

Insect, Nematode, and Disease Control in Michigan Field Crops

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**This bulletin contains information on the management of field crops insects, nematodes, and diseases, including recommendations for pesticide use. Every attempt is made to verify product names, formulations, use rates, and other important information, but products and labels may change before the field season begins. Always read the label of a product to reconfirm rates, precautions, PPE, and other important information before use.

Corn (field & seed) Insect Pests

NOTE: Check the “Herbicide/ Organophosphate Insecticide Compatibility” chart on page 41 prior to choosing an organophosphate insecticide (for example, Counter, or Lorsban).

Aphids

Pest status: Common insects, rarely economic pests

Description: Small oval to pear shaped soft-bodied insects, varying shades of green. Have cornicles (“tailpipes”) at rear end.

Life cycle: During the summer, all aphids are female and do not need to mate to reproduce; females produce live young (parthenogenesis). Multiple overlapping generations.

Type of damage: Sucks plant sap from leaves, removing water and nutrients. In heavy infestations, honeydew secretions may result in sticky leaves, whorls, and tassels, inhibiting pollen shed and weakening plants.

Conditions favoring damage: Drought stress may be amplified by aphids removing plant sap.

Management: Biological = natural enemies (ladybugs, lacewings, and wasps) and diseases generally keep populations in check. Heavy rainfall may also reduce the population.

Scouting: Check twenty groups of five plant

Threshold: General guidelines - Consider control if you find 50-400 corn leaf aphids per plant on 50% of the plants, or when there is one colony (group) of aphids or more per plant large enough to make the leaves sticky, but before milk stage.

List of registered insecticides, *RUP (rate per acre):

Asana XL* (5.8 to 9.6 fl oz)

Lorsban 4E* (1 to 2 pt)

Capture 2EC* (2.1 to 6.4 oz)

Malathion 5EC (1.5 pt)

Dimethoate 4EC and 400 (0.67 to 1 pt)

Malathion 8 Aquamul (1 pt) or 8F (1 pt)

Dimethoate 267 (1.0 to 1.5 pt)

PennCap-M* (2 to 3 pt)

Lannate LV* (0.75 to 1.5 pt) or SP* (0.25 to 0.5 lb)

Armyworm

Pest status: Occasional economic pest

Description: Caterpillars variable in color (black/brown/green), up to 1 ½ inches long. Narrow, light stripe across back and broad stripes running down sides of body.

Life cycle: Eggs are laid on the lower leaves of grasses, especially in the headlands of small grains. Larvae feed on leaves of weeds and corn, molting several times. Larvae pupate in the soil and adults emerge in about one week. There are two to three generations per year, the first in late May to early June. The first generation is most damaging.

Conditions favoring damage: Reduced tillage corn fields; corn near small grain fields.

Type of damage: Larvae feed on leaf margins, sometimes completely defoliating plants and leaving only the midrib. Corn plants usually recover if growing point is not injured, but a severe infestation can defoliate a field in two days.

Scouting: Mainly active at night and during overcast days. During the day, larvae often hide in the whorl, at the base of plants and under debris.

Management: Good weed control, especially grasses in the field and along field borders, reduces likelihood of severe infestation.

Threshold: Treat when 25% of plants have 2 or more larvae per whorl, OR 75% of plants have 1 larvae. Treat only if caterpillars are less than 1.25 inch in length. May be able to limit spray to the field edge, if armyworms invade from another field or grassy border.

List of registered insecticides, *RUP (rate per acre):

Ambush 25W* (6.4 to 12.8 oz)

Lorsban 15G (6 to 8 oz per 1000 row ft, into whorl)

Arctic 3.2EC* (4 to 8 oz)

Mustang* (3.4 to 4.3 oz) or Mustang Max* (3.2 to 4.0 oz)

Asana XL* (5.8 to 9.6 fl oz)

PennCap-M* (2 to 3 pt)

Bt - *Bacillus thuringiensis* (check specific products for rates)

Pounce 3.2EC* (4 to 8 fl oz)

[Biobit, Crymax, Dipel, Javelin, Lepinox]

Pounce 25WP* (6.4 to 12.8 oz) or WSB* (1 to 2 sol. bags)

Baythroid 2* (1.6 to 2.8 oz, controls 1st - 2nd instar larvae)

Proaxis * (2.56 to 3.84 oz)

Capture 2EC* (2.1 to 6.4 oz) or 1.15G (3.5 to 8.7 lbs into whorl)

Sevin 4F or XLR Plus (1 to 2 qt)

Intrepid 2F (4 to 8 oz)

Sevin 80S and 80WSP (1.25 to 2.5 lb)

Lannate LV* (0.75 to 1.5 pt) and SP* (0.25 to 0.5 lb)

Warrior* (2.56 to 3.84 fl oz)

Lorsban 4E* (1 to 2 pt)

Billbugs

Pest status: Infrequent, local

Description: Adult weevil is gray/brown/black ¼ to ½ inch long

Life cycle: One generation per year. Adults overwinter along field borders. Emergence occurs during corn planting and continues for about five weeks. Eggs are then laid in the soil or in holes eaten in the corn. After hatching, larvae feed on the root crown and go through five to six instars before pupating. Adults emerge between mid summer and fall.

Conditions favoring damage: Small, young plants much more susceptible. Non-rotated corn, reduced tillage corn, field borders, and areas with nutsedge are at greater risk for injury.

Type of damage: Adults create feeding slits on the lower stem and the leaf whorl. When leaves open may see rows of oval-shaped holes (long, oval shot-holing). Larvae feed on the root crown and may severely reduce yield.

Management: Cultural - Crop rotation is an excellent practice because adult billbugs are slow and don't move far. Control of nutsedge and alternate host is highly recommended. Early planting may get corn through susceptible early stages before billbugs emerge.

Threshold: Treat when one-third of small plants or more show feeding of billbugs. Localized treatment on field margins will reduce the amount of insecticide needed.

Special Note: Counter, Furadan, or Lorsban used pre- and at-planting for corn rootworm control will aid in billbug control.

List of registered insecticides, *RUP (rate per acre):

Counter CR* (4.5-6 oz /1,000 row ft), 15G* (8 oz /1,000 row ft) Lorsban 15G (see label for pre- and at-planting rates)

Cereal Leaf Beetle Adults (CLB)

Pest status: Infrequent pest in corn. More common with small grains nearby.

Description: Adult up to 1/4 inch long; black body, metallic blue wing covers, a red pronotum (neck), and orange-red legs with black tarsi (feet). Eggs- very tiny, oblong; yellow to brown. Larvae- Up to ¼ inch long pale yellow to black, usually covered in fecal material to camouflage themselves. First discovered in Berrien County in 1962.

Life cycle: Adults overwinter in plant stubble and in cracks and crevices such as under tree bark. Mating occurs during warm spring temperatures and eggs are laid on the upper surface of the grain leaves. Larvae feed for about two weeks and move to the soil to pupate. If soil moisture is high they may pupate on the plant. These adults emerge in late June and feed for about 3 weeks, then become sedentary. One generation per year.

Type of damage: Adults feed on the surface of leaves, between the veins, rarely causing economic damage.

Conditions favoring damage: Beetles usually abundant in the margins of corn fields adjacent to heavily infested small grain fields.

Management: Biological ~ wasp parasitoids, lady beetles and various other natural enemies.

Threshold: Treat areas where leaves of whorl stage corn are whitened ("frosted") from feeding beetles (i.e. over 50% defoliation).

List of registered insecticides, *RUP (rate per acre):

Capture 2EC* (2.1 to 6.4 oz)

Proaxis * (2.56 to 3.84 oz)

Malathion ULV (4 to 8 fl oz) or 8 Aquamul (1pt)

Warrior* (2.56 to 3.84 fl oz)

Mustang Max* (2.72 to 4 oz)

Corn Rootworm (CRW) Adults

Pest status: Occasional pest, greatest problems in seed corn

Description: Adult beetles about 1/4 inch long; color varying from yellow with spots (southern CR), yellow with black stripes (western CR), or green (northern CR).

Life cycle: Overwinter as eggs in the soil. Eggs hatch in late May to early June. Larvae feed on corn roots for about three weeks; pupation lasts for about two weeks. Adults emerge in early July and feed through the summer; emergence peaks around late July-August. Adults mate soon after emergence, females continue to lay eggs until death.

Type of damage: Adults prefer feeding on silks, but also feed on leaves, and soft kernels.

Conditions favoring damage: Planting corn after corn. Late-planted corn with fresh silks later in the season.

Threshold: Treat only when silks are clipped shorter than 0.5 inch before pollination occurs and if adults are still active.

List of registered insecticides for Corn Rootworm Adults, *RUP (rate per acre):

Ambush 25W* (6.4 to 12.8 fl oz)

Mustang* (2.9 to 4.3 oz) or Mustang Max* (2.72 to 4 oz)

Arctic 3.2EC* (4 to 8 oz)

PennCap-M* (1 to 2 pt)

Asana XL* (5.8 to 9.6 fl oz)

Pounce 3.2 EC* (4 to 8 fl oz)

Baythroid 2* (1.6 to 2.8 oz)

Pounce 25 WP* (6.4 to 12.8 oz) or WSB* (1 to 2 sol. bags)

Capture 2EC* (2.1 to 6.4 oz)

Proaxis * (2.56 to 3.84 oz)

Dimethoate 4EC and 400 (0.67 to 1 pt), 267EC (1 to 1.5 pts)

Sevin 4F and XLR Plus (1 to 2 qt)

Lannate LV* (0.75 to 1.5 pt) or SP* (0.25 to 0.5 lb)

Sevin 80S and 80WSP (1.25 to 2.5 lb)

Lorsban 4E* (1 to 2 pt)

Warrior* (2.56 to 3.84 fl oz)

Malathion ULV (4 fl oz) or 8 Aquamul (1pt)

Corn Rootworm (CRW) Larvae

Pest status: Important economic pest, greatest problem in corn following corn

Description: Small, white larvae with a brown head, 3 pairs of short legs.

Life cycle: Overwinter as eggs in the soil. Eggs hatch in late May to early June. Larvae feed on corn roots for about three weeks; pupation lasts for about two weeks. Adults emerge in early July and feed through the summer. Eggs laid in soil of fields.

Type of damage: Small larvae feed on root hairs, tips. Larger larvae feed inside large roots, and can severely prune entire nodes of roots. Root loss leads to plant stress from poor water and nutrient uptake. Poor root formation also leads to lodging of plants, harvest problems.

Conditions favoring damage: Planting corn after corn. Late-planted corn with fresh silks later in the season (attract females for egg laying). Damage to first-year corn occasionally occurs in fields with lush growth of alfalfa, soybeans, or weeds during August and September of the previous year, and that are immediately adjacent to heavily infested fields.

Scouting: Count adult rootworms in the current season as a way to predict the threat of the pest the following season as a way to predict the threat of the pest the following season (described in MSU bulletin E-2438). You are strongly urged to make this count if you plan to grow corn after corn and apply a soil insecticide the following year if necessary.

Management: Cultural ~ Crop rotation remains the most effective way to control CRW.

Threshold: When scouting the current-season's corn to predict need for a soil insecticide the next season, 1 beetle per plant. In the current season, a rating scale is used to evaluate root damage after-the-fact, and assess performance of soil insecticides.

For more information: MSU bulletin E-2438, *Corn Rootworms: Biology, Ecology and Management*

Note: Damage from rotation-resistant variant of western corn rootworm can occur in southern Berrien, Branch, Calhoun, Cass, Kalamazoo, St. Joseph, and Van Buren Counties. Treatment of such fields may be warranted. Please notify your county MSU Extension agent to report damage in rotated corn and to get current scouting/ treatment recommendations.

List of registered insecticides, *RUP (rate based on a 30-inch row spacing – method of placement)

See the seed treatment section for additional rootworm control products.

Insecticide Placement:

B = seven inch Band placed behind press wheel

BC = Broadcast and incorporated.

IF = In-Furrow

PPI = Pre-Plant Incorporate

T = Seven inch band placed in front of press wheel (*T*-band)

Aztec 2.1G* (6.7 oz/ 1,000 row feet - T, B, IF)

Lorsban 15G (8 oz/1,000 row feet - T, B, IF, Cult)

Aztec 4.67G* (3 oz / 1,000 row feet – T, B, IF)

Lorsban 4E* (2 pt/acre - Cult) or (6 pt/acre - PPI)

Capture 2EC* (0.3 oz / 1,000 row feet - T)

Lorsban 4E* (2.4 oz/ 1,000 row feet - T)

Capture 1.15 G (6.4 to 8 oz/ 1,000 row feet - T)

Mocap 10G (10.5 oz/ 1,000 row feet - B)

Counter CR* (4.5 to 6 oz/1,000 row feet - T, B, IF, Cult)

Mocap 15G* (8 oz/ 1,000 row feet - B)

Counter 15G* (8 oz/ 1,000 row feet - T, B, IF, Cult)

Mocap EC* (1.4 to 2.9 fl oz/ 1,000 row feet)

Empower 2* 6.4 to 8 oz/ 1,000 row feet

Proaxis * (0.66 oz / 1,000 row feet – IF, T)

Force 3G* (4 to 5 oz/ 1,000 row feet - T, B, IF)

Regent 4SC* (0.24 oz/ 1,000 row feet – IF)

Fortress 5G* (3 to 4.5 oz/ 1,000 row ft - T, IF)

Warrior* (0.66 oz/ 1,000 row feet – IF, T)

Furadan 4F* (2.5 fl oz/ 1,000 row feet - T, B, Cult. BC)

Cutworms

Pest status: Sporadic pest, early season

Description: Several species, including black, dinghy, and variegated cutworms. Black cutworm is most common - larvae (caterpillar) up to 2 inches in length. Variable coloration (gray to black), 4 tubercles per body segment, inner tubercles smaller than the outer tubercles.

Life cycle: Adult moths migrate into Michigan in early spring. Females lay eggs on low-growing weeds (for example, chickweed) or crop debris. Small larvae first feed on weeds, then may move to the crop when larger, or after weed-kill. Several generations per season.

Type of damage: Small larvae create shot holes in the leaves. Older larvae feed on the leaves (variegated) or cut seedlings (black cutworms), reducing stand development. Older plants usually not as affected by cutting as small seedlings. Larvae generally feed at night, and can tunnel into the lower stalk.

Conditions favoring damage: Low, dense weeds in field (egg laying site for females), areas with high crop residue, planting into plowed sod or pasture, cover crops, wet areas, no-till, and late-planted corn after soybeans.

Sampling/ scouting: Begin scouting as soon as corn seedlings emerge. Look for wilted or cut plants; determine percent seedlings damaged. Dig around base of nearby seedlings to identify larvae.

Management: Biological - parasitoids attack older larvae, while ground beetle larvae and adults prey on cutworm larvae. Chemical – rescue (post-planting) treatment is effective and is the preferred option as populations vary from year to year and by location.

Threshold: Treat when five percent or more of crops show cutworm damage.

Special Note: Aztec, Counter, Force, Fortress, Lorsban and Mocap used for corn rootworm control will also control, or aid in control of cutworms. See product label.

List of registered insecticides, *RUP (rate per acre):

| | |
|---|--|
| Ambush 25W* (6.4 to 12.8 fl oz) | PennCap-M* (4 pt) |
| Arctic 3.2EC* (4 to 8 oz) | Pounce 3.2EC* (4 to 8 fl oz) |
| Asana XL* (5.8 to 9.6 fl oz) | Pounce 25WP* (6.4 to 12.8 oz) or WSB* (1 or 2 sol. bags) |
| Baythroid 2* (0.8 to 1.6 oz) | Proaxis* (1.92 to 3.2 oz foliar or 0.66 oz/1,000 row ft – IF, T) |
| Capture 2EC* (2.1 to 6.4 oz) | Sevin 4F and XLR Plus (2 qt) |
| Intrepid 2F (4 to 8 oz) | Sevin 80S and 80WSP (2.5 lb) |
| Lorsban 4E* (1 to 2 pt) | Warrior* (1.92 to 3.2 fl oz foliar) |
| Mustang* (1.4 to 3 oz) or Mustang Max* (1.28 to 2.8 oz) | Warrior* (0.66 oz/1,000 row ft – IF, T) |

(European corn borer is on the following page)

Flea Beetle

Pest status: Common insect, but rarely an economic pest in field corn

Description: Small, shiny black beetles, with enlarged back legs for jumping

Life cycle: Adults overwinter, emerge in the spring. Lay eggs in soil around corn plants. Larvae feed and pupate in soil. Several generations per year.

Type of damage: Beetles feed on the upper leaf surface, leaving white streaking or scratches on leaf epidermis. Beetles also carry and spread Stewarts wilt bacteria – generally not a problem in field corn, but can cause symptoms (linear yellow lesions, wilting, stunting) and yield loss in seed and sweet corn.

Conditions favoring damage: mild winters favor survival of both adults and the Stewarts wilt bacteria

Threshold: Treat when one-third of seedling plants or more show feeding of leaf beetles.

List of registered insecticides, *RUP (rate per acre):

| | |
|---|---|
| Ambush 25 W* (6.4 to 12.8 oz) | PennCap-M* (2 to 3 pt) |
| Arctic 3.2EC* (4 to 8 oz) | Pounce 3.2EC* (4 to 8 fl oz) |
| Asana XL* (5.8 to 9.6 fl oz) | Pounce 25WP* (6.4 to 12.8 fl oz) or WSB* (1 to 2 sol. bags) |
| Baythroid 2* (1.6 to 2.8 oz) | Proaxis * (2.56 to 3.84 oz) |
| Capture 2EC* (2.1 to 6.4 oz) | Sevin 4F and XLR Plus (1 to 2 qt) |
| Lannate LV* (0.75 to 1.5 pt) or SP* (0.25 to 0.50 lb) | Sevin 80S and 80WSP (1.25 to 2.5 lb) |
| Lorsban 4E* (1 to 2 pt) | Warrior* (2.56 to 3.84 fl oz) |
| Mustang* (2.9 to 4.3 oz) or Mustang Max* (2.72 to 4 oz) | |

European Corn Borer (ECB)

Pest status: Common insect. Outbreaks in some years and at some locations.

Description: Adult ~ white to brown moths with waves brown lines on wings. Eggs ~ white, pinhead sized, laid in masses, overlapping like fish scales. Larvae ~ whitish body with black heads, up to an inch when full grown.

Life cycle: Mature larvae overwinter in corn stubble, debris and soil, pupate occurs in late spring. Adult moths emerge in May. Females lay eggs of the 1st generation on the undersides of corn leaves. Eggs hatch within 5-7 days, larvae feed on the leaves or in the whorl. Mature larvae tunnel into stalk to complete development. 1st generation adults emerge, mate, and females lay 2nd generation eggs. 2nd generation larvae bore into the stalk, ear shank, and ear. In most locations of Michigan there are two generations (usually one generation in the UP). ECB have over 200 species of hosts besides corn, and they can be found in weeds, potatoes, peppers, apples, and small grains.

Type of damage: 1st Generation = Shot holing in the leaves by feeding on the whorl, then tunneling into stalk. 2nd generation = Larvae tunnel into the stalk, shank, and ear. Stalk tunneling weakens plant, disrupts water flow, and creates entry wounds for stalk rot fungus.

Conditions favoring damage: Early-planted (taller) fields at risk for 1st gen.; late-planted (shorter) fields at risk for 2nd gen.

Sampling/ scouting: 1st Generation = Mark off 5 sets of 20 consecutive plants. Count the number of plants with ECB feeding, and unroll some whorls to make sure live larvae are still present. 2nd Generation = Mark off 5 sets of 20 consecutive plants and examine each plant for ECB egg masses.

Management: Biological control - Many insect predators as well as birds, bats, and small mammals eat ECB. Parasitoids and pathogens are also common. Cultural- Stalk shredding and plowing reduce number of overwintering moths, but have little impact on subsequent generations. HPR – Resistant hybrids and early crop maturity also help suppress ECB. Transgenic - Bt hybrids effectively kill ECB; non-Bt corn refuge areas must be planted nearby to reduce the chance of resistance to Bt.

Threshold: A decision to treat for ECB depends on many factors including percent infestation, stage of plant and insect growth, and expected yield. A worksheet for calculating the economic threshold can be found in the North Central Regional Publication No. 327, *European Corn Borer: Development and Management*. Scouting and following the worksheet guidelines are strongly recommended for this pest. The following general guidelines should be used only if the more accurate worksheet method cannot be followed. *First Generation* – (last half of June) 50% or more of plants show early feeding (small, whitish marks on the leaves / shot-holing). *Second Generation* (late July) - eggs present on 50% or more of plants and early feeding is first seen.

Note: Timing is critical for ECB control. Large larvae (1/2 in long or longer) are usually deep in the whorls or leaf sheaths, and cannot be reached by insecticides. Do not try to control large larvae. Granules penetrate better into whorls or leaf sheaths than sprays, so granules should be used, when practical.

For more information: Scouting worksheet for 1st generation ECB is in MSU bulletin E-2275

List of registered insecticides, *RUP (rate per acre):

Ambush 25W* (6.4 to 12.8 fl oz)

Arctic 3.2EC* (4 to 8 oz)

Asana XL* (7.8 to 9.6 fl oz)

Bt - *Bacillus thuringiensis* (check specific products for rates)
[Agree WG, Biobit, Crymax, Dipel, Javelin, Lepinox]

Baythroid 2* (1.6 to 2.8 oz)

Capture 2EC* (2.1 to 6.4 oz)

Capture 1.15G* (3.5 to 8.7 lbs / acre directed into whorl)

Empower 2* (3.5 to 8.7 lbs/ acre directed into whorl - 1st generation)

Furadan 4F* (1.5 to 2 pt)

Intrepid 2F (4 to 8 oz)

Lorsban 4E* (1.5 to 2 pt)

Lorsban 15G (5 to 6.5 lb aerial, broadcast into whorl)

Lorsban 15G (3.5 to 8 oz/ 1,000 row feet, 1st gen. or 6 to 8 oz/ 1,000 row feet, 2nd gen. Directed into whorl)

Mustang* (2.9 to 4.3 oz) or Mustang Max* (2.72 to 4 oz)

PennCap-M* (2 to 4 pt)

Pounce 3.2EC* (4 to 8 fl oz)

Pounce 25WP* (6.4 to 12.8 oz) or WSB* (1 to 2 sol. bags)

Proaxis * (2.56 to 3.84 oz)

Regent 4SC* (0.24 oz / 1,000 feet of row)

Sevin 4F and XLR Plus (1.5 to 2 qt)

Sevin 80S and 80WSP (1.87 to 2.5 lb)

Warrior* (2.56 to 3.84 fl oz)

Grasshoppers

Pest status: Common insects, occasional outbreaks

Life cycle: Eggs overwinter in the soil, and nymphs hatch in June. Nymphs molt as they grow, and feeding increases with size. Females lay eggs in the soil in late summer.

Type of damage: Defoliation (chewing) by nymphs and adults.

Conditions favoring damage: Unplowed or fallow areas next to fields are preferred egg-laying sites, and may contribute to populations in a field. Dry, warm weather often enhances survival of nymphs.

Management: Cultural - plowing and cultivation to destroy eggs. Biological – a fungal pathogen can kill many eggs and nymphs under wet spring conditions. Natural enemies include animals (birds, rodents, amphibians), parasitic wasps, and ground beetles.

Threshold: Treat when there are five grasshoppers or more per plant. In tasseled plants, treat when large numbers of hoppers are feeding on the upper leaves.

List of registered insecticides, *RUP (rate per acre):

| | |
|--|---|
| Asana XL* (5.8 to 9.6 fl oz) | Malathion ULV (8 fl oz) |
| Baythroid 2* (2.1 to 2.8 oz) | Mustang* (2.9 to 4.3 oz) or Mustang Max* (2.72 to 4 oz) |
| Capture 2EC* (2.1 to 6.4 oz) | Penncap-M* (2 to 3 pt) |
| Dimethoate 4EC / 400 (1 pt), 5lb (12.8 oz), or 267 (1.5 pts) | Proaxis * (2.56 to 3.84 oz) |
| Furadan 4F* (0.25 to 0.5 pt) | Sevin 4F or XLR Plus (0.5 to 1.5 qt) |
| Lorsban 4E* (0.5 to 1 pt) | Sevin 80S and 80WSP (0.66 to 1.875 lb) |
| Malathion 5EC (1.5 pt) | Warrior* (2.56 to 3.84 fl oz) |
| Malathion 8F and Aquamul (1pt) | |

Japanese beetle adults

Pest status: Common insects, rarely economic pests

Description: Various, depending on species. Japanese beetle is metallic green or bronze with reddish wing-covers and tufts of white hair down the side.

Life cycle: Japanese beetle and rose chafer have many host plants. Larvae (grubs) feed underground on roots. Adult emerge mid-summer, and feed on leaves, flowers, and pollen. One generation per year.

Type of damage: Adults clip silks. Severe clipping can reduce pollination. Adults also feed on leaves, giving them a skeletonized appearance. However, leaf feeding usually doesn't cause economic damage.

Scouting: Randomly examine plants in five areas of the field. Note length and maturity of the silks.

Management: Typically do not cause enough damage to warrant treatment.

Threshold: Treat if unpollinated silks are pruned to within one-half inch of the husk.

List of registered insecticides, *RUP (rate per acre):

| | |
|------------------------------|--------------------------------------|
| Baythroid 2* (1.6 to 2.8 oz) | Sevin 4F and XLR Plus (1 to 2 qt) |
| Capture 2EC* (2.1 to 6.4 oz) | Sevin 80S and 80WSP (1.25 to 2.5 lb) |
| Penncap-M* (2 to 4 pts) | Warrior* (2.56 to 3.84 fl oz) |
| Proaxis * (2.56 to 3.84 oz) | |

Mites

Pest status: Common, but rarely an economic pest

Description: Tiny, wingless, 8-legged; two-spotted spider mite is greenish yellow to orange with 2 black spots on body.

Life cycle: Adults overwinter in field borders and sheltered areas. In spring, adults move to new growth and lay eggs on underside of leaves. Mites spread by crawling or blowing in the wind. Populations can increase quickly in hot, dry weather.

Type of damage: Sucking pest. Adults and nymphs insert mouthparts and feed in individual plant cells, resulting in small speckled yellow spots (stippling), water loss, and leaf damage.

Conditions favoring damage: Prolonged dry, hot weather

Sampling/scouting: Look for mites on undersides of leaves using hand lens, or tap leaves over a piece of paper. Webbing may be present on leaves if population is high.

Management: Biological – a natural fungal pathogen can infect and wipe out large mite populations.

Threshold: Treat when one-third of plants or more have mites and when the first yellowing of the leaves appears.

List of registered insecticides, *RUP (rate per acre):

| | |
|-------------------------------|---|
| Capture 2EC* (5.12 to 6.4 oz) | Dimethoate 4EC, 400 (0.67 to 1 pt) or 267EC (1 to 1.5 pt) |
| Comite 25 (2 to 3 pt) | Dimethoate 5lb (8.4 to 12.8 oz) |

Seedcorn Maggot

Pest status: Occasional, localized pest

Description: Larva is a small (1/4 inch), white maggot, with no legs or visible head; adult is a small gray fly.

Life cycle: Overwinter as pupae in soil. Adult flies emerge in early spring, laying eggs in disturbed soil with decaying organic matter. Larvae feed on decaying matter or seeds. Several generations per year.

Type of damage: Maggots feed on germinating seed; may cause variable emergence, stand loss and delayed development.

Conditions favoring damage: Cool wet soil (delays germination) or any other factor that slows germination; soils high in organic matter from cover crop or manure.

Management: Cultural – Shallow seeding in prepared, warm soil decreases potential for injury. Delay planting into cover crops until after organic matter decomposition.

Threshold: Treat where corn is planted in soils high in organic matter where manure has been applied, or fields that have a heavy growth of green plant material plowed down in the spring.

List of registered insecticides, *RUP (rate based on a 30-inch row - placement)

Insecticide Placement:

B = Seven-inch Band placed behind press wheel *BC = Broadcast and incorporated.*
IF = In-Furrow *PPI= Pre-Plant Incorporate*
T =Seven-inch band placed in front of press wheel (T-band)

See the seed treatment section for additional maggot control products.

| | |
|--|--|
| Aztec 2.1G* (6.7 oz/ 1,000 row feet - T, B, IF) | Force 3G* (4 to 5 oz/ 1,000 row feet - T, B, IF) |
| Aztec 4.67G* (3 oz/ 1,000 row feet - T, B, IF) | Fortress 5G* (3.0/ 1,000 row feet - T, IF) |
| Capture 1.15G* (rate varies with application method - see label) | Lorsban 4E* (4 pt/ acre preplant, 2.6 pts/ acre – T) |
| Capture 2EC* (0.15 to 0.3 oz/ 1,000 row feet - T) | Lorsban 15G (8 oz/ 1,000 row feet – B, IF) |
| Counter CR* (4.5 to 6 oz/ 1,000 row feet - T, B, IF) | Proaxis * (0.66 oz / 1,000 row ft – IF, T) |
| Counter 15G* (8 oz/ 1,000 row feet - T, B, IF) | Regent 4SC* (0.24 oz/ 1,000 row feet – IF) |
| Empower 2* (rate varies with application method - see label) | Warrior* (0.66 oz / 1,000 row feet - T, IF) |

Slugs

Pest status: Common pest, but only a sporadic (though increasingly) economic pest.

Description: 1-2 inches, usually gray to brown in color.

Life cycle: Overwinter as eggs and adults. Females deposit egg masses in soil; these hatch in about one month. Multiple overlapping generations.

Type of damage: May damage seeds and seedlings by feeding on stems, cotyledons, and leaves; heavy feeding on the whorl stage corn may inhibit stand development and reduce yield. Damage often occurs at night.

Conditions favoring damage: Cool, wet conditions in the spring; planting into wheat stubble or other heavy crop residue, or into a field with recent history of slug damage.

Sampling/ scouting: No established method. Note slime trails on the foliage and soil.

Threshold: No thresholds have been established for slugs in corn. Consider treatment if slug damage threatens to reduce plant vigor or stand density below an acceptable level.

List of registered insecticides (rate per acre)

Deadline MPs 4% bait (10 to 40 lb)
 Snail and Slug Pellets 3.5% bait (products and rates vary)

Stalk Borers

Pest status: Rarely an economic pest.

Description: Larvae purple to black. Front half of body is generally darker than rear-half. White stripe down back. Adult moths are dull, white.

Life cycle: Overwinter as eggs. Small larvae tunnel into grasses and other weeds, large larvae may move to corn. Larvae pupate inside tunnels, emerging as moths in August. Eggs (overwinter) deposited on weeds. Stalk borers have a wide host range, and will feed on several hundred different broadleaf and grassy weeds.

Type of damage: Stalk tunneling by larvae – kills small plant outright. Tunneling in larger plants causes “dead heart” (a dead whorl). Infestations can also cause stunting, tillering, and other development problems.

Conditions favoring damage: Corn after corn, grassy field edges, or buffer strips.

Management: Biological - Many insect predators and pathogens. Cultural – mowing field edges to remove egg-laying sites.

Chemical – insecticides can sometimes be applied to field margins, rather than the entire field.

Threshold: Treat when one-third of plants or more show early damage from stalk borers.

List of registered insecticides, *RUP (rate per acre):

Ambush 25W* (6.4 to 12.8 oz)

Arctic 3.2EC* (4 to 8 oz)

Asana XL* (5.8 to 9.6 oz)

Baythroid 2* (1.6 to 2.8 oz)

Capture 2EC* (2.1 to 6.4 oz)

Lorsban 4E* (2 to 3 pt)

Lorsban 15G (8 oz/1,000 row ft)

Mustang* (2.9 to 3.4 oz) or Mustang Max* (2.72 to 4 oz)

Pounce 3.2EC* (4 to 8 fl oz)

Pounce 25WP* (6.4 to 12.8 oz) or WSP* (1 to 2 sol. bags)

Proaxis* (2.56 to 3.84 oz)

Regent 4SC* (0.24 oz / 1,000 feet of row)

Warrior* (2.56 to 3.84 fl oz)

Thrips

Pest status: Common insect, rarely an economic pest

Description: Adult – small, slender, brown and white-banded abdomen, narrow fringed wings; larvae – resemble adults, but are wingless, yellow/orange

Life cycle: Adults move into corn in the spring. Females insert eggs in plant tissue. Larvae and adults both feed on corn. Multiple, overlapping generations.

Type of damage: Most obvious early in season; adult & nymph rasping/sucking mouthparts scrape cells of leaves, stalks and husks, causing silvery lesions. Severe injury may cause stunting. Injury at the base of ears may cause poor quality, under-developed ears susceptible to secondary infection.

Conditions favoring damage: Hot dry weather coupled with large thrips populations.

Management: Biological – many natural enemies (minute pirate bugs, predacious thrips and mites) attack thrips. Chemical control not usually recommended.

Threshold: None. A tremendous number of thrips would have to be present to cause damage.

List of registered insecticides, *RUP (rate per acre):

Malathion 5EC (1.5 pt), 8 aquamul (1 pt), or 8F (1 pt)

White Grubs

Pest status: Localized economic pest (especially in last few years)

Description: White, C-shaped larvae of scarab beetles (includes Japanese, May/ June, European chafer beetles). Up to one inch long in last instar. Orange to brown head.

Life cycle: JB and chafer ~ Adults emerge in mid-summer, lay eggs in fields and turf. Grubs feed until the ground freezes, reaching largest stage in late fall. Grubs resume feeding in early spring, can do considerable damage to small plants. Chafer pupates in late May, JB feeds a little longer. May/June beetle ~ remain in larval stage for several years in undisturbed grassy areas and fallow fields.

Type of damage: Prune small roots and damage larger roots. Corn can wilt, or occasionally turn purple due to inability to take up phosphorus. Severe injury lead to plant death.

Conditions favoring damage: May/June beetles ~ Fields following an established grass, planting into fallow areas.

Sampling/ scouting: Dig one-foot square samples several inches deep and check for grubs. Also watch for grubs moved to the surface when plowing in the spring.

Management: Cultural = spring and fall plowing of established sod is recommended before planting; Chemical = soil insecticide generally not required, but rescue treatments are ineffective.

Threshold: General guideline, minimum of 1 grub per square foot.

List of registered insecticides, *RUP (rate per acre):

Insecticide Placement:

B = seven inch Band placed behind press wheel *BC = Broadcast and incorporated.*

IF = In-Furrow *PPI= Pre-Plant Incorporate*

T = seven inch band placed in front of press wheel (T-band)

See the seed treatment section for additional grub control products.

| | |
|---|--|
| Annex 2EC* (rate varies w/ application method - see label) | Force 3G* (4 to 5 oz/ 1,000 feet of row - T, B, IF) |
| Aztec 2.1G* (6.7 oz/ 1,000 feet of row - T, B, IF) | Fortress 5G* (3.0 to 3.75 oz/ 1,000 feet of row - T, IF) |
| Aztec 4.67G* (3 oz/ 1,000 feet of row - T, B, IF) | Lorsban 15G (8 oz/ 1,000 feet of row - T, IF) |
| Capture 2EC * (rate varies with application method -see label) | Mocap 15G* (8 oz/ 1,000 feet of row - B) |
| Capture 1.15G* (rate varies with application method -see label) | Proaxis* (0.66 oz / 1,000 feet of row - T, IF) |
| Counter CR* (4.5 to 6 oz/ 1,000 feet of row - T, IF) | Regent 4SC* (0.24 oz / 1,000 feet of row - IF) |
| Counter 15G* (8 oz/ 1,000 feet of row - T, IF) | Thimet/ Phorate 20G* (6 oz/ 1,000 feet of row - T, B) |
| Empower 2* (rate varies with application method - see label) | Warrior* (0.66 oz / 1,000 feet of row - T, IF) |

Wireworms

Pest status: Common insect; economic infestations often localized within a field.

Description: Slender, shiny, yellow to brown insect with wiry, segmented, hard body; up to 1.5 inches long.

Life cycle: Wireworms are the immature form of click beetles; found in grasslands, sod, or fallow fields. Wireworms can spend several years in the immature stage. Overlapping generations.

Type of damage: Feed on newly-planted corn seeds as well as roots of established corn. May tunnel into the base of seedlings below the soil surface.

Conditions favoring damage: Porous, well drained loam soils. Corn planted into long-standing fallow fields & pasture.

Sampling/ scouting: Scout for wireworms with a bait trap (see web site below) at least one week before planting.

Management: Cultural – If practical, spring and fall plowing of established sod is recommended before crop is planted

Threshold: It using bait trap, one or more wireworm per trap. Otherwise, consider treating when wireworms are seen while plowing old pasture or fields that had grasses, or where damage has occurred previously.

For more information: http://www.ipm.msu.edu/CAT02_fld/FC5-16-02.htm

List of registered insecticides, *RUP (rate based on 30-inch row - placement)

Insecticide Placement:

B = seven inch Band placed behind press wheel *BC = Broadcast and incorporated.*

IF = In-Furrow *PPI= Pre-Plant Incorporate*

T = seven inch band placed in front of press wheel (T-band)

See the seed treatment section for additional wireworm products.

Wireworms, Continued from previous page

| | |
|---|--|
| Aztec 2.1G* (6.7 oz/ 1,000 feet of row - T, B, IF) | Force 3G* (4 to 5 oz/ 1,000 feet of row - T, B, IF) |
| Aztec 4.67G* (3 oz/ 1,000 feet of row - T, B, IF) | Fortress 5G* (3.0 to 3.75 oz/ 1,000 feet of row - T, IF) |
| Capture 2EC* (rate varies with application method -see label) | Lorsban 15G (8 to 12 oz/ 1,000 feet of row - T, IF, B) |
| Capture 1.15G* (rate varies with application method -see label) | Lorsban 15G (13.5 lb/acre - BC) |
| Counter CR* (4.5 to 6 oz/ 1,000 feet of row - T, IF, B) | Mocap 15G* (8 oz/ 1,000 feet of row - B) |
| Counter 15G* (8 oz/ 1,000 feet of row - T, IF, B) | Regent 4SC* (0.24 oz / 1,000 feet of row - IF) |
| Empower 2* (rate varies with application method - see label) | Thimet/ Phorate 20G* (6 oz/ 1,000 feet of row - T, B) |

Herbicide / Organophosphate (OP) insecticide compatibility chart for conventional & IT corn

| Herbicide | Soil-applied OP ¹ | | | | | | Foliar applied OP ⁴ | |
|--|------------------------------|-------------------------|----------------------|-----------------|----------------|--------------------|------------------------------------|-----------------------------------|
| | Counter 15G | Counter 20 CR in-furrow | Counter 20 CR T-band | Thimet/ phorate | Lorsban 15G | Other ² | ⁵ Days before herbicide | ⁶ Days after herbicide |
| <i>Accent</i> | DNU | DNU | NR | T | T | T | 7 | 3 |
| <i>Accent Gold</i> <i>Accent Gold WDG</i> | DNU | DNU | DNU | DNU | NR | T | 7 | 3 |
| <i>Beacon</i> | DNU | DNU | NR | T | T | T | 10 | 7 |
| <i>Basis</i> | DNU | DNU | NR | NR | NR | T | 7 | 3 |
| <i>Basis Gold</i> | DNU | DNU | NR | NR | NR | T | 7 | 3 |
| <i>Callisto (foliar)</i> | DNU | DNU | NR | NR | T | T ³ | 7 | 7 |
| <i>Hornet WDG (soil-applied)</i> | DNU | DNU | DNU | DNU | T ³ | T ³ | NA | NA |
| <i>Hornet WDG (foliar-applied)</i> | DNU | DNU | DNU | DNU | T ³ | T ³ | 10 | 10 |
| <i>Lightening - IT corn only</i> | DNU | DNU | T ³ | T ³ | T ³ | T ³ | -- | -- |
| <i>Option</i> | DNU | DNU | DNU | DNU | T | T | 7 | 7 |
| <i>Steadfast</i> | DNU | DNU | NR | NR | NR | T | 7 | 3 |

¹ DNU = Do Not Use. Do not apply herbicide to corn treated with soil applied OP; severe injury may result.
 NR = Not Recommended to make an application of herbicide to corn treated with soil applied OP.
 T = Temporary injury may result from application of herbicide to corn treated with soil applied OP.
 NA = not applicable -- = no information

2 Includes *Diazinon* & *Mocap*. *Aztec* & *Fortress* do not appear to interact with herbicides, and can be used without risk of injury.
 3 OP insecticides should be banded to reduce risk of crop injury.
 4 Includes dimethoate, diazinon, Imidan, Lorsban 4F, malathion, PennCap, Basagran and Laddock
 5 Foliar-applied OP can be safety applied this many days BEFORE herbicide treatment
 6 Foliar-applied OP can be safety applied this many days AFTER herbicide treatment

Insecticides Registered for Corn (field and seed)

| Trade name | Common name | Class | Recommended for: | PHI days | REI hrs | Precautions and Remarks |
|--|-------------------------------|-----------|---|----------|---------------------------|---|
| Ambush (RUP) 25W | permethrin | Pyr | armyworm, CRW adults, cutworm, ECB, flea beetle, stalk borers | 30 | 12 | Do not apply more than 0.6 lb a.i. per acre per season. Allow minimum of six days between treatments. PHI for forage is 0 days. Several generics available. |
| Arctic (RUP) 3.2 EC | permethrin | pyr | Armyworm, CRW adults, cutworm, ECB, flea beetle, stalk borer | 30 | 12 | Same precautions as Ambush (above). |
| Asana XL (RUP) | esfenvalerate | Pyr | aphids, armyworm, CRW adults, cutworm, ECB, flea beetle, grasshoppers, stalk borer | 21 | 12 | Maximum 48 oz per acre per season. |
| Aztec 2.1G (RUP) | tebupirimphos + cyfluthrin | OP Pyr | CRW larvae, seedcorn maggot, white grubs, wireworm | -- | 48 | Maximum of 7.3 lbs per acre per season. |
| Aztec 4.67G (RUP) | tebupirimphos + cyfluthrin | OP Pyr | CRW larvae, seedcorn maggot, white grubs, wireworm | -- | 48 | Maximum of 3.27 lbs per acre per season. |
| Bt [Agree, Biobit, Crymax, Dipel, Javelin, Lepinox] | <i>Bacillus thuringiensis</i> | Bio | armyworm, ECB | 0 | 4 | Use only to control small armyworm when populations are low. Full spray coverage is needed. |
| Baythroid 2 (RUP) | cyfluthrin | Pyr | armyworm, CRW adults, cutworm, ECB, flea beetle, grasshopper, JB adults, stalk borer. | 21 | 12 | Maximum of 11.2 oz per acre per season. |
| Capture (RUP) 2EC, 1.15G | bifenthrin | Pyr | aphids, armyworm, CLB, CRW adults, CRW larvae, cutworm, ECB, flea beetle, grasshopper, JB adults, mites, seedcorn maggot, stalk borer, white grub, wireworm | 30 | 12 -EC 24 -G | Maximum 12.8 oz a.i. of the 2EC per acre per season. Note that the REI for detasseling and roguing seed corn treated with Capture 1.15G is 18 DAYS. |
| Comite 25 | propargite | other | mites | 30 | 168 | Maximum 1 application per season. Apply only when corn leaves are dry to prevent crop injury. Rotation interval to small grains is 82 days. Rotation interval to other food/feed crops is 6 months, unless propargite is registered on that crop. |
| Counter (RUP) CR, 15G | terbufos | OP | billbugs, CRW larvae, ECB, seedcorn maggot, white grub, wireworm | 30 | 48 | Maximum 6.5 lb 20 CR per acre. |
| Deadline MPs 4% bait | metaldehyde | other | slugs | --- | 12 | Broadcast by ground or air every 3 to 4 weeks during season as needed. For best results apply in the evening, preferably after a rain or irrigation. |
| Dimethoate 4EC, 400, 5 lb, 267 EC | dimethoate | OP | CRW adults, grasshoppers, mites | 14 | 48 | Maximum 2 applications per season. Do not apply during pollen shed if bees are actively foraging in field. Dimethoate is systemic and full coverage is not required. Several generics available. |

CORN

| Trade name | Common name | Class | Recommended for: | PHI days | REI hrs | Precautions and Remarks |
|-----------------------------------|--------------------|--------------|--|-----------------|----------------|---|
| Empower 2 (RUP) | bifenthrin | Pyr | CRW larvae, ECB, seedcorn maggot, white grub, wireworm | 30 | 24 | Note that the REI for detasseling and roguing seed corn treated with Empower is 18 DAYS. |
| Force 3G (RUP) | tefluthrin | Pyr | CRW larvae, seedcorn maggot, white grubs, wireworm | -- | 48 | Use only high rate for severe infestations. Apply in-furrow for best control. Do not apply within 20 yards of water. |
| Fortress 5G (RUP) | chlor-ethoxyfos | OP | CRW larvae, seedcorn maggot, white grubs, wireworm | -- | 48 | Rotation interval is 30 days. For optimal control apply IF. Fortress 5G is available in closed handling system. |
| Furadan 4F (RUP) | carbofuran | Carb | CRW larvae, ECB, grasshoppers | 30 | 48 | Max two applications per season. |
| Intrepid 2F | methoxy-fenozide | Other | armyworm, cutworm, ECB | 30 | 24 | Maximum of 8.7 lbs per acre at planting. Maximum of 26.1 lbs per acre per season. |
| Lannate (RUP) LV & SP | methomyl | Carb | aphids, armyworm, CRW adults, flea beetle | 21 | 48 | |
| Lorsban 15G | chlor-pyrifos | OP | armyworm, billbugs, CRW larvae, ECB, seedcorn maggot, stalk borers, white grubs, wireworm | 35 | 24 | Maximum 13.5 lb per acre per season. For best control, apply as an in-furrow treatment. Pre-harvest interval for grazing is 14 days, and for fodder, 35 days. |
| Lorsban 4E (RUP) | chlor-pyrifos | OP | aphids, armyworm, billbugs, CRW adults; CRW larvae, cutworms, ECB, flea beetle, grasshoppers, seedcorn maggot, stalk borers | 35 | 24 | Maximum 15 pts per acre per season. Pre-harvest interval for grazing is 14 days, and for fodder, 35 days. Several generics available. |
| Malathion 8F, 5EC, 8 aquamul, ULV | malathion | OP | aphids, CLB, CRW adults, grasshoppers, thrips | 5 | 12 | |
| Mocap 10G, EC (RUP), 15G (RUP) | ethoprop | OP | CRW larvae, white grubs, wireworm | -- | 48 | For CRW, apply in a band and mix with top 2 to 4 inch of soil. See label for other band-widths and row spacing varying from 30 inches. Do not allow granules to contact seed. |
| Mustang and Mustang Max (RUP) | zeta-cypermethrin | Pyr | aphids, armyworm, CRW adults, cutworms, ECB, flea beetles, grasshoppers, stalk borer | 30 | 12 | Max rate varies with pest, see label. Pre-harvest interval is 30 days for fodder, 60 days for silage and forage. |
| PennCap-M (RUP) | methyl parathion | OP | aphids, armyworm, CRW-adults, cutworms, ECB, flea beetles, grasshoppers, Japanese beetle | 12 | 96 | Do not apply at pollen shed if bees are visiting field. |
| Pounce (RUP) 3.2EC, 25WP, WSP | permethrin | Pyr | armyworm, CRW adults, cutworm, ECB, flea beetle, stalk borers | 30 | 12 | Do not apply more than 0.6 lb a.i. per acre per season. Allow minimum of six days between treatments. Preharvest interval is 30 days for fodder, 0 days for forage. Several generics available. |
| Proaxis (RUP) | gamma cyhalothrin | Pyr | armyworm, CLB, CRW adults, CRW larvae, cutworms, ECB, flea beetle, grasshoppers, Japanese beetle, seedcorn maggot, stalk borer, white grub | 21 | 24 | |

CORN

| Trade name | Common name | Class | Recommended for: | PHI days | REI hrs | Precautions and Remarks |
|--|--------------------|--------------|--|-----------------|----------------|---|
| Regent (RUP) 4SC | fipronil | Other | CRW larvae, ECB, stalk borers, seedcorn maggot, white grubs, wireworms | 90 | 24 | Do not apply on row spacings LESS THAN 30 INCHES. Do not apply to sweet corn or popcorn. Do not plant small grains or other rotational crops within 12 months following application. Regent will aid in control of first-generation corn borer. |
| Sevin 4 F, XLR Plus 80 S, 80 WSP | carbaryl | Carb | armyworm, CRW adults, cutworms, ECB, flea beetles, grasshoppers, Japanese beetle, | 48 | 12 | Maximum 4 applications per season. . Preharvest interval is 48 days for fodder, 14 days for grazing and silage. |
| Snail and Slug Pellets 3.5% bait | metaldehyde | other | slugs | --- | 12 | May apply every 2 weeks or as needed. Broadcast pellets and wet soil before or after application. Do not allow pellets to contact edible portion of plant. Keep children, pets, and poultry away from treated areas. |
| Thimet / Phorate 20 G (RUP) | phorate | OP | white grubs, wireworms | 30 | 48 | For suppression of wireworms only. Maximum two applications per season. |
| Warrior (RUP) | lambda cyhalothrin | Pyr | armyworm, CLB, CRW adults, CRW larvae, cutworms, ECB, flea beetle, grasshoppers, Japanese beetle, seedcorn maggot, stalk borer, white grub | 21 | 24 | |