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IFAS EXTENSION

ENY-461

Insect Management for Tomatoes, Peppers, and Eggplant[1]

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Pest management should be based on the proper identification of pests and knowledge of their biology. The major pests of tomatoes, peppers, and eggplant in Florida and guidelines for their management are described below. Some insects may be more important in some areas of the state than others. Scouting guidelines and action thresholds for tomatoes are from the Florida Tomato Scouting Guide, SP 22, 2nd edition.

For each pest described, a table of management options will be found after the damage. These tables will be expanded as more information becomes available. Tables 13-15, at the end of this publication, list pesticides labeled for each major fruiting vegetable grown in Florida: tomatoes, peppers, and eggplants. Pesticides for controlling insects not described below can be found by looking under the "Insects" column in the tables.

Silverleaf Whitefly, *Bemisia argentifolii*

Description

The adult silverleaf whitefly (Figure 1) is small, approximately 1/16 of an inch in length, and has powdery white wings held tent-like over a yellow body while at rest. Whiteflies are usually found on the undersides of leaves, often in pairs. Males are smaller than females. Eggs, which are yellow and football-shaped, are attached upright by a tiny stalk inserted into the lower leaf surface. A mobile first instar or crawler stage hatches from the egg and settles on the leaf. It then develops through immobile second, third, and fourth instars, which look like semi-transparent, flat, oval scales. The fourth instar or "pupa" is more yellow and more easily seen without the aid of a hand lens, typically has very distinct eyespots, and is referred to as a "red-eyed nymph."

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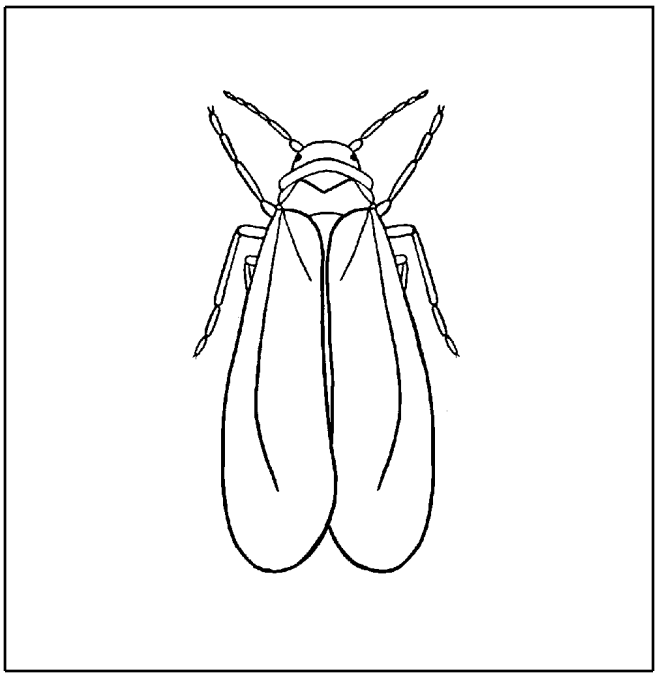

Figure 1. Silverleaf whitefly.

Biology

The life cycle from egg to adult can be as short as two weeks when the weather is very warm. Adult females lay most of their eggs on young leaves so young nymphs also generally occur on the underside of younger leaves. As the plant grows, leaves bearing the maturing nymphs are found lower down on the plant, so older nymphs can be found by looking at older leaves. Whiteflies feed in the plant vascular system (phloem) through a stylet similar to that of aphids and, like aphids, process a relatively large volume of plant sap by excreting excess liquid in the form of a sugary substance called honeydew.

Damage

Heavy whitefly populations can damage plants directly by removing sap. The honeydew that they excrete while feeding serves as food for sooty mold, which can reduce the amount of light reaching leaves. Moderate numbers of nymphs can cause irregular ripening of tomatoes, characterized by incomplete ripening of longitudinal sections of fruit. Nymphal feeding also causes an increase in objectionable white tissue in interior fruit walls. Adults also transmit plant viruses. After feeding on infected plants, whiteflies can then transfer the virus to healthy plants. Unlike the mosaic viruses transmitted rapidly by aphids, the geminiviruses are transmitted persistently. It takes longer for the whitefly to acquire the virus and the virus must pass through the body of the insect into the salivary glands before the whitefly can transmit it to a healthy plant. The whitefly has to feed on a healthy plant for some time to cause infection. Once the whitefly acquires the virus, it may transmit it for the rest of its life. In addition to tomato mottle geminivirus, the very severe tomato yellow leaf curl virus has recently been introduced into Florida.

Silverleaf whitefly can reach high numbers on tomato and eggplant but is rarely a problem on peppers. Generally, whitefly populations are highest in South, Southwest and West Central Florida during the spring although, in West Central Florida, the number of whiteflies carrying virus is usually higher in the fall. The whitefly is less often a problem in North Florida but may reach damaging numbers in summer and fall. Tomato yellow leaf curl virus causes problems in all tomato-growing areas in Florida.

Table 1. Silverleaf Whitefly

Management Option	Recommendation
Scouting/ thresholds	For tomatoes, examine six feet of row (a sample) for every 2.5 acres. When plants have three or fewer true leaves, examine six plants per sample for adult whiteflies. If plants have more than three leaves, examine the terminal leaflet of the third leaf from the top of the stalk. For nymphs, examine a terminal leaflet from the third leaf from the top until seven leaves are present and from the seventh leaf from the top thereafter. Look at six leaflets per six feet of row and calculate an average per leaflet. Tentative thresholds are 0.5 pupae or nymphs per leaflet or 10 adults per plant (0-3 true leaves) or 1 adult per leaflet (over 3 true leaves).

Table 1. Silverleaf Whitefly

Management Option	Recommendation
Note(s)	Soil application of a systemic, nicotinoid insecticide at crop initiation controls whiteflies well and reduces virus spread. To avoid the development of resistance to this insecticide, it is recommended that applications be made to the earliest "at risk" plantings using the lowest labeled rate. Fields should be scouted to determine the need for additional applications, using a different active ingredient, preferably an insect growth regulator or other selective material.
Mulches	Reflective aluminum mulches may reduce virus spread by deterring adult whiteflies from landing on plants.
Natural enemies	Parasitic wasps, lady beetles, lacewings, minute pirate bugs, fungi, particularly when whiteflies are developing on weeds.
Cultural controls	Tomato is the major source of whitefly-transmitted viruses, so attention should be paid to the probable source of whiteflies invading a field, given that highest risk is from senescing, abandoned or 'volunteer' tomatoes. A two-month or more crop-free period will reduce virus and whitefly populations.

Aphids

Description and Biology

Aphids (Figure 2) are soft-bodied, sucking insects that can rapidly colonize plants due to their short generation time. Adults are delicate, pear- or spindle-shaped insects with a posterior pair of tubes (cornicles), which project upward and backward from the dorsal surface of the abdomen and which are used for excreting a defensive fluid. In Florida, winged and wingless forms are all female and give birth to living young (nymphs). Nymphs are smaller but otherwise similar in appearance to wingless adults, which they become in 7 to 10 days.

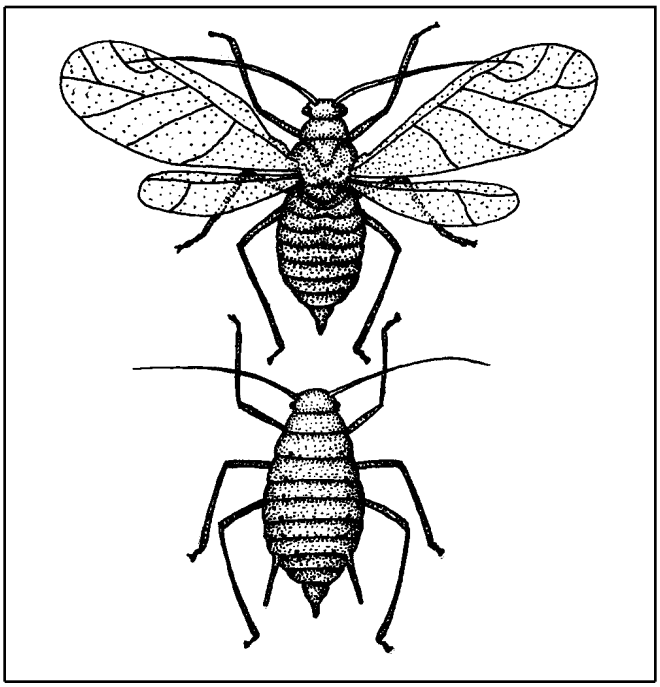

Figure 2. Winged aphid (top) and wingless aphid (bottom).

The green peach aphid, *Myzus persicae*, is the most common aphid species in Florida peppers and tomatoes, although the potato aphid (*Macrosiphum euphorbiae*) may also occur. Green peach aphid adults vary from 0.04 to 0.08 inch in length and are light green to yellow to pink and pear-shaped. The tubercles (bumps between antennae) point inward and are a distinguishing characteristic. Winged forms have a black patch on the back of the abdomen.

Damage

Heavy aphid infestations may cause stunting and leaf distortion. Feeding on blossoms reduces fruit set. Sooty mold will grow on the honeydew that the aphids excrete. They also spread plant viruses such as tobacco etch, potato virus Y, and pepper mottle. Most transmission results from winged aphids probing the leaf surface, rejecting the plant as a host, flying to another plant, and probing again. Aphids that settle, feed, and reproduce on the plant are less likely to transmit virus. Aphids can acquire and transmit the virus in a matter of seconds (although they lose the virus after probing a few plants) so conventional insecticides are of no help in controlling the spread of these viruses. Sources of infection are nearby virus-infected tomato, pepper, tobacco or other host plants. Related weeds such as nightshade may also be infected and serve as a source of virus for the crop.

Table 2. Aphids

Management Option	Recommendation
Scouting/ thresholds	For tomatoes, examine six feet of row (a sample) for every 2.5 acres. When plants have two or fewer true leaves, examine six plants per sample for aphids. If plants have more than three leaves but are not yet blooming, examine the terminal three leaflets (trifoliate) of the third expanded leaf from the top of the main stem. After bloom, examine the terminal trifoliate of the seventh leaf from the tip of any branch. Look at six trifoliates per six feet of row and calculate an average per trifoliate. Treat with appropriate insecticides if aphids reach 3 to 4 per plant.
Note(s)	Insecticides will not slow the spread of most aphid-transmitted plant viruses. Certain mineral oil formulations, if applied strictly according to the label before 5%-10% infection, may delay spread of these viruses by interfering with the attachment of virus to the aphid's mouthparts.
Mulches	Reflective aluminum mulches will deter aphids from landing on plants. The effect is lost once plants are large enough to cover the mulch.
Natural enemies	Parasitic wasps, ladybird beetles, syrphid fly larvae, and lacewing larvae attack aphids that reproduce on the crop. In humid weather, fungi may kill many aphids.

True Bugs (Hemiptera)

Description

Like aphids and whiteflies, true bugs are sucking insects. True bugs can be recognized by their front wings, which are leathery close to the body but membrane-like at the tips. Nymphs resemble adults in shape but are often colored differently and do not have fully developed wings. Stink bugs (Pentatomidae) (Figure 3) are green or brown shield-shaped bugs 1/2 to 2/3 of an inch long. Eggs are barrel-shaped and found on the undersides of leaves in masses of 10 to 50. Nymphs are similar in shape to adults, but more brightly colored and patterned. Leaffooted bugs (Coreidae) (Figure 4) are dark-colored true bugs with parallel sides. Three species attack tomato in Florida, two of which have flattened hind tibia (lower legs). Eggs are metallic and ovate but somewhat flattened laterally and laid in clusters. Some leaffooted bugs lay their eggs end to end in a single row or chain along a stem or leaf midrib. Nymphs are oblong in shape and red, especially on the abdomen.

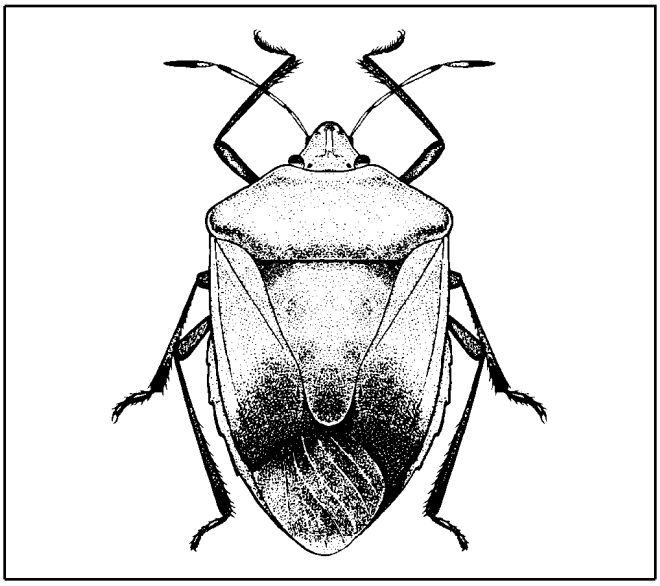

Figure 3. Green stink bug.

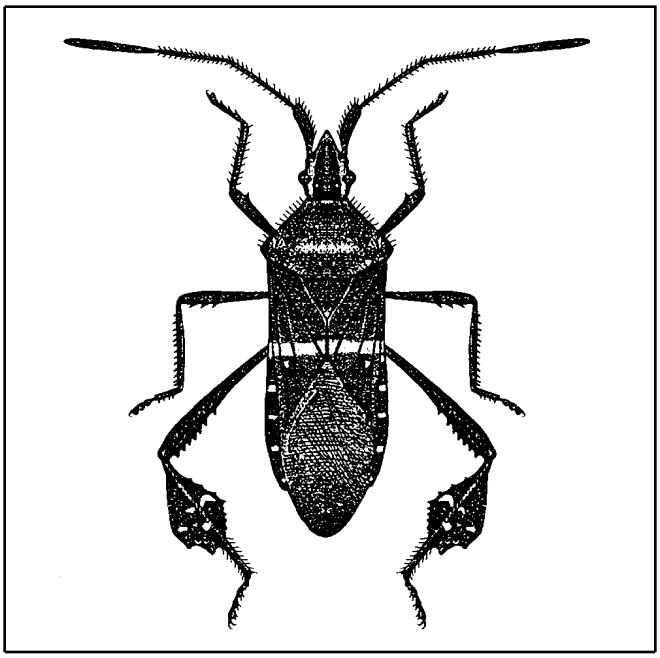

Figure 4. Leaffooted plant bug.

Biology

Southern green stinkbug can complete its life cycle in 65 to 70 days. It overwinters as an adult in leaf litter, tree bark, and other protected sites. Weed hosts include beggarweed, rattlebox, Mexican clover, wild blackberry, and nutgrass. Leaffooted bugs also attack a wide variety of plants, although thistles and nightshade are principal hosts. Both stink bugs and leaffooted bugs emit a strong odor when disturbed.

Damage

Nymphs and adults of both stink bugs and leaffooted bugs suck juices from green fruit leaving a puncture which later may become surrounded by a discolored zone due to invasion of secondary pathogens. Stink bug feeding punctures are often surrounded with a lightened, sometimes depressed, blotch beneath the fruit surface caused by the removal of cell contents and the enzymes injected by the bug. Leaffooted punctures may cause fruit to become distorted as they enlarge. True bugs are occasional pests throughout Florida.

Table 3. True Bugs

Management Option	Recommendation
Scouting/ thresholds	After fruit set, examine 10 fruit per 6-foot section of row for each 2.5 acres. If there is more than one stink bug per six plants, apply insecticide.
Natural enemies	Several species of parasitoid wasps attack eggs of leaffooted bugs. Insect predators also consume eggs. A tachinid fly parasitizes stink bug nymphs and adults, and a wasp parasitizes eggs.
Cultural controls	Trap crops (cowpeas and beans in summer, cruciferous plants in early spring and fall) may have some value. The trap crop should be sprayed before stink bug nymphs become adults. Weed management in and around the field prior to planting the crop is important.

Western Flower Thrips, *Frankliniella occidentalis*

Description and Biology

Adults (Figure 5) are tiny (1/16 inch) slender, dark yellow insects with brown, fringed wings. They are most often located in flowers, but also occur in terminal buds and, occasionally, on leaves. The egg is inserted in plant tissue, especially flower parts and very small fruit. Larvae, which are small, yellow and wingless, inhabit primarily flowers but also terminal buds and leaves. A prepupal stage resembling the larva does not feed but falls to the ground and pupates in the soil. Thrips can complete their life cycle in 15 to 30 days depending on temperature.

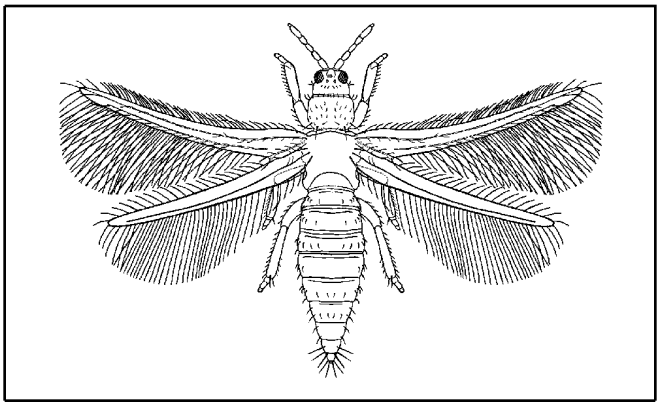

Figure 5. Western flower thrip.

Damage

Eggs inserted individually in tomato fruit cause dimples, sometimes surrounded by a white area, especially on the blossom end of the fruit. Heavy dimpling results in cullout and downgrading. The western flower thrips is a vector of tomato spotted wilt virus and is a key pest in north Florida during the spring but is rarely a pest in the fall. Although the western flower thrips has not been a pest of field tomatoes in South Florida, tomato spotted wilt virus has occurred sporadically but at low incidence.

Table 4. Western Flower Thrips

Management Option	Recommentation
Scouting/ thresholds	For tomatoes, examine one 6-foot section of row for each 2.5 acres. Gently exhale on each of 10 flowers per 6-foot section and count the number of thrips seen coming out of the flower. Treat if there are more than 5 thrips per flower.
Natural enemies	Minute or insidious pirate bugs feed on thrips, as does a certain mite.
Cultural practices	Because western flower thrips pupae occur in the soil, new plantings of tomatoes, eggplants, and peppers should not be planted following, near or adjacent to old, infested plantings. Reflective aluminum mulches reduce spread of tomato spotted wilt virus.

Melon Thrips, *Thrips palmi*

Description and Biology

Adults (Figure 6) are tiny (about 1/25 inch long), slender, dark yellow insects with brown-lined wings. They may first appear in flowers but may also occur on foliage, especially on the undersides of young leaves. Many similar species inhabit flowers, so identification requires a microscope. The egg is inserted in plant tissue, especially flower parts and very small fruit. Larvae, which are yellow and small without wings, inhabit flowers, fruit (especially under the calyx), and foliage, congregating where veins converge. Such congregations clearly denote melon thrips. A prepupal stage resembling the larva does not feed but falls to the ground and pupates in the soil or in leaf litter. Generation type varies from 15 to 30 days, depending on temperature. Melon thrips have a broad host range and are a primary foliage pest on watermelon, eggplant, pepper, and cucumber. So far, melon thrips has been reported only south of Orlando.

Damage

Heavy infestations cause silvered or bronzed leaves, stunted leaves and terminals, and scarred and deformed fruit. On peppers, fruit scaring emanates from the stem end following crevices between locule lobes. Foliar damage may also be severe. Melon thrips also damages eggplant. Tomatoes are not affected.

Table 5. Melon Thrips

Management Option	Recommendation
Scouting/ Thresholds	No guidelines available.
Note(s)	Most conventional insecticides seem to stimulate melon thrips populations, possibly by eliminating predators that otherwise control them. Therefore, broad-spectrum insecticides should be avoided as much as possible in preference to selective materials when available.
Natural enemies	Pirate bugs (*Orius* spp.), several species of predacious mites and predacious thrips, and a parasitoid wasp.
Cultural controls	Adults are quite mobile and can move into new plantings quickly from old fields. Therefore, old fields should be destroyed as soon as possible after the last harvest and new fields should not be planted adjacent to or near old fields. In addition to infesting pepper and eggplant, melon thrips can easily increase on successive plantings of cucumber, potato, beans, and watermelon, which are also hosts of this pest. Tomato, which is not susceptible, can be used to separate such crops in time and space.
Mulches	Reflective mulches give some control when plants are small.

Tobacco Thrips, *Frankliniella fusca*

Description

Adults (Figure 7) are dark brown or black and thereby easily distinguished from the western flower thrips. There are other dark thrips, however, so identification by an expert is advisable. It is an occasional inhabitant of flowers, terminal buds, and leaves. The tobacco thrips also vectors tomato spotted wilt virus. Although tomato is not a preferred host,

viruliferous adults may migrate into fields from tobacco or peanut, especially in the fall, and transmit tomato spotted wilt virus to tomatoes and peppers by probing with their mouthparts. Therefore, tomatoes and peppers should not be planted adjacent to or near these tomato spotted wilt virus-susceptible crops.

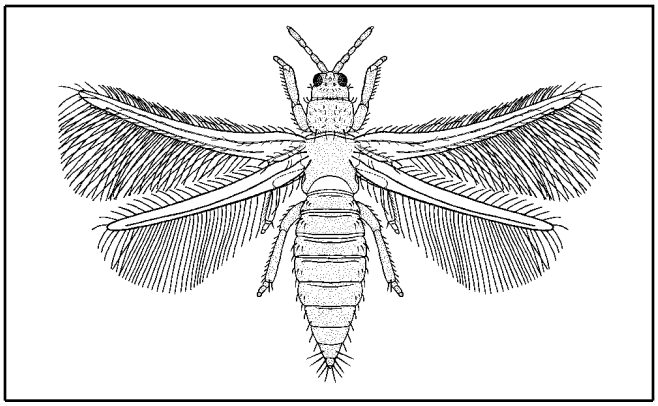

Figure 7. Tobacco thrip.

Other Thrips

Eastern flower thrips (*F. tritici*) and the Florida flower thrips (*F. bispinosa)* are some common thrips that resemble western flower thrips and may be numerous in blooms. Eastern flower thrips is most abundant in north Florida but is not a pest of tomato. Florida flower thrips is common throughout the state and may cause bud abscission if present in very high numbers (>5 per flower). Experimentally, it has been shown to be a vector of tomato spotted wilt virus but its potential as a vector in nature has not been determined.

Vegetable Leafminer, *Liriomyza sativae*, *L. trifolii*

Description and Biology

The adult is a small fly (Figure 8), approximately 1/8 inch long, with a black head, yellow between the eyes, a black thorax and a tube-like “ovipositor” at the end of the abdomen used to puncture the upper leaf surface for egg laying. The white, oval egg is inserted in the leaf tissue, but many punctures (called stipples) are used by the adult for feeding and do not contain eggs. The larva, a yellow maggot with black, sickle-shaped mouth hooks, feeds between the upper and lower leaf surface for approximately seven days, leaving a serpentine mine containing a string of black frass (fecal matter). The mature larva exits from the mine and falls to the ground (or plastic mulch) where it molts to a pupa within a golden brown, barrel-shaped and ribbed, puparium from which the adult emerges in seven to 14 days. Generation time is 15 to 28 days depending upon temperature.

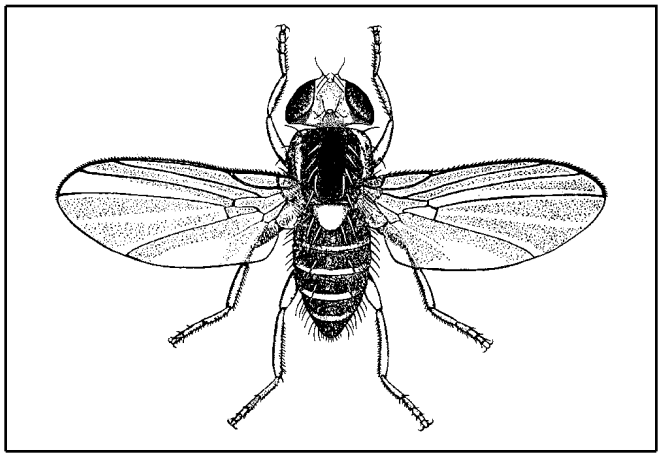

Figure 8. Vegetable leafminer.

Damage

Leafmines reduce photosynthetic area and may provide entry points for foliar pathogens. Heavily damaged leaves become necrotic, predisposing fruit to sunscald. Vegetable leafminer may be an important pest in south and central Florida but is only an occasional pest in north Florida. It is not usually a serious pest of pepper or eggplant.

Table 6. Vegetable Leafminer

Management Option	Recommendation
Scouting/ Thresholds	For tomatoes, examine six feet of row (a sample) for every 2.5 acres. When plants have two or fewer true leaves, examine six plants per sample for leafminers. If plants have three to seven leaves, examine the terminal three leaflets (trifoliate) of the third expanded leaf from the top of the main stem. After seven leaves are present, examine the terminal trifoliate of the seventh leaf from the tip of any branch. Look at six trifoliates per six feet of row and calculate an average per trifoliate. Treat with appropriate insecticides if the average is 0.7 larvae per plant (0-2 true leaves) or 0.7 larvae per 3 terminal leaflets (>2 leaves per plant).
Note(s)	Insecticides applied for leafminer control should target small larvae for best results.
Natural enemies	A number of parasitic wasps attack vegetable leafminer in Florida and may provide high levels of mortality, especially late in the season. Therefore, insecticides with low or no toxicity to leafminer parasites should be selected for controlling leafminers and other pests.

Tomato Pinworm, *Keiferia lycopersicella*

Description

The adult is a small gray moth (wing span about 1/2 inch) with a reddish-brown, mottled head and thorax. Eggs are pale yellow to orange, oval in shape, and are usually deposited singly or in groups of two to three on lower surfaces of foliage. Larvae (Figure 9) are purplish-gray, 3/8 inch long at maturity, and found inside blotch mines, leaf folds or fruit, usually around the stem attachment. The pupa is formed in a silken cocoon covered with sand particles near the soil surface or on the plastic mulch surface.

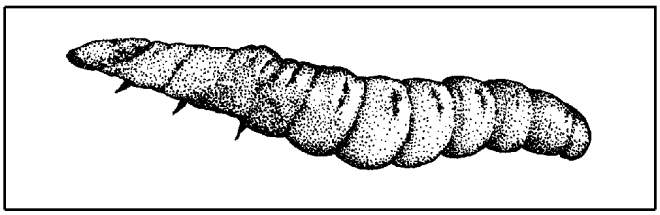

Figure 9. Tomato pinworm larva.

Biology

Moths are most active at dusk. The female emits an odor, or pheromone, which attracts males from long distances downwind for mating. After hatching, first instars spin silk over themselves and tunnel into the leaf. Third and fourth stages fold or tie leaves or feed in stems or fruit. The pupal stage can last 1 to 4 weeks. Total generation time varies from 21 to 67 days depending on temperature. Seven to eight overlapping generations a year occur in South Florida.

Damage

The tomato pinworm feeds only on solanaceous plants such as tomato, eggplant, and potato. Pepper is not a host. Heavy feeding on foliage may cause defoliation, but damage to fruit is usually the worst consequence of tomato pinworm infestations. Damaged fruits are contaminated with insect parts, silk and frass, and may rot from introduction of pathogens. The tomato pinworm is an important pest in the spring in south and central Florida and summer or late fall in North Florida, especially after populations have built up over the preceding season.

Table 7. Tomato Pinworm

Management Option	Recommendation
Scouting/ Thresholds	Count the number of larvae on the foliage of whole plants (up to 7th true leaf stage), or on one leaf selected from the lower canopy of each plants (from 8th true leaf to end of crop). Treat if the following thresholds are reached: 0.7 larva per plant (0-7 leaves), 0.7 larva per leaf (>7 true leaves). Also treat with pheromone for mating disruption if 5 or more moths are caught per night in a pheromone trap.

Table 7. Tomato Pinworm

Management Option	Recommendation
Note(s)	Mating disruption by application of commercially available pheromone preparations is preferred over insecticidal control in order to conserve parasites and predators of tomato pinworm.
Cultural controls	Use clean transplants, separate plantings from previous crops of tomato, eggplant, or potato. Field sanitation and destruction of crop residue from previous plantings is important for reducing summer populations.

Tomato Fruitworm (corn earworm), *Heliocoverpa zea*

Description

The wingspan is about 1.5 inches. The forewing of the adult male is cream-colored with an orange or olive cast; the females is light yellow-brown with indistinct vertical lines. Eggs are waxy, white, dome-shaped and ribbed, with a flat base. They are deposited singly on the undersides of leaves or flower petals. Larvae (Figure 10) can vary in color from light green or pink to brown or nearly black and are lighter underneath. The body is marked with lengthwise alternating light and dark stripes. Spines have raised dark areas at their bases.

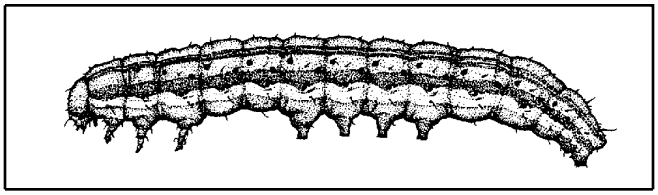

Figure 10. Tomato fruitworm (corn earworm) larva.

Biology

Adults are active at night. Eggs hatch in 2 or 3 days and the larval stage lasts 14 – 21 days. Larvae move to green fruit soon after hatching, where they bore deeply into the fruit. Tomato fruitworm pupates in the soil; the adult emerges in 7 to 14 days.

Damage

Larvae chew large deep holes in tomato fruit, especially at the stem end. They occasionally feed on foliage. Eggplant and pepper fruits may also be damaged by tomato fruitworm.

Table 8. Tomato Fruitworm (corn earworm)

Management Option	Recommendation
Scouting/ Thresholds	Examine 6 feet of row for every 2.5 acres. Concentrate on areas where there is evidence of feeding (leaves, fruit). Examine the undersides of leaves adjacent to flowers for eggs. Treat if there is one larva or more per six plants before bloom; after bloom, treat if one egg or larva is found per field. Pheromone traps, placed on the edge of the field, have been useful for monitoring purposes in the Midwest.
Note(s)	Insecticides must be present on plants when eggs hatch so that newly hatched larvae will contact a lethal dose.
Natural enemies	General predators, such as big-eyed bugs and pirate bugs, feed on eggs. Parasitoid wasps attack eggs and larvae.

Southern Armyworm, *Spodoptera eridania*

Description

The adult is relatively large (1.5 - inch wingspan) with the front wing streaked with cream, gray, light brown and black and the hindwing white with some dark on the margins. Eggs are laid on the undersides of leaves in large masses of 100 to 200, covered with a felt-like mat of body hair, which hatch in about three to four days. Larvae are dark caterpillars, two yellowish lateral lines interrupted by a large dark spot on the first abdominal segment (Figure 11). Large larvae have two rows of dark triangles on the dorsal surface. The generation time is 29 to 35 days. Southern armyworm is the most common armyworm pest of tomato in south and central Florida but is only an occasional pest in north Florida.

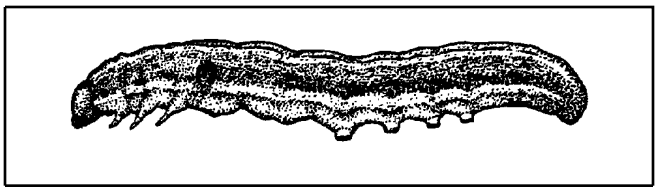

Figure 11. Southern armyworm larva.

Beet Armyworm, *Spodoptera exigua*

Description

The adult is smaller than southern armyworm, (wingspan one inch) with the front wing light brownish gray with indistinct lines and the hindwing white. Egg masses are also smaller than southern armyworm, numbering usually 50 to 75 eggs but are otherwise similar. Larvae (Figure 12) are generally green, mottled with white spots, one to 1 1/4 inch long at maturity and often with a small black spot above the second pair of true legs. Generation time 25 to 35 days. Tomato is not a preferred host for beet armyworm but the insect may occasionally reach damaging levels anywhere in the state. Pepper is a preferred host, and larvae may feed on buds, silk leaves together, or may bore into fruit. The beet armyworm is more difficult to control than the southern armyworm.

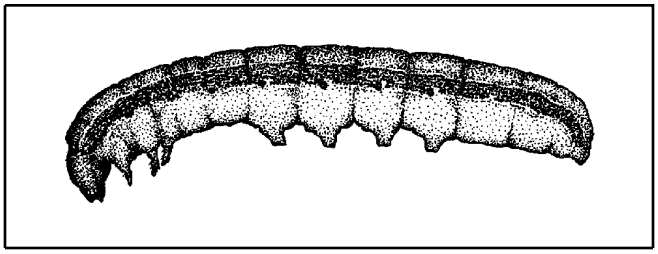

Figure 12. Beet armyworm larva.

Yellowstriped Armyworm, *Spodoptera ornithogalli*

Description

The adults and eggs are similar to the southern armyworm. Yellowstriped armyworm larvae (Figure 13) have dark heads and dark lateral marks bisected by a thin, white line on each segment behind the true legs. The yellowstriped armyworm is a serious pest in north Florida during the fall but is rarely present in south and central Florida.

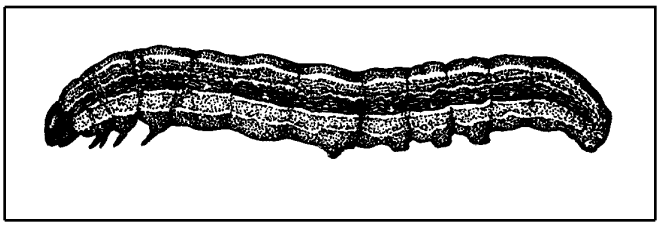

Figure 13. Yellowstriped armyworm larva.

Table 9. Management of Beet, Southern, Fall and Yellowstriped Armyworms

Management Option	Recommendation
Scouting/ Thresholds	Examine 6 feet of row for every 2.5 acres. Concentrate on areas where there is evidence of feeding (leaves, fruit). Treat if there is one larva or more per six plants before bloom; after bloom, treat if one egg or larva is found per field.
Note(s)	Younger larvae are always easier to control than older larvae, especially when using *Bacillus thuringiensis* (Bt) products.
Natural enemies	Many natural enemies attack armyworms, including parasitoid wasps and tachinid flies. General predators feed on eggs and small larvae.

Pepper Weevil, *Anthonomus eugenii*

Description

The adult (Figure 14) is a small (1/6 inch) black or gray beetle with a long snout (proboscis) and elbowed antennae. Larvae are tiny, legless grubs, found inside the pepper fruit.

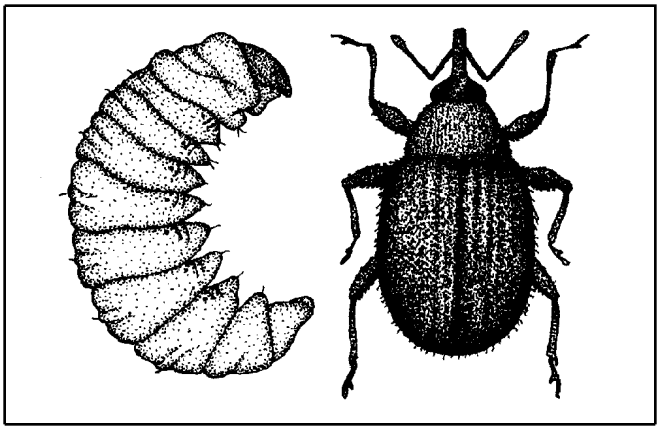

Figure 14. Pepper weevil larva and adult.

Biology

Adults use the mandibles at the end of the proboscis to feed on leaf or flower buds. Females also use the mandibles to bore a small hole in developing fruit or flower buds. The hole is plugged with fecal matter (frass) after an egg is deposited. A tiny legless grub hatches from the egg and eats its way toward the seed core of the fruit where it feeds on seeds and pulp, passing through larval growth stages or instars. Pupation takes place inside the fruit within a small cell created by larval feeding. The emerging adult may feed within the fruit for awhile before escaping through a circular hole chewed in the wall of the fruit.

Black nightshade can serve as a secondary host to maintain small numbers of pepper weevil during fallow periods. Since development times decrease as temperature increases and since adults will migrate readily from old fields to new plantings, populations generally build up during the season so that populations are greatest in later spring plantings.

Damage

Damaged fruit become contaminated by insect parts, frass and rotted tissue, and will eventually fall from the plant.

Table 10. Pepper Weevil

Management Option	Recommendation
Scouting/ Thresholds	Since adults tend to move to lower, more protected and less visible plant parts as temperatures increase, scouting efforts should concentrate on a search for adults in leaf whorls, flowers, and fruit during morning hours. Commercially available pheromone traps may also aid in early detection. Fruit and flower buds should be examined for damage and fallen fruit and buds examined for presence of larvae.

Table 10. Pepper Weevil

Management Option	Recommendation
Note(s)	Chemical control is difficult because all stages except the adult are protected within the fruit, so that only the adult weevil is vulnerable to insecticides. Frequent sprays may be necessary starting in the initial stages of infestation, usually pre-bloom, in order to avoid unacceptable levels of damage.
Natural enemies	A few parasites and predators are known to attack the weevil, but are not thought to be a factor in suppressing populations.
Cultural controls	If possible, all damaged and fallen fruit should be removed and destroyed. Adjacent or nearby sequential plantings should be avoided. Crops should be deep-plowed immediately following harvest and after treating with insecticide to reduce adult movement into nearby fields and to reduce survival over the summer. Nightshade in and around fields should be controlled to reduce population survival between crops.

Broad Mite, *Polyphagotarsonemus latus*

Description and Biology

Adults (Figure 15) are tiny, white, eight-legged mites and are usually most numerous on the underside of young, emergent foliage. Males can sometimes be seen carrying females “piggyback." Nymphs are similar though somewhat smaller than adults are. Eggs are about 1/4 the size of adults, round with white, opalescent spots, and glued to the plant surface. Generation time may be as short as 5 days, depending on temperature.

Damage

In peppers, broad mite feeding distorts plant tissue, causing leaves to become thickened and narrow, giving them a “strappy” appearance. Heavy feeding causes flower abortion and dark, smooth

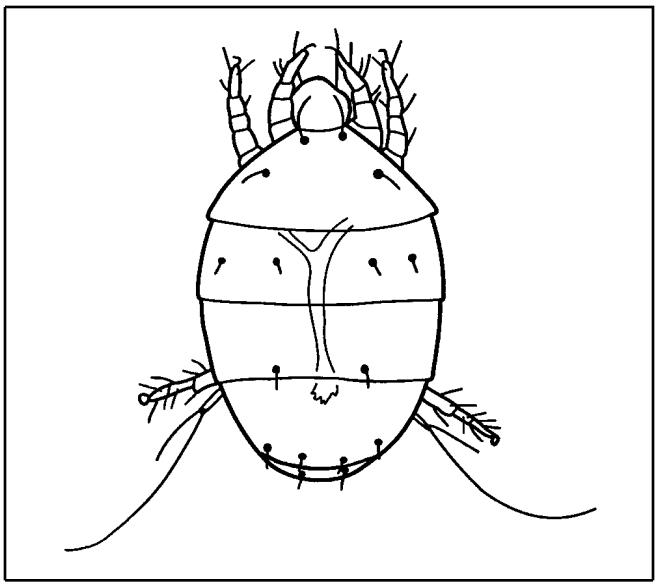

Figure 15. Broad mite.

russeting of fruit. Infestations are often spotty, but may become more generalized, especially in late fall. Broad mite is a major pest of pepper and eggplant.

Table 11. Broad Mite

Management Option	Recommendation
Scouting/ Thresholds	None currently available for Florida. Infestations occurring during at or before the early fruiting stage of peppers cause the most damage.
Note(s)	Chemical control is not difficult but should be timely. Heavy infestation may require two applications five days apart to allow time for eggs to hatch. Specific acaricides are usually recommended over broad-spectrum acaricide/insecticides to better conserve beneficial insects.
Natural enemies	General mite predators can be effective.

Colorado Potato Beetle, *Leptinotarsa decemlineata*

Description

Adults (Figure 16) have 10 lengthwise black stripes on yellow-orange wing covers and are approximately 3/8 inch long by 1/4 inch wide. They are distinctly convex in shape. Clusters of 10 or more yellow to orange spindle-shaped eggs can be found on the undersides of leaves. The larvae are humpbacked, red to orange, and have two rows of black spots on each side of their soft bodies.

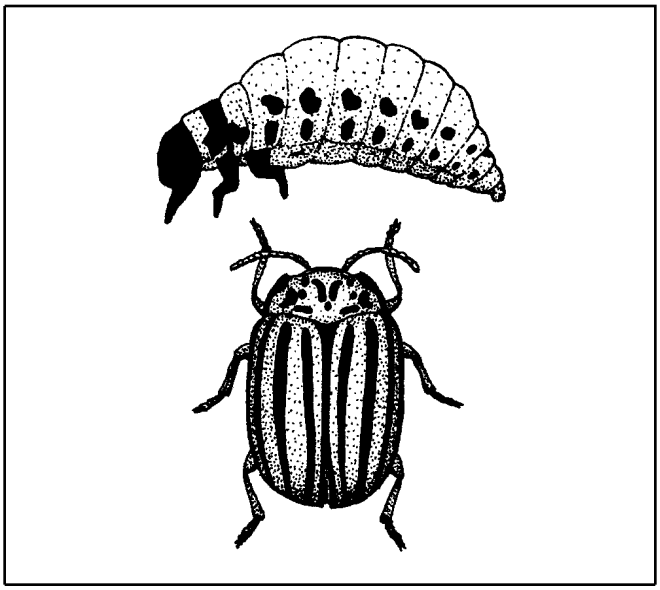

Figure 16. Colorado potato beetle larva and adult.

Biology

Colorado potato beetle is primarily a pest in the northern half of the state. Adults will overwinter in debris around the edges of fields planted the previous season with potatoes, eggplant, or tomatoes. In the spring, they lay eggs in clusters of 10 – 40 that will hatch in 3 to 7 days, depending on temperature. Females may deposit over 300 eggs over a 4 to 5-week period. Larvae complete 4 instars while feeding on leaves for two to three weeks and drop to the soil to pupate. New adults emerge from the soil 5 to 10 days later, or longer, depending on temperature. Colorado potato beetle attacks primarily potatoes, eggplant, and tomatoes, but it will also feed on peppers, tobacco, and solanaceous weeds, such as nightshade, horse-nettle, and ground cherry.

Damage

They are voracious leaf feeders and will totally defoliate plants.

Table 12. Colorado Potato Beetle

Management Option	Recommendation
Scouting/ Thresholds	There are no thresholds for Florida. Other states recommend examining at least 30 plants per field and treating if more than 1 adult, larva, or egg mass per plant is found (average of 30 plants).
Note(s)	Insecticide resistance is a major problem in other parts of the country.
Natural enemies	Good results have been obtained with a tiny wasp that parasitizes eggs. The wasp, *Edovum puttleri*, was introduced from South America and mass-reared for release in the Northeast.
Cultural practices	Rotation with non-host plants, such as corn, is effective, because beetles are weak fliers. Plant at least 1/2 mile away from a previously infested field. Potatoes can be used as a trap crop for tomatoes. One or two rows of potatoes planted 20 to 30 days before tomatoes will attract adult beetles, which can then be killed with insecticides before they move into the tomatoes.

Table 13. Selected insecticides approved for use on insects attacking tomatoes.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
Acramite 50-WS (bifenazate)		12	3	twospotted spider mite	2	One application per season.
Admire 2F (imidacloprid)	16-24 fl oz	12	21	aphids, Colorado potato beetle, flea beetles, foliar-feeding thrips, whiteflies	4A	Most effective if applied to soil at transplanting.
Admire 2F (imidacloprid)	1.4 fl oz/1000 plants	12	0 (soil)	aphids, whiteflies	4A	**Greenhouse use:** 1 application to mature plants, see label for cautions
Admire 2F (imidacloprid)	0.1 fl oz/1000 plants	12	21	aphids, whiteflies	4A	**Planthouse:** 1 application. See label.
Agree WG (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lb	4	0	lepidopteran larvae (caterpillar pests)	11B1	Apply when larvae are small for best control. Can be used in greenhouse. OMRI-listed[2].
***Agri-Mek 0.15EC** (abamectin)	8-16 fl oz	12	7	Colorado potato beetle, *Liriomyza* leafminers, spider mite, tomato pinworms, tomato russet mite	6	Do not make more than 2 sequential applications. Do not apply more than 0.056 lb ai per acre per season.
***Ambush 25W** (permethrin)	3.2-12.8 oz	12	up to day of harvest	beet armyworm, cabbage looper, Colorado potato beetle, granulate cutworms, hornworms, southern armyworm, tomato fruitworm, tomato pinworm, vegetable leafminer	3	**Do not use on cherry tomatoes.** Do not apply more than 1.2 lb active ingredient per acre per season. Not recommended for control of vegetable leafminer in Florida.
***Asana XL 0.66EC** (esfenvalerate)	2.9-9.6 fl oz	12	1	beet armyworm (aids in control), cabbage looper, Colorado potato beetle, cutworms, flea beetles, grasshoppers, hornworms, potato aphid, southern armyworm, tomato fruitworm, tomato pinworm, whiteflies, yellowstriped armyworm	3	Not recommended for control of vegetable leafminer in Florida. Do not apply more than 0.5 lb ai per acre per season.

Table 13. Selected insecticides approved for use on insects attacking tomatoes.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
Assail 70 WP (acetamiprid)	0.6-1.7 oz	12	7	aphids, Colorado potato beetle, whiteflies	4A	Do not apply to crop that has been already treated with imidacloprid or thiamethoxam at planting. Begin applications for whiteflies when first adults are noticed. Do not apply more than 4 times per season or apply more often than every 7 days.
Avaunt (indoxacarb)	2.5-3.5 oz	12	3	beet armyworm, hornworms, loopers, southern armyworm, tomato fruitworm, tomato pinworm	22	Do not apply more than 14 ounces of product per acre per crop. Minimum spray interval is 5 days.
Aza-Direct (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	4	0	aphids, beetles, caterpillars, leafhoppers, leafminers, mites, stink bugs, thrips, weevils, whiteflies	26	Antifeedant, repellent, insect growth regulator. OMRI-listed[2].
Azatin XL (azadirachtin)	5-21 fl oz	4	0	aphids, beetles, caterpillars, leafhoppers, leafminers, mites, stink bugs, thrips, weevils, whiteflies	26	Antifeedant, repellent, insect growth regulator.
***Baythroid 2** (cyfluthrin)	1.6-2.8 fl oz	12	0	beet armyworm[(1)], cabbage looper, Colorado potato beetle, dipterouus leafminers, European corn borer, flea beetles, hornworms, potato aphid, southern armyworm[(1)], stink bugs, tomato fruitworm, tomato pinworm, variegated cutworm , western flower thrips, whitefly[(2)]	3	[(1)] lst and 2nd instars only [(2)] suppression Do not apply more than 0.26 lb ai per acre per season. Maximum number of applications: 6.
Biobit HP (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	caterpillars (will not control large armyworms)	11B2	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. OMRI-listed[2].

Table 13. Selected insecticides approved for use on insects attacking tomatoes.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
BotaniGard 22 WP, ES (*Beauveria bassiana*)	**WP:** 0.5-2 lb/100 gal **ES:** 0.5-2 qts 100/gal	4	0	aphids, thrips, whiteflies	--	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix fungicides.
***Capture 2 EC** (bifenthrin)	2.1-5.2 fl oz	12	1	aphids, armyworms, corn earworm, cutworms, flea beetles, grasshoppers, mites, stink bug spp., tarnished plant bug, thrips, whiteflies	3	Make no more than 4 applications per season. Do not make applications less than 10 days apart.
CheckMate TPW, TPW-F (pheromone)	**TPW:** 200 dispenser **TPW-F:** 1.2-6.0 fl oz	0	0	tomato pinworm	--	For mating disruption. See label. TPW formulation OMRI-listed[2].
Condor (*Bacillus thuringiensis* subspecies *kurstaki*)	0.67-1.67 qts	4	0	caterpillars	11B2	Do not use in combination with any chlorothalonil-based fungicides. Use caution when mixing with other oil-based products or surfactants. Treat when larvae are young. Good coverage is essential.
Confirm 2F (tebufenozide)	6-16 fl oz	4	7	armyworms, black cutworm, hornworms, loopers	18	Product is a slow-acting IGR that will not kill larvae immediately. Do not apply more than 1.0 lb ai per acre per season.
Courier 70WP, 40SC (buprofezin)	**70WP:** 6-9 oz **40SC:** 9-13.6 fl oz	12	7	whitefly nymphs	16	See label for plantback restrictions. Apply when a threshold is reached of 5 nymphs per 10 leaflets from the middle of the plant. Product is a slow-acting IGR that will not kill nymphs immediately. No more than 2 applications per season. Allow at least 28 days between applications.

Table 13. Selected insecticides approved for use on insects attacking tomatoes.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
Crymax WDG (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	caterpillars	11B2	Use high rate for armyworms. Treat when larvae are young.
***Danitol 2.4 EC** (fenpropathrin)	10.67 fl oz	24	3 days, or 7 if mixed with Monitor 4	beet armyworm, cabbage looper, fruitworms, potato aphid, silverleaf whitefly, stink bugs, thrips, tomato pinworm, twospotted spider mites, yellowstriped armyworm	3	Use alone for control of fruitworms, stink bugs, twospotted spider mites, and yellowstriped armyworms. Tank-mix with Monitor 4 for all others, especially whitefly. Do not apply more than 0.8 lb ai per acre per season. Do not tank mix with copper.
Deliver (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25-1.5 lb	4	0	caterpillars	11B2	Use higher rates for armyworms. OMRI-listed[2].
***Diazinon AG400, 4E, *50 W** (diazinon)	AG500, 4E:	24	1	**foliar application:** aphids, beet armyworm, banded cucumber beetle, *Drosophila*, fall armyworm, dipterous leafminers, southern armyworm **soil application at planting:** cutworms, mole crickets, wireworms	1B	Will not control organophosphate-resistant leafminers. Do not apply more than five times per season.
	AG500, 4E: 1-4 qts **50W:** 2-8 lb	24	preplant	cutworms, mole crickets, wireworms		
Dimethoate 4 EC, 2.67 EC (dimethoate)	**4EC:** 0.5-1.0 pt **2.67:** 0.75-1.5 pt	48	7	aphids, leafhoppers, leafminers	1B	Will not control organophosphate-resistant leafminers.
DiPel DF (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	caterpillars	11B2	Treat when larvae are young. Good coverage is essential. OMRI listed[2].

Table 13. Selected insecticides approved for use on insects attacking tomatoes.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
Endosulfan 3EC (endosulfan)	0.66-1.33 qt	24	2	aphids, blister beetle, cabbage looper, Colorado potato beetle, flea beetles, hornworms, stink bugs, tomato fruitworm, tomato russet mite, whiteflies, yellowstiped armyworm	2	Do not exceed a maximum of 3.0 lb active ingredient per acre or apply more than 6 times. Can be used in greenhouse.
Entrust (spinosad)	0.5-2.5 oz	4	1	armyworms, Colorado potato beetle, flower thrips, hornworms, *Liriomyza* leafminers, loopers, other caterpillars, tomato fruitworm, tomato pinworm	5	Do not apply more than 9 oz per acre per crop. OMRI-listed[2].
Esteem Ant Bait (pyriproxyfen)	1.5-2.0 lb	12	1	red imported fire ant	7C	Apply when ants are actively foraging.
Extinguish ((S)-methoprene)	1.0-1.5 lb	4	0	fire ants	7A	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks. This is the only fire ant bait labeled for use on cropland. May be applied by ground equipment or aerially.
Fulfill (pymetrozine)	2.75	12	0	green peach aphid, potato aphid, suppression of whiteflies	9B	Do not make more than two applications. 24 (c) label for growing transplants also.
Intrepid (methoxyfenozide)	4-16 fl oz	4	1	beet armyworm, cabbage looper, fall armyworm, hornworms, southern armyworm, tomato fruitworm, true armyworm, yellowstriped armyworm	18	Do not apply more than 1.0 lb ai/acre per season. Product is a slow-acting IGR that will not kill larvae immediately.
Javelin WG (*Bacillus thuringiensis* subspecies *kurstaki*)	0.12-1.5 lb	4	0	most caterpillars, but not *Spodoptera* species (armyworms)	11B2	Treat when larvae are young. Thorough coverage is essential. OMRI-listed[2].

Table 13. Selected insecticides approved for use on insects attacking tomatoes.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
Kelthane MF 4 (dicofol)	0.75-1.5 pt	12	2	tomato russet mites, twospotted and other spider mites	20	Do not apply more than twice a year or more than 1.6 pts per season.
Knack IGR (pyriproxyfen)	8-10 fl oz	12	14	immature whiteflies	7C	Apply when a threshold is reached of 5 nymphs per 10 leaflets from the middle of the plant. Product is a slow-acting IGR that will not kill nymphs immediately. Make no more than two applications per season.
Kryocide; Prokil Cryolite 96 (cryolite)	8-16 lb	12	14	blister beetle, cabbage looper, Colorado potato beetle larvae, flea beetles, hornworms, tomato fruitworm, tomato pinworm	9A	Minimum of 7 days between applications. Do not apply more than 64 lbs per acre per season.
***Lannate LV, *SP** (methomyl)	**LV:** 0.75-3.0 pt **SP:** 0.25-1.0 lb	48	1	aphids, armyworms, beet armyworm, fall armyworm, hornworms, loopers, southern armyworm, tomato fruitworm, tomato pinworm, variegated cutworm	1A	Do not make more than 16 applications per crop.
Lepinox WDG (*Bacillus thuringiensis* subspecies *kurstaki*)	1.0-2.0 lb	12	0	for most caterpillars, including beet armyworm (see label)	11B2	Treat when larvae are small. Thorough coverage is essential.
Malathion 8 F (malathion)	1.5-2 pt	12	1	aphids, *Drosophila*, mites	1B	Can be used in greenhouse.
***Monitor 4EC** (methamidophos) [24(c) labels]	1.5-2 pts	48	7	thrips (North Florida only), whiteflies(1)	1B	(1) Use as tank mix with a pyrethroid for whitefly control. Do not apply more than 10 pts per acre, or 18 pts per acre in North Florida per season.
M-Pede 49% EC (Soap, insecticidal)	1-2% V/V	12	0	aphids, leafhoppers, mites, plant bugs, thrips, whiteflies	--	OMRI-listed[2].

Table 13. Selected insecticides approved for use on insects attacking tomatoes.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
***Mustang Max** (zeta-cypermethrin)	2.24-4.0 oz	12	1	beet armyworm, cabbage looper, Colorato potato beetle, cutworms, fall armyworm, flea beetles, grasshoppers, green and brown stink bugs, hornworms, leafminers, leafhoppers, *Lygus* bugs, plant bugs, southern armyworm, tobacco budworm, tomato fruitworm, tomato pinworm, true armyworm, yellowstriped armyworm. Aides in control of aphids, thrips and whiteflies.	3	Not recommended for vegetable leafminer in Florida. Do not make applications less than 7 days apart. Do not apply more than 0.3 lb ai per acre per season.
Neemix 4.5 (azadirachtin)	4-16 fl oz	12	0	aphids, armyworms, hornworms, psyllids, Colorado potato beetle, cutworms, leafminers, loopers, tomato fruitworm (corn earworm), tomato pinworm, whiteflies	18A	IGR, feeding repellant. OMRI-listed[2].
NoMate MEC TPW (pheromone)		0	0	tomato pinworm	--	For mating disruption. See label.
Oberon 2SC (spiromesifen)	7.0-8.5 fl oz	12	7	twospotted spider mite, whiteflies (eggs and nymphs)	23	Maximum amount per crop: 25.5 fl oz/acre. No more than 3 applications.
Platinum (thiamethoxam)	5-8 fl oz	12	30	aphids, Colorado potato beetles, flea beetles, whiteflies	4A	Soil application. See label for rotational restrictions.
***Pounce 3.2 EC** (permethrin)	2-8 oz	12	0	beet armyworm, cabbage looper, Colorado potato beetle, dipterous leafminers, granulate cutworm, hornworms, southern armyworm, tomato fruitworm, tomato pinworm	3	Do not apply to cherry or grape tomatoes (fruit less than 1 inch in diameter). Do not apply more than 1.2 lb ai per acre per season.

Table 13. Selected insecticides approved for use on insects attacking tomatoes.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
***Proaxis Insecticide** (gamma-cyhalothrin)	1.92-3.84 fl oz	24	5	aphids(1), beet armyworm(2), blister beetles, cabbage looper, Colorado potato beetle, cucumber beetles (adults), cutworms, hornworms, fall armyworm(2), flea beetles, grasshoppers, leafhoppers, plant bugs, southern armyworm(2), spider mites(1), stink bugs, thrips(1), tobacco budworm, tomato fruitworm, tomato pinworm, vegetable weevil (adult), whiteflies(1), yellowstriped armyworm(2)	3	(1) Suppression only. (2) First and second instars only. Do not apply more than 2.88 pints per acre per season.
***Proclaim** (emamectin benzoate)	2.4-4.8 oz	48	7	beet armyworm, cabbage looper, fall armyworm, hornworms, southern armyworm, tobacco budworm, tomato fruitworm, tomato pinworm, yellowstriped armyworm	6	No more than 28.8 oz/acre per season.
Prokil Cryolite 96 (cryolite)	10-16 lb	12	14	blister beetle, cabbage looper, Colorado potato beetle larvae, flea beetles, hornworms, tomato fruitworm, tomato pinworm	9A	Minimum of 7 days between applications. Do not apply more than 64 lbs per acre per season. Not for cherry tomatoes.
Provado 1.6F (imidacloprid)	3.8 oz	12	0 - foliar	aphids, Colorado potato beetle, leafhoppers, whiteflies	4A	Do not apply to crop that has been already treated with imidacloprid or thiamethoxam at planting. Do not apply more than 18.75 oz per acre as foliar spray.
Pyrellin EC (pyrethrin + rotenone)	1-2 pt	12	12 hours	aphids, Colorado potato beetle, cucumber beetles, flea beetles, flea hoppers, leafhoppers, leafminers, loopers, mites, plant bugs, stink bugs, thrips, vegetable weevil, whiteflies	3, 21	

Table 13. Selected insecticides approved for use on insects attacking tomatoes.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
Sevin 80S; XLR; 4F (carbaryl)	**80S:** 0.63-2.5 **XLR, 4F:** 0.5-2.0 A	12	3	Colorado potato beetle, cutworms, fall armyworm, flea beetles, lace bugs, leafhoppers, plant bugs, stink bugs (1), thrips (1), tomato fruitworm, tomato hornworm, tomato pinworm, sowbugs	1A	(1) suppression Do not apply more than seven times. Do not apply a total of more than 10 lb or 8 qt per acre per crop.
SpinTor 2SC (spinosad)	1.5-8.0 fl oz	4	1	armyworms, Colorado potato beetle, flower thrips, hornworms, *Liriomyza* leafminers, loopers, *Thrips palmi*, tomato fruitworm, tomato pinworm	5	Do not apply to seedlings grown for transplant within a greenhouse or shadehouse. Leafminer and thrips control may be improved by adding an adjuvant. Do not apply more than three times in any 21 day period. Do not apply more than 29 ozs per acre per crop.
Spod-X LC (beet armyworm nuclear polyhedrosis virus)	1.7-3.4 fl oz	4	0	beet armyworm	--	Treat when larvae are young (1st and 2nd instar). Follow label instructions for mixing. Use only non-chlorinated water at a pH near 7 for mixing. OMRI-listed[2].
Sulfur (many brands)	See label	24	see label	tomato russet mite	--	
***Telone C-35** (dichloropropene + chloropicrin)	See label	5 days (See label)	preplant	garden centipedes (symphylans), wireworms	--	See supplemental label for restrictions in certain Florida counties.
Trigard (cyromazine)	26.6 oz	12	0	Colorado potato beetle (suppression of), leafminers	17	No more than 6 applications per crop.
Trilogy (extract of neem oil)	0.5-2.0% V/V	4	0	aphids, mites, suppression of thrips and whiteflies	26	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed[2].
Ultra Fine Oil, JMS Stylet Oil, and others (oil, insecticidal)	3-6 qts/100 gal (JMS)	4	0	aphids, beetle larvae, leafhoppers, leafminers, mites, thrips, whiteflies	--	Do not exceed four applications per season. Organic Stylet-Oil is OMRI-listed[2].

Table 13. Selected insecticides approved for use on insects attacking tomatoes.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
Venom 20SG (dinotefruan)	**foliar:** 0.44-0.895 lb **soil:** 1.13-1.34 lb	12	**foliar:** 1 **soil:** 21	Colorado potato beetle, green peach aphid, flea beetles, leafhoppers, leafminers, potato aphid thrips, whiteflies	4A	Use only one application method (soil or foliar) do not apply more than 1.34 lb/acre (foliar) or 2.68 lb/acre (soil) per crop season.
***Vydate L 2EC** (oxamyl)	**foliar:** 2-4 pt	48	3	aphids, Colorado potato beetle, leafminers (except *Liriomyza trifolii*), whiteflies (suppression only)	1A	Do not apply more than 32 pts per acre per season.
***Warrior** (lambda-cyhalothrin)	1.92-3.84 fl oz	24	5	aphids[(2)], beet armyworm[(1)], cabbage looper, Colorado potato beetle, cutworms, fall armyworm[(1)], flea beetles, grasshoppers, hornworms, leafhoppers, leafminers[(2)], plant bugs, southern armyworm[(1)], stink bugs, tomato fruitworm, tomato pinworm, whiteflies[(2)], yellowstriped armyworm[(1)]	3	[(1)] for control of 1st and 2nd instars only. [(2)] suppression only. Do not apply more than 0.36 lb ai per acre per season.
Xentari DF (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2 lb	4	0	caterpillars	11B1	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production. OMRI-listed[2].
The pesticide information presented in this table was current with federal and state regulations at the time of revision. The user is responsible for determining the intended use is consistent with the label of the product being used. Use pesticides safely. Read and follow label instructions.						

Table 13. Selected insecticides approved for use on insects attacking tomatoes.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes

[1] Mode of Action codes for vegetable pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v.3.3 October 2003.

1A. Acetylcholine esterase inhibitors, Carbamates
1B. Acetylcholine esterase inhibitors, Organophosphates
2A. GABA-gated chloride channel antagonists
3. Sodium channel modulators
4A. Nicotinic Acetylcholine receptor agonists/antagonists, Neonicotinoids
5. Nicotinic Acetylcholine receptor agonists (not group 4)
6. Chloride channel activators
7A. Juvenile hormone mimics, Juvenile hormone analogues
7C. Juvenile hormone mimics, Pyriproxifen
9A. Compounds of unknown or non-specific mode of action (selective feeding blockers), Cryolite
9B. Compounds of unknown or non-specific mode of action (selective feeding blockers), Pymetrozine
11B1. Microbial disruptors of insect midgut membranes, *B.t.* var *aizawai*
11B2. Microbial disruptors of insect midgut membranes, *B.t.* var *kurstaki*
12B. Inhibitors of oxidative phosphorylation, disruptors of ATP formation, Organotin miticide
15. Inhibitors of chitin biosynthesis, type 0, Lepidopteran
16. Inhibitors of chitin biosynthesis, type 1, Homopteran
17. Inhibitors of chitin biosynthesis, type 2, Dipteran
18. Ecdysone agonist/disruptor
20. Site II electron transport inhibitors
21. Site I electron transport inhibitors
22. Voltage-dependent sodium channel blocker
23. Inhibitors of lipid biosynthesis
25. Neuroactive (unknown mode of action)
26. Unknown mode of action, Azadirachtin

[2] OMRI-listed: Listed by the Organic Materials Review Institute for use in organic production.

*** Restricted Use Only**

Table 14. Selected insecticides approved for use on insects attacking peppers.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
Acramite 50-WS (bifenazate)	0.75-1.0 lb	12	3	twospotted spider mite	25	One application per season.
Actara (thiamethoxam)	2-4 oz	12	0	aphids, flea beetles, pepper weevil, stink bugs, whiteflies	4A	Toxic to bees. Do not apply to blooming plants if bees are foraging.
Admire 2F (imidacloprid)	16-32 fl oz	12	21	aphids, Colorado potato beetle, flea beetles, foliar-feeding thrips, whiteflies	4A	Most effective if applied to soil at transplanting.
Admire 2F (imidacloprid)	0.1 fl oz/1000 plants	12	21 (soil)	aphids, whiteflies	4A	Planthouse: 1 application to transplants. See label.
Agree WG (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lb	4	0	lepidopteran larvae (caterpillar pests)	11B1	Apply when larvae are small for best control. Can be used in greenhouse. OMRI-listed[2].
***Agri-Mek 0.15 EC** (abamectin)	8-16 fl oz	12	7	broad mite, *Liriomyza* leafminers, spider mites, *Thrips palmi*	6	Do not make more than two sequential applications. Do not apply more than 0.056 lb ai per acre per season.
***Ambush 2EC** (permethrin)	6.4-12/8 oz	12	3	cabbage looper, flea beetles, pepper weevil, vegetable leafminer	3	Do not apply more than 1.6 lb active ingredient per acre per season.
***Asana XL 0.66EC** (esfenvalerate)	5.8-9.6 fl oz	12	7	Colorado potato beetle, corn earworm, cucumber beetles (adults), European corn borer, flea beetles, loopers, southern armyworm, (aids in control of beet armyworm and pepper weevil)	3	Do not apply more than 0.35 lb ai per acre per season.
Assail 70WP (acetamiprid)	0.8-1.7 oz	12	7	aphids, Colorado potato beetle, whiteflies	4A	Begin applications for whiteflies when first adults are noticed. Do not apply more than 4 times per season or apply more often than every 7 days.
Avaunt (indoxacarb)	2.5-3.5 oz	12	3	beet armyworm, loopers, southern armyworm, tomato fruitworm	22	Minimum spray interval is 5 days. Do not use more than 14 ounces of product per acre per crop.

Table 14. Selected insecticides approved for use on insects attacking peppers.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
Aza-Direct (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	4	0	aphids, beetles, caterpillars, leafhoppers, leafminers, mites, stink bugs, thrips, weevils, whiteflies	26	Antifeedant, repellent, insect growth regulator. OMRI-listed[2].
Azatin XL (azadirachtin)	5-21 fl oz	4	0	aphids, beetles, caterpillars, leafhoppers, leafminers, mites, stink bugs, thrips, weevils, whiteflies	26	Antifeedant, repellent, insect growth regulator.
***Baythroid 2E** (cyfluthrin)	1.6-2.8 fl oz	12	7	beet armyworm (1), cabbage looper, corn earworm, leafhoppers, leafminers (2), pepper weevil, thrips (except *Thrips palmi*)	3	(1) 1st and 2nd instars only (2) aids in suppression Do not apply more than 0.26 lb ai per acre per season (6 applications)
Biobit HP (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	caterpillars (will not control large armyworms)	11B2	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. OMRI-listed[2].
BotaniGard 22 WP, ES *(Beauveria bassiana)*	**WP:** 0.5-2 lb 100/gal **ES:** 0.5-2 qt 100/gal	4	0	aphids, thrips, whiteflies	--	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides.
***Capture 2EC** (bifenthrin)	2.1-6.4 fl oz	12	7	armyworms, corn earworm, cucumber beetles, cutworms, leafminers, loopers, mites, pepper weevil, thrips, whiteflies	3	Do not make applications less than 7 days apart. Do not apply more than 0.2 lb active ingredient per acre per season.
Condor (*Bacillus thuringiensis* subspecies *kurstaki*)	0.67-1.67 qts	4	0	caterpillars	11B2	Do not use in combination with any chlorothalonil- based fungicides. Use caution when mixing with other oil-based products or surfactants. Treat when larvae are young. Good coverage is essential.
Confirm 2F (tebufenozide)	6-16 fl oz	4	7	beet armyworm, black cutworm, cabbage looper, fall armyworm, southern armyworm, tobacco hornworm, tomato hornworm, true armyworm, yellowstriped armyworm	18	Do not apply more than 1.0 lb ai per acre per season.

Table 14. Selected insecticides approved for use on insects attacking peppers.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
Crymax WDG (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	caterpillars	11B2	Use high rate for armyworms. Treat when larvae are young.
Deliver (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-1.25 lb	4	0	caterpillars	11B2	Use higher rates for armyworms. OMRI-listed[2].
Dibrom 8EC (naled)	1 pt	48	1	aphids, blister beetle, flea beetles, leafminers, mites	1B	Apply no more than 1 pt/acre in Florida. Do not apply when temperature is over 90°F.
Dimethoate 4EC, 2.67EC (dimethoate)	**4EC:** 0.5-0.67 pt **2.67:** 0.75-1 pt	48	7 - 4 EC 0 - 2.67 EC	aphids, leafminers	1B	Highly toxic to bees.
Dimilan (diflubenzuron)	4-8 oz	12	7	foliage-feeding caterpillars, pepper weevil (reduces hatching of eggs produced by adults that have consumed treated foliage)	15	Up to 5 applications per season, but no more than 24 oz. per acre per season.
DiPel DF (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	caterpillars	11B2	Treat when larvae are young. Good coverage is essential.
***Di-Syston 15G** (disulfoton)	6.7-13.3 lb	48	90	aphids	1B	Apply once at transplanting or planting.
Endosulfan 3EC (endosulfan)	0.66-1.33 qt	24	See label 1 or 4, depending on rate used.	aphids, armyworms, flea beetles, hornworms, leafhoppers, pepper maggot, whiteflies	2	Do not apply more than twice a year. Do not exceed 2.0 lb active ingredient per acre per year.
Entrust (spinosad)	0.5-2.5 oz	4	1	armyworms, flower thrips, hornworms, leafminers, loopers, other caterpillars, *Thrips palmi*, tomato fruitworm	5	Do not use more than 9 oz per acre per crop. OMRI-listed[2].
Esteem Ant Bait (pyriproxyfen)	1.5-2.0 lb	12	1	red imported fire ant	7C	Apply when ants are actively foraging.

Table 14. Selected insecticides approved for use on insects attacking peppers.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
Extinguish ((S)-Methoprene)	1.0-1.5 lb	4	0	fire ants	7A	Slow-acting IGR (insect growth regulator). Best applied early spring and fall whre crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks. This is the only firea nt bait labeled for use on cropland. May be applied by ground equipment or aerially.
Fulfill (pymetrozine)	2.75 oz	12	0	green peach aphid, potato aphid, suppression of whiteflies	9B	Do not make more than two applications.
Intrepid 2F (methoxyfenozide)	4-16 fl oz	4	1	beet armyworm, cabbage looper, cutworms, fall armyworm, southern armyworm, tobacco/tomato hornworms, tomato fruitworm, true armyworm, yellowstriped armyworm	18	Do not apply more than 1.0 lb per acre per season.
Javelin WG (*Bacillus thuringiensis* subspecies *kurstaki*)	0.12-1.50	4	0	most caterpillars, but not *Spodoptera* species (armyworms)	11B2	Treat when larvae are young. Thorough coverage is essential. OMRI-listed[2].
Kelthane MF 4 (dicofol)	0.75-1.5 pt	12	2	mites	20	Do not apply more than 2 applications per year or more than 1.6 pts per year.
Knack IGR (pyriproxyfen)	8-10 fl oz	12	14	sweetpotato/silverleaf whiteflies (immature)	7C	Do not make more than 2 applications per growing season.
***Lannate LV, *SP** (methomyl)	**LV:** 0.75-3.0 pt **SP:** 0.25-1.0 lb	48	3	armyworms, beet armyworm, fall armyworm, green peach aphid, loopers, variegated cutworm	1A	No more than 10 applications per crop.
Lepinox WDG (*Bacillus thuringiensis* subspecies *kurstaki*)	1.0-2.0 lb	12	0	for most caterpillars, including beet armyworm (see label)	11B2	Treat when larvae are small. Thorough coverage is essential.

Table 14. Selected insecticides approved for use on insects attacking peppers.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
Lorsban 50-W (chlorpyrifos) [24(c) label]	1.33 lb	24	7	beet armyworm	1B	Do not apply within 10 days of transplanting or to plants under severe heat or drought stress. Do not make more than 8 applications.
Malathion 5EC, 8F (malathion)	1.5 pt	12	3	aphids	1B	Can be used in greenhouse.
***MSR 2 Spray Concentrate** (oxydemeton-methyl)	2 pt	48	3	aphids	1B	Do not apply more than 2 times per season.
M-Pede 49% EC Soap, insecticidal	1-2% V/V	12	0	aphids, leafhoppers, mites, plant bugs, thrips, whiteflies	--	
Neemix 4.5 (azadirachtin)	4-16 fl oz.	12	0	aphids, armyworms, cabbage looper, Colorado potato beetle, corn earworm, cutworms, hornworms, leafminers, thrips, tomato pinworm, tomato fruitworm, weevils, whiteflies	26	OMRI-listed[2].
Oberon 2SC (spiromesifen)	7.0-8.5 fl oz	12	7	twospotted spider mite, whiteflies (eggs & nymphs)	23	Maximum amount per crop: 25.5 fl oz/acre. No more than 3 applications.
Orthene 75 S (acephate)	0.33-1.33 lb	24	7	cabbage looper, grasshoppers, green peach aphid, tobacco hornworm	1B	Do not apply more than 2 lb ai per season.
Platinum (thiamethoxam)	5-8 fl oz	12	30	aphids, flea beetles, whiteflies	4A	Soil application. See label for rotational restrictions.
***Pounce 3.2 EC** (permethrin)	4-8 oz	12	3	cabbage looper, corn earworm, cutworms, flea beetles, leafminers, pepper weevil	3	Do not apply more than 1.6 lb ai per acre per season.
***Proclaim** (emamectin benzoate)	2.4-4.8 oz	48	7	beet armyworm, cabbage looper, fall armyworm, hornworms, southern armyworm, tobacco budworm, tomato fruitworm, tomato pinworm, yellowstriped armyworm	6	No more than 28.8 oz/acre per season.

Table 14. Selected insecticides approved for use on insects attacking peppers.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
Provado 1.6 F (imidacloprid)	3.8 oz or 6.2 for pepper weevil only	12	0 foliar	aphids, Colorado potato beetle, leafhoppers, whiteflies	4A	Do not apply to crop that has been treated with imidacloprid or thiamethoxam. Do not apply more than 18.75 ozs per acre as foliar spray.
Pyrellin EC (pyrethrin + rotenone)	1-2 pt	12	12 hours	aphids, cabbage looper, Colorado potato beetle, cucumber beetles, flea beetles, leafhoppers, leafminer, loopers, mites, plant bugs, stink bugs, thrips, whiteflies	3, 21	
Sevin 80S; XLR; 4F (carbaryl)	**80S:** 0.63-2.5 lb **XLR; 4F:** 0.5-2.0 qt	12	3	Colorado potato beetle, cutworms, fall armyworm, flea beetles, lace bugs, leafhoppers, stink bugs (suppression), tarnished plant bug, thrips (suppression), tomato fruitworm, tomato hornworm, tomato pinworm	1A	Do not apply more than seven times.
SpinTor 2 SC (spinosad)	1.5-8.0 fl oz	4	1	armyworms, flower thrips, hornworms, *Liriomyza* leafminers, loopers, *Thrips palmi*, tomato fruitworm	5	Do not apply to seedlings grown for transplant within a greenhouse or shadehouse. Leafminer and thrips control may be improved by adding an adjuvant. Do not apply more than three times in any 21 day period. Do not apply more than 29 ozs per acre per crop.
Spod-X LC (beet armyworm nuclear polyhedrosis virus)	1.7-3.4 fl oz	4	0	beet armyworm	--	Treat when larvae are young (1st and 2nd instar). Follow label instructions for mixing. Use only non-chlorinated water at a pH near 7 for mixing.
***Telone C-35** (dichloropropene + chloropicrin)	See label	5 days - See label	preplant	symphylans, wireworms	--	See supplemental label for restrictions in certain Florida counties.
Trigard (cyromazine)	2.66 oz	12	0	leafminers	17	No more than 6 applications per crop.

Table 14. Selected insecticides approved for use on insects attacking peppers.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
Trilogy (extract of neem oil)	0.5-2.0% V/V	4	0	aphids, mites, suppression of thrips and whiteflies	26	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed[2].
Ultra-Fine Oil, JMS Stylet-Oil, others (oil, insecticide)	3-6 qt/100 gal (JMS)	4	0	aphids, beetle larvae, leafhoppers, leafminers, mites, thrips, whiteflies	--	Stylet-Oil helps manage aphid-borne viruses but does not kill aphids. Organic Stylet-Oil is OMRI-listed[2].
Venom 20SG (dinotefuran)	**foliar:** 0.44-0.895 **soil:** 1.13-1.34 lb	12	**foliar:** 1 **soil:** 21	flea beetle, green peach aphid, leafhoppers, leafminers, potato aphid, thrips, whiteflies	4A	Use only one application method (soil or foliar). Limited to 1.34 lb/acre (foliar) or 2.68 lb/acre (soil).
***Vydate L** (oxamyl)	**foliar:** 2-4 pt	48	7	green peach aphid, leafminers, pepper weevil, thrips	1A	Do not apply more than 24 pts per acre per season.
***Warrior** (lambda-cyhalothrin)	1.92-3.84 fl oz	24	5	armyworms (1st & 2nd instars), cutworms, grasshoppers, hornworms, leafhoppers, loopers, plant bugs, stink bugs, thrips[(1)], tomato fruitworm, vegetable weevil Suppression of aphids, mites whiteflies	3	Do not apply more than 0.36 lb ai/acre per season. [(1)] Does not control western flower thrips.
Xentari DF (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lb	4	0	caterpillars	11B1	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.

The pesticide information presented in this table was current with federal and state regulations at the time of revision. The user is responsible for determining the intended use is consistent with the label of the product being used. Use pesticides safely. Read and follow label instructions.

Table 14. Selected insecticides approved for use on insects attacking peppers.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes

[1] Mode of Action codes for vegetable pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v.3.3 October 2003.

1A. Acetylcholine esterase inhibitors, Carbamates
1B. Acetylcholine esterase inhibitors, Organophosphates
2A. GABA-gated chloride channel antagonists
3. Sodium channel modulators
4A. Nicotinic Acetylcholine receptor agonists/antagonists, Neonicotinoids
5. Nicotinic Acetylcholine receptor agonists (not group 4)
6. Chloride channel activators
7A. Juvenile hormone mimics, Juvenile hormone analogues
7C. Juvenile hormone mimics, Pyriproxifen
9A. Compounds of unknown or non-specific mode of action (selective feeding blockers), Cryolite
9B. Compounds of unknown or non-specific mode of action (selective feeding blockers), Pymetrozine
11B1. Microbial disruptors of insect midgut membranes, *B.t.* var *aizawai*
11B2. Microbial disruptors of insect midgut membranes, *B.t.* var *kurstaki*
12B. Inhibitors of oxidative phosphorylation, disruptors of ATP formation, Organotin miticide
15. Inhibitors of chitin biosynthesis, type 0, Lepidopteran
16. Inhibitors of chitin biosynthesis, type 1, Homopteran
17. Inhibitors of chitin biosynthesis, type 2, Dipteran
18. Ecdysone agonist/disruptor
20. Site II electron transport inhibitors
21. Site I electron transport inhibitors
22. Voltage-dependent sodium channel blocker
23. Inhibitors of lipid biosynthesis
25. Neuroactive (unknown mode of action)
26. Unknown mode of action, Azadirachtin

[2] OMRI-listed: Listed by the Organic Materials Review Institute for use in organic production.

*** Restricted Use Only.**

Table 15. Selected insecticides approved for use on insects attacking eggplant.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
Acramite 50-WS (bifenazate)	0.75-1.0 lb	12	3	twospotted spider mite	25	One application per season.
Admire 2 F (imidacloprid)	16-24 fl oz	12	21	aphids, Colorado potato beetle, flea beetles, foliar-feeding thrips, leafhoppers, whiteflies	4A	Most effective if applied to soil at transplanting.
	0.1 fl oz/1000 plants	12	21	aphids, whiteflies	4A	Planthouse: 1 application. See label.
***Agri-mek 0.15EC** (abamectin)	8-16 fl oz	12	7	broadmite, Colorado potato beetle, *Liriomyza*, leafminers, spider mites, *Thrips palmi*, tomato russet mite	6	Do not use on transplants. No more than 2 sequential applications.
***Ambush 25 W** (permethrin)	6.4-12.8 oz	12	3	cabbage looper, Colorado potato beetle, flea beetles, leafminers	3	Do not apply more than 2 lb ai per acre per season.
***Asana XL (0.66 EC)** (esfenvalerate)	5.8-9.6 fl oz	12	7	Colorado potato beetle, corn earworm, flea beetle, loopers	3	Do not apply more than 0.35 lb ai per acre per season.
Assail 70 WP (acetamiprid)	0.6-1.7 oz	12	7	aphids, Colorado potato beetle, thrips, whiteflies	4A	Begin applications for whiteflies when first adults are noticed. Do not apply more than 4 times per season or apply more often than every 7 days.
Avaunt (indoxacarb)	2.5-3.5 oz	12	3	beet armyworm, loopers, southern armyworm, tomato fruitworm, tomato pinworm	22	Do not apply more than 14 oz of Avaunt per acre per crop. Minimum spray interval is 5 days.
Aza-Direct (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	4	0	aphids, beetles, caterpillars, leafhoppers, leafminers, mites, stink bugs, thrips, weevils, whiteflies	26	Antifeedant, repellent, insect growth regulator. OMRI-listed[2].
Biobit HP (*Bacillus thuringiensis* subspecies *kurstaki*)	5-21 fl oz	4	0	caterpillars (will not control large armyworms)	11B2	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. OMRI-listed[2].

Table 15. Selected insecticides approved for use on insects attacking eggplant.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
BotaniGard 22 WP, ES *(Beauveria bassiana)*	**WP:** 0.5-2.0 lb/100 gal **ES:** 0.5-2 qts/100 gal	4	0	aphids, thrips, whiteflies	--	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides.
***Capture 2 EC** (bifenthrin)	2.1-6.4 fl oz	12	7	armyworms, cabbage looper, Colorado potato beetle, corn earworm, cucumber beetles, flea beetles, *Lygus* spp., mites, plant bugs, stink bugs, thrips, tomato hornworm, tomato pinworm, vegetable leafminer, whiteflies	3	Do not make applications less than 7 days apart. Do not apply more than 0.2 lb active ingredient per acre per season.
Checkmate TPW-F (pheromone)	1.2-6.0 fl oz	0	0	tomato pinworm	--	For mating disruption - see label.
Condor (*Bacillus thuringiensis* subspecies *kurstaki*)	0.67-1.67 qts	4	0	caterpillars	11B2	Do not use in combination with any chlorothalonil-based fungicides. Use caution when mixing with other oil-based products or surfactants. Treat when larvae are young. Good coverage is essential.
Confirm 2F (tebufenozide)	6-16 fl oz	4	7	beet armyworm, black cutworm, cabbage looper, fall armyworm, southern armyworm, tobacco hornworm, tomato hornworm, true armyworm, yellowstriped armyworm	18	Do not apply more than 16 ounces per application or more than 64 ounces product per season.
Crymax WDG (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	caterpillars	11B2	Use high rate for armyworms. Treat when larvae are young.
Deliver (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25-1.5 lb	4	0	caterpillars	11B2	Use higher rates for armyworms. OMRI-listed[2].

Table 15. Selected insecticides approved for use on insects attacking eggplant.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
Dibrom 8 EC (naled)	1 pt	48	1	aphids, blister beetles, flea beetles, leafminers, mites	1B	Apply no more than 1 pt/acre in Florida. Do not apply when temperature is over 90°F.
DiPel DF (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0	4	0	caterpillars	11B2	Treat when larvae are young. Good coverage is essential. Can be used in greenhouses.
Endosulfan 3 EC (endosulfan)	0.66-1.33 qt	24	1	Colorado potato beetle, blister beetle, flea beetles, green peach aphid, green stick bug, whiteflies	2	No more than 2 applications or 1.0 lb ai per year.
Entrust (spinosad)	0.5-2.5 oz	4	1	armyworms, flower thrips, hornworms, leafminers, loopers, other caterpillars, *Thrips palmi*, tomato fruitworm	5	No more than 9 oz per acre per crop. OMRI-listed[2].
Esteem Ant Bait (pyriproxyfen)	1.5-2.9 lb	12	1	red imported fire ant	7C	Apply when ants are actively foraging.
Extinguish ((S)-Methoprene)	1.0-1.5 lb	4	0	fire ants	7A	Slow-acting IGR (insect growth regulator). Best applied early spring and fall whre crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks. This is the only firea nt bait labeled for use on cropland. May be applied by ground equipment or aerially.
Fulfill (pymetrozine)	2.75 oz	12	0	green peach aphid, potato aphid, suppression of whiteflies	9B	Apply before populations build to damaging levels. Minimum of 7 days between applications. Do not make more than two applications.

Table 15. Selected insecticides approved for use on insects attacking eggplant.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
Intrepid (methoxyfenozide)	0.12-1.50 lb	4	1	beet armyworm, cabbage looper, fall armyworm, hornworms, southern armyworm, tomato fruitworm, true armyworm, yellowstriped armyworm	18	Do not apply more than 16 oz per application or more than 64 oz product per season.
Javelin WG (*Bacillus thuringiensis* subspecies *kurstaki*)	0.12-1.50 lb	4	0	most caterpillars, but not *Spodoptera* species (armyworms)	11B2	Treat when larvae are young. Thorough coverage is essential. OMRI-listed[2].
Knack IGR (pyriproxyfen)	8-10 fl oz	12	14	immature whiteflies	7C	Apply when nymphs first appear. Make no more than two applications.
Kryocide (cryolite)	8-16 lb	12	14	blister beetles, cabbage looper, Colorado potato beetle larvae, flea beetles, fruitworm, hornworms, tomato pinworm	9A	Do not exceed 64 lb per acre per season.
***Lannate LV; *SP** (methomyl)	**LV:** 0.75-3.0 pt **SP:** 0.25-1.0 lb	48	5	beet armyworm, corn earworm, green peach aphid, tomato pinworm (ground application only)	1A	No more than 10 applications per crop.
Lepinox WDG (*Bacillus thuringiensis* subspecies *kurstaki*)	1.0-2.0 lb	12	0	most caterpillars, including beet armyworm (see label)	11B2	Treat when larvae are small. Thorough coverage is essential.
Malathion 8 F (malathion)	0.75-3.5 pt	12	3	aphids, lacebugs, spider mites	1B	Can be used in greenhouse.
***MSR Spray Concentrate** (oxydemeton-methyl)	2 pt	48	7	aphids, mites	1B	Do not apply more than 3 times per season.
M-Pede 49% EC Soap, insecticidal	1-2% V/V	12	0	aphids, leafhoppers, mites, plant bugs, thrips, whiteflies	--	

Table 15. Selected insecticides approved for use on insects attacking eggplant.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
***Mustang Max** (zeta-cypermethrin)	2.24-4.0 oz	12	1	brown stink bugs, cabbage looper, Colorado potato beetle, cutworms, fall armyworm, flea beetles, grasshoppers, green stink bugs, hornworms, leafhoppers, pepper weevil, plant bugs, southern armyworm, tomato fruitworm, tomato pinworm, true armyworm, yellowstriped armyworm	3	Do not make applications less than 7 days apart.
Neemix 4.5 (azadirachtin)	4-16 fl oz	12	0	aphids, armyworms, cabbage looper, Colorado potato beetle, cutworms, hornworms, leafminers, saltmarsh caterpillar, thrips, tomato fruitworm (corn earworm), tomato pinworm, whiteflies	26	OMRI-listed[2].
Oberon 2SC (spiromesifen)	7.0-8.5 fl oz	12	7	twospotted spider mite, whiteflies (eggs and nymphs)	23	Maximum amount per crop: 25.5 fl oz/acre. No more than 3 applications.
Platinum (thiamethoxam)	5-8 fl oz	12	30	aphids, Colorado potato beetle, flea beetles, whiteflies	4A	For most crops that are not on the label, a 120-day plant-back interval must be observed. To manage resistance, avoid using Provado or other related pesticides (Actara, Assail) in conjunction with Platinum.
***Pounce 3.2 EC** (permethrin)	4-8 oz	12	3	cabbage looper, Colorado potato beetle, flea beetles, vegetable leafminer	3	Do not apply more than 2.0 lbs ai per season.

Table 15. Selected insecticides approved for use on insects attacking eggplant.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
***Proaxis Insecticide** (gamma-cyhalothrin)	1.92-3.84 fl oz	24	5	aphids(1), beet armyworm(2), blister beetles, cabbage looper, Colorado potato beetle, cucumber beetles (adults), cutworms, hornworms, fall armyworm(2), flea beetles, grasshoppers, leafhoppers, plant bugs, southern armyworm(2), spider mites(1), stink bugs, thrips(1), tobacco budworm, tomato fruitworm, tomato pinworm, vegetable weevil (adult), whiteflies(1), yellowstriped armyworm(2)	3	(1) Suppression only. (2) First and second instars only. Do not apply more than 2.88 pints per acre per season.
***Proclaim** (emamectin benzoate)	2.4-4.8 oz	48	7	beet armyworm, cabbage looper, fall armyworm, hornworms, southern armyworm, tobacco budworm, tomato fruitworm, tomato pinworm, yellowstriped armyworm	6	No more than 28.8 oz/acre per season.
Provado 1.6F (imidacloprid)	3.8 oz	12	0 - foliar	aphids, Colorado potato beetle, leafhoppers, whiteflies	4A	Do not apply if imidacloprid or thiamethoxam have been used.
Pyrellin EC (pyrethrin + rotenone)	1-2 pt	12	12 hours	aphids, Colorado potato beetle, flea beetles, leafhoppers, leafminers, loopers, mites, stink bugs, thrips, whiteflies	3, 21	
Sevin 80 S; XLR; 4F (carbaryl)	**80S:** 0.63-2.5 lb **XLR, 4F:** 0.5-2 qt	12	3	Colorado potato beetle, cutworms, fall armyworm, flea beetles, lace bugs, leafhoppers, stink bugs (suppression), tarnished plant bug, thrips (suppression), tomato fruitworm, tomato hornworm, tomato pinworm	1A	Do not apply more than seven times.

Table 15. Selected insecticides approved for use on insects attacking eggplant.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
SpinTor 2 SC (spinosad)	1.5-8 fl oz	4	1	armyworms, Colorado potato beetle larvae, hornworms, leafminers (*Liriomyza* spp.), loopers, thrips, tomato fruitworm, tomato pinworm	5	Control of leafminers and thrips may be improved by addition of an adjuvant to spray mixture. Do not apply more than three times in any 21 day period.
***Telone C-35** (dichloropropene + chloropicrin)	See label	5 days	preplant	garden centipedes, wireworms	--	See supplemental label for use restrictions in south and central Florida.
Trilogy (extract of neem oil)	0.5-2.0% V/V	4	0	aphids, mites, suppression of thrips and whiteflies	26	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed[2].
Ultra-Fine Oil, JMS Stylet-Oil (oil, insecticidal)	3-6 qts/100 gal (JMS)	4	0	aphids, leafhoppers, leafminers, mites, thrips, whiteflies	--	Do not exceed four applications per season. Stylet-Oil will not control aphids or beetles. Organic Stylet-Oil is OMRI-listed[2].
***Vendex 50 WP** (fenbutatin-oxide)	2-3 lb	48	3	twospotted spidermite	12B	Apply when mites first appear, no more than 3 applications per year.
Venom 20SCG (dinotefuran)	**foliar:** 0.44-0.895 lb **soil:** 1.13-1.34 lb	12	**foliar -** 1 **soil -** 21	Colorado potato beetle, flea beetle, green peach aphid, leafhopper, leafminer, potato aphid, thrips, whiteflies	4A	Do not apply more than 1.34 lb per acre per season (foliar) or 2.68 lb per acre per season (soil). Do not use both application methods.
***Vydate L** (oxamyl)	2-4 pt	48	1	aphids, Colorado potato beetle, leafminers, mites	1A	Do not apply more than 24 pt per acre per season.

Table 15. Selected insecticides approved for use on insects attacking eggplant.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
***Warrior** (Lambda-cyhalothrin)	1.92-3.84 fl oz	24	5	armyworms (1st & 2nd instars), cutworms, grasshoppers, hornworms, leafhoppers, loopers, plant bugs, stink bugs, thrips(1), tomato fruitworm, vegetable weevil Suppression of aphids, mites, whiteflies.	3	Do not apply more than 0.36 lb ai/acre per season. (1) Does not control western flower thrips.
Xentari DF (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lb	4	0	caterpillars	11B1	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.
The pesticide information presented in this table was current with federal and state regulations at the time of revision. The user is responsible for determining the intended use is consistent with the label of the product being used. Use pesticides safely. Read and follow label instructions.						

Table 15. Selected insecticides approved for use on insects attacking eggplant.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes

[1] Mode of Action codes for vegetable pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v.3.3 October 2003.

1A. Acetylcholine esterase inhibitors, Carbamates
1B. Acetylcholine esterase inhibitors, Organophosphates
2A. GABA-gated chloride channel antagonists
3. Sodium channel modulators
4A. Nicotinic Acetylcholine receptor agonists/antagonists, Neonicotinoids
5. Nicotinic Acetylcholine receptor agonists (not group 4)
6. Chloride channel activators
7A. Juvenile hormone mimics, Juvenile hormone analogues
7C. Juvenile hormone mimics, Pyriproxifen
9A. Compounds of unknown or non-specific mode of action (selective feeding blockers), Cryolite
9B. Compounds of unknown or non-specific mode of action (selective feeding blockers), Pymetrozine
11B1. Microbial disruptors of insect midgut membranes, *B.t.* var *aizawai*
11B2. Microbial disruptors of insect midgut membranes, *B.t.* var *kurstaki*
12B. Inhibitors of oxidative phosphorylation, disruptors of ATP formation, Organotin miticide
15. Inhibitors of chitin biosynthesis, type 0, Lepidopteran
16. Inhibitors of chitin biosynthesis, type 1, Homopteran
17. Inhibitors of chitin biosynthesis, type 2, Dipteran
18. Ecdysone agonist/disruptor
20. Site II electron transport inhibitors
21. Site I electron transport inhibitors
22. Voltage-dependent sodium channel blocker
23. Inhibitors of lipid biosynthesis
25. Neuroactive (unknown mode of action)
26. Unknown mode of action, Azadirachtin

[2] OMRI-listed: Listed by the Organic Materials Review Institute for use in organic production.

*** Restricted Use Pesticide**