

Insect Management for Potatoes¹

S. E. Webb²

Chewing insects can cause serious yield and quality losses in potatoes by feeding on the leaves, stems or tubers. Sucking insects can cause direct losses from feeding and indirect losses by transmitting viral diseases. The most important of these insects are described below. A table at the end of the chapter lists insecticides currently registered for potatoes.

Colorado Potato Beetle, *Leptinotarsa decemlineata*

Description

Adult beetles have 10 lengthwise black stripes on yellow-orange wing covers and are approximately 3/8 to 1/2 inch long. They are stout and strongly convex in shape. The yellow-orange spindle-shaped eggs are laid in clusters of 10 to 30 on the undersides of leaves. They are very similar to ladybird beetle eggs but are larger. The larvae are humpbacked, red to orange, and have two rows of black spots on each side of their soft bodies.

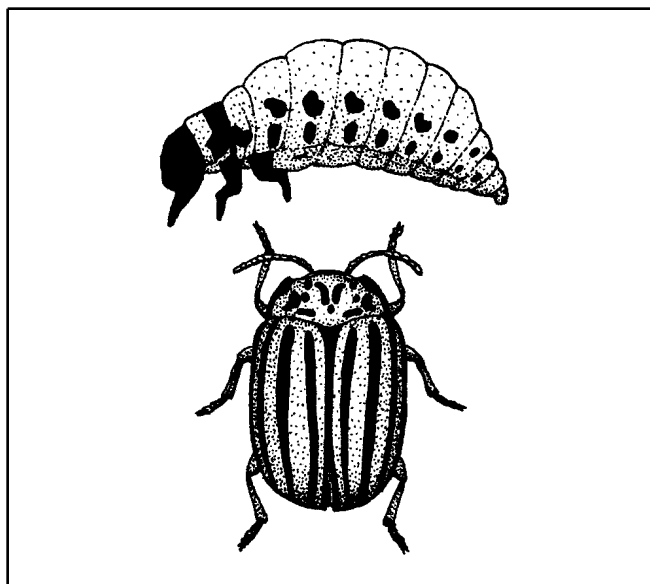


Figure 1. Colorado potato beetle.

Biology

The major food plant of the Colorado potato beetle is potato. Other crop hosts include tomato and eggplant. Wild hosts found in Florida include horsenettle and groundcherry. Horsenettle is found mainly in North Central and North Florida, which is also where the beetle is generally found. Adults

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overwinter in fields where they developed as larvae or in uncultivated areas adjacent to fields. They can also overwinter in wooded areas. Only a small proportion of a population leaves its field of origin by flying. Each adult female can produce about 450 eggs. Larvae, which pass through 4 instars, are generally found near the top of the plant and they seldom move far from the plant on which they hatch unless all the leaves are eaten. About two-thirds of all feeding by larvae occurs in the fourth or last instar. When the larvae have completed their development they enter an inactive pupal stage in the soil. After 5 to 7 days, adults emerge and begin to feed on the potato plants. Under ideal conditions, the life cycle can be completed in three weeks. Potato beetles are unaffected by high concentrations of toxic glycoalkaloids, the naturally occurring bitter compounds in potatoes. The efficient detoxification system of the beetle may also play a part in detoxifying insecticides and in the development of insecticide resistance.

Damage

The Colorado potato beetle is a significant problem only in North Florida production regions. High numbers of late instar larvae can defoliate plants. Yield loss is greatest if heavy damage occurs during tuber formation. Bacterial ring rot and potato spindle tuber disease, which are easily spread by mechanical means, can also be transmitted by Colorado potato beetle.

Table 1. Management options for Colorado potato beetle.

Management Option	Recommendation
Scouting/ Thresholds	Examine about 50 plants or main stems along a V-shaped path extending at least 100 yards into the field and intersecting 50 to 100 rows. Check field edges early in the season. Thresholds used in New England for applying broad-spectrum insecticides are 200 or more small larvae per 50 plants or 30 large larvae. For control with Bt, a threshold of 75 or fewer small larvae is used. Bt is not effective for control of large larvae.

Table 1. Management options for Colorado potato beetle.

Management Option	Recommendation
Notes	More damage can be tolerated before and after tuber formation.
Cultural Practices	Crop rotation is essential and effective for delaying and reducing the initial infestation. Fields should be at least several hundred yards from areas previously infested with beetles.
Natural Enemies	Lady beetles, predacious stinkbugs, parasitic flies, and fungi can help reduce populations. Conserve by limiting applications of broad-spectrum insecticides.
Resistant Varieties	Genetically engineered to contain Bt toxin genes

Wireworms, *Melanotus communis*, *Conoderus* spp.

Description

Wireworms are the larvae of the click beetle. They are shiny, slender, hard-bodied and yellow to brown. Adults are large brown beetles that make a clicking sound when they try to right themselves after being turned over.

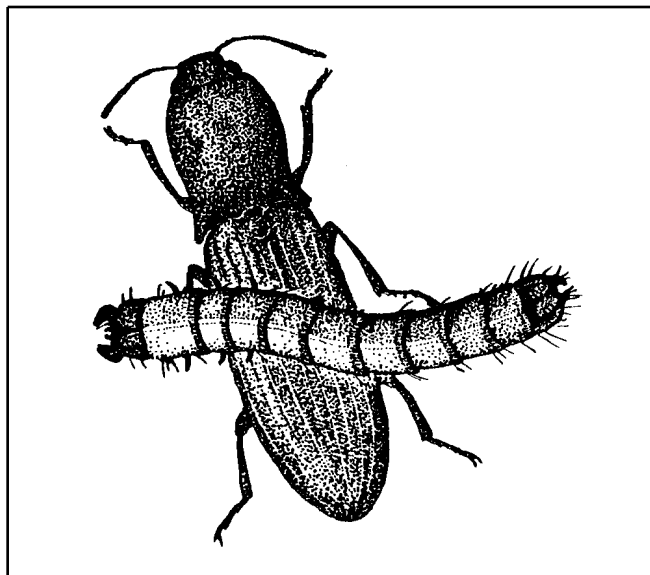


Figure 2. Wireworm larva and adult.

Biology

Depending on species and soil temperature, wireworm larvae can take from 1 to 5 years to develop. Corn wireworm (*Melanotus communis*), common in Florida, may complete its development in 2 to 3 years in South Florida. Most flight activity occurs in May and June. Females lay eggs in cracks or crevices or burrow into the soil. Larvae tend to move deeper as soil temperatures become hotter and move closer to the soil surface when it is cooler. If temperatures drop further, larvae will again move deeper into the soil. Other wireworms found in Florida (*Conoderus* spp.) can complete their development in a year or less, resulting in up to three generations per year in South Florida. These species tend to stay close to the soil surface.

Damage

The adult wireworms do not attack potatoes, however the larvae ("wireworms") feed on potato seed pieces and developing tubers. Wounds to seed pieces allow disease organisms, such as fungi and bacteria, to enter. The greatest damage occurs when larvae tunnel into developing tubers, reducing their quality and value. Damaged tubers are often malformed.

Table 2. Management options for wireworms.

Management Option	Recommendation
Scouting/ Threshold	Determine population density 4 to 5 weeks before planting. Baits are the easiest method. Small amounts of corn, oats, or wheat can be enclosed in a mesh bag and buried 4 to 6 inches deep in 4 or 5 sites per acre for two to three weeks. If soil is below 45 to 50 F, covering the baited area with a clear plastic sheet will help warm it and increase wireworm activity. One wireworm per bait station justifies treatment with a soil insecticide.
Notes	To determine if a sidedress treatment of insecticide is needed after planting, dig seed pieces at random throughout the field as shoots emerge to check for wireworm damage.

Table 2. Management options for wireworms.

Management Option	Recommendation
Natural Enemies	Not well known, do not seem to be important. A fungus and a parasitic wasp have been reported.
Site Selection	If possible, avoid areas with a history of wireworm problems.
Cultural Practices	Avoid planting potatoes in areas that have been in cereals or grasses. In South Florida, delaying the planting of sorghum-sudangrass cover crops until July (well after harvest of winter potatoes) helps keep wireworm populations low.

Leafminers

Description and Biology

The adult is a small fly, 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 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.

Damage

Leafminer damage is only foliar, caused by serpentine mines carved in leaves by feeding leafminer larvae. Heavy damage can reduce photosynthesis and cause leaf desiccation and abscission.

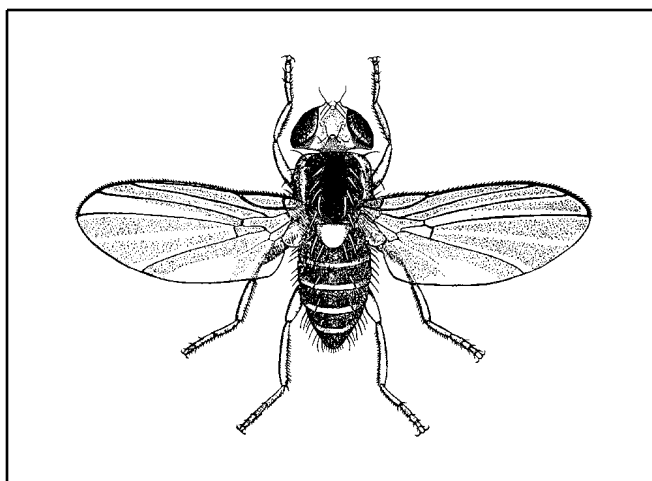


Figure 3. Vegetable leafminer.

Table 3. Management options for leafminers.

Management Options	Recommendation
Scouting/ Threshold	Sampling can be done at the same time that plants are examined for Colorado potato beetle. No thresholds have been determined for leafminers on potatoes, however.
Note(s)	Insecticides applied for leafminer control should target small larvae for best results.
Natural Enemies	A number of parasitic wasps attack vegetable and serpentine leafminers 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.

Flea Beetle, *Epitrix hirtipennis*, others

Description

Tobacco flea beetle (Figure 4) is a fairly typical flea beetle pest of potatoes in Florida. Adults are very small, 1/12 to 1/20 of an inch long. They are reddish-yellow with a brown abdomen and a brown patch crossing the wing covers. Eggs are elongate and slightly pointed at one end. They change from white to lemon yellow as they get close to hatching. Larvae are whitish except for their yellow or yellow-brown heads and reach a length of 1/6 of an inch long.

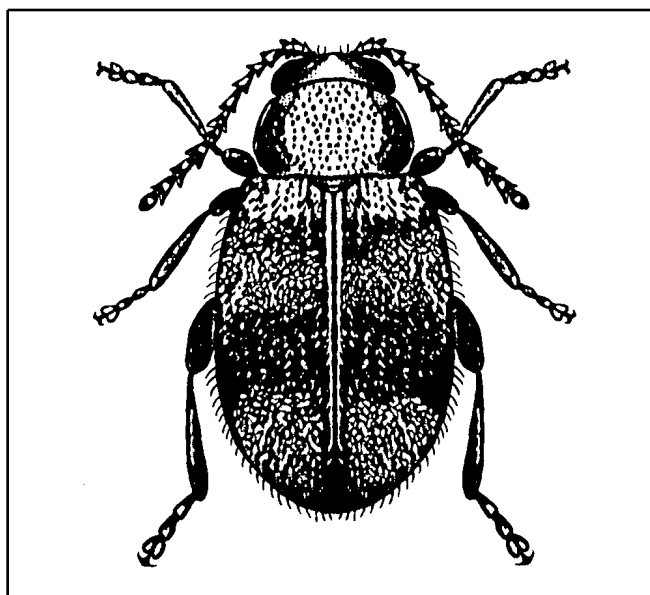


Figure 4. Tobacco flea beetle.

Biology

Tobacco flea beetle feeds on tobacco, potato, tomato, eggplant and other plants in the family Solanaceae. In Florida, at least 4 generations a year can develop. Beetles overwinter as adults under plant debris. If the weather is warm enough, they may remain active all winter. Eggs are laid in the soil near the base of the host plant, in clusters of 5 or 6. Overwintering females can produce up to 200 eggs with later generations producing about 100 eggs per female. Larvae develop through three instars and feed mainly on fine roots near the soil surface. They pupate near the soil surface also. Adults feed on leaves.

Damage

The adult beetle eats small holes partly or completely through the leaves, resulting in the formation of many small "shot holes" in the leaves. Seedlings are most vulnerable to severe damage. Feeding wounds may serve as a point of entry for pathogens.

Table 4. Management options for flea beetles.

Management Options	Recommendation
Scouting/ Threshold	Adults can be monitored with yellow sticky traps or by sweeping, but no thresholds for treatment have been developed.

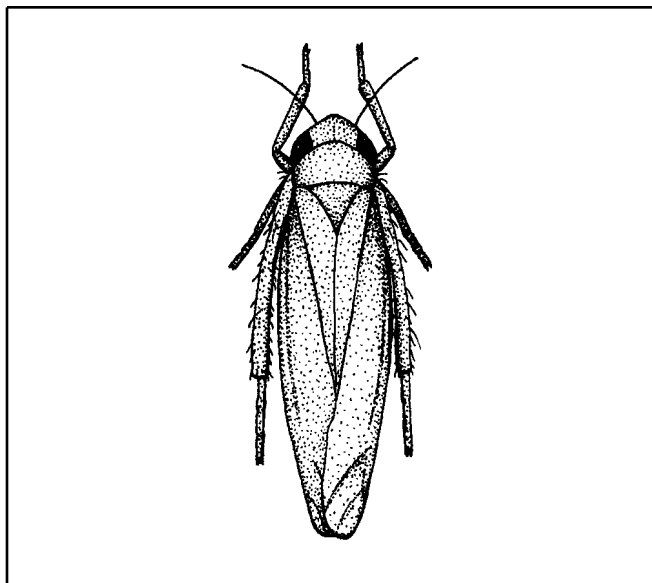
Table 4. Management options for flea beetles.

Management Options	Recommendation
Note(s)	Systemic insecticides are useful for protecting seedlings in areas where flea beetles are a consistent problem.
Natural Enemies	General predators such as big-eyed bug, a parasitoid wasp, and a nematode, <i>Howardula dominicki</i>
Cultural Practices	No effective methods available.

Leafhopper, *Empoasca fabae* and close relatives

Description

The adult potato leafhopper (Figure 5) is pale green with a row of white spots just behind its head. It has a slender body form and is about 1/8 to 1/7 inch long. Eggs are transparent to pale yellow and are inserted into the veins and petioles of leaves. Young nymphs are very small (about 1/25 inch). Wing pads develop from the third through fifth instars.

**Figure 5.** Leafhopper.

Biology

The adult potato leafhopper overwinters in Gulf Coast States, including Florida, and disperses northward. In Florida, it can complete six generations

a year. It feeds on many wild and cultivated plants, but potato is a particularly good host plant. Females can produce 200 to 300 eggs. These hatch in from 7 to 20 days depending on temperature. The average developmental time for nymphs is about 15 days. Adults can live from one to two months. Leafhoppers seem to have few effective natural enemies.

Damage

Leafhopper damage (hopper burn) late in the season is often confused with maturity of the plants (damaged leaves first turn brown along the margins but remaining foliage is often green). The adults and nymphs attack the underside of the leaves and suck the sap. They secrete a toxin into the plant as they feed. This causes the leaves to curl, yellow, and exhibit hopper burn symptoms. Plants may be stunted and yields reduced.

Aphids, *Myzus persicae* and *Macrosiphum euphorbiae*

Description

Aphids are small, soft-bodied insects that reproduce rapidly and feed on plant sap. In Florida, green peach aphid (*Myzus persicae*) (Figure 6) is the most common aphid on potatoes, but potato aphid (*Macrosiphum euphorbiae*) (Figure 7) can also be found. Aphids occur in both winged and wingless forms. The mature wingless form of green peach aphid is egg-shaped, the tubercles at the base of the antennae are prominent and point inward, and the cornicles, tube-like structures on the back of the aphid, are long and unevenly swollen. They can range in color from light green to pink to almost translucent. Potato aphid is larger and more elongated with longer, straight cornicles and can be green, yellow, or pink. The pink form is common in the Hastings area. Its antennal tubercles point outward.

Biology

In Florida, aphids can reproduce without mating all year, as long as host plants are available. They give birth to nymphs rather than laying eggs and their offspring can be producing nymphs of their own in 7 to 10 days depending on temperature. High populations can develop very quickly as plants get

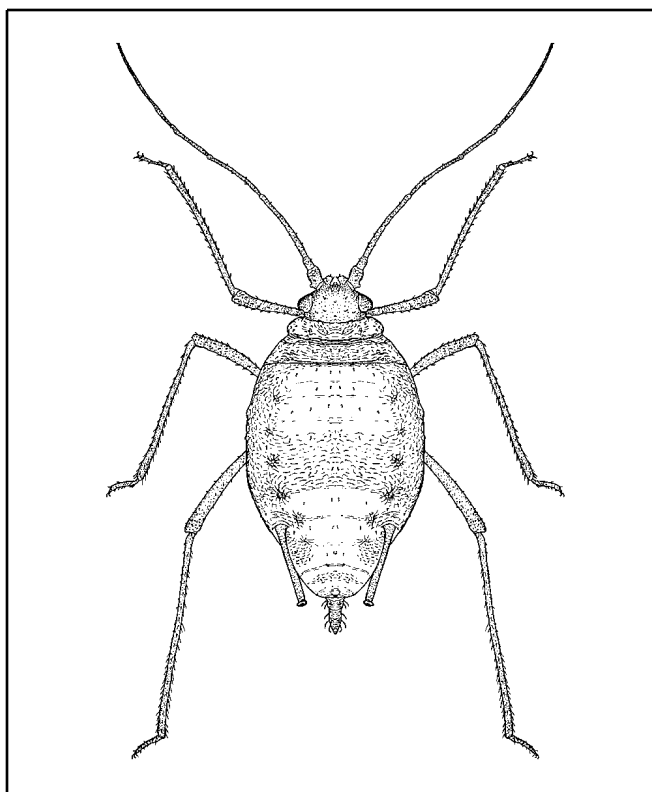


Figure 6. Wingless green peach aphid.

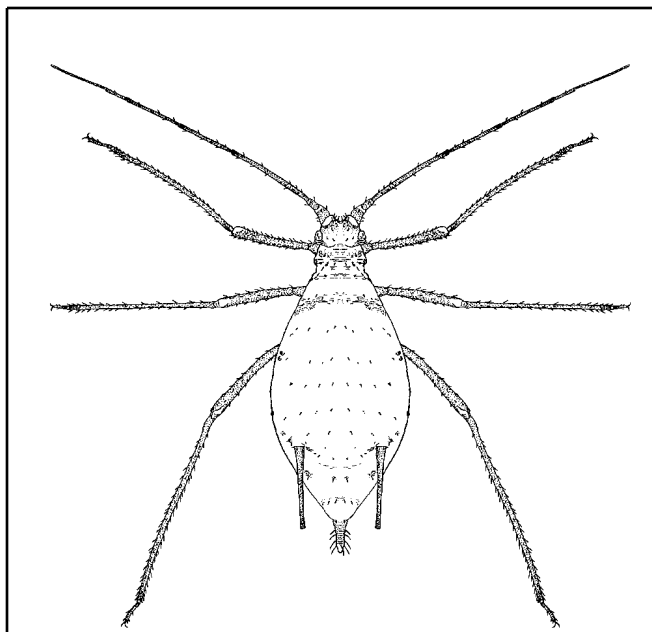


Figure 7. Potato aphid.

crowded. Winged forms develop and fly to new host plants. Aphids have many natural enemies, both general predators such as lacewing and ladybeetle larvae, and more specific parasitoid wasps. Fungi can kill large numbers of aphids in a short period of time.

Damage

Aphids cause damage by sucking juices from the underside of leaves on the above ground portion of the potato plant. Feeding by potato aphids can cause distortion of young leaves and the dying back of the shoot or stem. Green peach aphid is more common in Florida. Early season infestation is the most damaging and can result in yield loss. Green peach aphid is also an excellent virus vector, transmitting viruses from plant to plant. At this time, potato leafroll virus and potato virus Y, the most important of the aphid-transmitted plant viruses affecting potato, are not common in Florida potato fields. Currently, aphids are managed with systemic insecticides applied at planting.

Caterpillar-type Pests (beet armyworm, fall armyworm, southern armyworm, cutworms, cabbage looper, etc.)

Larvae of moths can damage and occasionally defoliate potato plants. Two examples are described below.

Cabbage looper, *Trichoplusia ni* (Hübner) (Figure 8), feeds on a variety of crops. The adults (Figure 9) are night-flying moths with brown, mottled forewings marked in the center with a small, silver figure eight. They lay their eggs (small, ridged, round, greenish-white) singly on both upper and lower leaf surfaces. The eggs hatch into larvae that are green with white stripes running the length of their bodies. The caterpillar has three pairs of slender legs near its head and then three pairs of thick prolegs near the end of its body. It moves in a characteristic looping motion, alternately stretching forward and arching its back as it brings the back prolegs close to its front legs. After feeding for two to four weeks, the caterpillar, about 1.25 inches long when fully grown, spins a cocoon and pupates. The adults emerge 10 days to two weeks later. There can be several generations per year depending on climate. They tend to feed on older leaves.

Beet armyworm, *Spodoptera exigua* (Hübner) (Figure 10), also feeds on many crops and weeds. The highly mobile adult moth (Figure 11) has dark

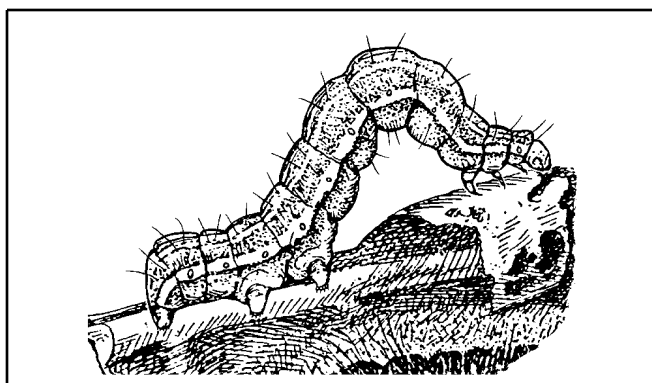


Figure 8. Cabbage looper larva.

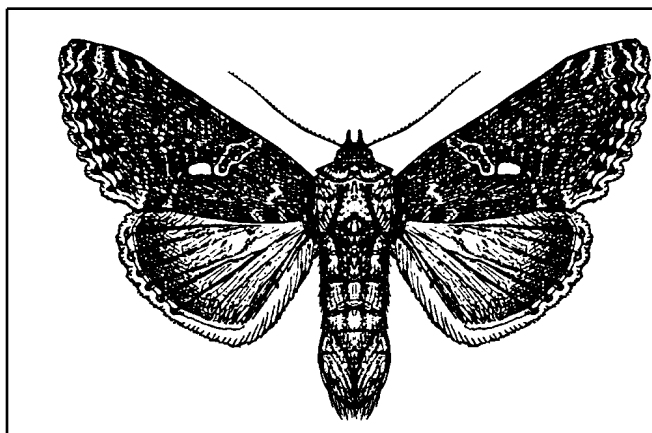


Figure 9. Cabbage looper adult male.

forewings with mottled lighter markings and hind wings thinly covered with whitish scales. Each female can lay over 600 eggs, generally in masses of about 100 on the undersides of leaves in the lower plant canopy. Very young caterpillars feed in groups, and then disperse as they grow older (third instar). The dull green caterpillars have wavy, light-colored stripes lengthwise down the back and broader stripes on each side. After feeding from one to three weeks, they construct a cocoon and pupate, emerging as adults about one week later. Beet armyworm survives the winter in South Florida and can complete many generations a year there. From South Florida, adults migrate into North Florida and other parts of the Southeast.

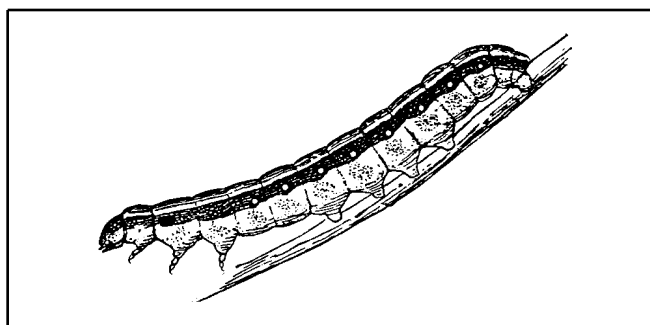


Figure 10. Beet armyworm larva.

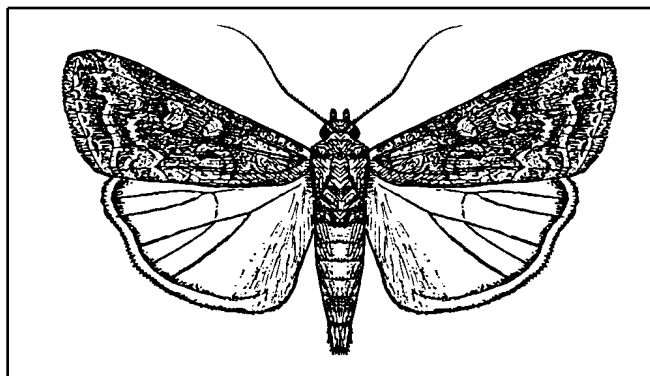


Figure 11. Beet armyworm adult.

Table 5. Management options for caterpillar-type pests.

Management Option	Recommendation
Scouting/ Thresholds	Fields should be monitored for the presence of caterpillars and feeding damage.
Note(s)	Many different forms of <i>Bacillus thuringiensis</i> are available that are highly specific for caterpillar pests and will not harm beneficial insects. However, only small caterpillars are highly susceptible.
Natural Enemies	In Florida, cabbage loopers have been found naturally infected with an insect virus and granulate cutworm has been found infected with a protozoan. A virus and fungal pathogens also infect beet armyworm. Parasitoids, both wasps and tachinid flies, attack beet armyworm. A number of small wasps and a tachinid fly parasitize caterpillars or eggs of cabbage looper. Predaceous bugs, wasps, green lacewings, and spiders may consume eggs and small caterpillars.

Table 6. Selected insecticides approved for use on insects attacking potatoes.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code ¹	Notes
Actara (thiamethoxam)	1.5-3.0 oz	12	14	Colorado potato beetle, potato leafhopper	4A	Toxic to bees. Do not use following soil application of Platinum.
Admire 2F (imidacloprid)	13-20 fl oz/acre; seed-piece treatment: 8-16 oz/acre	12	at planting	aphids, Colorado potato beetle, flea beetles, potato leafhopper, wireworms (seed-piece only)	4A	Do not apply more than 0.31 lb active ingredient per season.
Agree WG (<i>Bacillus thuringiensis</i> subspecies <i>aizawai</i>)	1.0-2.0 lb	4	0	lepidopteran larvae (caterpillar pests)	11B1	Apply when larvae are small for best control. OMRI-listed ² .
*Agri-Mek 0.15 EC (abamectin)	8-16 fl oz	12	14	Colorado potato beetle, <i>Liriomyza</i> leafminers, spider mites	6	No more than 2 sequential applications.
*Ambush 25W (permethin)	3.2-12.8 oz	12	14	cabbage looper, Colorado potato beetle, potato aphid, potato flea beetle, potato tuberworm	3	Do not apply more than 1.6 lb active ingredient per season.
*Asana XL 0.66 EC (esfenvalerate)	2.9-9.6 fl oz	12	7	beet armyworm (aids in control), cabbage looper, Colorado potato beetle, cucumber beetles (adults), cutworms, flea beetles, grasshoppers, potato aphid, potato leafhopper, potato tuberworm, tarnished plant bug	3	Do not apply more than 0.35 lb ai/acre per season.
Avaunt (indoxacarb)	2.5-6.0 oz	12	7	cabbage looper, Colorado potato beetle	22	Do not apply more than 0.44 lb ai/acre per crop.
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.

Table 6. Selected insecticides approved for use on insects attacking potatoes.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code ¹	Notes
*Baythroid 2 (cyfluthrin)	0.8-2.8 fl oz	12	0	cabbage looper, Colorado potato beetle, cutworms, flea beetles, potato leafhopper, potato tuberworm, tarnished plant bugs	3	Allow at least 5 days between applications. A total of 6 applications and a maximum of 16 oz may be applied per acre per season.
Biobit HP (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	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 (<i>Beauveria bassiana</i>)	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 with fungicides.
Clinch (Abamectin)	1 lb	12	0	fire ants	6	Apply when ants are actively foraging. Apply after dew or rainfall has dried for maximum effectiveness. Do not apply if rainfall is anticipated within 4-6 hours.
Condor (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	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.
Crymax WDG (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.5-2.0 lb	4	0	caterpillars	11B2	Use high rate for armyworms. Treat when larvae are young.
Deliver (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.25-1.5 lb	4	0	caterpillars	11B2	Use higher rates for armyworms. OMRI-listed ² .

Table 6. Selected insecticides approved for use on insects attacking potatoes.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code ¹	Notes
Dimethoate 4 EC, 2.67 EC (dimethoate)	4EC: 0.5-1 pt 2.67: 0.75-1.5 pt	48	7 - 4 EC 0 - 2.67 EC	aphids, grasshoppers, leafhoppers, leafminers	1B	Highly toxic to bees.
Dipel DF (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.5-2.0 lb	4	0	caterpillars	11B2	Treat when larvae are young. Good coverage is essential. OMRI-listed ² .
*Di-Syston 15 G (soil only) (disulfoton) 8 EC (soil or foliar)	13.5-20.5 lb	48	75, soil	aphids, Colorado potato beetle, flea beetles, leafhoppers, wireworms	1B	Do not make more than 2 soil applications. See label for details.
	2-3 pt		30 - foliar 75 - soil	green peach aphid (East of Rocky Mountains)	1B	No more than 3 foliar applications.
Endosulfan 3 EC (endosulfan)	0.66-1.33 qts	24	1	aphids, armyworms, Colorado potato beetle, false chinchbugs, flea beetles, leafhoppers, plant bugs, potato tubeworm, stink bugs, threepotato beetle, whiteflies	2	No more than 6 applications per year.
Entrust (spinosad)	1-3 oz	4	7	armyworms, Colorado potato beetle, loopers, thrips	5	Do not apply to consecutive generations of Colorado potato beetle. Do not apply more than 4 times/crop.
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 that is labeled for use on cropland. May be applied by ground equipment or aerially.
Fulfill (pymetrozine)	2.75 oz	12	14	green peach aphid, potato aphid	9B	Apply when aphids first appear.
*Furadan 4F (carbofuran)	1-2 pts	48	14	Colorado potato beetle, flea beetles, leafhoppers	1A	See label for restrictions based on soil type and water table.

Table 6. Selected insecticides approved for use on insects attacking potatoes.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code ¹	Notes
Gaucha (imidacloprid + mancozeb)	0.75 lb/100 lb cut seed-pieces	24	seed-piece treatment	aids in control of aphids, Colorado potato beetle, flea beetles, wireworms	4A	See label for restrictions.
Imidan 70 W (phosmet)	1.3 lb	24	7	Colorado potato beetle, flea beetles, potato leafhoppers	1B	Use only on potatoes to be harvested by machine.
Javelin WG (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.12-1.5 lb	4	0	most caterpillars, but not <i>Spodoptera</i> species (armyworms)	11B2	Treat when larvae are young. Thorough coverage is essential. OMRI-listed ² .
Kryocide (cryolite)	10-12 lb	12	not on label	Colorado potato beetle	9A	Application to exposed tubers may result in excess residues.
*Lannate LV; *SP (methomyl)	LV: 1.5-3.0 pt SP: 0.5-1.0 lb	48	6	aphids, beet armyworm, fall armyworm, flea beetles, leafhoppers, loopers, potato tuberworm, variegated cutworm	1A	
Lepinox WDG (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	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 5 EC; 8 F (malathion)	1-3 pt	12	0	aphids, false chinchbugs, grasshoppers, mealybugs, leafhoppers	1B	
Mocap 10 G, *15 G (ethoprop)	See labels	48	preplant or at planting	symphylans, wireworms	1B	
*Monitor 4 EC (methamidophos)	1-2 pts	48	14	aphids, armyworms, cabbage looper, Colorado potato beetle, cutworms, flea beetles, lygus bug, potato leafhopper, potato tuberworm	1B	
Mi-Pede 49% EC Soap, insecticidal	1-2% V/V	12	0	aphids, Colorado potato beetle, leafhoppers, plant bugs, thrips, whiteflies, mites	--	
Oberon 2SC (spiromesifen)	8-16 fl oz	12	7	potato psyllid, twospotted spider mite, whiteflies	23	Maximum amount per crop: 32.0 fl oz/acre. Maximum applications: 2.

Table 6. Selected insecticides approved for use on insects attacking potatoes.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code ¹	Notes
*PennCap-M (methyl parathion)	2-6 pt	4 days - See label	5	Colorado potato beetle, cutworms, flea beetles, grasshoppers, potato leafhopper, tarnished plant bug	1B	Do not apply more than 24 pt per acre per year.
Platinum (thiamethoxam)	5-8 fl oz	12	applied at planting or at plant emergence	aphids, Colorado potato beetles, flea beetles, potato leafhoppers, 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 Actara or Provado in conjunction with Platinum.
*Pounce 3.2 EC (permethrin)	4-8 oz	12	14	aphids, aster leafhopper, beet armyworm, cabbage looper, Colorado potato beetle, cutworms, flea beetles, leafhoppers, potato tuberworm, tarnished plant bug	3	
Provado 1.6 EC (imidacloprid)	3-8 oz	12	7	aphids, Colorado potato beetle, flea beetles, leafhoppers	4A	
Pyrellin EC (pyrethrin + rotenone)	1-2 pt	12	12 hours	aphids, Colorado potato beetle, cucumber beetles, flea beetles, leafhoppers, leafminers, loopers, lygus bugs, mites, plant bugs, stinkbugs, thrips, vegetable weevil, whiteflies	3, 21	
Rimon 0.83EC (novaluron)	9-12 fl oz	12	14	armyworms, Colorado potato beetle, loopers, other foliage feeding caterpillars, potato tuberworm, whiteflies	15	Do not apply more than 24 oz per acre per season. Limited to 2 applications.
Sevin XLR, 4 F; 80 S (carbaryl)	XLR, 4F: 0.5-2.0 qt 80S: 0.63-2.5 lb	12	7	Colorado potato beetle, corn earworm, cutworms, fall armyworm, flea beetles, hornworms, leafhoppers, stink bugs, tarnished plant bug, tomato fruitworm, tomato hornworm	15	Do not apply more than a total of 6 qt or 7.5 lb.

Table 6. Selected insecticides approved for use on insects attacking potatoes.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code ¹	Notes
SpinTor 2 SC (spinosad)	3-6 fl oz	4	7	armyworms, Colorado potato beetle, leafminers (<i>Liriomyza</i> spp.), loopers, thrips	5	Do not apply to consecutive generations of Colorado potato beetle, or make more than 2 applications per single generation.
Sun Spray 98.8%, JMS Stylet-Oil, others (oil, insecticidal)	3-6 qt/100 gal (JMS)	4	0	leafhoppers, leafminers, thrips, whiteflies, mites	--	See label for tank mix cautions. Organic Stylet-Oil is OMRI-listed ² .
*Telone C-35 (dichloropropene + chloropicrin)	See label	5 days - See label	preplant	symphylans, wireworms	--	See supplemental label for additional use restrictions for certain counties.
*Temik 15 G (aldicarb)	14-20 lb	48	Apply at planting using Positive Displacement ONLY, 100 days PHI	aphids, Colorado potato beetle, flea beetles, leafhoppers	1A	Do not apply after planting. See label for other restrictions.
*Thimet 20-G (phorate)	See label - varies with soil type and time of application.	48	90	aphids, Colorado potato beetle, flea beetles (larvae), leafhoppers, leafminers, wireworms	1B	One application per season.
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 .
Venom 20SG (dinotefuran)	foliar: 0.33 lb soil: 1.4-1.65 lb	12	foliar - 7 soil - at planting	Colorado potato beetle, flea beetle, green peach aphid, potato leafhopper, psyllid	4A	Do not apply more than a total of 2.64 lb/acre per season (0.99 lb foliar plus 1.65 lb soil). Soil application one time either at preplant, preemergence, or at ground crack.
*Vydate L (oxamyl)	foliar: 2-4 pt	48	7	aphids, Colorado potato beetle, flea beetles, leafhoppers, tarnished plant bug	1A	No more than 6 applications per crop.

Table 6. Selected insecticides approved for use on insects attacking potatoes.

Chemical Name	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code ¹	Notes
Xentari DF (<i>Bacillus thuringiensis</i> subspecies <i>aizawai</i>)	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.						
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, Pyriproxyfen						
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, <i>B.t.</i> var <i>aizawai</i>						
11B2. Microbial disruptors of insect midgut membranes, <i>B.t.</i> var <i>kurstaki</i>						
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.						