apply according to label	3	Do not apply L formulation more than 16 times. Do not apply D formulation more than 10 times per season.
	spinosad 0.5% L	4 Tbsp	1	Maximum of 6 applications per season. Wait 4 days before reapplying.
flea beetle	carbaryl 22.5% L	1 ½-3 Tbsp	3	On foliage as needed. Repeat up to 7 times, but not more than once every 7 days.
	bifenthrin 0.3% L	1 1/2 fl. oz.	7	Wait at least 7 days between each application.
	carbaryl 22.5% L	1 1/2 - 3 Tbsp	14	Repeat up to 4 times, but not more than once every 7 days.
lacebug	malathion 50% L (Bonide)	4 tsp	3	Wait at least 7 days between each application.
spider mite	malathion 50% L (Bonide)	4 tsp	3	Repeat treatments are often necessary. Do not use Kelthane! Wait at least 7 days between each application.
	Safer Brand Insect Killing Soap Concentrate II 49.52% L	5Tbsp	0	For suppression. Repeat applications may be needed. Repeat at weekly to biweekly intervals up to 3 times. Do not make more than 3 sequential applications over a 2 week period. Do not apply during heat of day or when temps exceed 90F.
whitefly	pyrethrin (aerosol)		1	
	bifenthrin 0.3% L	1 1/2 fl. oz.	7	Wait at least 7 days between each application.
	Safer Brand Insect Killing Soap Concentrate II 49.52% L	5Tbsp	0	For suppression. Repeat applications may be needed. Repeat at weekly to biweekly intervals up to 3 times. Do not make more than 3 sequential applications over a 2 week period. Do not apply during heat of day or when temps exceed 90F.

VEGETABLE/INSECT	INSECTICIDE & FORMULATION L=liquid, D=Dust, G=granular	AMOUNT OF FORMULATION PER GALLON OF SPRAY (or as otherwise noted)*	MIN. INTERVAL (DAYS) BETWEEN LAST APPLICATION AND HARVEST	REMARKS AND PRECAUTIONS
LETTUCE aphid	malathion 50% L (Spectracide)	1 ½ to 2 tsp.	head lettuce(7) leaf lettuce(14)	Wait at least 7 days between each application. Repeat as necessary.
	bifenthrin 0.3% L	1 1/2 fl. oz.	head lettuce (7)	Wait at least 7 days between each application.
cabbageworms	Bacillus thuringiensis subsp. kurstaki (Dipel, Thuricide and other formulations)	As recommended on the label	0	Begin treatments as soon as damage is found and repeat weekly until harvest.
	bifenthrin 0.3% L	1 1/2 fl. oz.	head lettuce (7)	Wait at least 7 days between each application.
	permethrin 2.5% L 0.25%D	4 Tbsp Apply according to label	1	Apply every 5 to 10 days as needed, but do not apply L formulation more than 10 times per season. Do not apply D formulation more than 5 times per season.
	spinosad 0.5% L	4 Tbsp	1	Maximum of 6 applications per season. Wait 4 days before reapplying.
MUSTARD GREENS aphid	malathion 50% L (Bonide)	3 tsp	7	Wait at least 7 days between each application.
	bifenthrin 0.3% L for Chinese mustard only	1 1/2 fl. oz.	7	Wait at least 7 days between each application.
caterpillars	Bacillus thuringiensis subsp. kurstaki (Dipel, Thuricide and other formulations)	As recommended on the label	0	Begin treatments as soon as damage is found and repeat weekly or as necessary until harvest.
caterpillars	spinosad 0.5% L	4 Tbsp	1	Maximum of 6 applications per season. Wait 4 days before reapplying.
flea beetles	carbaryl 22.5% L	1 1/2 - 3 Tbsp	14	Repeat up to 4 times, but not more than once every 7 days.
OKRA aphids	Safer Brand Insect Killing Soap Concentrate II 49.52% L	5Tbsp	0	Repeat applications may be needed. Repeat at weekly to biweekly intervals up to 3 times. Do not make more than 3 sequential applications over a 2 week period. Do not apply during heat of day or when temps exceed 90F.
corn earworm	carbaryl 5D	1 - 2 oz./ 50 ft. row	0	
	permethrin 2.5% L	As recommended on the label	1	Every 5 to 10 days as needed, but do not apply L formulation more than 10 times per season.

VEGETABLE/INSECT	INSECTICIDE & FORMULATION L=liquid, D=Dust, G=granular	AMOUNT OF FORMULATION PER GALLON OF SPRAY (or as otherwise noted)*	MIN. INTERVAL (DAYS) BETWEEN LAST APPLICATION AND HARVEST	REMARKS AND PRECAUTIONS
OKRA (Cont'd) stink bug	carbaryl 5D	1-2oz./50ft. row	0	
ONIONS thrips	malathion 50% L (Bonide)	2 ½ tsp	3	Wait at least 7 days between each application.
PEAS aphid	malathion 50% L (Spectracide)	1 ½ to 2 tsp	3	Wait at least 7 days between each application.
	Safer Brand Insect Killing Soap Concentrate II 49.52% L	5Tbsp	0	For suppression. Repeat applications may be needed. Repeat at weekly to biweekly intervals up to 3 times. Do not make more than 3 sequential applications over a 2 week period. Do not apply during heat of day or when temps exceed 90F.
cowpea curculio		2 Tbsp	21 (dried peas)	Wait at least 7 days between each application.
European corn borer	carbaryl 22.5% L	3-4 1/2 Tbsp	3 (fresh peas) 21 (dried peas)	This insect is a more serious pest on late peas. Treat 1-2 weeks prior to bloom. Repeat applications as necessary up to 4 times, but not more often than once every 7 days.
	esfenvalerate 0.425% L	2 Tbsp	3 (green peas) 21 (dried peas)	Wait at least 7 days between each application.
	spinosad 0.5% L	4 Tbsp	3	Maximum of 6 applications per season. Wait 5 days before reapplying.
lesser cornstalk borer	spinosad 0.5% L	4 Tbsp	3	A problem on late peas. Maximum of 6 applications per season; Wait 5 days before reapplying.
PEPPER aphid	bifenthrin 0.3% L	1 1/2 fl. oz.	7	Wait at least 7 days between each application.
	malathion 50% L (Bonide)	2 ½ tsp	3	Wait at least 7 days between each application.
armyworms, cabbage loopers, corn earworms, leafminers	Safer Brand Insect Killing Soap Concentrate II 49.52% L	5Tbsp	0	For suppression. Repeat applications may be needed. Repeat at weekly to biweekly intervals up to 3 times. Do not make more than 3 sequential applications over a 2 week period. Do not apply during heat of day or when temps exceed 90F.
	cyfluthrin 0.75% L	Ready-to-spray formula	7	Apply to flowering plants during early morning or late evening, when bees are not present. Do not apply more than 6 times per season.
	cyfluthrin 0.75% L	1 Tbsp	7	
	permethrin 0.25%D	Apply according to label	3	Do not apply more than 8 times per season.

VEGETABLE/INSECT	INSECTICIDE & FORMULATION L=liquid, D=Dust, G=granular	AMOUNT OF FORMULATION PER GALLON OF SPRAY (or as otherwise noted)*	MIN. INTERVAL (DAYS) BETWEEN LAST APPLICATION AND HARVEST	REMARKS AND PRECAUTIONS
PEPPER (Cont'd) armyworms, cabbage loopers, corn earworms, leafminers	spinosad 0.5% L	4 Tbsp	1	Maximum of 6 applications per season; Wait 4 days before reapplying.
flea beetle	carbaryl 22.5% L	1 1/2-3Tbsp	3	Repeat applications as necessary up to 7 times, but not more often than once every 7 days.
European corn borer	carbaryl 22.5% L	3-6 Tbsp	3	Spray plants thoroughly, especially pepper caps, every 7 days after blossoms appear and fruit forms, but not more than 7 times.
	cyfluthrin 0.75% L cyfluthrin 0.75% L	Ready-to-spray formula 1 Tbsp	7	Apply to flowering plants during early morning or late evening, when bees are not present. Do not apply more than 6 times per year.
	esfenvalerate 0.425% L	2 tsp	7	Wait at least 7 days between each application.
	permethrin 2.5% L 0.25%D	4 Tbsp Apply according to label	3	Do not apply more than 8 times per season.
	spinosad 0.5% L	4 Tbsp	1	Maximum of 6 applications per season. Wait 4 days before reapplying.
POTATOES, IRISH aphid	esfenvalerate 0.425% L	2 Tbsp	7	Wait at least 7 days between each application.
	malathion 50% L (Bonide)	1 ½ tsp	0	Wait at least 7 days between each application.
Colorado potato beetle	esfenvalerate 0.425% L	2Tbsp	7	Wait at least 7 days between each application.
	permethrin 2.5% L 0.25%D	3 Tbsp Apply according to label	7 14	Do not apply L formulation more than 12 times. Do not apply D formulation more than 8 times per season.
	spinosad 0.5% L	4 Tbsp	7	Maximum of 6 applications per season. Wait 7 days before reapplying.
flea beetle, leafhoppers	carbaryl 22.5% L 5D	1 1/2-3Tbsp 1 oz./50ft row	7 0	Repeat applications as necessary up to 6 times, but not more often than once every 7 days.
	esfenvalerate 0.425% L	2 Tbsp	7	Wait at least 7 days between each application.

VEGETABLE/INSECT	INSECTICIDE & FORMULATION L=liquid, D=Dust, G=granular	AMOUNT OF FORMULATION PER GALLON OF SPRAY (or as otherwise noted)*	MIN. INTERVAL (DAYS) BETWEEN LAST APPLICATION AND HARVEST	REMARKS AND PRECAUTIONS
POTATOES, IRISH (Cont'd) potato tuberworm	esfenvalerate 0.425% L	2Tbsp	7	Wait at least 7 days between each application.
	permethrin 2.5% L 0.25%D	3 Tbsp Apply according to label	7 14	Do not apply L formulation more than 12 times. Do not apply D formulation more than 8 times per season.
	spinosad 0.5% L	4 Tbsp	7	Maximum of 6 applications per season. Wait 7 days before reapplying.
RADISHES aphid	malathion 50% L (Spectracide)	1 ½ to 2 tsp	7	Wait at least 7 days between each application.
	esfenvalerate 0.425% L	2 Tbsp	7	Wait at least 7 days between each application.
cutworms	cyfluthrin 0.75% L cyfluthrin 0.75% L	Ready-to-spray formula 1 Tbsp	0	Do not apply more than 5 times per season.
	esfenvalerate 0.425% L	2 Tbsp	7	Wait at least 7 days between each application.
flea beetles	carbaryl 22.5% L 5D	1 ½ to 3 Tbsp 1oz./50ft. row	7 3	Repeat applications as necessary up to 6 times, but not more often than once every 7 days.
	cyfluthrin 0.75% L cyfluthrin 0.75% L	Ready-to-spray formula 1 Tbsp	0	Do not apply more than 5 times per season.
SQUASH & PUMPKIN aphid	bifenthrin 0.3% L	1 1/2 fl. oz.	3	Wait at least 7 days between each application.
	malathion 50% L (Bonide)	3 tsp	3 pumpkin- 1 squash	Do not apply unless leaves are dry. Wait at least 7 days between each application.
	Safer Brand Insect Killing Soap Concentrate II 49.52% L	5Tbsp	0	For summer squash. For suppression. Repeat applications may be needed. Repeat at weekly to biweekly intervals up to 3 times. Do not make more than 3 sequential applications over a 2 week period. Do not apply during heat of day or when temps exceed 90F.

VEGETABLE/INSECT	INSECTICIDE & FORMULATION L=liquid, D=Dust, G=granular	AMOUNT OF FORMULATION PER GALLON OF SPRAY (or as otherwise noted)*	MIN. INTERVAL (DAYS) BETWEEN LAST APPLICATION AND HARVEST	REMARKS AND PRECAUTIONS
SQUASH & PUMPKIN (Cont'd) cucumber beetles, flea beetles	carbaryl 22.5% L	3 Tbsp	3	Apply Sevin late in the day to minimize killing pollinating insects. Leaf injury may occur if tender foliage is wet or humidity is high. Repeat applications as necessary up to 6 times, but not more often than once every 7 days.
	5D	1oz./50ft. row	0	
	bifenthrin 0.3% L	1 1/2 fl. oz.	3	Wait at least 7 days between each application.
	esfenvalerate 0.425%L	2 Tbsp	3	Wait at least 7 days between each application.
	permethrin 2.5% L 0.25%D	4 Tbsp Apply according to label	3 0	Do not apply L more than 8 times per year. Do not apply D more than 8 times per season.
leafminer	spinosad 0.5% L	4 Tbsp	3	Maximum of 6 applications per season. Wait 5 days before reapplying.
pickleworm, squash vine borer	carbaryl 22.5% L	1 1/2-3 Tbsp	3	Treat when damage to blossoms or other plant parts is noticed. More of a problem on late squash than early. Direct sprays at base of plants for vine borer control. Repeat applications as necessary up to 6 times, but not more often than once every 7 days.
	bifenthrin 0.3% L	1 1/2 fl. oz.	3	Wait at least 7 days between each application.
	esfenvalerate 0.425% L	2Tbsp	3	Wait at least 7 days between each application.
	permethrin 0.25%D	Apply according to label	0	Do not apply more than 8 times per season.
	spinosad 0.5% L	4 Tbsp	3	Maximum of 6 applications per season; Wait 5 days before reapplying.
squash bug	bifenthrin 0.3% L	1 1/2 fl. oz.	3	Wait at least 7 days between each application.
	esfenvalerate 0.425% L	2 T bsp	3	Wait at least 7 days between each application.
	permethrin 2.5% L 0.25%D	As recommended on the label	0	Do not apply more than 8 times per season.
TOMATO aphid	bifenthrin 0.3% L	1 1/2 fl. oz.	1	Wait at least 7 days between each application.

VEGETABLE/INSECT	INSECTICIDE & FORMULATION L=liquid, D=Dust, G=granular	AMOUNT OF FORMULATION PER GALLON OF SPRAY (or as otherwise noted)*	MIN. INTERVAL (DAYS) BETWEEN LAST APPLICATION AND HARVEST	REMARKS AND PRECAUTIONS
TOMATO (Cont'd) aphid	malathion 50% L (Spectracide)	1 ½ to 2 tsp	7	Wait at least 7 days between each application.
	Safer Brand Insect Killing Soap Concentrate II 49.52% L	5Tbsp	0	For suppression. For suppression. Repeat applications may be needed. Repeat at weekly to biweekly intervals up to 3 times. Do not make more than 3 sequential applications over a 2 week period. Do not apply during heat of day or when temps exceed 90F. Apply to cucumbers at night or during coolest part of day.
cutworms	carbaryl 22.5% L	6 Tbsp	3	Mix in enough water to get sufficient coverage of plants and soil around plants. Repeat applications as necessary up to 7 times, but not more often than once every 7 days.
	cyfluthrin 0.75% L cyfluthrin 0.75% L	Ready-to-spray formula 1 Tbsp	0	Apply to flowering plants during early morning or late evening, when bees are not present. Do not apply more than 5 times per season.
cutworms	esfenvalerate 0.425% L	2 Tbsp	1	Wait at least 7 days between each application.
	permethrin 2.5% L 0.25%D	3 Tbsp As recommended on the label	0	Do not apply L formulation more than 8 times per season. Do not apply D formulation more than 6 times per year.
beetles, blister beetles	carbaryl 22.5% L 5D	1 1/2-3 Tbsp 1oz./50ft. row	3 0	Flea beetles are more destructive on new set plants. Blister beetles are more common later in the season. Repeat applications as necessary up to 7 times, but not more often than once every 7 days.
	bifenthrin 0.3% L	1 1/2 fl. oz.	1	Wait at least 7 days between each application.
	esfenvalerate 0.425% L	2 Tbsp	1	Wait at least 7 days between each application.
	permethrin 0.25%D	Apply according to label	0	Do not apply more than 6 times per season.
Colorado potato beetle	carbaryl 22.5% L	3-6 Tbsp	3	Repeat applications as necessary up to 7 times, but not more often than once every 7 days.
	bifenthrin 0.3% L	1 1/2 fl. oz.	1	Wait at least 7 days between each application.

VEGETABLE/INSECT	INSECTICIDE & FORMULATION L=liquid, D=Dust, G=granular	AMOUNT OF FORMULATION PER GALLON OF SPRAY (or as otherwise noted)*	MIN. INTERVAL (DAYS) BETWEEN LAST APPLICATION AND HARVEST	REMARKS AND PRECAUTIONS
TOMATO (Cont'd) Colorado potato beetle	permethrin 2.5% L 0.25%D	3 Tbsp As recommended on the label	0	Do not apply L formulation more than 8 times per season. Do not apply D formulation more than 6 times per year.
	spinosad 0.5% L	4 Tbsp	1	Maximum of 6 applications per season; Wait 4 days before reapplying.
leafminer	spinosad 0.5% L	4 Tbsp	1	Maximum of 6 applications per season; Wait 4 days before reapplying.
spider mite	Safer Brand Insect Killing Soap Concentrate II 49.52% L	5Tbsp	0	No more than 3 applications in 2 weeks. Do not apply in heat of day when leaf temp above 90F.
	malathion 50% L (Spectracide)	1 Tbsp	7	Wait at least 7 days between each application.
stink bug and leaf-footed bug	carbaryl 22.5% L	3-6 Tbsp	3	Repeat applications as necessary up to 7 times, but not more often than once every 7 days.
	cyfluthrin 0.75% L cyfluthrin 0.75% L	Ready-to-spray formula 1 Tbsp	0	Apply to flowering plants during early morning or late evening, when bees are not present. Do not apply more than 5 times per season.
	bifenthrin 0.3% L	1 1/2 fl. oz.	1	Wait at least 7 days between each application.
	esfenvalerate 0.425% L	2 Tbsp	1	Wait at least 7 days between each application.
	permethrin 0.25%D	Apply according to label	0	Do not apply more than 6 time per season.
tomato fruitworm and hornworm	Bacillus thuringiensis subsp. kurstaki (Dipel, Thuricide and other formulations)	As recommended on the label	0	Begin treatments when damage is first noted and repeat weekly until harvest. Handpicking of hornworms is often sufficient if few plants are involved.
	carbaryl 22.5% L	3-6 Tbsp	3	Repeat applications as necessary up to 7 times, but not more often than once every 7 days.
	cyfluthrin 0.75% L cyfluthrin 0.75% L	Ready-to-spray formula 1 Tbsp	0	Apply to flowering plants during early morning or late evening, when bees are not present. Do not apply more than 5 times per season.
	bifenthrin 0.3% L	1 1/2 fl. oz.	1	Wait at least 7 days between each application.

VEGETABLE/INSECT	INSECTICIDE & FORMULATION L=liquid, D=Dust, G=granular	AMOUNT OF FORMULATION PER GALLON OF SPRAY (or as otherwise noted)*	MIN. INTERVAL (DAYS) BETWEEN LAST APPLICATION AND HARVEST	REMARKS AND PRECAUTIONS
TOMATO (Cont'd) tomato fruitworm and hornworm	esfenvalerate 0.425% L	2 Tbsp	1	Wait at least 7 days between each application.
	permethrin 2.5% L 0.25%D	3 Tbsp As recommended on the label	0	Do not apply L formulation more than 8 times per season. Do not apply D formulation more than 6 times per year.
	spinosad 0.5% L	4 Tbsp	1	Maximum of 6 applications per season. Wait 4 days before reapplying.
whitefly	Pyrethrin (aerosol)	According to label	0	Inspect undersides of leaves when purchasing transplants. Do not buy if whiteflies are observed. Spray underside of leaves; repeated weekly applications needed for control.
	bifenthrin 0.3% L	1 1/2 fl. oz.	1	Wait at least 7 days between each application.
whitefly	Safer Brand Insect Killing Soap Concentrate II 49.52% L	5Tbsp	0	No more than 3 applications in 2 weeks. Do not apply in heat of day when leaf temp above 90F.
tomato pinworm	spinosad 0.5%	4 Tbsp	1	Maximum of 6 applications per season; Wait 4 days before reapplying.
	bifenthrin 0.3% L	1 1/2 fl. oz.	1	Wait at least 7 days between each application.
TURNIPS aphid	malathion 50% L (Bonide)	3 tsp	3	On foliage as needed. Wait at least 7 days between each application.
caterpillars	Bacillus thuringiensis subsp. kurstaki (Dipel, Thuricide and other formulations)	As recommended on the label	0 0	Begin treatment when damage is first found and repeat weekly until harvest.
flea beetles, harlequin bug	carbaryl 5D	1/2 - 1oz./50ft. row	3 (roots) 14 (tops)	
WATERMELON aphid	bifenthrin 0.3% L	1 1/2 fl. oz.	3	Wait at least 7 days between each application.
	Safer Brand Insect Killing Soap Concentrate II 49.52% L	5Tbsp	0	For suppression. For suppression. Repeat applications may be needed. Repeat at weekly to biweekly intervals up to 3 times. Do not make more than 3 sequential applications over a 2 week period. Do not apply during heat of day or when temps exceed 90F.

VEGETABLE/INSECT	INSECTICIDE & FORMULATION L=liquid, D=Dust, G=granular	AMOUNT OF FORMULATION PER GALLON OF SPRAY (or as otherwise noted)*	MIN. INTERVAL (DAYS) BETWEEN LAST APPLICATION AND HARVEST	REMARKS AND PRECAUTIONS
WATERMELON (Cont'd) cucumber beetles	carbaryl 22.5% L	3 Tbsp	3	Apply late in the day to minimize killing pollinating insects. Repeat applications as necessary up to 6 times, but not more often than once every 7 days.
	5D	1oz./50ft. row	0	
	esfenvalerate 0.425% L	2 Tbsp	3	Wait at least 7 days between each application.
	permethrin 2.5% L 0.25%D	As recommended on the label	0	Do not apply L formulation more than 8 times per year. Do not apply D formulation more than 8 times per season. For use on adult beetles.
rindworms	See pickleworms on cantaloupes, but check label to ensure watermelon is listed.			
spider mite	Safer Brand Insect Killing Soap Concentrate II 49.52% L	5Tbsp	0	No more than 3 applications in 2 weeks. Do not apply in heat of day when leaf temp above 90F.
thrips	spinosad 0.5%	4 Tbsp	3	Maximum of 6 applications per season; Wait 5 days before reapplying.

* Rates vary according to manufacturer; read the label to determine the correct rate for the product chosen.

NOTE: Slugs and snails can be controlled in home gardens using iron phosphate (Sluggo, Escar-Go!, Worry Free) or metaldehyde baits. Do not contact plant material with slug baits. Consult the label for specific vegetables it can be used on. Grasshoppers and crickets can be controlled in the home garden using a 5% Sevin bait.

Fire Ants

Ants occasionally feed on vegetable plants in home gardens. They tunnel into potatoes underground and feed on okra buds and developing pods. The worst damage usually occurs during hot, dry weather. Ants may also be a nuisance to gardeners during weeding and harvesting. See our fire ant web site http://fireants.utk.edu or the eXtension web site at http://www.extension.org/fire+ants for more information on managing fire ants.

Fire ant treatment options

* A bait, Extinguish (methoprene), is labeled for cropland. Another fire ant bait, Esteem (pyriproxyfen), is labeled for some crops such as broccoli, cabbage, cauliflower, kale, mustard greens, cucumber, pumpkins, squash, melons, okra, pepper, tomato, etc. Extinguish and Esteem are insect growth regulators and may require several months to work. Fertilome Come and Get It Fire Ant Killer (spinosad) lists most crops including, but not limited to, soybeans and vegetables and may require 1 to 4 weeks to work.
* Ant mounds can be shoveled out of the garden or treated with very hot water, taking care not to disturb or treat the garden plants. Caution should be taken to prevent hot water and/or steam from injuring the applicator.
* Since most other baits are not registered for use inside gardens, those baits can be applied around the garden perimeter. Foraging ants from colonies both inside and outside the garden will collect the bait and take it to their colonies.
* To prevent ants from entering a garden, apply insecticidal spray or granules around the perimeter of the garden as a barrier, and treat individual mounds near the garden as needed.

Listed below are some of the products used to give rate recommendations in the previous tables. These are suggested products, other products do exist. If you are unable to find the product listed, but can find the active ingredient and formulation, always check the label on the pesticide container to ensure the formulation chosen can be used on the pest or site needed. As always, follow the label directions when applying pesticides.

Active Ingredient	**Trade Name & Web Site**
bifenthrin 0.3% L	Ortho Bug-B-Gon MAX Lawn & Garden Insect Killer$_1$ http://www.ortho.com
carbaryl 22.5% L	GardenTech Sevin Concentrate Bug Killer http://www.gardentech.com
carbaryl 5%D	GardenTech Sevin-5 Ready-To-Use 5% Dust Bug Killer http://www.gardentech.com
cyfluthrin 0.75% L	Bayer Advanced PowerForce Multi-Insect Killer, Concentrate http://www.bayeradvanced.com
cyfluthrin 0.75% L (RTS)	Bayer Advanced PowerForce Multi-Insect Killer, Ready-to-spray (hose end sprayer) http://www.bayeradvanced.com
esfenvalerate 0.425% L	Ortho Bug-B-Gon® MAX Lawn & Garden Insect Killer, Concentrate http://www.ortho.com
gamma-cyhalothrin 0.25%	Spectracide Triazicide Once & Done! Insect Killer Concentrate http://www.spectracide.com
Malathion 50% L	Bonide Malathion Insect Control Concentrate http://www.bonide.com/
Malathion 50% L	Spectricide Malathion Insect Spray Concentrate http://www.spectracide.com/ProductCategories/
permethrin 2.5% L	Bonide® Eight Insect Control Vegetable, Fruit and Flower Concentrate http://www.bonideproducts.com
permethrin 0.25%D	Ortho Bug-B-Gon® Max Garden Insect Dust http://www.ortho.com
Potassium salts of fatty acids	Safer Brand Insect Killing Soap Concentrate II http://www.saferbrand.com
spinosad 0.5% L	Ferti-lome Borer, Bagworm, Tent Caterpillar and Leafminer Spray http://www.fertilome.com/products/ProductLabels/10081.pdf

PRECAUTIONARY STATEMENT

To protect people and the environment, pesticides should be used safely. This is everyone's responsibility, especially the user. Read and follow label directions carefully before you buy, mix, apply, store, or dispose of a pesticide. According to laws regulating pesticides, they must be used only as directed by the label.

DISCLAIMER STATEMENT

This publication contains pesticide recommendations that are subject to change at any time. The recommendations in this publication are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. The label takes precedence over the recommendations found in this publication. Use of trade or brand names in this publication is for clarity and information; it does not imply approval of the product to the exclusion of others which may be of similar, suitable composition, nor does it guarantee or warrant the standard of the product. The author(s), The University of Tennessee Institute of Agriculture and the University of Tennessee Extension assume no liability resulting from the use of these recommendations.

HOME

BLOG

WHAT IS BIOCONTROL
Natural Control
Biological Control

BENEFICIAL INSECTS
Predators
Parasites
Look-A-Likes

HABITAT FOR BENEFICIALS
Why Provide Habitat
Principles
Habitat Example

USING BIOCONTROL
Home Gardener
Q&A

Biological Control: Questions and Answers for the Home Gardener

Stephen Bambara and David Orr
Department of Entomology, North Carolina State University

What is Biological Control? Biological control is, generally, using a living organism to control a specific pest. When you ch predator, parasite, or disease that will attack a harmful insect, you are manipulating nature to achieve a desired effect. A c biological pest control program may range from choosing the pesticide that is least harmful to beneficial insects to raising and re one organism to have it attack another, almost like a "living insecticide."

What are the Advantages of Biological Pest Control? As part of an overall Integrated Pest Management (IPM) program, bi control methods can reduce the legal, environmental, and health hazards of using chemicals in the garden. In some cases, bi control measures can actually prevent economic damage to the plants. Unlike most insecticides, biological controls are often very for a particular pest. People, animals, or helpful insects may be completely unaffected or undisturbed by their use. There is a danger to the environment and water quality.

What are the Disadvantages? Biological control takes more intensive management and planning. It can take more time, requi record-keeping, and demand more patience and education or training.

To be successful, you need to understand the biology of the pest and its enemies. Many of the predators you will want to use home garden are very susceptible to pesticides. Using them successfully in an IPM program takes great care. In some cases, bi control is more costly than pesticides. Often, the results of using biological control are not as dramatic or immediate as the re pesticide use. Most natural enemies attack only specific types of insects, whereas broad-spectrum insecticides may kill a wide r insects. But this seeming advantage of insecticides can be a disadvantage when it kills beneficial insects.

What is a Beneficial Insect? In your garden, a beneficial insect is any insect that preys upon a harmful insect that damages your Beneficial insects are the "good" insects that destroy insect pests. The beneficial insect might eat the harmful insect immediat harmful insect may be paralyzed and eaten later, or the beneficial insect may lay eggs so that its offspring will consume the harmfu For example, lacewing larvae eat aphids, paper wasps catch caterpillars and feed them to their young, and tiny parasitic wasps l into other insects and their offspring eat the insect from within.

Click on the "Beneficial Insects" categories in the left hand column of this website to see some examples of beneficial insects.

How Can I Protect the Beneficial Insects Already in My Garden? First identify any unknown insects in your garden. Then you w whether an insect is eating a plant, looking for another insect to eat, just seeking shelter, or merely passing through. If you find a insect, you can determine how much damage it could cause and if a chemical is needed. Since chemicals can also kill beneficial they must be used wisely and only if needed. Wise use includes choosing the correct chemical and using it at the correct strengt correct time, and in the correct place. When chemicals are necessary, look for the one that kills the pest without harming your be insects.

Pest insect populations often recover more quickly that the predator insect populations, so you don't want to kill all the insects garden. (This is why outbreaks of harmful insects sometimes follow chemical treatments.)

How Can I Identify an Insect? You can contact your county Cooperative Extension office, or use field guides, gardening re books, and NC State University's online guides to local insects at the following web addresses:

Quick Identification: http://www.cals.ncsu.edu/course/ent425/library/spotid/index.html
More Details: http://www.cals.ncsu.edu/course/ent425/library/compendium/index.html
Insects on Specific Plants: http://www.cals.ncsu.edu/entomology/bug .

You will need to identify beneficial insects in any life state. If you are uncertain, ask you county's Cooperative Extension center f Trained and experienced agents and specialists will be able to help.

Which Sprays Are The Safest To Use? The three most common "safe" compounds contain *Bt*, horticultural oil, or insecticidal s three are available as ingredients in different brand-name products.

- *Bt* is an abbreviation for *Bacillus thuringiensis*, which is a bacterium that attacks only specific insects and makes them sick. It harm the beneficial ones. Be sure that the pest you wish to kill is listed on the label because not all strains of this bacterium all insects.

- Horticultural oils are specially refined oils that can be sprayed on insects. Only certain insects are susceptible, and the sp only the insects that it touches.

- Insecticidal soaps are special formulations of soaps (not the same as dishwashing detergent). An insecticidal soap will

fragile pest insects that it touches.

Can I Add Beneficial Insects to My Garden? Yes. You may catch beneficial insects and release them in your garden, or you n them from supply houses. But purchasing beneficials is "buyer beware." Because the government doesn't regulate this indus quality of material you could receive varies widely among producers and suppliers. To become well informed before choosing a su beneficial insects, contact your Extension center. Some of the beneficial insects offered for sale may not be suited to our climate, r be appropriate for release in a garden, or are very specific regarding which insects they attack. For example, praying mant commonly sold as natural insect control. However, mantids tend to be ambush predators, eating anything that passes in front of th they can subdue. In other words, they do not seek out insects like aphids, caterpillars, and thrips that are typical garden pests. Th these entertaining, watchable insects are essentially useless for pest control. Another example is ladybeetles. A single lady beetle larva can consume many aphids. But when hundreds of them are collected into a container and released, they also tend to fly av disperse in order to avoid competing with each other for food. Don't forget that there has to be a lot of food to support a lot of insec your garden is not full of harmful insects, it won't support large numbers of beneficial ones. It is best to strive for a balance of low l both harmful and good insects.

What Else Can I Do?

- When pests are present, don't overlook handpicking the insects from the plant and destroying them. Some insects may res traps, baits, or sticky cards placed in or near the garden.

- Don't overfertilize. Too much nitrogen will promote vegetative growth and stimulate an increase in aphid and mite populations

- Provide a diverse habitat. Natural enemies often do better when they have a diversity of hosts or plants. Raise flowering p provide an alternative food source of pollen and nectar for many beneficial insects, such as syrphid flies, robber flies, lady l and parasitoid wasps. They can also provide shelter and humidity.

- Employ cultural practices. Some plants will lure a pest away from the desired plant. Then, when the time is right, you ca pesticides to the lure or "trap" plant. This is known as "trap cropping".

- Supplement the needs of the beneficial insects. In addition to planting flowers for food, leave undisturbed natural areas w around the garden to provide nesting and over-wintering sites for beneficial insects, such as lady beetles and parasitic s wasps.

How Do I Start?

Identify the pests in your garden. List the control measures that will be helpful against these pests. Then develop a plan.

Biological, cultural, chemical, and mechanical controls can all be used to assemble an integrated pest management (IPM) plan home garden. Determine your priorities. Are you interested in using fewer chemicals? Can you tolerate a few holes in leaves? C the cost of your program. Do you want to spend less money? If you can identify your goals ahead of time, you will be able to evalua success later. Biological control does not offer a simple, complete answer to all insect problems in the garden, and it certainly is not You may not be able to eliminate the use of chemical insecticides. Learn what you can expect from any of the parasites or predat purchase for release in you garden. Are they the correct species? When should you release them? Will they all fly away when yo the container, or be dead the next day?

Using biological control in your home garden takes knowledge, patience, and motivation, but you can also reap great rewards.

Managing Diseases in Home Vegetable Gardens

All vegetables are susceptible to several diseases. Thus, in North Carolina you can expect to have disease problems in your vegetable garden sooner or later, especially if you grow a garden on the same site year after year. However, by following good cultural practices and taking preventive measures, good yields and high-quality vegetables may be obtained even if some diseases are present.

This publication gives guidelines that will help you obtain good yields of disease-free vegetables. It is not intended to provide the final answer to all questions about vegetable disease control. Remember that disease management starts with proper disease identification; have a knowledgeable person identify the problem before implementing any control strategy. Successful disease management in vegetable gardens will result from using the control methods discussed in this publication.

Crop Rotation

Rotating crops is one of the oldest and most economical methods of controlling plant diseases, including plant-parasitic nematodes. Rotation is the practice of not growing a certain crop on the same site for more than one year. Frequently, just by planting a susceptible crop a few feet from where it was grown the previous year, you can avoid damage from disease-producing organisms (pathogens), particularly nematodes. Also, if space is available, the entire garden site may be moved to a new location after two or three years. When you move the garden site, select a new site that has been covered by grass for several years.

Be sure to consider succession planting (multiple cropping) in the rotational scheme. For example, if a short-season vegetable that is susceptible to root-knot nematodes is grown in one area of the garden, you can often produce a fall crop (such as a resistant variety of tomato or sweet corn) in the same soil without a yield loss. Plan a rotational program by dividing the garden site into thirds. With this scheme, it is easier to consider all factors that affect plant growth, such as shade, fertilization, water, and time of harvest.

Resistant Varieties

Planting resistant varieties is a very economical way of controlling vegetable diseases. Use resistant varieties in areas where diseases are present or where the soil is known to be infested with disease-causing organisms. Home gardeners can often use the disease-resistant varieties that commercial growers avoid because of handling and marketing considerations, such as fruit size, shape, color, and storage characteristics. (For example, Venus and Saturn

North Carolina Cooperative Extension Service
NORTH CAROLINA STATE UNIVERSITY
COLLEGE OF AGRICULTURE & LIFE SCIENCES

tomatoes are resistant to southern bacterial wilt, but the fruit is too small for commercial use.) You may need to use rotation and chemicals to control diseases to which the selected variety is not resistant.

Disease-Free Seed and Transplants

Using disease-free planting stock is a must because many important vegetable diseases, particularly bacterial diseases, are caused by pathogens that are seed borne or brought into the garden site on infected transplants. Do not save seed from gardens where diseases are prevalent. However, if you prefer to save seed of your favorite vegetable variety (for example, beans), select seed only from healthy, nonhybrid plants. Purchase seed from a reputable dealer because external appearances normally do not reveal whether the seed is contaminated with disease-causing organisms. People in certain geographical areas are able to produce disease-free seed because of climatic conditions. For example, western-grown bean seed are usually free of pathogens because of the arid climate in which they are produced. Request seed from such regions. Likewise, if you are starting your crop from transplants, insist on disease-free transplants. If a plant is infected at an early age, the disease will only get worse and the plant will not perform as expected. A good disease-control program is based on prevention, not cure.

Sanitation

Sanitary practices are very important in helping to prevent or control plant diseases. Many disease-causing organisms survive the winter in plant debris, cull piles, compost piles, or plant stubble that remains in the garden site. Any practice that eliminates these overwintering sites for fungi, bacteria, viruses, and nematodes reduces the occurrence of disease problems the following year. Some disease-producing organisms can also survive the off-season on contaminated equipment or containers. Equipment that has been used in disease-infested vegetable gardens and containers that have been used to harvest diseased vegetables should be disinfected before being used in vegetable gardens. Also, as soon as harvest is complete, remove the remaining plant residue from the garden site and expose the roots to the sun and wind to kill the pathogens, particularly nematodes.

Solarization

Once the soil has been prepared and is ready for planting, place a clear sheet of plastic over the site, burying the edges in the soil. Over the course of several warm, sunny days, temperatures under the plastic will rise to over 125°F, killing many soil-home pests including plant pathogens, nematodes, insects, and weeds. However, these pests may not be affected if they are more than 4 inches below the soil surface. It normally takes four to six weeks of very sunny weather to eliminate disease-causing organisms at greater depths.

Solarization also works well for preparing soil to use in producing transplants. In this case, put the soil in a sealed plastic bag and place it on the driveway, walkway, or similar location so that the bag can remain in bright sunshine for a period of several weeks. Solarization probably works best for fall-planted vegetables because the optimum time to use this technique in North Carolina is during June, July, or August.

Seed Treatment

Seed is usually treated by the seed producer or seller; if you purchase untreated seed, treat it with a proper fungicide before you plant it. Properly treated seed will produce a better stand than untreated seed and will normally produce more vigorous plants that are better able to resist attack by weak pathogens.

Thiram and captan are good fungicides to use on most vegetable seed. However, be sure to check the label to determine if the vegetable that you want to treat is listed. Treat only those vegetables listed on the label. Treat seed by placing the desired amount of fungicide in the seed container and shaking vigorously. A small jar or can with a lid attached also works well.

Proper Nutrition

Proper fertilization helps to control several diseases, such as tomato blossom-end rot and potato scab. Always have the soil in the garden site analyzed and apply fertilizer and lime according to the directions of the North Carolina Department of Agriculture (Agronomic Division). The NCDA also assays the soil for nematodes and suggests whether or not it is necessary to treat for nematodes. (There is a small fee for the latter service.) Your county Cooperative Extension agent can supply the necessary forms, containers, and address to ensure that your soil samples are handled properly.

Also be aware of the organic-matter content of the soil in the garden site and maintain it at as high a level as possible. This helps to control some diseases and to maintain a uniform water supply, which is very important in obtaining good yields from vegetable plants. Ideally, a vegetable plant should not suffer from any stress during its life.

Time of Planting

Planting vegetables at the proper time of year helps reduce losses from several pests. Damping-off is less of a problem if the seed are planted in soil within the desirable temperature range for a particular vegetable.

For example, garden peas and potatoes may be planted in relatively cool soil, whereas squash, beans, or cucumbers must be planted in fairly warm soil. Quite often, vegetables planted in the spring do not become as heavily in-

fected with pathogens as those planted in the fall, particularly for second plantings of the same vegetable or same variety. Thus, many growers produce most of their vegetables in the spring and do not try to produce a fall crop because of the pest pressure.

Chemical Control

Many growers prefer to produce their vegetables without the use of pesticides. However, even if you follow the above practices, you may still find that you want to use fungicides and nematicides in the garden to prevent diseases and to obtain the maximum yield of blemish-free fruit. For a detailed discussion on control of root-knot nematodes in home vegetable gardens, see Cooperative Extension Service publication AG-420, *Control of Root-Knot Nematodes in the Home Vegetable Garden* (available from your county Cooperative Extension Center).

Table 1 lists some of the more important diseases of vegetables widely grown in North Carolina gardens and provides suggestions on how to reduce losses from these diseases. Always be sure to read and follow all label directions on the pesticide container and use the chemical only on the vegetables listed on the label. The labeling of a pesticide can change without notice. It is your responsibility to be sure the chemical is labeled for use on the vegetable before you apply it to that crop.

Chlorothalonil, the common name for Bravo or Evade, is available in several formulations (both liquid and dry) and is suggested in the table as the choice to control several diseases on many vegetables. In the table, chlorothalonil refers to a formulation containing 40.4 percent active ingredient (Evade). Thus, if another formulation is used, the rates must be adjusted accordingly. For example, if a formulation such as Bravo W-75 (75 percent wettable powder) is used, follow the rates listed on the label. Generally, it is accepted that if the rate is 1 pound per acre, a tablespoonful per gallon is a reasonable alternative.

Also, it is best to use a fungicide in a preventive program. Most will not perform satisfactorily if they are applied after the disease has reached damaging levels.

Copper, available in several formulations, is labeled for use on several vegetables and is an excellent bactericide as well as a good fungicide. You may want to consider the use of this material, even if you are an organic gardener, because it is approved by several organizations that are strong proponents of organic farming.

Table 1. Disease Control in Home Vegetable Gardens

Crop	Disease	Control
Asparagus	Rust	Plant a resistant variety such as Mary Washington.
	Crown rot	Plant in a well-drained site.
Bean (snap, pole, and lima)	Bacterial blights	Use disease-free seed. Do not save your own seed.
	Damping-off Root rot	Use seed treated with a fungicide. Grow beans on a ridge to get good air movement. Reseed if necessary. Use soil solarization.
	Rust	Spray with chlorothalonil (1 1/2 to 3 tablespoons)[1] during early bloom stage or when disease first threatens and repeat weekly. Do not apply within 7 days of harvest.
Cabbage, Cauliflower, and Broccoli	Black rot Black leg	Use western-grown, hot-water-treated seed and healthy plants. Use a two-year rotation.
	Downy mildew Altemaria leafspot	Spray with chlorothalonil (1 2/3 tablespoons) beginning when plants are set in the field, or when conditions favor disease development. Repeat at 7- to 10-day intervals.
	Club root Wirestem	Use 1 pound of hydrated lime per 33 square feet. Use PCNB (Terraclor 75 WP) in the plant water. Apply a solution containing 1.5 pounds of Terraclor 75 WP in 25 gallons of water at the rate of 3/4 pint per plant.
	Cabbage yellows	Plant resistant varieties.

[1] The rate given for chlorothalonil is to be mixed in 2.5 gallons of water, which should be applied to 1,000 square feet (based on 40.4% active ingredient = 0.52 pound per pint). The crops listed and rates given were labeled as of October, 1991.

Crop	Disease	Control
Cucumber	Angular leafspot	Plant certified seed; plant treated seed; rotate crops.
	Bacterial wilt	Use approved insecticide or other means to control the cucumber beetles.
	Anthracnose Downy mildew	Plant resistant variety. Spray with chlorothalonil (1 2/3 to 2 tablespoons) when plants are in first true leaf stage or when conditions are favorable for disease development. Repeat *applications at 7-day intervals.*
	Powdery mildew Scab	Plant resistant variety. Spray with chlorothalonil as above except use 2 to 3 tablespoons.
	Fruit rots	Grow the cucumbers on a trellis using cucumber-mosaic-resistant variety. Spray with chlorothalonil (9 tablespoons in sufficient water to obtain runoff). Make a single application when vines begin to run. (Use Bravo for these diseases only if a trellis is not used.)
Cantaloupe, Squash, Muskmelon, Honeydew melon, Watermelon, Squash, Pumpkin	Anthracnose Downy mildew Cercospora leafspot Gummy stem blight Leaf blight Scab Powdery mildew	Spray with chlorothalonil (1 2/3 to 3 tablespoons) beginning when plants are in the first true leaf stage or when conditions are favorable for disease development. Repeat applications at 7-day intervals.
Pepper	Damping-off (Plant bed)	Locate plant bed in sunny, well-drained area. Produce plants in sterilized soil. To get sterile soil, purchase sterile potting soil or bake soil in the oven until a medium-sized potato placed in the middle of the soil is done; or have a licensed pesticide applicator treat the soil with methyl bromide or Vapam or use solarization. If damping-off becomes a problem, drench with captan (50 WP) at the rate of approximately 2 tablespoons per gallon of water applied to 100 square feet at first appearance of disease and repeat if necessary.
	Bacterial leafspot	Spray with copper (2 to 3 tablespoons per gallon of water) at first *appearance of disease. Repeat every 7 to 10 days.*
Potato	Early blight Late blight and other leaf diseases	Spray with chlorothalonil (1 to 1 1/2 tablespoons). Begin applications when plants are 6 to 8 inches high or when diseases first appear. Continue at 7- to 10-day intervals or as needed to maintain control.
	Seed-piece decay	Warm potatoes to 55°F before cutting; after cutting, keep potatoes at 55°F and high relative humidity (95 percent) for 3 to 5 days to aid the healing process, but do not let water condense on the potatoes; dust with maneb or captan before planting.
	Scab	Do not grow potatoes in soil that has been limed too heavily. (A pH of 5.2 to 5.5 is preferred.)
	Virus diseases	*Plant only certified seed.*
Sweet corn	Bacterial wilt (Stewart's disease)	Plant resistant varieties. Spray susceptible varieties with a labeled insecticide to control flea beetles.
	Southern corn leaf blight and other leaf diseases	Plant resistant varieties.
	Smut	Plant resistant varieties; grow corn in full sun; use only recommended amount of nitrogen.
Sweetpotato	Black rot Scurf	Use only disease-free roots for plant production; use cut plants; produce cuttings in pathogen-free soil.
	Storage rots	Do not expose sweetpotatoes to temperatures below 55°F. Cure roots immediately after digging for one week at 85°F and high humidity. Never place sweetpotatoes in airtight bag or container.

Crop	Disease	Control
Tomato	Bacterial leafspot	Use disease-free transplants. Spray with copper fungicide (2 to 4 tablespoons per gallon of water) at first appearance of disease and repeat at 7- to 10-day intervals.
	Damping-off (Plant bed)	Same as pepper.
	Early blight Late blight Grey leafspot Septoria leafspot Leaf mold	Rotate; use disease-free transplants; follow good sanitation practices; spray with chlorothalonil (1 1/2 to 2 1/2 tablespoons) when disease first appears and repeat every 7 to 10 days.
	Southern bacterial wilt	Plant resistant variety, either Venus or Saturn. Follow a long rotation (three years or more).
	Verticillium wilt Fusarium wilt	Plant resistant variety (many are available). VFN used in the name means that a variety is resistant to Verticillium wilt (V), Fusarium wilt (F), and root-knot nematodes (N). Varieties are available with resistance to one or more of these diseases.
	Tobacco mosaic	Only preventive measures are effective. Do not use tobacco products (or, if you do, wash hands with a strong soap after you use tobacco) before handling plants or foliage.
Other Vegetables	Virus diseases	Plant resistant varieties whenever possible. Many viruses that affect vegetables are present in weeds and are carried from the weed host to vegetable plants by insects, particularly aphids and leafhoppers. Controlling insects and removing weeds will decrease the threat of virus infection. Use virus-free plants.
	Damping-off (Plant beds)	Locate the plant bed in a well-drained site in full sun. Use sterilized soil (see pepper). Use only disease-free seed. Plant at proper time. Use solarization.

Ornamentals Disease Information Notes

- ODIN-002 Rose Diseases and Their Control in the Home Garden
- ODIN-003 Some Common Pecan Diseases and Their Control in North Carolina
- ODIN-004 Powdery Mildew of Ornamentals and Shade Trees
- ODIN-005 Nematodes and Their Control on Woody Ornamentals in the Nursery
- ODIN-006 Pine Wood Nematode
- ODIN-007 Holly Diseases and Their Control in the Landscape
- ODIN-008 Slime Flux / Wet Wood
- ODIN-009 Southern Bacterial Wilt on Marigolds
- ODIN-010 Scorch Diseases on Shade Trees
- ODIN-011 Entomosporium Leaf Spot on Red Tip
- ODIN-012 Rhododendron Diseases
- ODIN-013 Phytophthora Root Rot and Its Control on Established Woody Ornamentals
- ODIN-014 Damping-off in Seed Beds - Flower and Vegetable Seedlings
- ODIN-015 Juniper Diseases and Their Control in the Landscape
- ODIN-016 Azalea Diseases and Their Control
- ODIN-017 Diseases of Leyland Cypress
- ODIN-018 Dutch Elm Disease
- ODIN-019 Some Common Pine Diseases in North Carolina Landscapes and Their Control
- ODIN-021 Common Diseases and Disorders with the Gold-Dust Plant, *Aucuba japonica*
- ODIN-023 Dogwood Diseases
- ODIN-030 Root and Butt Rots of Oaks
- ODIN-031 Nematode Management in Bedding Plants in the Landscape
- NEMA-063 Nematodes and Their Control in Woody Ornamentals in the Landscape

Move directly to:

- Plant Disease Information Notes Home Page
- North Carolina Insect Notes

This web page last modified February 2002 by Tom Creswell

NC State University
A&T State University
COOPERATIVE EXTENSION
Empowering People · Providing Solutions

North Carolina State University and North Carolina A&T State University commit themselves to positive action to secure equal opportunity regardless of race, color, creed, national origin, religion, sex, age, veteran status, or disability. In addition, the two Universities welcome all persons without regard to sexual orientation. North Carolina State University, North Carolina A&T State University, U.S. Department of Agriculture, and local governments cooperating.