

# 2020 Corn Insect Control Recommendations

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## Introduction

Insects rob Tennessee corn producers of about five percent of their potential yields on an annual basis. However, severe pest infestations can cause complete crop loss. While pesticides play an important role in crop protection, they should be used only when there is the potential for damage severe enough to cause economic loss. There are several cultural practices that can be used to reduce insect problems and minimize pesticide use. Scouting fields for insect infestations and monitoring pest populations with pheromone traps can provide an estimate of insect pressure in a field, and thus, help to guide any treatment decisions.

## Prevention

**Early Planting:** Planting field corn early, during the recommended planting window, will reduce the chances of crop damage from several insect species. For example, corn borers and fall armyworm are frequent pests of late-planted corn in Tennessee.

**Weed Control:** Certain insects carry (or transmit) virus diseases in corn. By controlling weeds such as Johnsongrass early in the season, the chances of leafhoppers and aphids transmitting viruses to corn are reduced. When planting corn in fields known to be heavily infested with Johnsongrass, choose a hybrid with good tolerance to the maize dwarf mosaic virus (MDMV) complex.

**Tillage:** No-tillage production can increase soil insect pest problems in many cases. Cutworms, wireworms, white grubs, seedcorn maggots and lesser cornstalk borers may build up in grass sod or where previous crop residue has been left on the soil surface at planting. Burndown with herbicides well in advance of planting (3-4 weeks) can reduce the risks of infestation. Look for white grubs, wireworms and any other insects that may be exposed during land preparation.

**Seed and At-Planting Insecticide Treatments:** Almost all seed corn comes treated with insecticide. These insecticides will control or suppress a number of seed and seedling insect pests. Insecticide seed treatments, specifically clothianidin (e.g., Poncho) and thiamethoxam (e.g., Cruiser), have largely replaced the use of in-furrow insecticides which were applied at planting. However, at-planting insecticides or higher labeled rates of insecticide seed treatments can be used for supplemental control of seed and seedling pests (see Below Ground Pests).

**Bt Corn Traits:** Bt corn for the control of corn borers is typically recommended on at least part of a grower's acreage and particularly in late planted fields. The table below is intended to provide growers with the information needed to help them select among the various Bt trait packages offered by seed distributors. Some trait packages may also express Bt proteins that control western and northern corn rootworm. These are uncommon pests in Tennessee, and Bt traits for corn rootworm control are seldom needed. However, continuous corn production in the same field increases the likelihood of western corn rootworm infestations.

**Resistance management guidelines for Bt corn require a producer to plant a refuge of non-Bt corn.** Some newer trait packages require a smaller refuge of non-Bt corn. Please refer to the grower licensing agreement and refuge guidelines provided by the company for complete details.

## Relative Efficacy and Refuge Requirements of Selected, Commercially Available Bt Corn Products

Traits / Brands	Corn borers	Cutworm	Corn earworm	Fall armyworm	Western corn rootworm
Agrisure GT/CB/LL, Agrisure Artesian <sup>1</sup>	Excellent	Poor	Fair	Fair	None
Agrisure 3011 GT <sup>1</sup>	Excellent	Poor	Fair	Fair	Good
Agrisure Viptera 3110 <sup>2</sup>	Excellent	Good	Excellent	Excellent	None
Agrisure Viptera 3111 <sup>2</sup>	Excellent	Good	Excellent	Excellent	Good
Genuity VT Triple Pro (GENVT3P) <sup>2</sup>	Excellent	Poor	Good	Very Good	Excellent
Genuity VT Double Pro (GENVT2P) <sup>3</sup>	Excellent	Poor	Good	Very Good	None
Genuity SmartStax or SmartStax (GENSS or SSX) <sup>3</sup>	Excellent	Good	Good	Very Good	Excellent
Herculex I (HX1 or HR) <sup>1</sup>	Excellent	Good	Poor	Good	None
Optimum Intrasect (YHR) <sup>3</sup>	Excellent	Good	Fair	Very Good	None
Optimum Intrasect Xtra (YXR) <sup>2</sup>	Excellent	Good	Fair	Very Good	Excellent
Optimum Intrasect XTreme <sup>3</sup>	Excellent	Good	Fair	Very Good	Excellent
Optimum Leptra (VYHR) <sup>3</sup>	Excellent	Good	Excellent	Excellent	None
Optimum TRlsect <sup>1</sup>	Excellent	Good	Poor	Good	Excellent
Genuity Trecepta <sup>3</sup>	Excellent	Good	Excellent	Excellent	None
YieldGard Corn Borer (YGCB) <sup>1</sup>	Excellent	Poor	Fair	Fair	None
YieldGard VT Triple (VT3) <sup>1</sup>	Excellent	Poor	Fair	Fair	Excellent
<b>Below are RIB Systems (Non-Bt Refuge Seed Included in Each Bag of Seed), For Non-Cotton Growing Areas Only *</b>					
Agrisure Viptera 3220 <sup>4</sup>	Excellent	Good	Excellent	Excellent	None
Agrisure Viptera 3122 <sup>4</sup>	Excellent	Good	Excellent	Excellent	Excellent
Genuity VT Double Pro RIB (GENVT2P RIB) <sup>4</sup>	Excellent	Poor	Good	Very Good	None
Genuity SmartStax or SmartStax RIB (GENSS or SSX) <sup>4</sup>	Excellent	Good	Good	Very Good	Excellent
Optimum AcreMax <sup>4</sup>	Excellent	Good	Fair	Very Good	None
Optimum AcreMax Xtra <sup>5</sup>	Excellent	Good	Fair	Very Good	Excellent
Optimum AcreMax XTreme <sup>4</sup>	Excellent	Good	Fair	Very Good	Excellent
PowerCore <sup>4</sup>	Excellent	Good	Good	Very Good	None
Genuity Trecepta RIB <sup>4</sup>	Excellent	Good	Excellent	Excellent	None

<sup>1</sup> 50% and 20% non-Bt corn refuge requirement in cotton and corn areas, respectively.

<sup>2</sup> 20% non-Bt corn refuge is required in cotton and corn areas.

<sup>3</sup> 20% and 5% refuge requirement in cotton and corn areas, respectively.

<sup>4</sup> 5% refuge in bag system in non-cotton areas; a separate 20% non-Bt refuge is required in cotton growing areas.

<sup>5</sup> 10% refuge in bag system in non-cotton areas; a separate 20% non-Bt refuge is required in cotton growing areas.

## Scouting Corn

**Seedling Corn:** Check twice weekly for cutworms, seedcorn maggots, armyworms, white grubs and other pests of seedling corn. Walk in a zigzag pattern through the field, checking at least 10 places in the field. Count the number of damaged plants in 10 feet of row. Check at least 100 plants. Look for silken tubes at the bases of plants for lesser corn stalk borers. Plants less than 12 inches tall are most susceptible to injury.

**Whorl-Feeding Insects:** Corn fields should be checked at least weekly until the crop is mature to determine the presence of insect pests or their damage. Walk in a U-shaped pattern over the field. Sample 10 plants in 10 locations on a weekly basis, but fewer plants can often be checked depending upon pest density. To check for live larvae, cut open at least two (or more) plants in each sample and record the number of larvae.

Look on the undersides of leaves for fall armyworm or corn borer egg masses. Southwestern and European corn borers lay their eggs in an overlapping pattern that appears like small fish scales. However, southwestern corn borer egg masses are usually smaller (2-8 eggs) than those of European corn borer (10 or more eggs). Fall armyworms lay their eggs in clusters of 50 to several hundred on corn leaves and other vegetation.

**Silking/Tasseling Stages:** Examine plants for European and southwestern corn borers. Look for egg masses or small larvae feeding on the leaves. Corn borers lay their egg masses on the middle third of the plant near the ear zone. Check on the undersides of leaves for these egg masses. Small larvae may be found between ear husks or behind leaf collars. It is important to correctly identify larvae which are found because corn borers, corn earworm and fall armyworm may all be present. Treatment for insect pests during this stage will be more difficult. Insecticidal control for corn borers in tasseling corn is generally not as efficient as for plants in the whorl stage. Small larvae are more easily controlled than larger worms.

**Black Light and Pheromone Traps:** Black light traps can be used to monitor movement of adult insects. Pheromone (sex-attractant) traps are also used to monitor various insect flights, such as southwestern corn borers. Light or pheromone traps can be used to complement a scouting program. Traps can be used in each county or on individual farms to provide producers with advance warnings of insect infestations.

## Below Ground (Soil) Insect Pests

Most insect pests that attack corn at or below the soil surface are most damaging to seedling corn. Planting corn early can reduce the chances of insect infestations and injury. Controlling soil insects that threaten corn stands and seedling health is important for corn production. Factors such as reduced tillage, no-till corn, and fields with a history of soil insects justify the use of insecticides or insecticide seed treatments at planting. These products are used as prevention, because when there is high potential for infestation rescue treatments offer less control.

Adult **Southern Corn Rootworms** are also called the twelve-spotted cucumber beetle and have a wide host range. Females lay eggs at the base of corn plants or alternate weed hosts and, after hatching, larvae feed on roots, leading to wilting or lodging (known as “goose necking”) or plant death. The larvae have three pairs of legs just behind the head. Larvae are up to 1/2 inch long with brownish patches on the head and tail end.

- **Western or Northern Corn Rootworms** are rare pests in Tennessee. However, serious damage is sometimes seen if corn is continuously grown for many consecutive years, as sometimes done in dairy operations. Insecticide seed treatments are much less effective on these species compared with the southern corn rootworm. Because of the biology of these rootworm species, rotating to an alternate crop every 3-4 years is suggested to prevent infestations. Some Bt corn technologies provide excellent control of western or northern corn rootworm, but do not affect southern corn rootworm (see table below).

The **Seedcorn Maggot** is the larval stage of a fly that feeds on decaying organic matter in the soil. Larvae are less than 1/4 inch, pale white, and lack legs or an obvious head. Seedcorn maggots feed on germinating corn seed planted in cool, wet weather or when corn is planted into fields with freshly decaying vegetation.

**Wireworms** are the larval stage of click beetles. Larvae are usually brown, elongated and slender and may take between 2 and 5 years to mature, depending on the species. Control is often difficult in fields that were fallow or pasture before corn. Wireworms feed on the seed and roots and bore into the underground part of the corn seedling, which can lead to wilting, deadheart, or plant death.

**White Grubs** are the larvae of scarab beetles (e.g., May and June beetles), and some species feed on the roots of seedling corn plants. Grubs are C-shaped and white to cream in color.

- The **Sugarcane Beetle** is a scarab beetle that may cause significant economic damage in corn less than 2 feet tall. Although the larva is a white grub, it is the adults that cause damage by feeding on the stem and roots just below the soil surface. The adult beetle is about ½-inch long, black, with strong legs and coarse spines adapted for digging. The back of the beetle has numerous “pits.” Adults can infest fields after planting. Infestation can be especially severe in fields where Bermudagrass is common.

**Cutworms** are the larvae of several species of moths which spend much of their time below ground, typically venturing out at night to feed above ground on the stems and leaves of plants. Additional information about the management of cutworms is below.

**Sampling:** There are no standardized sampling methods for most below-ground pests of seedling corn. Because foliar-applied insecticides are generally ineffective, sampling is often done to evaluate the health of seedling plants, determine the cause of weak or dying plants, and to determine if re-planting is needed. The symptoms of below-ground insect feeding are often similar, regardless of which insect caused the injury. Plants may be stunted, leaning or lodged, leaves may have white or yellow streaking, and if severe, affected plants may wilt and die.

To check for the presence of wireworms, bait stations of untreated seed (e.g., 1 cup mixture of corn and wheat) can be buried a few inches deep prior to planting. Several bait stations should be used in a field and checked after 7-10 days. An average of one or more wireworms per station suggests in-furrow insecticides or an insecticide seed treatment should be used.

- **No-till or reduced-tillage farming generally increases the likelihood of soil insect pests.**
- **Consider using the higher-labeled rates of an insecticide seed treatment or an in-furrow applied insecticide (see tables below) when you have a known soil insect problem, planting in a field that was fallow, pasture or sod the previous season, or a cover crop was used and not terminated at least 3-4 weeks before planting.**
- **Economic damage from southern corn rootworm, seedcorn maggot, and white grubs is uncommon because most seed corn companies apply an insecticide seed treatment.**
- **Higher insecticide seed treatment rates or the use of in-furrow insecticides may be needed if wireworms, western corn rootworms, or sugarcane beetles are present in significant numbers.**

## Relative Efficacy of Selected Insecticide Seed Treatments on Seed and Seedling Insect Pests

Trade Names*	Active Ingredients and Rates*	Billbugs	White grubs	Wire-worms	Seedcorn maggot	Cutworms	Sugarcane beetle**	Stink bugs	Chinch bugs	Southern corn rootworm	Western corn rootworm
Poncho 250, Acceleron, NipsIt Inside	clothianidin, 0.25 mg ai/kernel	NL	F	G	E	P - F	F	F	G	E	P, NL
Poncho 500, Acceleron with Poncho Votivo, NipsIt Inside	clothianidin, 0.50 mg ai/kernel	F	E	G	E	P - F	G	F - G	G - E	E	P
Poncho 1250, Acceleron with Poncho Votivo 1250, PPST + Poncho 1250/Votivo, NipsIt Inside	clothianidin, 1.25 mg ai/kernel	G	E	E	E	F - G	G	G	E	E	G
Cruiser Maxx 250, PPST 250	thiamethoxam, 0.25 mg ai/kernel	NL	F	F-G	E	P	P	P	F	G - E, NL	P, NL
Cruiser Maxx Corn 500, Avicta Complete Corn 500	thiamethoxam, 0.50 mg ai/kernel	NL	G	G	E	P	F?	F	F	E	P, NL
Cruiser Maxx Corn 1250, Avicta Complete Corn 1250	thiamethoxam, 1.25 mg ai/kernel	G	E	E	E	F	F?	G	G	E	P
PPST 250 plus Lumivia	thiamethoxam, 0.25 mg ai/kernel; chlorantraniliprole, 0.25 mg ai/kernel	E	G?	G?	E	G?	P	P	F	G - E, NL	NL
Gaicho 600, Dynashield, Imidacloprid 5, Nitro Shield, Senator 600, etc.	imidacloprid, 0.60 mg ai/kernel (mid labeled rate)	P, NL	G	G	E	P, NL	P, NL	P, NL	F	G, NL	P, NL
Latitude	imidacloprid, 3.5 oz/100 lb seed	P, NL	F, NL	G	G	P, NL	P, NL	P, NL	F, NL	G, NL	P, NL
Concur	imidacloprid, 1.5 oz/42 lb seed	P, NL	F	G	G	P, NL	P, NL	P, NL	F, NL	G, NL	P, NL

E = excellent, G = good, F = fair, P = poor or no activity, ? = insufficient data to provide confident ranking, NL = pest not listed on label. Some ratings are based on incomplete data and are only meant to provide a general guideline of relative efficacy to the best knowledge of the author. Parts of this table are courtesy of Auburn University's corn insect, disease, nematode, and weed control recommendations for 2017

\* Formulated product may also include fungicidal and/or nematocidal ingredients that are not listed.

\*\* Efficacy of seed treatments on sugarcane beetle is dependent upon the timing of infestation. Expect less control if infestations occur several weeks after emergence.

## Examples of At-Planting Treatments for Seed and Seedling Insect Pests

Insecticide (Trade Names)	Rates	Common Pests Controlled or Suppressed
chlorpyrifos (Lorsban 15G)*	8 - 12 oz/1000 row ft	Seedcorn maggot, Southern corn rootworm, Wireworms, White grubs, Cutworms
terbufos (Counter 20G)*	5 - 6 oz/1000 row ft	Seedcorn maggot, Southern corn rootworm, Wireworms, White grubs
cyfluthrin, tebufos (Aztec 2.1G)*	6.7 oz/1000 row ft	Seedcorn maggots, Southern corn rootworm, Wireworms, White grubs, Cutworms
tefluthrin (Force 3G)	4 - 5 oz/1000 row ft	Seedcorn maggots, Southern corn rootworm, Wireworms, White grubs, Cutworms
bifenthrin (Brigade 2E, Discipline 2E, Fanfare 2E)**	0.15 - 0.3 oz/1000 row ft	Seedcorn maggots, Southern corn rootworm, Wireworms, White grubs
bifenthrin (Capture LFR 1.5)	0.2 - 0.78 oz/1000 row ft	Seedcorn maggots, Southern corn rootworm, Wireworms, White grubs, Cutworms, Sugarcane beetle
λ-cyhalothrin (Ballista LFC 1)	0.66 oz/1000 row ft	Seedcorn maggots, Southern corn rootworm, Wireworms, White grubs, Cutworms

See the insecticide label for specific use instructions.

\* Caution: When using organophosphate insecticides such as Aztec, Counter or Lorsban with herbicides such as Accent, Callisto, Capreno, Halex GT, Steadfast, Option or Resolve, the possibility for plant injury exists. See herbicide label for restrictions.

\*\* Many other pyrethroid insecticides are labeled for at-planting control of cutworms and some other pests. These include Asana XL, Baythroid XL, Declare, Mustang Max and Pounce. Please see their labels for specific use instructions.

## Cutworms

Several species of **cutworms** damage field corn in Tennessee, with the black cutworm being most common. Cutworm damage is most frequently found during cool, wet seasons when corn is following legume cover crops or in reduced tillage systems. Moths lay eggs on winter weeds in early spring and cutworms move to emerging corn once this vegetation has been killed. Cutworms are less likely to cause economic damage after corn reaches two feet in height.

**Sampling:** Check twice weekly for cutworms and other pests of seedling corn. Walk in a zigzag pattern through the field, checking at least 10 places in the field. Count the number of damaged plants in 10 feet of row. Check at least 100 plants. Plants less than 12 inches tall are most susceptible to injury.

**Treatment Thresholds:** Treat when larvae are present and 5 percent or more of plants are damaged or when two larvae per 100 plants are present.

- **Burndown with herbicides well in advance of planting (3-4 weeks) can reduce the risks of infestation.**
- **Certain Bt corn technologies provide some protection against cutworms.**

Insecticide (Trade Names) for CUTWORMS	Lb Active Ingredient per Acre	Amount Formulation per Acre	Performance Rating
bifenthrin (Brigade 2E, Discipline 2E, Fanfare 2E)	0.033 - 0.10	2.1 - 6.4 oz	8
carbaryl (Sevin XLR Plus 4)	2	64 oz	5
chlorpyrifos (Lorsban 4E, Nufos 4E)* (Lorsban Advanced 3.755)*	0.75 - 1 0.70 - 0.94	24 - 32 oz 24 - 32 oz	7 -
esfenvalerate (Asana XL 0.66E)	0.03 - 0.05	5.8 - 9.6 oz	8
permethrin (Pounce 3.2E)	0.1 - 0.2	4 - 8 oz	8
$\beta$ -cyfluthrin (Baythroid XL 1)	0.006 - 0.0125	0.8 - 1.6 oz	8
$\gamma$ -cyhalothrin (Declare 1.25)	0.008 - 0.0125	0.77 - 1.28 oz	8
$\lambda$ -cyhalothrin (Karate 2.08, Warrior II)	0.016 - 0.026	0.96 - 1.6 oz	8
Z-cypermethrin (Mustang Max 0.8E)	0.008 - 0.0175	1.28 - 2.8 oz	8

## Flea Beetles

Several species of **flea beetles** may occasionally cause economic damage, with the corn flea beetle being the most common. Adults are small (1/16 inch), shiny black beetles known for their ability to jump long distances when disturbed. Corn flea beetles injure corn by removing leaf tissue and transmitting the bacterium *Erwinia stewartii*, which causes Stewart's wilt. Beetles feed on the upper and lower sides of corn leaves causing scarring that may appear whitish or silvery.

**Sampling:** Begin scouting corn for scarring from flea beetles when seedlings emerge. Flea beetles will often first appear around field edges as they move from grassy areas and other overwintering sites.

**Treatment Thresholds:** Treat seedling plants with five or fewer leaves when 75 percent of the plants show obvious scarring by beetles on stems and leaves. Insecticide seed treatments and some other at-planting insecticides typically provide adequate protection from flea beetles.

Insecticide (Trade Names) for FLEA BEETLES	Lb Active Ingredient per Acre	Amount Formulation per Acre	Performance Rating
bifenthrin (Brigade 2E, Discipline 2E, Fanfare 2E)	0.047 - 0.1	3 - 6.4 oz	6
carbaryl (Sevin XLR Plus 4)	1 - 2	32 - 64 oz	8
chlorpyrifos (Lorsban 4E, Nufos 4E)* (Lorsban Advanced 3.755)*	1 0.94	32 oz 32 oz	6? 6?
esfenvalerate (Asana XL 0.66E)	0.03 - 0.05	5.8 - 9.6 oz	6?
permethrin (Pounce 3.2E)	0.1 - 0.2	4 - 8 oz	5?
$\beta$ -cyfluthrin (Baythroid XL 1)	0.006 - 0.0125	0.8 - 1.6 oz	6
$\gamma$ -cyhalothrin (Declare 1.25)	0.01 - 0.015	1.02 - 1.54 oz	6
$\lambda$ -cyhalothrin (Karate 2.08, Warrior II)	0.02 - 0.03	1.28 - 1.92 oz	6
Z-cypermethrin (Mustang Max 0.8E)	0.017 - 0.025	2.75 - 4 oz	6

## Armyworms

Armyworms may feed on seedling corn, in whorls, and occasionally on developing kernels. Because they may appear in large numbers, quick control is important. Feeding from smaller armyworm larvae can result in “window-paning” of the upper side of leaves, while large larvae can chew holes in leaves.

**Fall armyworms** are multicolored, striped caterpillars with a characteristic inverted “Y” on the head and four pairs of abdominal prolegs.

Mature **True Armyworm** larvae are smooth, almost without any hairs, greenish-brown to reddish-brown, with a dark stripe along each side. A broad dorsal stripe runs down the length of the back. This species differs from the fall armyworm by having a dark lateral band on the outer portion of each proleg.

**Sampling:** During the whorl stage, look on the undersides of leaves for fall armyworm egg masses. Fall armyworms lay their eggs in clusters of 50 to several hundred on corn leaves and other vegetation.

Pheromone (sex-attractant) traps are also used to monitor various insect flights, and can complement an effective scouting program. Traps can be used in each county or on individual farms to provide producers with advance warnings of insect infestations.

### Treatment Thresholds:

Seedling plants. Treat when 50 percent of the plants have one or more larvae per plant.

Whorl stage or larger plants. Controls should be initiated when 75 percent of whorls have larvae present. Control of larvae in ears is not economically practical in field corn.

- **Production of an early crop and preservation of beneficial insects will reduce the risk of armyworm outbreaks.**
- **Several of the new Bt corn technologies are effective at controlling fall armyworms in corn ears.**

Insecticide (Trade Names) for FALL ARMYWORM	Lb Active Ingredient per Acre	Amount Formulation per Acre	Performance Rating
bifenthrin (Brigade 2E, Discipline 2E, Fanfare 2E)	0.063 - 0.10	4 - 6.4 oz	6
carbaryl (Sevin XLR Plus 4)	1 - 2	32 - 64 oz	4
chlorpyrifos (Lorsban 4E, Nufos 4E)* (Lorsban Advanced 3.755)*	0.75 - 1 0.70 - 0.94	24 - 32 oz 24 - 32 oz	4 -
chlorantraniliprole (Prevathon 0.43 SC)	0.05 - 0.07	14 - 20 oz	9
chlorantraniliprole, λ-cyhalothrin (Besiege)	see label	6 - 10 oz	9
methomyl (Lannate LV 2.4)*	0.225 - 0.3	12 - 16 oz	7
methoxyfenozide (Intrepid 2F)	0.6 - 0.125	4 - 8 oz	7
permethrin (Pounce 3.2E)	0.1 - 0.2	4 - 8 oz	5
spinetoram (Radiant SC 1)	0.02 - 0.05	3 - 6 oz	8?
spinosad (Blackhawk 36% WDG)	0.04 - 0.07	1.7 - 3.3 oz	7
β-cyfluthrin (Baythroid XL 1)	0.02	2.8 oz	6
γ-cyhalothrin (Declare 1.25)	0.01 - 0.015	1.02 - 1.54 oz	6
λ-cyhalothrin (Karate 2.08, Warrior II)	0.02 - 0.03	1.28 - 1.92 oz	6
Z-cypermethrin (Mustang Max 0.8E)	0.02 - 0.025	3.2 - 4 oz	6

## Corn Earworm

**Corn earworms**, or bollworms, feed directly on developing kernels. Large caterpillars may be green, brown or yellow with a pale brown or orange head. Corn earworms have light and dark stripes running the length of their body and four pairs of abdominal prolegs.

**Sampling:** During whorl stages, corn fields should be checked at least weekly until the crop is mature to determine the presence of insect pests or their damage. Sample 10 plants in 10 locations on a weekly basis for signs of tattered and torn whorls. Fewer plants can be sampled depending on pest density. To check for live corn earworm larvae, cut open at least two (or more) plants in each sample and record the number of larvae.

Pheromone (sex-attractant) traps are also used to monitor various insect flights, and can complement an effective scouting program. Traps can be used in each county or on individual farms to provide producers with advance warnings of insect infestations.

**Treatment Thresholds:** *Whorl stage plants:* Controls should be initiated when 75 percent of whorls have larvae present. Control of larvae in ears is not economically practical in field corn.

- **Planting in the recommended planting window is suggested to avoid late-season infestations of caterpillar pests.**
- **Certain Bt corn technologies are effective at controlling corn earworms in whorls or in corn ears.**

Insecticide (Trade Names) for CORN EARWORM	Lb Active Ingredient per Acre	Amount Formulation per Acre	Performance Rating
bifenthrin (Brigade 2E, Discipline 2E, Fanfare 2E)	0.063 - 0.1	4 - 6.4 oz	6
carbaryl (Sevin XLR Plus 4)	1 - 2	32 - 64 oz	4
chlorantraniliprole (Prevathon 0.43 SC)	0.05 - 0.07	14 - 20 oz	9
chlorantraniliprole, $\lambda$ -cyhalothrin (Besiege)	See label	6 - 10 oz	9
esfenvalerate (Asana XL 0.66E)	0.03 - 0.05	5.8 - 9.6 oz	6
methomyl (Lannate LV 2.4)*	0.225 - 0.3	12 - 16 oz	7
permethrin (Pounce 3.2E)	0.1 - 0.2	4 - 8 oz	5
spinetoram (Radiant SC 1)	0.023 - 0.05	3 - 6 oz	7?
spinosad (Blackhawk 36% WDG)	0.05 - 0.07	2.2 - 3.3 oz	7
$\beta$ -cyfluthrin (Baythroid XL 1)	0.0125 - 0.02	1.6 - 2.8 oz	6
$\gamma$ -cyhalothrin (Declare 1.25)	0.008 - 0.0125	0.77 - 1.28 oz	6
$\lambda$ -cyhalothrin (Karate 2.08, Warrior II)	0.016 - 0.026	0.96 - 1.6 oz	6
Z-cypermethrin (Mustang Max 0.8E)	0.0125 - 0.025	2 - 4 oz	6

## Grasshoppers

**Grasshoppers** are an occasional pest of corn in Tennessee. Nymphs and adults can feed on corn at any stage, but are not typically observed until the silking stage and later. Infestations often begin and are usually worse along field margins. Grasshoppers may injure corn by feeding on the leaves, silks, and ear tips.

**Sampling:** During the whorl stage and later, corn fields should be checked at least weekly until the crop is mature to determine the presence of insect pests or their damage. Walk in a U-shaped pattern over the field. Sample 10 plants in 10 locations on a weekly basis, but fewer plants can often be checked depending upon pest density.

**Treatment Thresholds:** Treatment is rarely needed, and thresholds have not been established in Tennessee.

Insecticide (Trade Names) for GRASSHOPPERS	Lb Active Ingredient per Acre	Amount Formulation per Acre	Performance Rating
bifenthrin (Brigade 2E, Discipline 2E, Fanfare 2E)	0.047 - 0.1	3 - 6.4 oz	8
chlorpyrifos (Lorsban 4E, Nufos 4E)* (Lorsban Advanced 3.755)*	0.25 - 0.5 0.23 - 0.47	8 - 16 oz 8 - 16 oz	6 -
esfenvalerate (Asana XL 0.66E)	0.03 - 0.05	5.8 - 9.6 oz	7
β-cyfluthrin (Baythroid XL 1)	0.016 - 0.022	2.1 - 2.8 oz	8
γ-cyhalothrin (Declare 1.25)	0.01 - 0.015	1.02 - 1.54 oz	8
λ-cyhalothrin (Karate 2.08, Warrior II)	0.02 - 0.03	1.28 - 1.92 oz	8
Z-cypermethrin (Mustang Max 0.8E)	0.017 - 0.025	2.75 - 4 oz	8

## Japanese Beetles

The **Japanese beetle** is a scarab beetle commonly found in Tennessee. This beetle can be a pest of gardens, trees, shrubs, turf grass and agricultural fields. Adults have a bright metallic green head and thorax with copper-colored elytra (hardened wings) and a row of five spots of white hairs on each side of the abdomen below the wings. Japanese beetles injure corn by feeding on the fresh silks of developing ears. This feeding/clipping may interfere with kernel pollination if it occurs during the first week of silking. Drought conditions may exacerbate this issue.

**Sampling:** Corn fields should be checked the first week of silking to determine the presence of Japanese beetles and other pests of corn. Walk in a U-shaped pattern over the field looking for beetles feeding on silks. Sample 10 plants in 10 locations throughout the field.

**Treatment Thresholds:** Treat when three or more beetles are found per ear during the first week of silking. Infestations are usually worse along field margins.

Insecticide (Trade Names) for JAPANESE BEETLE	Lb Active Ingredient per Acre	Amount Formulation per Acre	Performance Rating
bifenthrin (Brigade 2E, Discipline 2E, Fanfare 2E)	0.047 - 0.1	3 - 6.4 oz	8
carbaryl (Sevin XLR Plus 4)	1 - 2	32 - 64 oz	6
β-cyfluthrin (Baythroid XL 1)	0.0125 - 0.022	1.6 - 2.8 oz	8
γ-cyhalothrin (Declare 1.25)	0.01 - 0.015	1.02 - 1.54 oz	8
λ-cyhalothrin (Karate 2.08, Warrior II)	0.02 - 0.03	1.28 - 1.92 oz	8
Z-cypermethrin (Mustang Max 0.8E)	0.017 - 0.025	2.75 - 4 oz	8

## Stink Bugs

Several species of **stink bugs** can occasionally be pests of corn in Tennessee. Stink bugs can damage the growing point of small plants resulting in irregular growth or even death. Feeding on small developing ears (1/2 to 3/4 inches long) prior to silking may also result in malformed or aborted ears.

**Sampling:** In seedling corn, check twice weekly for stink bugs and other seedling corn pests. Walk in a zigzag pattern through the field, checking at least six places in a field. Count the number of stink bugs and damaged plants in ten feet of row. Check at least 100 plants.

Just prior to tassel emergence, corn fields should be checked for the presence of stink bugs. Walk in a U-shaped pattern over the field. Visually examine 10 plants in 10 locations of a field. Infestations are likely to be worse on field margins.

**Treatment Thresholds:**

Seedling plants. Treat corn less than 24 inches tall if 10 percent or more of plants are infested with stink bugs.

Late Whorl stage. Treat corn if 10 percent or more of plants are infested with stink bugs at or shortly before ear shoots appear (about V15). Treating for stink bugs is generally not recommended once silking has begun.

- **In Tennessee, stink bug injury to seedling plants is often more common in the earliest planted corn.**
- **Some at-planting insecticides and seed treatments may suppress stink bug feeding on seedling corn but may not provide adequate protection.**
- **Pyrethroid insecticides are generally less effective on brown stink bugs.**

Insecticide (Trade Names) for STINK BUGS	Lb Active Ingredient per Acre	Amount Formulation per Acre	Performance Rating Green / Brown
bifenthrin (Brigade 2E, Discipline 2E, Fanfare 2E)	0.047 - 0.1	3 - 6.4 oz	9 / 8
carbaryl (Sevin XLR Plus 4)	1 - 2	32 - 64 oz	4 / 4
methyl parathion 4 (Methyl 4E)	0.25 - 0.05	8 - 16 oz	8 / 8
β-cyfluthrin (Baythroid XL 1)	0.0125 - 0.022	1.6 - 2.8 oz	8 / 4
γ-cyhalothrin (Declare 1.25)	0.01 - 0.015	1.02 - 1.54 oz	8 / 4
λ-cyhalothrin (Karate 2.08, Warrior II)	0.02 - 0.03	1.28 - 1.92 oz	8 / 4
Z-cypermethrin (Mustang Max 0.8E)	0.017 - 0.025	2.75 - 4 oz	8 / 4

**Corn Borers**

The **southwestern corn borer** (SWCB) is a well-known caterpillar pest of corn. Larvae are creamy white with large brown or black dots on each body segment and a dark head. Older larvae tunnel into the stalk, in ear shanks, or feed on ears until they pupate (usually inside the stalk). Tunneling interferes with nutrient and water flow within the plant and to the ears. Tunneled shanks may break, causing ears to fall on the ground. Overwintering larvae usually girdle the stalk from the inside. Girdling often results in lodging below the ear, particularly in high winds or when infested corn is not harvested in a timely manner. Lodging can dramatically reduce yield and slow harvesting operations.

The **European corn borer** (ECB) is found throughout Tennessee and may be the most common corn borer species found in the Middle and Eastern parts of the state, although it is only an occasional pest of corn. ECB larvae are gray or tan with rows of light brown spots. The injury caused by ECB is similar to southwestern corn borer. During the whorl stage, feeding from ECB include elongated window-pane lesions on emerging leaves. In tasseling corn, small larvae are found behind leaf collar and sheath areas or in silks. Older larvae tunnel into the stalk, ear shanks, or ears until they pupate inside stalks or ears. Tunneling interferes with nutrient and water flow in the plant. Tunneled shanks may break, causing ears to fall on the ground. Injury to ears may affect kernel quality and introduce or spread disease organisms. Unlike SWCB, late-season tunneling tends to be concentrated in the stem near or above the ear, and ECB larvae do not girdle the stem prior to overwintering. One sign of ECB infestation is when stalks break above the ear compared to SWCB which often cause lodging below the ear.

**Sampling:** Scouting is not needed where Bt corn hybrids are used for corn borer control. For non-Bt corn, look on the undersides of leaves for corn borer egg masses. SWCB and ECB lay eggs in an overlapping pattern that look like small fish scales. SWCB egg masses are usually smaller (2-8 eggs) than those of ECB (10 or more eggs).

When corn is tasseling or silking, look for egg masses or small larvae feeding on the leaves. Corn borers lay their egg masses on the middle third of the plant near the ear zone, on the undersides of the leaves. Small larvae may be found between ear husks or behind leaf collars. It is important to correctly identify larvae which are found because corn borers, corn earworm and fall armyworm may all be present. Treatment for insect pests during this stage will be more difficult. Insecticidal control for corn borers in tasseling corn is generally not as efficient as corn in the whorl stage. Small larvae are more easily controlled than larger larvae.

Pheromone (sex-attractant) traps are also used to monitor various insect flights, and can complement an effective scouting program. Traps can be used in each county or on individual farms to provide producers with an advance warning of insect infestations. When several traps are run on a farm, the numbers of southwestern corn borer moths caught can be used to trigger a foliar insecticide application.

### Treatment Thresholds:

Southwestern corn borer. Prior to tasseling, treat for SWCB when 5 percent (or more) of plants are found with egg masses or live larvae or 7 to 10 days after pheromone traps catch an average of 50-plus moths over a seven-day period. Beginning at tasseling (VT) and through the milk stage (R3), treat for SWCB when 10 percent (or more) of plants are found with egg masses or live larvae or 7 to 10 days after pheromone traps catch an average of 100+ moths on a seven-day catch. Treatment is generally not recommended once corn reaches the dough stage (R4).

European corn borer. For non-Bt corn, treat for ECB when 50 percent of the plants are infested or when one egg mass is found per plant. Use at least 20 gallons of water per acre for treating whorl-feeding insects. Direct the coarse spray down into the whorls for most effective control.

- **Planting field corn early, during the recommended planting window, will reduce the chances of crop damage from several insect species.**
- **Bt technologies with corn borer protection provide a high level of control for SWCB and ECB.**

Insecticide (Trade Names) for SOUTHWESTERN AND EUROPEAN CORN BORER	Lb Active Ingredient per Acre	Amount Formulation per Acre	Performance Rating
bifenthrin (Brigade 2E, Discipline 2E, Fanfare 2E)	0.063 - 0.1	4 - 6.4 oz	7
chlorantraniliprole (Prevathon 0.43 SC)	0.05 - 0.07	14 - 20 oz	9
chlorantraniliprole, $\lambda$ -cyhalothrin (Besiege)	See label	6 - 10 oz	9
esfenvalerate (Asana XL 0.66E)	0.04 - 0.05	7.8 - 9.6 oz	6
methoxyfenozide (Intrepid 2F)	0.0625 - 0.125	4 - 8 oz	8
permethrin (Pounce 3.2E)	0.1 - 0.2	4 - 8 oz	5
spinetoram (Radiant SC 1)	0.023 - 0.047	3 - 6 oz	8?
spinosad (Blackhawk 36% WDG)	0.05 - 0.07	2.2 - 3.3 oz	6
$\beta$ -cyfluthrin (Baythroid XL 1)	0.0125 - 0.02	1.6 - 2.8 oz	6
$\gamma$ -cyhalothrin (Declare 1.25)	0.01 - 0.015	1.02 - 1.54 oz	6
$\lambda$ -cyhalothrin (Karate 2.08, Warrior II)	0.02 - 0.03	1.28 - 1.92 oz	6
Z-cypermethrin (Mustang Max 0.8E)	0.017 - 0.025	2.75 - 4 oz	6

## Premixed Insecticide Products

The following products are available as premixes of two or more insecticides. The use of these premixes may provide suppression or control of multiple pests, and thus, are typically recommended when several pests are present at treatment level.

Trade Name (Insecticides)	Amount Product per Acre	Comments and Primary Target Pests (see label for other pests that may be controlled)
Besiege (chlorantraniliprole, $\lambda$ -cyhalothrin)	6 - 10 oz	Corn borers, corn earworm, stink bugs; Pre-harvest interval - 21 days
Cobalt Advanced (chlorpyrifos, $\gamma$ -cyhalothrin)	See label	Foliar applications: Corn borers, corn earworm, stink bugs; Pre-harvest interval - 21 days grain, 14 days forage
Hero 1.24 (bifenthrin, Z-cypermethrin)	4 - 10.3 oz	Corn borers, corn earworm, stink bugs, corn earworm; Pre-harvest interval - 30 days grain, 60 days forage
Stallion (chlorpyrifos, Z-cypermethrin)	See label	Foliar applications: Corn borers, corn earworm, stink bugs; Pre-harvest interval - 30 days grain, 60 days forage

\* Caution: When using Cobalt Advanced with ALS herbicides such as Accent, Capreno, Halex GT, Steadfast, Lightning, Option or Resolve, the possibility for plant injury exists. See herbicide label for restrictions.