

Study Manual for Private Applicator Certification
Vegetable Grower



State of Connecticut
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Preface

Any person who uses restricted-use pesticides must be licensed in order to be able to purchase such products. Licensing is not required if only general-use pesticides are used, with the exception of commercial applications.

Any person who sprays another's property in exchange for money must possess a commercial applicator's license. However, individuals that are licensed as a private applicator can spray another's property in exchange for services. (ie; he might trade a spray job in the spring for help with harvest in the fall)

A farmer wishing to use restricted-use pesticides would apply for a "private applicator's license." The private applicator may then buy and apply restricted-use pesticides on their own farm, property they rent or on the farms of others, provided that they do not get paid to do so.

It is not necessary for the licensed private applicator to actually perform all pesticide applications. An employee or family member can apply pesticides, however, the license holder is responsible for training the person who actually does the work, and must be available if needed.

Private applicators are required to maintain records with respect to each use of restricted-use pesticide and must file a report of their usage on or before January thirty-first each year for the previous year's applications.

This booklet was prepared as a study guide for those individuals seeking certification as private applicators in Connecticut. It contains brief descriptions of the major pests of each crop, their life cycles and the damage they cause to the host plants.

As a minimum requirement for certification, a private applicator must show that they possess a practical knowledge of laws pertaining to pesticide applications and the pest problems associated with their farming operation. This practical knowledge includes ability to recognize common pests and damage caused by them. Recognition is critical because it is the first step in control. The private applicator must be able to recognize the pest problem before they select among the available pesticides.

This booklet is not to be considered a complete source of information. Information on integrated pest management (IPM) and suggested spray schedules may be obtained from the Connecticut Cooperative Extension Service.

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General Insect Pests

Aphids

Description

Aphids are small soft-bodied sucking insects that usually feed in groups on stems or on the undersides of leaves. They may vary from yellow to pink or reddish-brown in color. The nymphs are smaller, but otherwise resemble the adults. Adults may be either winged or wingless.

Life Cycle

Most aphids found in Connecticut pass the winter in the egg stage on the leaves and stems of old plants remaining in the field; species not capable of surviving the winter migrate annually from the south. Some over-winter on plants in greenhouses.

In the spring, wingless nymphs hatch from over-wintering eggs. These are all females and reproduce without mating. After a succession of generations, a number of winged females develop, which may fly to other plants and produce a number of winged generations.

A generation of males and females appears in September and October. These mate and lay over-wintering eggs.

Damage

Both nymphs and adults suck the sap from the plant causing discoloration and curling of the leaves. Severe damage may cause stunting or death of the plant. Aphids excrete a clear, sweetish liquid known as "honeydew" which may collect in quantities on the stems, fruits and leaves. A black sooty fungus often develops on the honeydew. Aphids are also important carriers of viruses that injure plants.

Control

Begin treatments when aphids appear and repeat as necessary. Direct the pesticide to the undersides of the leaves.

Cutworms

Description

Cutworms are stout, soft-bodied caterpillars which grow to a length of 1 1/4 inches. They are dull gray, brown or black in color and may be striped or spotted. They curl up tightly when disturbed. The adults are dull gray or brownish-yellow moths.

Life Cycle

Most cutworms pass the winter as larvae hidden in soil, under trash, or in clumps of grass. They resume feeding in the spring and grow until early summer. The mature

larvae pupate beneath the soil surface and later emerge as moths. The females then lay eggs for another generation.

Damage

Cutworms cause severe damage by cutting off new plants at or below ground level. Some cutworms feed on leaves; buds or fruits and others feed on the underground portions of plants.

Control

Treatment should begin two or three days before the plants are set or before seedlings emerge or when damage occurs.

Wireworms

Description

Wireworms are hard bodied, yellow or brown larvae that grow to a length of 1 inch. The adults are elongated click beetles.

Life Cycle

Adult beetles appear in early spring and deposit their eggs in moist soil. The larvae hatch and feed on plant roots and other underground portions for one to six seasons, depending upon the species. The larvae mature in mid-summer and transform into pupae near the soil surface. In three weeks to one month the pupae change into adult beetles.

Damage

Typical wireworm injury consists of the destruction of planted seed or in a sudden withering of plants when they are from six to eighteen inches high. Almost all types of vegetables and grains may be severely damaged, particularly when plantings are made following sod. Larvae eat small roots, burrow into tubers and fleshy roots, and destroy germinating seeds.

Control

After plowing, broadcast insecticide evenly and mix with the upper six inches of soil by thorough harrowing. One treatment should last for three to four years.

Beans

Mexican Bean Beetle (*Epilachna varivestis*)

Description

The Mexican bean beetle is a lady beetle that is about 1/4 inch long, pale yellow to coppery-brown in color with 16 black spots on its wing covers. The larvae are yellow with 6 rows of spines on their backs.

Life Cycle

Adults over-winter in sheltered places, first appearing on bean plants during late May. The larvae feed almost entirely on the undersurface of the bean leaves, and pupate there when they have completed their growth. The second batch of adults emerges in late July and deposit eggs for the next generation. These mature in September and go into hibernation in the fall.

Damage

This is the most destructive of all insects feeding on beans in Connecticut. The larvae and adults feed on the undersurface of bean foliage and leave only the lace-like structure of the leaf veins.

Control

Control measures should begin when injury or first young are noticed. Repeat treatment 7 to 10 days if necessary and again in August for a second brood.

Potato Leafhopper (*Empoasca fabae*)

Description

Adult leafhoppers are pale green, wedge shaped, sucking insects that are about 1/8 inch long. They are usually found on the undersides of the leaves. Leafhoppers may be present as winged adults or as wingless nymphs.

Life Cycle

Potato leafhoppers have not been found over-wintering in the north. The adults migrate to the northern states from areas of milder climate. Large numbers of flying adults often appear suddenly in fields as soon as the plants come up. After mating, eggs are deposited in the main veins, on the undersides of the leaves. There are several generations each year.

Damage

Adults and nymphs suck the sap from leaves and stems. When feeding, the leafhoppers inject a poison into the leaf tissues that cause them to turn yellowish-green and curl upwards. This is known as "hopperburn."

Control

Treatment should begin when the insects are first noticed. Repeat applications in 7 to 10 days if necessary.

Two-Spotted Mite (*Tetranychus urticae*)

Description

The adult two-spotted mite can usually be recognized by the prominent dark spots on its back. These mites tend to be lighter in color and have a more greenish appearance than the European red mite. In severe infestations there may be a network of webs on the undersides of the leaves.

Life Cycle

Two-spotted mites over-winter in the adult stage, and hibernate near their host plants. They emerge in the spring and lay eggs on the undersides of the leaves. The eggs hatch and give rise to six-legged larvae, which feed and molt several times before developing into the eight-legged adult form. There are numerous overlapping generations a year.

Damage

Two-spotted mites feed on a variety of plants, both wild and cultivated. Mites establish themselves on the lower leaf surface, puncture the epidermis and feed on sap and chlorophyll. The infested leaves have a sickly appearance, with yellow or reddish-brown blotches. Injury is the most severe in hot dry weather.

Control

Treatment should begin when injury is first noticed. Pesticide application should be repeated in 5 to 7 days. Be sure to treat the undersides of the leaves.

Broccoli, Cabbage, Cauliflower

Cabbage Root Maggot (*Hylemya brassicae*)

Description

The adult cabbage root maggot is a small gray fly, closely resembling the common housefly. The larvae are shiny white maggots that are about 1/3 inch long when mature.

Life Cycle

The insect over-winters as a pupa in the soil. The flies emerge about the middle of May and deposit eggs on the plant stems or in the soil cracks near the host plants. After hatching, the maggots tunnel in the stem or in the roots. The flies emerge late in the season to produce another brood or two of root maggots.

Damage

This insect infests the stems of early-set cabbage and cauliflower plants. The maggots feed on the roots and stems below ground. Infested plants may be stunted or wilt on hot days. Plants that have died recently from maggot injury usually show either mature maggots or brownish cocoons which are the pupal stage of the maggot.

Control

Pre-treat the soil before transplanting, dip transplants before planting or drench transplant on the day of planting.

Cabbage Looper (*Trichoplusia ni*)

Description

The cabbage looper is a pale green caterpillar marked with a conspicuous white line down the side of the body. It crawls about with a peculiar looping motion like an inchworm. The adult is a dark brown moth with a figure eight on the forewing.

Life Cycle

The pupae over-winter in the ground. In the spring the moths emerge, mate and lay their eggs on the lower surfaces of the cabbage leaves. Newly hatched loopers usually feed on the underside of plant leaves. As the caterpillars become larger, they move nearer to the center of the plant. Adults appear again during the summer. There are three generations a year.

Damage

Newly hatched cabbage loopers usually eat out small areas on the underside of plant leaves. As caterpillars become larger, they move nearer to the center of the plant and eat entirely through the leaves between the veins, or feed inward from the edges of the leaves.

Control

Treat regularly at 7 to 10 day intervals to prevent infestation. During heavy infestations shorten the interval to 5 days. Begin treating in May or June soon after setting plants.

Imported Cabbageworm (*Pieris rapae*)

Description

The cabbageworm is velvety green in color, covered with close-set hairs and about 1 inch long when mature.

The butterfly has a wingspread of about 1 3/4 inches and is white with 3 or 4 black spots on the wings.

Life Cycle

The winter is passed as a pupa. Each female lays several hundred eggs, usually on the undersides of cabbage leaves. The eggs hatch in about one week and the larvae feed on the leaves and heads until mature. Pupation occurs under leaves or in any sheltered location.

Damage

Young larvae feed at first on the undersides of the leaves. Later they move about freely on the plant and eat out large ragged holes in smaller leaves and often burrow into the head itself.

Control

(See Cabbage Looper)

Cabbage Aphid (*Brevicoryne brassicae*)

Description

The cabbage aphid is distinguished from other species by a powdery, waxy covering over its body. It is grayish-green in color.

Life Cycle

This aphid feed primarily on cabbage, cauliflower, broccoli and other cole crops. Over-wintering eggs are usually laid on the residue of host crops that have been left in the field.

Damage and Control

(See General Insect Pests - Aphids)

Carrots

Six-spotted Leafhopper (*Macrostelus fascifrons*)

Description

Adult leafhoppers are about 1/8 inch long, pale greenish-yellow, wedge shaped insects with six black spots on the hind wings. Nymphs, when first hatched, are light yellow with reddish eyes.

Life Cycle

Eggs over-winter on perennial weeds and flowers, such as dandelion and chrysanthemum. Nymphs emerge in early spring and molt five times before becoming adults. There are numerous overlapping generations annually.

Damage

The adults and nymphs feed mainly on the undersides of the leaves, sucking the plant sap. The most serious feeding effect of this pest is the transmission of aster yellows virus from infested plantbeds.

Control

Treatment should begin when insects are first noticed. Repeat in 7 to 10 days if necessary. Be sure to get coverage on the undersides of the leaves.

Rust Fly Maggot (*Psila rosae*)

Description

Rust fly larvae are slender, straw-colored maggots that are about 1/3 inch in length. The adult is a small shiny dark green fly with a yellowish head and red eyes.

Life Cycle

The rust fly over-winters as a pupa in the soil. The adults emerge about mid-May and deposit their eggs in crevices in the ground close to the base of the plants. After

hatching, the young maggots feed on the smaller roots and then begin attacking the main root. The pupal stage is passed in the soil near the roots. A second generation of flies emerges in July with a partial third generation in September.

Damage

The larvae burrow through the roots in all directions, leaving channels that acquire a rusty color. Carrots, parsnips and celery are subject to attack.

Control

A drench treatment will control first brood maggots only. To avoid second brood maggot injury, pull carrots in late August.

Cucurbits

Striped Cucumber Beetle (*Acalymma vittata*)

Description

Adult beetles are about 1/5 inch long and 1/10 inch wide. Their upper surface is equally black and yellow, and their folded wing covers form three longitudinal black stripes. Mature larvae are a whitish color, about 1/3 inch long and 1/10 inch wide.

Life Cycle

Striped cucumber beetles over-winter as adults, and become active with warm spring temperatures. When cucurbit plants appear above the ground, the beetles feed, mate and lay their eggs around the base of the plants. The eggs hatch and the larvae feed for 2 to 6 weeks on the roots and underground portions of the stem. There is only one generation annually.

Damage

This is the most destructive insect pest of cucumbers. The larvae injure the vines during the summer by devouring the roots and tunneling through the underground portions of the stems. The beetles feed on foliage, shoots, blossoms and the fruits. The adults also carry the bacterial wilt of cucurbits and have been implicated as carriers of cucumber mosaic.

Control

If necessary, begin treatments as plants emerge. Apply weekly or more often if needed. Repeat treatment after rains. Make treatments late in the afternoon to avoid injury to bees and set.

Spotted Cucumber Beetle (*Diabrotica undecimpunctata howardi*)

Description

Adults are yellowish-green beetles about 1/4 inch long with conspicuous black spots on their wing covers. The yellow-white larvae have a brownish head and six small legs and may vary in length from 1/2 to 3/4 inch when mature.

Life Cycle

The insect over-winters as an adult, becoming active with warm temperatures. Females deposit eggs in the ground around the bases of plants. Newly hatched larvae bore into roots and underground parts of the stems. When mature, the larvae pupate in the soil. There is only one generation annually.

Damage and Control
(See Striped Cucumber Beetle)

Melon Aphid (*Aphis gossypii*)

Description

Adult melon aphids range from pale yellow to greenish-black in color.

Life Cycle

Melon aphids over-winter as eggs on catalpa and Rose-of-sharon. This aphid infests many different kinds of plants both in the field and in greenhouses, but is particularly troublesome on cucurbits. It usually occurs in large numbers in the field in the late summer.

Damage and Control
(See General Insect Pests - Aphids)

Squash Vine Borer (*Milittia cucurbitae*)

Description

The adult moth has a wingspread of 1 to 1 1/2 inches. The wings are a metallic olive-brown, and the abdomen is ringed with red, black and copper. Mature grubs are white, brown-headed caterpillars which grow to a length of 1 inch.

Life Cycle

The insect over-winters as a larva in the soil. The adults lay their eggs on the plants in late June and July, and the larvae enter the stems where they live as borers. When mature, they leave the plant and descend into the soil. There is one generation a year.

Damage

The primary hosts of the squash vine borer are late summer and fall varieties of squash. Injury is first evident by the sudden wilting of a long runner or the entire plant. On examination, the vine will be found to be hollow and partly filled with moist, shiny frass. The presence of the larvae is often indicated by the frass pushed out from the stem.

Control

Start treatment during the first week of July. Repeat weekly for 3 or 4 applications. Treat stems thoroughly within four feet of the roots.

Eggplant

Potato Flea Beetle (*Epitrix cucumeris*)

Description

The potato flea beetle is a small, black beetle that is about 1/16 to 1/12 inch long. Mature larvae are about 1/5 inch long with a brown head and a yellowish-brown shield behind the head.

Life Cycle

The adults pass the winter under rubbish and in other sheltered places. In the spring they emerge and lay eggs in the soil. In 3 to 4 weeks the larvae mature and the adults appear in July.

Damage

Adult beetles eat small holes in the foliage, giving it a shot hole appearance. These beetles carry the organisms of some virus diseases.

Control

Begin treatments soon after setting out to prevent a second brood. Repeat treatment in 5 to 7 days.

Potato Aphid (*Macrosiphum euphorbiae*)

Description

The potato aphid is about 1/8 inch long. It occurs as both a pink and green form.

Life Cycle

This aphid over-winters outdoors in the egg stage on roses and related plants. Indoors it over-winters in greenhouses. In the spring and early summer winged aphids fly from the roses to potatoes or eggplants.

Damage and Control

(See General Insect Pests - Aphids)

Lettuce

Six-spotted Leafhopper (*Macrosteles fascifrons*)

Description and Life Cycle

(See Carrots)

Damage

Leafhoppers are capable of spreading a virus disease called yellows from infected weeds to the crop.

Control

After June 1 treat weekly, beginning in each planting as seedlings appear. In addition, dust or spray the borders of the field. Plow under old plantings immediately after harvest.

Peas

Pea Aphid (*Macrosiphum pisi*)

Description

This is a green, long-legged aphid that is about 3/16 of an inch long.

Life Cycle

The pea aphid lays its eggs primarily on alfalfa, peas, beans, clover and other legumes.

Damage and Control

(See General Insect Pests - Aphids)

Pepper

Green Peach Aphid (*Myzus persicae*)

Description

The green peach aphid is about 1/16 of an inch in length. Both wingless and winged forms are yellowish-green or pinkish-green in color.

Life Cycle

The green peach aphid over-winters in the egg stage on peach trees. In the spring two or three generations are produced on the trees after which most of the individuals migrate to other plants. It is known to occur on over four hundred kinds of plants.

Damage and Control

(See General Insect Pests - Aphids)

Potato Leafhopper

(See Beans)

European Corn Borer

(See Sweet Corn)

Potato Aphid
(See Eggplant)

Squash

Striped Cucumber Beetle
(See Cucurbits)

Squash Vine Borer
(See Cucurbits)

Melon Aphid
(See Cucurbits)

Sweet Corn

Corn Flea Beetle (*chaetocnema pulicaria*)

Description

These are very small black beetles, 1/16 inch in length. They jump from leaves when disturbed.

Life Cycle

Flea beetles hibernate beneath trash and leaves and migrate to their host plants in the spring when feeding begins. Eggs are laid in the soil near the roots of the plants. There are several generations a year.

Damage

Feeding marks appear as narrow pin stripes, 1/4 to 1/2 inch in length, parallel to the leaf veins. Nearly all the damage to corn is caused by the adults feeding on the leaves and disseminating wilt disease.

Control

If these beetles are a problem, start treatment when plants are in the "spike" stage. Make 3 to 4 applications at 4 to 5 day intervals, then weekly until borer sprays are begun.

European Corn Borer (*Pyrausta nubilalis*)

Description

Adult moths have a wingspread of about 1 inch and are buff to brown in color. Mature larvae are dirty white or gray in color, one inch long and marked with round black spots.

Life Cycle

Fully-grown larvae pass the winter in infested stubble and refuse. The adult moths emerge in late May or early June and lay their eggs on the undersides of the lower leaves of young corn plants. The larvae hatching from these eggs feed first on the developing tassel and later enter the ear shoots. The adult moth of this generation emerge late in July and deposit their eggs on young corn. There are usually two generations a year.

Damage

The first evidence of borer injury can be seen when corn is 12 to 18 inches high. Newly hatched borers eat pin-like holes or slightly larger irregular shaped holes in the leaves or midribs. Larger worms bore into the unfolding tassel or into its base and cause the tassel to shrivel or break over. They later bore into the stalk or ears. The most destructive injury is the feeding of borers among the rows of kernels in the ears.

Control

Control treatments are designed to kill the newly hatched larvae on the plant surfaces. To protect the plant over the egg laying period, a series of 3 to 4 treatments at 5 day intervals is normally required.

Corn Earworm (*Heliothis zea*)

Description

Mature larvae reach a length of almost two inches and vary greatly in color from a light green or pink to a tan and dark purplish brown. The head is yellow and the body is marked with longitudinal stripes. Adult moths are light to dark brown and have a wingspread of about 1 1/2 inches.

Life Cycle

Earworms are unable to survive the winter in Connecticut. Each season, moths fly in from southern over-wintering grounds and lay eggs singly or on corn silk. After hatching, the caterpillars feed upon the silk and the tip of the ear. When mature, they drop to the ground, work their way into the soil and pupate. There are two to three generations each season.

Damage

Foliage is sometimes damaged but feeding on the ears is the most serious injury.

Control

Begin treatment to individual plants when silks start to show. Make 4 to 5 applications at two, three or four day intervals.

Corn Leaf Aphid (*Aphis maidis*)

Description

Corn leaf aphids are greenish or greenish-blue in color, 1/16 of an inch long with black appendages.

Life Cycle

The adults are unable to over-winter in the north and migrate from the south during the spring and early summer.

Damage and Control

(See General Insect Pests - Aphids)

Armyworm (*Pseudaletia unioincta*)

Description

Mature larvae are greenish and have black stripes along each side and down the center of the back. They are about 1 1/2 inches long. The adults are brownish gray and their wingspan measures about 1 1/2 inches.

Life Cycle

Partially grown larvae pass the winter in the soil. They feed early in the spring, reaching maturity in early May. Pupation takes place just below the surface of the soil. In about two weeks the adults emerge, mate and lay eggs. There are three generations a year.

Damage

The larvae cause crop damage. They start feeding on vegetation early in the spring, eating leaves and immature seeds, often devouring plants down to the ground.

Control

Treatment should begin when worms appear or when damage and worms are noticed. The caterpillars may first appear in grains, grasses or weeds adjacent to corn. Watch for armyworm outbreaks following cool, retarded springs.

Fall Armyworm (*Laphygma frugiperda*)

Description

Mature larvae are 1 1/2 inches long, varying in color from light yellowish-brown to nearly black. There are three narrow yellowish stripes down the back with a broader line on each side. The moths are ash-gray in color with variably spotted forewings and white hindwings.

Life Cycle

The winter is passed as a pupa in the soil in southern Florida and the Gulf Coast area. Pupae do not survive the winters farther north. The moths do not arrive in northern parts of the country until late summer or fall. After hatching, the young caterpillars feed in groups by day near the ground. It takes about a month for the larvae to mature. Pupation occurs in the soil. There are two generations a year.

Damage

The young larvae feed on the lower leaf surfaces, skeletonizing the leaves. After the plant has tasseled and the ears have begun to form, the larvae feed principally on the tips of the ears and cut off the silk. Heavy infestations will strip plants.

Control
(See Armyworm)

Tomato

Tobacco Hornworm (*Protoparce Sexta*)

Description

The adult moths have a wingspan of up to four inches. They are gray or brownish with white and dark mottlings. The closely related tomato hornworm, *Protoparce quinquemaculata*, has five sets of orange marks on the abdomen, whereas the tobacco hornworm has six sets of similar markings. The green larvae are three to four inches long when mature and have diagonal white stripes on the sides of their bodies. The tobacco hornworm has a red horn projecting over the tip of the abdomen, whereas the tomato hornworm has a similar black horn.

Life Cycle

The winter is passed as a pupa in the soil. Adult moths emerge during May and June and lay eggs. The larvae feed for about four weeks and when mature burrow into the soil to pupate. There is probably only one generation per year.

Damage

These two caterpillars cause identical injury; both devour the leaves of pepper, tobacco and tomato. Because of their large size and voracious appetite, they are able to eat a great quantity of leaves and may defoliate the plant.

Control

Begin treatments where larvae are found.

Tomato Fruitworm (*Heliothis zea*)

Description, Life Cycle and Control
(See Corn Earworm)

Damage

The tomato fruitworm, known as the corn earworm when it attacks corn, occasionally feeds on the fruit of the tomato. The caterpillars are restless and frequently move from fruit to fruit, thus damaging many while not consuming a single one.

Stalk Borer (*Papaipema nebris*)

Description

Larvae are dark brown, ranging from 3/4 inch to nearly 2 inches in length. All but the largest of these worms have a single continuous white stripe down the back, with broken white stripes on the sides and interrupted by a dark area on the fore part of the abdomen.

Life Cycle

The insect passes the winter in the egg stage on grasses and weeds. After hatching in the spring, the borers feed on the grasses and weeds and later migrate to adjacent tomato fields particularly when the weeds are mowed. The caterpillars are very active. Their restless habit of frequently changing from one plant stem to another increases the damage.

Damage

The stalks of the plants attacked will show irregular rows of holes through the unfolding leaves. Plants will often show unnatural growth, twisting or bending over, presenting a stunted appearance. Holes will be found in the sides of the stalks with moist castings thrown out. Most of the injury tends to be along the margins of the fields.

Control

A thorough cleanup of weeds bordering the fields will help eliminate over-wintering eggs.

Potato Flea Beetle

(See Eggplant)

Potato Aphid

(See Eggplant)

Green Peach Aphid

(See Pepper)

General Diseases

Damping-off or Seed Decay

Symptoms

Damping-off is a seedling disease which rots away the roots and base of the stem causing the small plant to fall over and die. This disease is caused by a number of different fungi which live in the soil. Seedlings of almost any crop are subject to attack.

Life Cycle

There are a half dozen or more fungal parasites that cause damping-off which are found in the soil. They usually grow very near the surface and enter the plant at the point where the seedling emerges from the ground. High moisture in the soil and air is required for quick growth.

Control

If healthy transplants are to be grown, damping-off fungi must be controlled. Field soil used in flats or seedbeds should be treated with steam or chemicals before planting.

Powdery Mildew

Symptoms

Powdery mildew appears as grayish white, often powdery masses of mold growing on the surface of leaves, stems and pod type fruits. Leaves become yellow, distorted, and often drop prematurely. Pods may become malformed.

Life Cycle

The fungus over-winters on plant debris in specialized spore bearing structures. Spore growth is favored by high temperature and the absence of washing rains.

Control

Begin treatment as soon as mildew appears.

Beans

Anthracnose (*Colletotrichum lindemuthianum*)

Symptoms

This disease appears on the leaves as reddish-brown discoloration of the veins, particularly on the undersides of the leaves. The main damage is to the pods, where blackish-brown spots appear. During moist weather these spots may have a pinkish ooze at their centers and borders of red.

Life Cycle

The fungus over-winters in the bean seed, in diseased material left in the field, or in bean straw. It cannot survive in the soil when separated from the bean plant or seed. The presence of water is necessary to free the spores so that they can be disseminated to healthy plants.

Control

Plowing under diseased bean refuse, practicing three year rotations, using well drained soil, and planting healthy seeds helps to reduce the severity of anthracnose.

Bacterial Blight (*Xanthomonas phaseoli*)

Symptoms

Large brown blotches, often bordered by a yellow or reddish halo, are distinctive symptoms on the leaf. The whole leaf may later die, and defoliation of the plant takes place. The second symptom is caused by a girdling of the stem at one of the lower joints, so that the whole plant wilts or falls over. On the pods, the blight causes rather indefinite, water soaked spots, usually with reddish margins.

Life Cycle

The bacteria over-winter in the seeds or in the plant refuse. Infection takes place when bacteria splash to the first true leaves, enter the stomata or wounds, and migrate to other parts of the host. Water is required for the spread of the disease.

Control

Use certified seed from disease free areas. Use a three-year rotation. Do not cultivate or harvest when plants are wet.

Downy Mildew

Symptoms

The most conspicuous symptom of downy mildew is the white downy mold found on the bean pod. The fungus grows through the bean pod wall into the bean. The whole structure finally dries and becomes black. The fungus also attacks young shoots, flowers and leaves.

Life Cycle

Much of the early infection comes from diseased seed. Spores formed on the stems and leaves of diseased plants are transported by insects to healthy plants. The wind is also an important factor in dissemination as are flowing water and splashing rain.

Control

Apply material at the first sign of infection.

Mosaic of Beans (*Marmor phaseoli*)

Symptoms

Bean leaves affected with mosaic virus have irregular, light yellow areas merging with dark green patches, producing the characteristic mottling or mosaic effect. The affected plant may have a sickly yellow color; nevertheless, it remains alive until the end of the season.

Life Cycle

A virus that over-winters in the bean seed causes mosaic. The virus is carried from one plant to another by sucking insects, by rubbing one leaf against another, and in any other manner that sap from one plant may be transferred to another.

Control

Use resistant varieties. Control weeds and insects, especially aphids. (See insect control - Aphids)

Broccoli, Cabbage, Cauliflower

Black Rot (*Xanthomonas campestris*)

Symptoms

Black rot causes a yellowing or browning of the foliage that shrivels and dies. Young plants may be killed outright, but in older plants the organism merely blackens and kills the veins through which it advances.

Life Cycle

The bacteria live in and on the seed or in cabbage refuse in the soil. They may live from one season to the next in seedbed soil, particularly in cold frames and hot beds. The bacteria may be spread by the blowing of leaves, by rainwater and possibly by insects.

Control

This disease is controlled by the use of clean, hot water treated seed, a plan of crop rotation, and the elimination of plant refuse.

Black-leg (*Phoma lingam*)

Symptoms

The first symptom of black-leg is a sunken area on the stem near the ground line. The area increases in size and depth until the stem is girdled. Small black dots (the fruiting bodies) develop within the lesion and bear innumerable spores.

Life Cycle

The organism may live for at least three seasons in the soil and is carried on and in the seed. When infected seed is planted, the dead seeds permit the fungus to live and fruit in the soil while the cotyledons of the viable seed push above the soil and serve as a fruiting place for the fungus.

Control

(See Control - Black Rot of Cabbage)

Clubroot (*Plasmodiophora brassicae*)

Symptoms

Plants affected with clubroot have yellowish, sickly leaves or green leaves that wilt on hot days. Young plants may die outright and older ones may fail to produce marketable heads. Roots of such plants are much enlarged and malformed.

Life Cycle

The disease is caused by a parasitic slime mold that gains entrance through root hairs and injured roots. The clubroot organism may be accidentally carried from place to place by infected soil. Farm machinery, implements or water may spread the disease.

The disease organisms are never carried in or on the seed. They are reported to be able to survive in the soil for a period of at least seven years.

Control

Use certified seeds in clean beds. Alteration of soil pH sometimes helps. Buy transplants with healthy root systems. If possible, plant on soil where there has been no clubroot in the past.

Yellows (*Fusarium conglutinans*)

Symptoms

Infected plants appear stunted, sickly and yellow. The leaves turn purple to brown, and the older leaves drop off. Scraping the lower stem will show streaks of discoloration.

Life Cycle

The fungus that causes cabbage yellows survives in the soil for many years and attacks the cabbage plants through the roots.

Control

Plant resistant varieties

Carrots

Yellows

Symptoms

Carrot yellows is a virus disease that is transmitted by leafhoppers. The tops of infected plants become yellow, stunted and twisted; the roots remain slender and have an abnormally high number of fine feeding roots.

Life Cycle

The virus is carried from season to season in adult leafhoppers.

Control

Control is best achieved by reducing the number of leafhoppers. (See General Insect Pests - Leafhopper)

Cucurbits

Anthracnose (*Colletotrichum lagenarium*)

Symptoms

This fungus produces angular black spots on the leaves and on elongated black spots with light colored centers on the petioles. The small fruits are sometimes killed, after which they turn black and drop off. The older infected fruits have dark bordered cankers with fresh colored ooze in the center.

Life Cycle

The fungus over-winters in diseased melon and cucumber refuse, as well as in and on the seed. When contaminated seed is planted or old vines are present, the fungus can be splashed to the new plants by rain. The fungus requires a fairly high temperature and an abundance of moisture for rapid growth.

Control

Keep new growth covered before rains. Make thorough applications weekly after mid-July. Sprays are more effective than dusts.

Bacterial Wilt (*Erwinia tracheiphila*)

Symptoms

Plants with this disease wilt quickly and may dry up so fast that the leaves remain green. When the stem is cut across, a sticky, white ooze may be seen.

Life Cycle

Bacteria that over-winters only in the digestive tracts of the striped and twelve-spotted cucumber beetles cause the disease. In the spring the bacteria are deposited on the cucurbit leaves in the droppings of the beetles. It enters the host tissues only through deep feeding wounds and migrates to all parts of the vine.

Control

(See Striped Cucumber Beetle)

Leaf Spot (*Macrosporium cucumerinum*)

Symptoms

Leaf spots on cucurbits at first are small, circular and somewhat water soaked. They enlarge rapidly and may be recognized by the concentric rings and a definite margin on the upper side of the leaf. When enough spots are present, the foliage dies.

Life Cycle

The fungus over-winters in old plant refuse, and during the summer is splashed by rains or carried by tools from one plant to another. It may possibly be carried in the seed, though that has not been proved.

Control

Spray every seven to ten days starting when the fruit forms.

Mosaic

Symptoms

Plants infected with this virus are stunted, have mottled leaves and produce small, light colored fruits with irregular green bumps. These fruits are called "white pickles".

Life Cycle

Mosaic is caused by a virus which is carried from plant to plant by aphids. This virus infects a great number of crops and weeds, so that the aphids usually become contaminated from infected weeds growing near the cucumber field.

Control

Grow resistant varieties.

Scab (*Cladosporium cucumerinum*)

Symptoms

This fungal disease appears as small angular dead spots on the leaves. The spots may fall out, giving a tattered appearance to the leaves. The most prominent symptom is the appearance on the fruit of discolored oozing areas which look like insect feeding punctures. These spots dry up, leaving small pits covered with olive-gray fungus.

Life Cycle

The fungus over-winters in old cucumber refuse, in the cracks about the greenhouse and on the seed.

Control

(See Cucumber Anthracnose)

Eggplant

Verticillium Wilt (*Verticillium alboatrum*)

Symptoms

The first symptom of eggplants infected with Verticillium is the wilting of leaves during the heat of the day and recovery as the day cools. Eventually these leaves wither and fall off.

Life Cycle

Verticillium is primarily a soil borne pathogen and may live in the soil for many years. It may be brought in with soil on the roots of transplants or in other ways in which soil organisms are disseminated.

Control

Use clean seed and practice four year crop rotation.

Phomopsis Blight (*Phomopsis vexans*)

Symptoms

Phomopsis blight may cause trouble at any stage in the development of the plant from damping-off of day old seedlings to the rotting of ripe fruit. The young plants blacken and die. The most serious phase of the disease is the fruit rot.

Life Cycle

The fungus over-winters in and on the seed, as well as in old diseased refuse, and can remain alive in the soil for at least three years. The spread of the disease is favored by warm wet weather.

Control

Use clean seed and practice four year crop rotation.

Lettuce

Bottom Rot (*Rhizoctonia solani*)

Symptoms

This disease rots the lower leaves of the plant but does not destroy the stem. The head will not fall over if infected with bottom rot.

Life Cycle

The fungus lives in the soil, on growing plants and on diseased plant refuse. It is very destructive when the lettuce leaves and supporting soil remain moist. Its greatest period of development is after the healthy plants have been harvested and the infected ones have been left to rot in the field.

Control

Avoid planting in wet, poorly drained locations. Use a three year rotation. Plant in raised beds. Do not bury the crown when transplanting.

Yellows

Symptoms

Lettuce yellows is known also as "white heart" because the center leaves become bleached and dwarfed. The head does not grow evenly though the plant may continue to live.

Life Cycle

This disease is transmitted by leafhoppers and is identical with the virus causing carrot yellows.

Control

After June 1, treat weekly for the leafhopper beginning in each planting as seedlings appear. In addition, dust or spray borders of fields. Plow under old plantings immediately after harvest.

Peppers

Mosaic

Symptoms

Pepper plants with mosaic have small, bumpy, off-color fruit and mottled leaves. The diseased plants are usually stunted and have smaller leaves than normal. The symptoms on the fruit may include light colored ring spots or target spots.

Life Cycle

Mosaic viruses are carried by aphids. Some of the viruses may last in crop refuse for many years and may sometimes be carried by touching a healthy plant after touching a diseased plant.

Control

To avoid mosaic on pepper, control insects; do not plant next to tomatoes, cucumbers, tobacco, alfalfa or clover; pull up and destroy plants showing symptoms.

Sweet Corn

Stewart's Wilt (*Bacterium stewartii*)

Symptoms

Corn infected with this disease is stunted and has wilted leaves on dry days. Brown streaks often appear along the leaf veins. Leaves dry up rapidly, remaining grayish-green in color even though withered. A sticky yellow ooze exudes from cut stalks. This ooze shows only after a rain or heavy dew.

Life Cycle

The bacteria enter the field on seed or in the bodies of adult corn flea beetles. Because of the importance of the flea beetle in carrying over the bacteria from one growing season to the next, the severity of the winter is one of the factors that controls the amount of Stewart's wilt.

Control

Stewart's wilt is more serious following a series of mild winters when beetles survive in large numbers. Start treatments for the beetles when plants are in the spike stage.

Tomato

Anthracnose (*Colletotrichum phomoides*)

Symptoms

In the early stages, the lesions appear as small, circular, sunken spots in the skin of the fruit as though the surface had been indented with a match-head or lead pencil eraser. These spots are fairly soft and serve as wounds for the entry of other rotting organisms which may destroy the whole fruit.

Life Cycle

The fungus lives over the winter in old diseased vines as well as on or in seed. In the seedbed and later in the fields, spots, which the casual observer would overlook entirely, occur on the foliage and stems. Even though the fungal fruiting is sparse on these infected areas, it enables the fungus to remain alive until mature tomato fruit is available.

Control

Use clean seed and practice crop rotation.

Blossom-end Rot

Symptoms

The first symptom of blossom-end rot is a slight water soaked area about the blossom end. The lesion soon darkens and enlarges in a constantly widening circle until the fruit begins to ripen. The decaying spot may be merely a speck or it may involve half or more of the tomato.

Life Cycle

The injury is not caused by any microbe. It is apparently brought about by a deficiency in calcium and water.

Control

Mulches, particularly on trellised plants, help to prevent injury. Cultivation should be very shallow. Fertilizer high in phosphate aids in reducing injury.

Early Blight (*Alternaria solani*)

Symptoms

Early blight is characterized by brown spots, with concentric rings on the leaves and black rot spots on the fruit, especially at the stem end. Infected leaves eventually turn yellow and fall off.

Life Cycle

The fungus is carried on old diseased plant refuse and will remain alive in the soil at least as long as the tomato stems are not completely rotted. It is also carried in or on the seed. This fungus grows best in wet weather and is disseminated by the splashing of rain.

Control

Plow under all diseased refuse directly after harvest.

Late Blight (*Phytophthora infestans*)

Symptoms

Leaf symptoms of late blight are irregular, dark, water-soaked areas covered on the underside by frosty white spores. Fruit infections show as peppery red-brown firm areas, usually near the stem end of the fruit. The discoloration is usually only skin deep.

Life Cycle

The fungus carries over from season to season in potato cull piles or in the compost heaps containing old tomato or potato debris. The spread of the fungus is favored by cool, wet nights and warm, humid days.

Control

Begin in mid-July and treat every seven to ten days; more often in wet weather. Keep new growth covered especially in wet weather with cool nights. Cover both sides of leaves, stem and fruit thoroughly.

Fusarium Wilt (*Fusarium lycopersici*)

Symptoms

Older leaves of diseased plants turn down and become yellow. Other leaves soon follow suit, and the whole plant may be killed. If the plant survives, it is usually stunted and the fruits are small and poor in quality. Scraping the stem near the ground reveals dark discoloration.

Life Cycle

The fusarium fungus may live in the soil for many years, reinfecting each succeeding tomato crop. The fungus invades the plant through the roots and grows up through the stem, causing internal discoloration, stunting and wilting. It occurs in greenhouses as well as in the field.

Control

No sprays protect against Fusarium wilt. It may be avoided in the greenhouse by soil pasteurization and the use of resistant varieties.

Mosaic (*Marmor tabaci*)

Symptoms

Tomato mosaic causes a yellow-green mottling on leaves and occasionally on fruit. Infected leaves are curled and slightly malformed. Plants are stunted and fruit yields are reduced. This disease is highly infectious.

Life Cycle

The mosaic virus is carried by aphids and other sucking insects, and will live in the soil for two months or possibly longer. The common tomato mosaic virus over-winters in the roots of such perennial hosts as ground cherries, horse nettle, nightshade and other related plants.

Control

Control aphids that spread the virus. Handle healthy plants first and wash hands frequently with soap and running water. Control weeds around tomato fields.

Honey Bees and Pesticides

Pesticides are the single most serious problem to beekeeping in agricultural areas. Many crops must be protected from insect pests and diseases, but they must also be pollinated. The annual value of crops in the United States that require bee pollination exceeds one billion dollars.

Honeybees frequently are in danger of being killed when crops are treated with pesticides. Bees may be poisoned when they feed on nectar or pollen contaminated with certain pesticides. They may also be poisoned if they fly through a cloud of pesticide dust or spray, or walk on the treated parts of the plant. They may be overcome by the fuming action of certain pesticides, either in the field or in the hive if the material has drifted there. Farmers and beekeepers are dependent on each other and need to cooperate fully in protecting the bees from pesticide exposure.

Observance of precautions can significantly reduce bee losses from pesticide poisoning.

Precautions for Farmers

1. Use pesticides only when needed - Do not apply a pesticide unless its benefit will outweigh any injury that it might cause to pollinators. Consider the effect the pesticide will have on the pollination of crops in the area. An application of insecticide might increase the production of the crop, but by reducing the population of insect pollinators it could seriously reduce the production of crops in adjoining fields.

2. Select the right pesticide - All pesticides are not equally toxic to bees. Some pesticides will kill an entire colony; some will seriously weaken it; others are relatively safe. Of the pesticides that are effective against harmful insects, select one that is least toxic to bees. Do not use the more toxic pesticide on flowering plants that attract bees. (See accompanying list, "Relative Toxicity of Insecticides to Honey Bees")

3. Apply granules or sprays rather than dusts - Sprays do not drift as much as dusts and, consequently, are less likely to harm bees. Granules are usually harmless to bees.

4. Time pesticide application - Do not apply pesticides when bees are working plants to be treated. Treat plants before or after flowering, at night, or at a time of day when bees are not visiting them. Bees may cluster outside the entrance of the hive on hot

nights. When this happens, pesticides drifting over the hives may kill the bees. Fumes of some pesticides can kill bees in the hive. Beekeepers should consider the normal wind directions when placing hives near fields that may be treated.

5. Notify beekeepers - Notify beekeepers in your area several days before you apply a pesticide. This will give them an opportunity to protect their colonies. However, notification is not a release of responsibility for damage.

State law requires all beekeepers in Connecticut to register their hives. A list of registered beekeepers in your area may be obtained from the Office of the State Entomologist at the Connecticut Agricultural Experiment Station, Box 1106, New Haven, CT 06504 or www.caes.state.ct.us/Bee.

Relative Toxicity of Insecticides to Honeybees

Group I - Highly Toxic: Severe losses may be expected if the following materials are used when bees are present at treatment time or within a day thereafter:

Acephate (Orthene)	Imidicloprid
Carbaryl (Sevin)	Imidan
Ciodrin	Malathion
Diazinon	Methyl Parathion
Dichlorvos	Naled (Dibrom)
Dimethoate	

Group II - Moderately Toxic: These can be used around bees if dosage, timing, and method of application are correct, but should not be applied directly to exposed bees in the field or at the hives:

Disulfoton (Disyston)
Endosulfan (Thiodan)
Fipronil
Pyrethrins
Synthetic pyrethroids

Group III - Relatively Non-Toxic: These can be used around bees with minimal injury:

Allethrin	Folpet
Bacillus thuringensis	Kelthane
Bordeau Mixture	Maneb
Captan	Paraquat
Chlorobenside	Rotenone
Copper sulfate (Monohydrated)	Sulfur
Diquat	Thiram
Dodine	2, 4-D
Ferbam	

Herbicides

Herbicides are grouped on the basis of use into selectives and non-selectives and on the basis of mode of action into contact, translocated, and sterilant chemicals.

Selective and Non-selective Herbicides

Selective herbicides are those that kill certain weeds without seriously injuring the desirable plants among which they are growing. The reasons for selectivity in some combinations of weeds and desirable plants are known; in other situations they are unknown.

Non-selective herbicides kill vegetation with little discrimination. However, certain species of plants may be physiologically resistant to the chemical or may escape through a particular growth habit. Some escapees are perennials that have part of their root system below treated layers of soil; others are annuals and shallow rooted perennials that reinfest an area after the chemical has leached below the surface layer.

Contact, Translocated and Soil Sterilant Chemicals

Contact herbicides kill the tissues that are wetted with the spray. Whether the plant dies or recovers depends on whether it has a protected growing point. Perennials usually have underground buds that will regrow.

Translocated chemicals are absorbed by the roots and move through the vascular system to leaves, buds and root tips. When absorbed by the leaves and stems the chemical is commonly moved with the food materials that were manufactured in the leaves and stems. When absorbed by the roots, it moves in the water-conducting tissue. The growth regulator type of translocated herbicide is a synthetic compound that behaves like a plant hormone. It accumulates mostly in areas of rapidly dividing cells, upsetting the normal metabolism of the plant and causing death of the cells.

A soil sterilant herbicide makes soil incapable of supporting higher plant life, but it does not necessarily kill all life in the soil, such as fungi, bacteria or other micro-organisms. Its toxic effects may remain for only a short time or for years depending upon the product used.

Properties of Herbicides

The properties of herbicides and the mode of action of herbicides are factors of fundamental importance to be considered in how to use the chemical most effectively. These properties determine how effective the chemical will be under varying conditions.

Adsorption

One of the most important interactions of the chemical with the environment is the tie up of the chemical by soil. This tie up or adsorption by various parts of the soil determines how much of the chemical will be available for action in the soil, how readily the chemical will leach, how fast the chemical will disappear from the soil.

Leaching

The movement of the herbicide in the soil is a factor that has to be considered in determining the maximum effectiveness of an herbicide. This movement is related to the adsorption of the chemical and also to the amount and intensity of water movement. The leaching is related the type of soil. Leaching decreases as one goes from sand, to loam, to clay, to soil high in organic matter.

Decomposition and Metabolism

The soil contains animals and microorganisms that possess the ability to detoxify or bring about the decomposition of most organic herbicides. Such breakdown is possible through various biochemical mechanisms available to them. The more favorable the soil conditions are for the growth of soil organisms, the more quickly organic herbicides are decomposed.

Many herbicides are also broken down through a process of chemical degradation.

Volatility

Volatility refers to the vaporization of a compound. Plant damage can be caused by the volatilization of certain herbicides. This is due to the vapors that are released by the herbicides. The volatilization of a chemical may reduce the concentration of a chemical on the treated site, thereby making it less effective or almost non-effective. Some herbicides that are applied to the soil are sufficiently volatile that their effectiveness would be largely lost if not incorporated into the soil shortly after application. The higher the temperature the more likely a substance is to volatilize.

Drift

Drift refers to the movement of spray droplets or vapor from one area to another. Drift is associated with the size of the spray droplets, wind speed and height of the sprayer above ground level. Drift problems can be avoided if certain precautions are followed.

1. Do not spray when there is a wind.
2. Use low pressure with a large nozzle to create a coarse spray droplet
3. Apply at slow speeds to reduce drift from turbulence.
4. Apply herbicide with spray nozzles as low to the ground as possible.

Safety in Using Herbicides

Any chemical is toxic to humans or other animals at a sufficiently high level of exposure. Concentrations of chemical and duration of exposure are important interacting factors. Some herbicides are fairly safe, but others are very toxic. All safety measures should be considered when using any herbicide.

Specific allowable herbicide residues are established by the U.S. Environmental Protection Agency for food, feed and livestock products. These residue tolerances are premised on the protection of human welfare. Registered herbicides and recommended application rates should be strictly observed to avoid the possibility of excessive residues.

Worker Protection Standard

Below is a *brief summary* of the Worker Protection Standard (WPS). The WPS is a federal regulation that is aimed at reducing the risk of pesticide exposures for employees of agricultural operations. Pesticide labels for all products that are used in agricultural production now refer to the WPS and, therefore, compliance with the entire regulation is required. Agricultural business owners and managers should familiarize themselves with these requirements by reading the "How To Comply Manual" or by going to EPA's website <http://www.epa.gov/oppfead1/safety>. You may also direct any questions that you may have to the State of Connecticut, DEP, Pesticide Management Program by calling 860/424-3369.

Under the Federal Insecticide Fungicide and Rodenticide Act (FIFRA) it is unlawful for any person to use a pesticide in a manner inconsistent with its labeling. When the WPS is referenced on a pesticide label, users must comply with all of its requirements or be subject to enforcement action, which may include monetary penalties.

Basic Principles of the Worker Protection Standard

EPA's Worker Protection Standard (WPS) is intended to reduce the risk of pesticide poisonings and injuries among persons who are employed at farms, forests, nurseries or greenhouses. The WPS contains requirements for pesticide safety training, notification of pesticide applications, use of personal protective equipment, restricted entry intervals following pesticide application, decontamination supplies, and emergency medical assistance.

The WPS identifies almost all agricultural employees as agricultural workers, early-entry workers or pesticide handlers depending upon the duties they perform. They are distinguished as follows;

Agricultural Workers are those who perform hand labor tasks related to the planting, cultivation and harvesting of plants on farms or in greenhouses, nurseries, or forests.

Workers include anyone employed for any type of compensation (including self-employed) doing tasks, such as carrying nursery stock, repotting plants, or planting, weeding, hoeing or watering, related to the production of agricultural plants on an agricultural establishment.

Workers do NOT include employees such as office employees, truck drivers, mechanics, and any other workers not engaged in worker/handler activities.

Early-Entry Workers are workers that, under limited circumstances, may be asked to enter a pesticide treated area before the expiration of the restricted entry interval to perform limited tasks. Employers must provide special protections to early entry workers such as additional training and instructions, decontamination sites and label specific personal protective equipment.

Pesticide Handlers are those who mix, load, assist with or apply agricultural pesticides; clean, maintain or repair equipment that is used pesticide applications; or perform other tasks that may bring them into direct contact with pesticides.

The WPS does not apply when pesticides are applied on an agricultural establishment in the following circumstances:

- For mosquito abatement, Mediterranean fruit fly eradication, or similar wide-area public pest control programs sponsored by governmental entities. The WPS does apply to cooperative programs in which the growers themselves make or arrange for pesticide applications.
- On livestock or other animals, or in or about animal premises.
- On plants grown for other than commercial or research purposes, such as home fruit and vegetable gardens, and home greenhouses.
- On plants that are in ornamental gardens, parks, and public or private lawns and grounds that are intended only for aesthetic purposes or climatic modification.
- By injection directly into agricultural plants. Direct injection does not include "hack and squirt," "frill and spray," chemigation, soil-incorporation, or soil-injection.
- In a manner not directly related to the production of agricultural plants, such as structural pest control, control of vegetation along rights-of-way and in other noncrop areas, and pasture and rangeland use.
- For control of vertebrate pests.
- As attractants or repellents in traps.
- On the harvested portions of agricultural plants or on harvested timber.
- For research uses of unregistered pesticides.

Summary of WPS Requirements

Protection During Applications

Pesticide handlers (applicators) are prohibited from applying a pesticide in a way that will expose workers or other persons. Workers are not allowed to enter areas where

pesticides are being applied. In some circumstances, workers must remain outside of prescribed buffer zones that may be from 25 to 100 feet, depending upon where a pesticide is applied and the method of application, until the application has been completed.

Restricted-entry Intervals (REI)

Restricted-entry intervals are specified on all agricultural plant pesticide product labels. Usually REI's are 12, 24 or 72 hours, although some low toxicity products may have a zero hour REI. Workers are excluded from entering a pesticide treated area during the restricted entry interval.

Personal Protective Equipment

Personal protective equipment (PPE) that is specified on the pesticide label must be provided and maintained for handlers and early-entry workers. PPE must be inspected and cleaned prior to each use.

Notification of Workers

Workers must be notified about treated areas either orally, by posting of signs or both, as indicated on the pesticide label, in order to avoid inadvertent exposures. Workers that are on the premises at the start of the applications must be orally warned before the application takes place. Workers that are not on the premises at the start of the application must be orally warned at the beginning of their first work period if (1) the application is still taking place or (2) if the REI for the pesticide is still in effect.

Pesticide Safety Training

Specific training is required for all workers, early-entry workers and handlers and must be conducted in a language that they understand. Generally, certified private applicators, commercial supervisors or persons that have attended a state approved train the trainer session can train workers and handlers. Those that have been trained as "handlers" can also train workers. EPA has developed WPS training materials for workers and handlers that are available as booklets, flip charts and videotapes, some of which is available in languages other than English. The training must contain at least the concepts as described in the "How To Comply Manual - Criteria for Worker and Handler Training".

Central Posting

Agricultural employers must post specific information at a central location that is accessible to their employees. The information that is required to be posted is as follows:

- **Application list**, which must include the location and description of the area to be treated, the product name, EPA registration number, and active ingredients of the pesticide, the time and date the pesticide is scheduled to be applied and the REI.
- **Emergency information**, which must include the name, telephone number and address of the nearest emergency medical facility.

- A **pesticide safety poster**, which must be either the WPS safety poster developed by EPA or an equivalent poster as described in the "How To Comply Manual - Criteria for Pesticide Safety Poster"

Access to Labeling and Site-Specific Information

Handlers and workers must be informed of required pesticide label information. Central posting of recent pesticide applications is required.

Decontamination Supplies

Handlers and workers must have an ample supply of water, soap and towels for routine washing and emergency decontamination, and a change of clothes as specified in the regulation and the How to Comply Manual.

Emergency Assistance

Transportation must be made available to a medical care facility if there is a reason to believe that a worker or handler may have been poisoned or injured by a pesticide used on the agricultural establishment. Information must be provided to medical personnel about the pesticide to which the person may have been exposed.

Revisions of the Worker Protection Standard

The Environmental Protection Agency made several revisions to the WPS in April 1995. The revisions that are pertinent to Connecticut applicators are summarized below.

I. Training Requirements

As of January 1, 1996, employers must provide brief pesticide safety training to untrained agricultural workers before they enter pesticide treated areas. Employers must be able to verify compliance with this requirement. The brief pesticide safety training must consist of those components highlighted on the WPS safety poster and a statement to workers that complete Pesticide Safety Training will be provided before the end of the 6th day of entering a treated area. This differs from the original 1992 WPS, which allowed a 15-day grace period for complete WPS worker training until October 1997.

The basic pesticide safety information must include the following concepts:

- Pesticide may be on or in plants, soil, irrigation water, or drifting from nearby applications.
- Prevent pesticides from entering your body by:
 - *Following directions and/or signs about keeping out of treated or restricted areas
 - *Washing before eating, drinking, using chewing gum or tobacco, or using the toilet

- *Wearing work clothing that protects the body from pesticide residues
- *Washing/showering with soap and water, shampoo hair and put on clean clothes after work
- *Washing work clothes separately from other clothes before wearing them again
- *Washing immediately in the nearest clean water if pesticides are spilled or sprayed on the body and, as soon as possible, showering, shampooing, and changing into clean clothes.
- Further training will be provided before the 6th day that a worker enters any area on the agricultural establishment where within the last 30 days, a pesticide has been applied or a REI has been in effect.

To clarify: before working in an area treated with pesticides, an agricultural worker must receive basic pesticide training. Prior to day 6, he must receive complete worker training as described in the "How To Comply Manual." The complete training information is included in EPA's manual entitled, "Protect Yourself from Pesticides-A Guide for Agricultural Workers", or various EPA approved videotapes. Once a worker receives complete WPS training, he will not be required to be retrained for a period of 5 years.

Nothing in this exception changes the WPS training requirements for agricultural pesticide handlers.

II. Exception for Limited Contact Tasks/Early Entry Workers

Agricultural pesticide labels specify a restricted entry level (REI), usually ranging from 12 to 72 hours. The WPS had limited early entry worker activity in treated areas under an REI to 1 hour in a 24-hour period. EPA granted an exception to the WPS that would allow, under specified conditions, workers to enter pesticide treated areas during an REI to perform limited contact tasks that could not be foreseen and which, if delayed until the expiration of the REI, would cause significant economic loss. Some examples of limited contact tasks that qualify for the exception include: the operation and repair of weather monitoring and frost protection equipment; the repair of greenhouse heating, air conditioning and ventilation equipment; the repair of non-application field equipment; the maintenance and moving of beehives. Some examples of hand labor activities and other tasks which would not qualify for this exception include: harvesting; thinning; weeding; topping; planting; sucker removal; packing produce into containers in the field; operating, moving or repairing irrigation equipment; and performing the task of a crop advisor.

This exception increases the time workers will be able to remain in treated areas under an REI for early entry activities from 1 hour to 8 hours within a 24-hour period providing the following conditions are met:

- 1) The worker's contact with treated surfaces is minimal and is limited to the feet, lower legs, hands and forearms.

- 2) The pesticide product does not have a statement in the labeling requiring workers to be notified both orally and by posting;
- 3) Personal protective equipment for early entry is provided to the worker and must either conform with the label requirements or include at least coveralls, chemical resistant gloves, shoes plus socks, chemical resistant footwear, and protective eyewear (if protective eyewear is required for handlers by the product labeling);
- 4) No hand labor such as hoeing, picking, pruning, etc. is performed;
- 5) The workers do not enter the treated area during the first 4 hours, and until applicable ventilation criteria have been met, and until any label specific inhalation exposure level has been reached;
- 6) Before early entry workers enter a treated area under an REI, the agricultural employer shall give them oral or written notification of the specifics of the exception to early entry as indicated on the pesticide label in a language the workers understand.

NOTE: Since this exception allows tasks to be performed during the REI, all persons engaged in the tasks under this exception must be trained as early entry workers as described in the How To Comply Manual or as a Handler prior to performing the tasks, in accordance with WPS.

III. Exception for Irrigation Tasks

EPA completed an exception to the WPS that allows early entry workers under specified conditions, to enter pesticide treated areas during a REI to perform irrigation tasks related to operating, moving or repairing irrigation or watering equipment. This exception extends the time that a trained early entry worker may remain in a pesticide treated area to perform irrigation tasks from one hour to 8 hours within a 24 hour period.

The terms of this exception further require that the need for the task could not have been foreseen and cannot be delayed until after the expiration of the REI. A task that cannot be delayed is one that, if not performed before the REI expires, would cause significant economic loss, and there are no alternative practices, which would prevent significant loss. (Discussions are currently underway with EPA to address watering needs in the greenhouse setting. At present, **this exception does not apply to routine watering needs in a greenhouse** since the need is not viewed as one that could not have been foreseen)

In addition to the above criteria, the terms of the exception for irrigation activities requires compliance with items 1 through 6 listed above for the limited contact exception.

IV. Reduced Restricted Entry Intervals for Low Risk Pesticides

The WPS established an interim minimum REI of 12 hours for all end use pesticide products for agricultural uses. However, EPA had been asked to consider reducing the minimum 12-hour REI for certain lower toxicity products. EPA determined that the reduction of the REI for specific low risk pesticides can be accomplished without jeopardizing worker safety and would also promote the use of less toxic products over those with greater risks and longer REI's. Therefore, EPA established a regulation to reduce the REI on 114 lower toxicity products to 4 hours or, in some cases, zero hours. EPA has instructed registrants to revise the labels of affected products to meet certain criteria. Pesticide users should examine labels closely for stickers or other indications of a reduced REI in accordance with this regulation.

The affected lower risk pesticides generally consist of microbial pesticides, biochemical pesticides and certain conventional agricultural pesticides.

V. Warning Signs

EPA amended the WPS to modify the warning sign size and language requirement. The amendment allows the substitution of the language commonly spoken and read by workers for the Spanish portion of the warning sign. The sign must be in the same format required by WPS and it must be visible and legible. Use of alternative languages is optional and the use of Spanish/English is always acceptable.

The amendment also allows the use of smaller signs provided that the minimum letter size and posting distance requirements are observed. In nurseries and greenhouses, smaller signs may be used at any time. A small sign may be used on a forest or farm if the treated area is too small to accommodate the standard sign.



For more information on the scope of the WPS, consult the How to Comply Manual or on the Internet at www.epa.gov/pesticides/safety.

11/15/2002

Glossary

Abdomen - The posterior of the three main body divisions.

Crawler - The active first stage of an insect.

Frass - Plant fragments made by an insect, usually mixed with excrement.

Head - The anterior body region which bears the eyes, antennae and mouth parts.

Larva - (pl., larvae) The immature stages, between the egg and pupa, of an insect having complete metamorphosis.

Maggot - A legless larva without a well developed head capsule.

Nymph - An immature stage (following hatching) of an insect that does not have a pupal stage.

Pupa - (pl., pupae) The stage between larva and the adult in insects that have complete metamorphosis, a non-feeding and usually inactive stage.

Puparium - (pl., puparia) A case formed by the hardening of the next to the last larval skin, in which the pupa is formed.

Pupate - Transform into a pupa

Thorax - The body region behind the head, which bears the legs and wings.