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PB1768 2010 Insect Control Recommendations for Field Crops –

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2010
Insect Control Recommendations for Field Crops

Cotton, Soybeans, Field Corn, Sorghum, Wheat and Pasture

THE UNIVERSITY of TENNESSEE UT
INSTITUTE of AGRICULTURE

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2010 Cotton Insect Control Recommendations

Integrated Pest Management

An Integrated Pest Management (IPM) program integrates control tactics including cultural practices, variety selection, biological control and insecticides to manage insect pest populations so that economic damage and harmful environmental side effects are minimized. Insecticides should only be used on an as-needed basis; therefore, insect scouting must be conducted regularly throughout the season to determine if an insecticide application is warranted.

Scouting/Monitoring

Insect populations vary from year to year and field to field during the growing season. All fields should be monitored for both insect pests and beneficial populations at least weekly during the season, preferably twice weekly after blooming has begun. In areas of high insect pressure or increasing populations, twice-a-week scouting is recommended. Monitoring plant growth and development is an important aspect of crop management, maximizing yield potential and managing insects.

Two basic components of decision making in IPM are the economic injury level (EIL) and the economic threshold (ET). The EIL is defined as the lowest pest population density that will cause economic damage. The EIL is a pre-determined number that will justify the cost of treatment. The ET is defined as the pest population level at which control should be initiated to keep the pest population from reaching economically damaging numbers.

Economic thresholds have been established for specific insect pests. Multiple pest thresholds are not well established. Therefore, it is important to monitor the plant for fruit loss and retention levels to evaluate treatment thresholds, involving either single or multiple pests. When losses from multiple pests are occurring, fixed individual pest thresholds may become dynamic or change. Decisions to apply controls should be based on thorough scouting and identification of pests, the cost of insecticide, the price of cotton, yield potential and fruit-retention goals. The economic value of each fruiting form changes on each fruiting branch (node); therefore, it is important to know how this value is distributed on the plant. The value and placement of fruit being protected should be considered when making treatment decisions. Monitor fruit retention levels weekly, along with insects. Scheduled insecticide sprays should be avoided. Unnecessary applications of insecticide are not cost effective. Applications of insecticides on an as-needed basis will preserve beneficial insects, reducing the likelihood of secondary pest outbreaks.

Certain production practices can have a significant impact on insect pest infestations. Some practices may increase the risk of insect attack and should be avoided, while others may have some level of control value. A production practice that has a negative impact on insect pests is desirable and is termed a cultural control. Some common cultural control practices include:

- **Fall Stalk Destruction**
  Destruction of cotton stalks as soon as possible following harvest reduces the food supply for boll weevils, thereby reducing the size of the overwintering population.
- **Pre-plant Vegetation Management**
  Destruction of weeds and/or cover crops by tillage or herbicide three or more weeks prior to planting will reduce the risk of cutworm infestations and some other pests.
- **Field Border Maintenance**
  Plant bugs often build up on flowering plants surrounding cotton fields and move into fields when these preferred hosts dry up or are destroyed. Timely mowing of such vegetation can aid in reducing available hosts for plant bugs.
- **Managing for Earliness**
  Early crop maturity decreases the period of crop susceptibility to yield loss by insects, reduces insect control costs and lowers selection pressure for resistance development to insecticides.

Crop Management Considerations

Insecticide Resistance

Management of tobacco budworm in non-Bt cotton varieties has become more difficult in Tennessee due to the development of pyrethroid-resistant populations. Historically, budworm populations have been higher in the southern part of the state, but high populations can also occur in other areas. In response to tobacco budworm resistance, and the potential for resistance in bollworm and tarnished plant bug populations, a resistance management plan will continue to be recommended.

The goal of the Insecticide Resistance Management Plan is to improve the potential of maintaining effective full-season control of tobacco budworm, bollworm and tarnished plant bug by the use of different classes of chemistry in a logical sequence throughout the season, without placing excessive reliance on any single class of chemistry.

In general, levels of resistance are lowest during the early part of the growing season but increase sharply following repeated exposure to a single class of chemistry. Therefore, repeated use of a single class of chemistry may no longer provide effective control. As a result, there is a potential risk of sustaining economic losses. Following a resistance management plan is a recommended method to reduce the risk.

Because cotton insect pest management is dynamic, these guidelines cannot address all situations. Therefore, these recommendations are not intended to limit the professional judgment of qualified individuals. However, the **maximum benefit of a resistance management strategy can only be realized if all producers in a wide geographic area participate.**

Selection of insecticides should be based on insect pests present in the field, stage of crop development, effects on non-target organisms and the risk of contributing to resistance problems in subsequent generations.

Insecticide selection for bollworm and tobacco budworm control should be made after determining the population mix and size of the infestation within a community, farm or field. When dealing with resistance, this determination can mean a control success or failure. Use all available information and techniques including scouting reports, pheromone trap catches, moth flushing counts and identification of "worms."

Phase I (Planting through June)

Phase I corresponds to that time between planting and first bloom. The first field generation of tobacco budworm and bollworm generally occurs during this time.

The primary objective in Phase I is to preserve the efficacy of the pyrethroids and organophosphate (OP) insecticides. Use of these insecticides in June will foster resistance in tobacco budworm, bollworm and tarnished plant bug populations. Insecticides should not be applied for control of any insect pests unless scouting techniques suggest economic losses are occurring. Producers should strive for a minimum of 80 percent square retention during Phase I.

Consider multiple pests and adjust treatment thresholds to achieve square retention goals. A goal of 100 percent pre-bloom square retention is not realistic if multiple insecticide applications are required. These additional insecticide sprays may increase cost, flare secondary pests and increase resistance selection pressure. Selection of specific compounds should consider all insect pests in the field to be treated, activity on beneficial insects and risks of contributing to control failures in subsequent generations. Automatic applications are discouraged.

Calculating Percent Square Retention

- Select 20 representative plants within a field.
- Examine each first fruiting position on the top five fruiting branches (nodes).
- Record the total number of missing fruit from 100 possible positions.
- 100 minus number missing = percent square retention.

Phase II (July to end of season)

Phase II includes the blooming and boll development period, during which the second and subsequent field generations of tobacco budworm/bollworm occur. It is during this window that cotton is most susceptible to insect injury, and pyrethroid or other appropriate classes of insecticides should be used whenever pest densities exceed economic thresholds. However, **pyrethroid insecticides should not be used for tobacco budworm.** Pyrethroid resistance in budworm populations is well-established in Tennessee. If a failure occurs with a pyrethroid or pyrethroid tank mixture, a second application with full rates of a non-pyrethroid insecticide should be made immediately. It is not realistic to expect follow-up applications made after an insecticide control failure to totally "clean-up" remaining larvae.

When Unsatisfactory Control with Foliar Insecticide Occurs

All control problems are not related to insecticide resistance, and several factors should be considered in response to these problems. Treatment decisions should consider a variety of factors that influence insecticide efficacy and damage potential: species composition, population density, population age structure, application timing, insecticide dosage, application methods, application carriers, treatment evaluation timing, the need for multiple applications, environmental conditions and insecticide resistance levels. Good coverage using labeled rates adjusted to infestation levels is necessary for satisfactory control. Do not expect 100 percent control with any insecticide treatment. Attempts to reduce insect populations to zero damage levels are not cost-effective and result in early field-control failures.

Managing for Earliness

Managing crop maturity is an important component of these guidelines. Cotton producers should plant an early-maturing cotton variety during a 20-day period between April 20 and May 10. At-planting fungicides and insecticides are recommended to promote plant establishment and seedling growth, manage early-season insect pests and accelerate crop maturity.

The goal is to obtain an optimal stand of healthy and actively growing cotton that initiates squaring 35-45 days after planting. Producers should avoid practices that delay crop maturity (some herbicides and excessive nitrogen) and increase the attractiveness of cotton to late-season insect pests. With timely planting and proper insect pest management, most of the harvestable bolls will be set on the plant by early August. Under these conditions, the cotton crop should mature soon enough to avoid severe damage by the August generations of tobacco budworm and bollworm. Early crop maturity will also reduce the probability of economic losses from other late-season insect pests.

Nodes Above White Flower and Terminating Insect Control

NAWF is the number of fruiting branches (nodes) above the uppermost first-position white flower. Counting from the top, the first branch has an unfolded leaf the size of a quarter. NAWF is a useful measure of plant maturity and can be used to help make insect management decisions (see below). Average NAWF counts should be recorded weekly for each cotton field once blooming has begun.

The plant physiological stage of "cutout" is when there are five or fewer nodes above the uppermost first-position white flower (i.e., NAWF5). At cutout, cotton starts becoming less attractive and less sensitive to late-season insect pests. Insect treatment thresholds can be adjusted to higher levels after cutout. Insecticide applications for some pests can be terminated once fields have accumulated 350 - 450 heat units (DD60s) after the cutout date (approximately 18-21 days). Research has shown that accumulating 350 - 450 DD60s after cutout is enough time to mature yield-contributing bolls beyond the point where economic losses from bollworm, tobacco budworm, plant bugs and stink bugs are likely to occur. It may be necessary to control some pests beyond NAWF5 + 350 - 450 DD60s. For example, fall armyworm can damage more mature bolls. Also, because leaves are important to complete boll maturation, treatments for spider mites or loopers may be necessary to prevent excessive defoliation before the crop is fully mature (about NAWF5 + 850 DD60s).

> **Calculating Heat Units (DD60s):** Use the maximum and minimum temperature for a 24-hour period to determine the average temperature for the day. Subtract 60 degrees from the average. The remainder is the number of heat units (DD60s) accumulated for that day. Add these daily units to obtain the accumulated total.

Guidelines to Manage Tobacco Budworm and Bollworm in Non-Bt Cotton

- Promote earliness (plant between April 20 and May 10 with an early-maturing variety, use an at-planting fungicide and insecticide, avoid excessive fertilization, control all insect pests when populations exceed thresholds, consider multiple pests and maintain 80 percent or higher square retention prior to bloom).
- Do not apply automatic applications of insecticides.
- Scout fields twice each week if possible.
- Time insecticide applications against eggs and 1 – 2 day-old larvae.
- Two treatments on a 4 – 5 day interval may be needed.
- Multiple applications, at median rates, are often more effective than a single application at a high rate.
- Consider pheromone-trapping data and moth-flushing counts to determine species composition (tobacco budworm vs. bollworm) before choosing an insecticide.
- Pyrethroids are generally not recommended for control of mixed budworm/bollworm populations.
- Only use pyrethroids, or pyrethroids tank-mixed

with carbamates or organophosphates, if tobacco budworms are a small part of the population (< 25 percent) and overall larval and egg numbers are < 8–10 per 100 plants.

- Use insecticides from different classes of chemistry if a pyrethroid failure occurs.
- Improve insecticide coverage by use of nozzles producing relatively small droplets while maintaining adequate spray volume.
- Monitor crop maturity and terminate insecticide applications when yield-contributing bolls are no longer susceptible to insect damage.

Bt Cotton Management

Bt cotton varieties, which produce toxins from the bacterium Bacillus thuringiensis, are widely used in Tennessee. The use of Bt cotton is recommended in areas with high occurrence of tobacco budworm and bollworm. Bt cotton must be monitored on a regular basis for pests, including bollworm. Tobacco budworm should not cause economic damage to Bt cotton at any time during the season, and damaging infestations of bollworm are uncommon prior to bloom. Prior to bloom, concentrate efforts in Bt cotton on monitoring square retention and scouting for pests such as plant bugs. However, fields should be checked for the presence of surviving larvae if a bollworm egg lay occurs. Larvae must feed on plant tissue to ingest a toxic dose of Bt toxin. This feeding is generally superficial and will not cause economic damage. A larva that is ¼ inch or greater in length is considered to have survived or "escaped" the toxin.

During the blooming period, bollworms can sometimes cause economic damage to Bt cotton. Twice a week scouting and closer examination within the plant canopy may be necessary to locate and determine bollworm survival before making a treatment decision. The Bt toxin should be given an opportunity to work; therefore, treatment based just on the presence of eggs is not usually recommended. Spray coverage and timing are critical for best control.

Resistance Management Plan – Refugia

A refuge of non-Bt cotton is required for Bollgard cotton. A refuge is not required for Bollgard II or WideStrike cotton varieties, but planting a refuge is still a potentially valuable resistance management strategy. Acreage of non-Bt cotton will provide a source of susceptible moths for mating with resistant moths that survive in Bt cotton. Designated refugia acreage should be located adjacent to or in close proximity of Bt cotton acreage. The refuge should be managed with the intent of producing a viable, vigorous crop.

Bollgard II and WideStrike Cotton

Bollgard II and WideStrike cottons are more effective than the original Bollgard technology, including better activity on bollworm, armyworms and loopers. Bollgard II and WideStrike cotton will require fewer insecticide applications for control of these caterpillar pests. However, new thresholds and scouting procedures are not fully developed for Bollgard II or WideStrike cotton. Bt cotton does not control tarnished plant bugs, stink bugs or other non-caterpillar pests. A non-Bt cotton refuge is not required for Bollgard II or WideStrike cotton varieties. However, a refuge may have some value in preventing or delaying the development of insect resistance to Bt toxins.

Boll Weevil

The boll weevil has been successfully eradicated from Tennessee. Post-eradication pheromone trapping will continue in order to detect re-infestations that may occur. **Evidence of boll weevil infestations should be reported immediately to boll weevil eradication officials.**

Expected Occurrence of Insect Pests in Cotton

Below is a timetable of when pests are typically encountered in cotton, although conditions vary from season-to-season or farm-to-farm within a season.

Stage of Plant Development	Common Pests	Occasional Pests
Emergence to fifth true leaf	Thrips	Aphids, Cutworms
Fifth true leaf to first square	---	Aphids, Plant bugs, Spider mites
First square to first bloom	Plant bugs	Aphids, Spider mites, Bollworm, Tobacco budworm
After first bloom	Bollworm, Tobacco budworm, Plant bugs, Stink bugs	Aphids, Loopers, Fall and Beet armyworm, Spider mites, Whiteflies

Cutworms

Cutworm damage occurs most frequently following legume cover crops or in reduced tillage systems. Cutworms may become established on existing vegetation and move to emerging cotton once this vegetation has been killed. Destroying all green vegetation 21 days prior to planting reduces the likelihood of cutworm attack.

Treat when cutworms are damaging the stand, and plant population is less than three plants per row foot. Infestations may be spotty within a field and only require treatment where damage and live cutworms are found. At-planting insecticides applied in a band (no less than 10 inches) may be justified if vegetation has not been burned down at least 21 days prior to planting.

Do not expect Bt cotton to provide adequate control of cutworms, although Bollgard II and WideStrike will provide some protection against small larvae or low infestation levels.

Insecticide (Trade Names) for CUTWORMS	Lb Active Ingredient per Acre	Amount Formulation per Acre	Acres Treated per Gal or Lb of Dry Product
acephate 90 (Orthene 90S)	0.72	0.8 lb	1.25
bifenthrin (Brigade 2, Discipline 2)	0.04 – 0.1	2.4 – 6.4 oz	53.3 – 20
chlorpyrifos (Lorsban 4, Nufos 4)	0.75 – 1	24 – 32 oz	5.3 – 4
chlorpyrifos (Lorsban Advanced 3.755)	0.75 - 1	25.6 – 34.1 oz	5 – 3.8
cypermethrin (Ammo 2.5)	0.025 – 0.1	1.3 – 5 oz	100 – 25
deltamethrin (Delta Gold 1.5)	0.013 – 0.019	1.11 – 1.62 oz	115 – 79
esfenvalerate (Asana XL 0.66E)	0.03 – 0.05	5.8 – 9.6 oz	22 – 13
thiodicarb (Larvin 3.2)	0.6	24 oz	5.3
β-cyfluthrin (Baythroid XL 1)	0.0065 – 0.0125	0.8 – 1.6 oz	160 – 80
γ-cyhalothrin (Declare 1.25, Prolex 1.25)	0.0075 – 0.01	0.77 – 1.02 oz	166 – 125
λ-cyhalothrin (Karate 2.08, Warrior II)	0.015 – 0.02	0.96 – 1.28 oz	133 – 100
Z-cypermethrin (Mustang Max 0.8)	0.008 – 0.012	1.28 – 1.92 oz	100 – 67

Thrips

Thrips injury causes foliar deformity (leaves crinkle and cup upward), plant stunting and delays in maturity. Preventative in-furrow or seed treatments are recommended. Under adverse growing conditions, additional treatment may be needed even when preventative controls have been used. Treat when cotton is up to a stand and thrips average one or more per plant and damage is observed.

Under some conditions, in-furrow treatments may adversely affect stand. A recommended fungicide should be used in fields where in-furrow systemic insecticides are used. Aphids and early spider mites are also suppressed by in-furrow systemic insecticides. Refer to the label for rate changes when using in-furrow materials for hill-dropped cotton.

Insecticide (Trade Names) for THRIPS	**Lb Active Ingredient per Acre**	**Amount Formulation per Acre**	**Acres Treated per Gal. or Lb of Dry Product**
In-furrow Systemic Granules:			
aldicarb (Temik 15G)	0.525 – 0.75	3.5 – 5 lb	---
In-furrow Systemic Sprays:			
acephate 90 (Orthene 90S)	0.9 – 1	1 – 1.1 lb	1 – 0.9
disulfoton (Di-Syston 8)	0.75 – 1	12 – 16 oz	10.7 – 7.8
Foliar Sprays*:			
acephate 90 (Orthene 90S)	0.18	3.2 oz	5
dicrotophos (Bidrin 8)	0.1 – 0.2	1.6 – 3.2 oz	80 – 40
dimethoate 4	0.125 – 0.25	4 – 8 oz	32 – 16
Treated Seed:			
acephate 90 (Orthene 90S)	20 – 25 oz Orthene 90S per 100 lb seed, 2.5 – 3.25 oz Orthene 90S/acre for hopper box (to achieve application rate of 3 – 4 oz per acre)		
imidacloprid (Gaucho Grande 5); Aeris contains imidacloprid at recommended rate	0.375 mg active ingredient per seed (about 5.3 oz Gaucho Grande per 250,000 seed, not to exceed 12.8 oz Gaucho Grande per 100 lb seed)		
thiamethoxam (Cruiser 5); Avicta Complete Cotton contains thiamethoxam at recommended rate	0.34 mg active ingredient per seed (about 4.8 oz Cruiser 5FS per 250,000 seed)		

* Acephate and methamidophos are preferred if western flower thrips are present in significant numbers.

Plant Bugs

The tarnished plant bug and clouded plant bug are the predominant species. Cotton fleahoppers are observed some years. The sweep net is a very effective tool for monitoring adult plant bugs and detecting movement into the field. The ground cloth is a more effective tool for monitoring nymphs. The presence of nymphs indicates reproduction is occurring, and they generally are more common after first bloom. Visual scouting is a less reliable method, but may also be used.

Visual sampling should include examining terminals for adults and nymphs, and checking inside squares, blooms and small bolls for nymphs. Boll injury appears as small, dark sunken spots on the outside. Seed and lint damage is usually localized to the lock where feeding occurred. Distinguishing plant bug damage from stink bug based on external symptoms is difficult. “Dirty blooms” (anthers dark and brown) are a sign of plant bug feeding.

First two weeks of squaring
Treat when plant bugs number **eight** or more per 100 sweeps (standard sweep net) or one or more per drop cloth (0.2 per row foot).

Third week of squaring until first bloom
Treat when plant bugs number **15 or more** per 100 sweeps or two or more per drop cloth (0.4 per row foot).

From first square to first bloom
Low or dropping square retention can be a warning of plant bug problems. If square retention drops below **80 percent** and plant bugs are present, treatment should be considered even if numbers are below threshold. The objective is to maintain the square retention goal. Consider if multiple pests are contributing to this square loss before selecting an insecticide.

After first bloom
Treat when plant bugs number three or more per drop cloth (0.6 per foot) or 15 or more per 100 sweeps. Count clouded plant bugs as equivalent to 1.5 tarnished plant bugs when determining if populations are above treatment level. Treatment should also be considered if 15 or more plant bugs are observed per 100 plants during visual examination, or 10 percent or more of squares show external evidence of plant bug feeding (i.e., dirty squares). Consecutive insecticide applications at a 4-5 day interval are often required to control high populations of nymphs and adults.

Insecticide (Trade Names)	Lb Active Ingredient per Acre	Amount Formulation per Acre	Acres Treated per Gal or Lb of Dry Product
PLANT BUGS – phase I, pre-bloom window*			
acetamiprid (Intruder 70WSP)	0.048	1.1 oz	14.5
flonicamid (Carbine 50WG)	0.081 – 0.089	2.6 – 2.8 oz	6.2 – 5.7
imidacloprid 4.44 (Trimax Pro)	0.047 – 0.062	1.35 – 1.8 oz	95 – 71
imidacloprid 4.0 (Couraze Max)	0.047 – 0.062	1.5 – 2.0 oz	85 – 64
thiamethoxam (Centric 40WG)	0.0375 – 0.05	1.5 – 2.5 oz	10.7 – 8
PLANT BUGS – phase II, blooming window			
acephate 90 (Orthene 90S)	0.30 – 0.45	0.33 – 0.5 lb	3 – 2
acephate 97 (Orthene 97SP)	0.30 – 0.45	0.31 – 0.46 lb	3.2 – 2.2
chlorpyrifos (Lorsban 4, Nufos 4)	0.5	16 oz	8
chlorpyrifos (Lorsban Advanced 3.755)	0.47	16 oz	8
dicrotophos (Bidrin 8)	0.31 – 0.5	5 – 8 oz	25.6 – 16
dimethoate 4	0.25	8 oz	16
malathion 5	1.25	32 oz	4
novaluron (Diamond 0.83)**	0.058 – 0.078	9 – 12 oz	14.2 – 10.7
oxamyl (Vydate C-LV 3.77)	0.29 – 0.35	10 – 12 oz	12.8 – 10.7
pyrethroids***	See labels (use mid- to high-recommended rates)		

* These products tend to perform better prior to bloom and are primarily recommended in this window. Applications can be banded to reduce costs. Avoiding the use of pyrethroid, organophosphate and carbamate insecticides prior to bloom is suggested as a resistance management tool.

** This product controls only immature plant bugs. Tank mixes with other insecticides are recommended if significant numbers of adults are present. A minimum of two applications is usually required when high populations are present.

*** Some pyrethroid insecticides should provide adequate control of plant bugs in areas where resistance is not established. However, tank mixes with reduced rates of other Phase II recommended insecticides are often suggested.

Aphids

Early-season
Parasites and predators usually control aphids on seedling cotton. If aphids are present on numerous plants and some leaves are curled along the edges (signs of stress), treatment is suggested, particularly if the crop is already suffering from drought stress. Some in-furrow insecticides and seed treatments used for thrips control can suppress early-season aphid populations.

Mid-late season
Treat when aphids are very numerous, honeydew is present, plants are showing signs of stress and natural control agents are not reducing aphid populations. Consider the possibility of a fungal epizootic (disease) before treating.

Insecticide (Trade Names) for APHIDS	Lb Active Ingredient per Acre	Amount Formulation per Acre	Acres Treated per Gal or Lb of Dry Product
acetamiprid (Intruder 70WSP)	0.026 – 0.048	0.6 – 1.1 oz	26.7 – 14.5
dicrotophos (Bidrin 8)*	0.25 – 0.5	4 – 8 oz	32 – 16
dimethoate 4*	0.125 – 0.25	4 – 8 oz	32 – 16
flonicamid (Carbine 50 WP)	0.044 – 0.089	1.4 – 2.8 oz	11.4 – 5.7
imidacloprid 4.44 (Trimax Pro)	0.031 – 0.047	0.9 – 1.35 oz	142 – 95
imidacloprid 4.0 (Couraze Max)	0.031 – 0.047	1 – 1.5 oz	128 – 85
thiamethoxam (Centric 40WG)	0.031 – 0.05	1.25 – 2 oz	12.8 – 8

* Because of resistance, these products may only provide suppression.

Bollworm/Tobacco Budworm

Non-Bt Cotton
Insecticides are recommended on the basis of knowing which species (bollworm vs. tobacco budworm) and how many are present in the field. **Prior to bloom**, treat when eight or more small larvae are present per 100 plants (or when populations threaten to reduce square retention below 80 percent). **After first bloom**, treat when four or more small larvae per 100 plants are present (or 5 percent or more of the squares are damaged and larvae are present).

In both Bt and non-Bt cotton, the treatment threshold should gradually increase after cotton reaches cutout (NAWF5) until NAWF5 + 350 – 450 DD60's, at which time insecticide applications for bollworm and budworm are no longer necessary.

Pyrethroid insecticides are NOT recommended against tobacco budworm infestations because of insecticide resistance. Time applications to control newly hatched larvae (< 1/4 inch length). Multiple applications on a 4 – 5 day interval may be needed. Tank-mixing pyrethroids with other insecticides may improve control of pyrethroid-resistant tobacco budworms, but are only recommended when the budworm ratio is no more than 25 percent and populations are less than 8 – 10 larvae per 100 plants. Change insecticide chemistry if a control failure occurs.

Bt Cotton
Prior to bloom, economic infestations are very unlikely. Treat when eight or more surviving larvae (> 1/4 inch or longer) are present per 100 plants, or when populations threaten to reduce square retention below 80 percent. **After first bloom**, treat when four or more surviving larvae (> 1/4 inch or longer) per 100 plants are present and/or 2 percent boll damage is found. Treatment based on eggs alone is not usually recommended. Scouting fields twice per week may be necessary once blooming has begun, especially if heavy egg lays are occurring. Whole plant examination may be necessary to find eggs and/or surviving larvae within the plant canopy.

Insecticide (Trade Names)	Lb Active Ingredient per Acre	Amount Formulation per Acre	Acres Treated per Gal or Lb of Dry Product
BOLLWORM*			
bifenthrin (Brigade 2, Discipline 2)	0.05 – 0.1	3.2 – 6.4 oz	40 – 20
cypermethrin (Ammo 2.5)	0.063 – 0.1	3.2 – 5 oz	40 – 26
deltamethrin (Delta Gold 1.5)	0.02 – 0.03	1.7 – 2.56 oz	75 – 50
esfenvalerate (Asana XL 0.66E)	0.03 – 0.05	5.8 – 9.6 oz	22 – 13
β-cyfluthrin (Baythroid XL 1)	0.0125 – 0.02	1.6 – 2.6 oz	80 – 49
γ-cyhalothrin (Declare 1.25, Prolex 1.25)	0.0125 – 0.02	1.28 – 2.05 oz	100 – 62
λ-cyhalothrin (Karate 2.08, Warrior II)	0.025 – 0.04	1.6 – 2.56 oz	83 – 52
Z-cypermethrin (Mustang Max 0.8)	0.0165 – 0.0225	2.64 – 3.6 oz	48.5 – 35.6
TOBACCO BUDWORM			
acephate 90 (Orthene 90S)	0.9	1 lb	1
emamectin benzoate (Denim 0.16)	0.01 – 0.015	8 – 12 oz	16 – 10.7
flubendiamide (Belt 4)	0.063 – 0.094	2 – 3 oz	64 – 42.7
indoxacarb (Steward 1.25)	0.11	11.3 oz	11.3
methomyl (Lannate LV 2.4)	0.45	24 oz	5.3
profenofos (Curacron 8)	0.75 – 1	12 – 16 oz	12 – 8
rynaxypyr (Coragen 1.67 SC)	0.065 - 0.09	5 - 7 oz	25.6 – 18.3
spinosad (Tracer 4)	0.045 – 0.089	1.4 – 2.8 oz	90 – 45
thiodicarb (Larvin 3.2)	0.6 – 0.9	24 – 36 oz	5.3 – 3.6

* Insecticides listed for tobacco budworm should also control bollworm, but pyrethroids are usually recommended when the population is exclusively bollworm.

Stink Bugs

Small, dark spots about 1/16-inch in diameter on the outside of bolls are usually associated with stink bug feeding. Stink bugs have piercing, needle-like mouthparts that can penetrate even more mature bolls. Stink bugs are seed feeders and migrate from other host crops into cotton when bolls begin to develop. Stink bugs are often difficult to detect. Intensively scout for this pest when stink bugs or bolls with dark feeding spots are observed.

Treat when stink bugs number one or more per 6 row feet. Treatment is also recommended if 20 percent or more of 12-16 day old (thumb-sized) bolls have internal feeding warts and/or stained lint indicating stink bug injury.

Insecticide (Trade Names) for STINK BUGS	Lb Active Ingredient per Acre	Amount Formulation per Acre	Acres Treated per Gal or Lb of Dry Product
acephate 90 (Orthene 90S)	0.49 – 0.72	0.54 – 0.8 lb	1.9 – 1.25
acephate 97 (Orthene 97SP)	0.49 – 0.73	0.5 – 0.75 lb	2 – 1.33
bifenthrin (Brigade 2, Discipline 2)*	0.05 – 0.1	3.2 – 6.4 oz	60 – 30
dicrotophos (Bidrin 8)	0.33 – 0.5	5.3 – 8 oz	24 – 16
methyl parathion 4 (Methyl 4E)	0.5	16 oz	8
oxamyl (Vydate C-LV 3.77)	0.32 – 0.5	10.9 – 17 oz	11.6 – 7.5

* Most pyrethroid insecticides are labeled and effectively control green and southern green stink bugs. Bifenthrin is the only pyrethroid recommended if brown stink bugs are present in significant numbers.

Spider Mites

Spider mites are found on the underside of leaves, and close examination is required to detect their presence. Reddish or yellow speckling of leaves indicates spider mite activity. Infestations often occur on field edges or in isolated spots and then spread across the field. Treat when 30 – 50 percent of plants are affected and mites are still present. More than one application on a 4 – 5 day schedule may be required if eggs continue to hatch.

Insecticide (Trade Names) for SPIDER MITES	Lb Active Ingredient per Acre	Amount Formulation per Acre	Acres Treated per Gal or Lb of Dry Product
abamectin (Agri-Mek 0.15, Zoro 0.15)	0.0047 – 0.0094	4 – 8 oz	32 – 16
bifenazate (Acramite 4)	0.375 – 0.75	16 – 24 oz	8 – 5.3
bifenthrin (Brigade 2, Discipline 2)*	0.06 – 0.1	3.8 – 6.4 oz	33 – 20
dicofol 4	1 – 1.5	32 – 48 oz	4 – 2.6
dimethoate 4*	0.25	8 oz	16
emamectin benzoate (Denim 0.16)*	0.01 – 0.015	8 – 12 oz	16 – 10.7
etoxazole (Zeal 72 WSP)	0.034 – 0.045	0.75 – 1 oz	21.3 – 16
fenpyroximate (Portal 0.4)	0.05 – 0.075	16 – 24 oz	8 – 5.3
profenofos (Curacron 8)*	0.5 – 1	8 – 16 oz	16 – 8
propargite (Comite II 6)	0.94 – 1.69	20 – 36 oz	6.4 – 3.6
spiromesifen (Oberon 4)	0.094 – 0.25	3 – 8 oz	42.7 – 16

See label for specific use rates at different times of the season.

* These products may only suppress spider mite populations.

Fall Armyworm

Proper identification of fall armyworm larvae is critical for effective control. Look for an inverted "Y" mark on the head. Treat when four or more larvae are found in 100 blooms and/or bolls or when 10-20 larvae are found per 100 plants. Timing applications to control small larvae is more effective than trying to control larger larvae. Small larvae are often found in white blooms, pink bloom tags or behind the bracts of medium- or large-sized bolls.

Bollgard II and WideStrike cotton provide some control of fall armyworm infestations. However, treatment may still be necessary, especially for Bollgard II. Insecticide treatments should not be made unless surviving larvae (> 1/4 inch in length) are found at the threshold numbers indicated above.

Insecticide (Trade Names)* for FALL ARMYWORM	Lb Active Ingredient per Acre	Amount Formulation per Acre	Acres Treated per Gal or Lb of Dry Product
acephate 90 (Orthene 90S)	0.9	1 lb	1
emamectin benzoate (Denim 0.16)	0.01 – 0.015	8 – 12 oz	16 – 10.7
flubendiamide (Belt 4)	0.0625	2 oz	64
indoxacarb (Steward 1.25)	0.09 – 0.11	9.2 – 11.3 oz	13.9 – 11.3
methomyl (Lannate LV 2.4)	0.45	24 oz	5.3
methoxyfenozide (Intrepid 2)	0.06 – 0.16	4 – 10 oz	32 – 12.8
novaluron (Diamond 0.83)	0.039 – 0.078	6 – 12 oz	21.3 – 10.7
profenofos (Curacron 8)	0.75 – 1	12 – 16 oz	10.6 – 8
rynaxypyr (Coragen 1.67 SC)	0.052 - 0.09	4 – 7 oz	32 – 18.3
spinosad (Tracer 4)	0.067 – 0.089	2.1 – 2.8 oz	60 – 45
thiodicarb (Larvin 3.2)	0.6 – 0.9	24 – 36 oz	5.3 – 3.6

* Most pyrethroid insecticides provide some suppression of fall armyworm infestations, and using the highest labeled rates or a tank mixture with products listed above will often improve control.

Beet Armyworm

Beet armyworms can be recognized by a characteristic small black dot directly above the second true leg. Newer insecticide chemistries have made established beet armyworm populations easier to control. Production of an early crop and preservation of beneficial insects will reduce the risk of a beet armyworm outbreak.

Prior to August 15: Treat for beet armyworm when 5-6 "hits" (active clusters of small larvae) are found per 300 row feet.

After August 15: Treat when 10 or more "hits" are found per 300 row feet.

Bollgard II and WideStrike cotton provide good control of beet armyworm infestations. Supplemental insecticide applications are unlikely unless infestation levels are unusually high.

Insecticide (Trade Names) for BEET ARMYWORM	Lb Active Ingredient per Acre	Amount Formulation per Acre	Acres Treated per Gal or Lb of Dry Product
emamectin benzoate (Denim 0.16)	0.0075 – 0.01	6 – 8 oz	21.3 – 16
flubendiamide (Belt 4)	0.0625	2 oz	64
indoxacarb (Steward 1.25)	0.09 – 0.11	9.2 – 11.3 oz	13.9 – 11.3
methoxyfenozide (Intrepid 2)	0.06 – 0.16	4 – 10 oz	32 – 12.8
rynaxypyr (Coragen 1.67 SC)	0.052 - 0.09	4 – 7 oz	32 – 18.3
spinosad (Tracer 4)	0.067 – 0.089	2.1 – 2.8 oz	60 – 45

Loopers

Two species of loopers (cabbage looper and soybean looper) may occur on cotton. Both are light green and have two pairs of prolegs; however, the soybean looper is more difficult to control with insecticides. Looper populations are often held below damaging levels by natural biological control agents. Treat when loopers cause 25 percent defoliation or populations threaten premature defoliation prior to boll maturity.

Bollgard II and WideStrike cotton provide good control of looper infestations. Supplemental insecticide applications are unlikely unless infestation levels are unusually high.

Insecticide (Trade Names) for LOOPERS	Lb Active Ingredient per Acre	Amount Formulation per Acre	Acres Treated per Gal or Lb of Dry Product
emamectin benzoate (Denim 0.16)	0.01 – 0.015	8 – 12 oz	16 – 10.7
flubendiamide (Belt 4)	0.0625	2 oz	64
indoxacarb (Steward 1.25)	0.09 – 0.11	9.2 – 11.3 oz	13.9 – 11.3
methoxyfenozide (Intrepid 2)	0.06 – 0.16	4 – 10 oz	32 – 12.8
rynaxypyr (Coragen 1.67 SC)	0.052 - 0.098	4 – 7.5 oz	32 – 17.1
spinosad (Tracer 4)	0.067 – 0.089	2.1 – 2.8 oz	60 – 45
thiodicarb (Larvin 3.2)	0.6 – 0.9	24 – 36 oz	5.3 – 3.6

Bandedwinged Whitefly

Treat when whiteflies are present on most plants, particularly if honeydew is accumulating on leaves. The adults are small, white, moth-like insects feeding on the underside of leaves and readily fly when disturbed. More than one application on a 4 – 5 day schedule may be required if eggs continue to hatch.

Insecticide (Trade Names) for WHITEFLY	Lb Active Ingredient per Acre	Amount Formulation per Acre	Acres Treated per Gal or Lb of Dry Product
acephate 90 (Orthene 90S)	0.45 - 0.9	0.5 - 1 lb	2 - 1
spiromesifin (Oberon 4)	0.125 - 0.25	4 - 8 oz	32 - 16
thiamethoxam (Centric 40 WG)	0.05	2 - 2.5 oz	8

Premixed Insecticide Products

The following products are available as premixes of two 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. Use of these products is suggested primarily after first bloom at mid-labeled rates.

Trade Name (Insecticides)	Amount Product per Acre	Acres Treated per Gal of Product	Primary Target Pests (see label for other pests that may be controlled)
Bidrin XP (dicrotophos, bifenthrin)*	5.0 – 6.4 oz	25.6 – 20	Plant bugs, stink bugs, bollworm
Brigadier (imidacloprid, bifenthrin)	5.1 – 7.7 oz	25.1 – 16.6	Plant bugs, stink bugs, bollworm
Cobalt (chlorpyrifos, γ-cyhalothrin)	24 – 38 oz	5.3 – 3.3	Plant bugs, stink bugs, bollworm
Endigo ZC (thiamethoxam, λ-cyhalothrin)	4.0 – 5.5 oz	32 – 23.3	Plant bugs, stink bugs, bollworm
Hero (bifenthrin, Z-cypermethrin)	5.2 – 10.3 oz	24.6 – 12.4	Stink bugs, bollworm
Leverage (imidacloprid, cyfluthrin)	3.8 – 5.0 oz	33.7 – 25.6	Plant bugs, stink bugs, bollworm
Leverage 360 (imidacloprid, β-cyfluthrin)	3.2 oz	40	Plant bugs, stink bugs, bollworm

* Bidrin XP may only be used prior to squaring or after flowering has begun.

Cotton Insecticide/Miticide Performance Charts

Disclaimer: The following ratings are based on a general consensus from multiple efficacy trials across the Mid-south. Insecticides with a higher numerical rating are expected to give the best control of the target pest. Insecticide performance is often dependent upon the timing of an application. Some ratings are based on limited data, and local performance may vary depending on insecticide resistance levels and previous use of insecticides. Whether single or multiple insecticide applications are made may also influence performance. Ratings are shown for recommended use rates. Efficacy is often influenced by using higher or lower use rates.

Cotton – Insecticide Performance of At-planting Treatments for Pre-Squaring Pests

Insecticide	Mites	Aphids	Thrips
Avicta CP (0.34 mg ai thiamethoxam/seed)	Disruptive	9	8
Cruiser (0.30-0.34 mg ai thiamethoxam/seed)	Disruptive	9	8
Gaucho Grande (0.375 mg ai/seed)	Disruptive	8	8
Orthene 90S, In-Furrow (1 lb/a)	Disruptive	0	8
Orthene 90S, Seed Treatment. (20-25 oz/cwt)	Disruptive	0	7
Temik 15G (3.5 lb/a)	6	8	9

Disruptive, may flare spider mites.

Cotton – Insecticide Performance Ratings for Hemipteran and Homopteran Pests

Insecticide	Tarnished Plant Bug	Stink Bugs		Cotton Aphid
		Green & S. Green	Brown	
Ammo (3 – 5 oz)	5*	7	4	Disruptive
Asana XL (6 - 9 oz)	5*	7	4	Disruptive
Baythroid XL (1.8 – 2.5 oz)	6*	8	6	Disruptive
Bidrin (6 – 8 oz)	9	9	9	6*
Brigade / Capture (4 – 6 oz)	8*	9	8	Disruptive
Carbine (2.6 – 2.8 oz)	7	4	3	9
Centric (2 oz)	8	7	4	8.5
Denim (8 – 12 oz)	3	3	3	0
Diamond (6 – 9 oz)	7 (immatures only)	5 (immatures only)	3 (immatures only)	Disruptive
Dimethoate (8 oz)	6	6	6	5*
Intruder (1.1 oz)	6.5	6	3	9
Karate (1.8 – 2.2 oz)	7*	9	6	Disruptive
Lorsban (12 – 16 oz)	5	5	4	Disruptive
Malathion ULV (12 – 16 oz)	6	7	5	Disruptive
Methyl parathion 4 (16 oz)	5	9	9	Disruptive
Mustang Max (2.8 – 3.2 oz)	7*	9	7	Disruptive
Orthene (0.5 lb)	8.5	8	8	Disruptive
Prolex (1.3 – 1.8 oz)	7*	9	5	Disruptive
Steward (11.3 oz)	3	3	3	Disruptive
Trimax Pro (1.35 oz)	7	6	3	8
Vydate (10 – 12 oz)	8	7	7	Disruptive

Disruptive, may flare aphids. * Efficacy varies substantially due to resistance.

Cotton – Insecticide and Bt Cotton Performance Ratings for Lepidopteran Insects

Trade Names or Traits	Bollworm*	Tobacco Budworm*	Beet Armyworm	Fall Armyworm	Soybean or Cabbage Looper	Saltmarsh Caterpillar	Black Cutworm
Belt (2 -3 oz)	7	8	8 ?	7 ?	9 ?	?	?
Coragen (6 oz)	8	9	8 ?	7 ?	8 ?	?	?
Curacron (12 – 16 oz)	6	5	Disruptive	6	3	5	?
Denim (8 – 12 oz)	7	7	8	6	8	8	?
Diamond (6 – 9 oz)	3	3	7	8	7	5	?
Intrepid (4 – 8 oz)	3	3	9	7	8	9	?
Larvin (24 – 36 oz)	7	6	3	6	7	?	8
Orthene (1 lb)	6	5	Disruptive	6	6	?	8
Pyrethroids (mid rates)	8	2	Disruptive	6	3	7	9
Steward (11.3 oz)	7	7	8	6	8	9	?
Tracer (1.75 – 2.25 oz)	7	8	8	6	7	3	8
Bollgard	7	10	4	5	3	4	3
Bollgard 2	9	10	9	8	9	9	4
WideStrike	8	10	8	9	9	?	6?

Disruptive, may flare pest population. ?, Limited data. * Assumes insecticides are applied for small larvae (< 1/4 inch long).

Cotton – Insecticide/Miticide Performance Ratings for Spider Mites

Common Trade Names	Rate	Mites
Acramite	16 oz	7
Brigade / Discipline / Fanfare	5 oz	6*
Comite II	20 – 24 oz	6
Curacron	8 – 16 oz	5*
Denim	8 – 12 oz	6
Dicofol 4	32 - 48 oz	8
Dimethoate 4	8 oz	5*
Lorsban 4	16 oz	3*
Oberon 4	4 – 6 oz	8
Portal	16 – 24 oz	8
Vydate	10 – 12 oz	3*
Zeal	0.75 – 1 oz	8.5
Zephyr/Zoro	4 – 6 oz	8

* Efficacy may vary widely at different times of season. Complete failure is possible.

Introduction

Many different insects can be found on soybeans in Tennessee. Some are detrimental, while others are beneficial. The most economical and effective insect control program must begin with scouting, proper insect identification and a determination of possible economic damage.

Serious reductions in yield and quality may result if an outbreak of an insect pest occurs and is not controlled. Some of these pests feed on leaves and stems; others are primarily pod feeders. Many times insecticides are not needed for control, but in some cases, damaging localized populations are not noticed until serious damage has occurred. Soybean fields should be scouted weekly, paying special attention during the time of early bloom (R1) to full seed (R6).

Insect Identification

Foliage Feeders

Loopers: Loopers are often the most common "worms" on soybeans. They are light green and have two pairs of abdominal prolegs (excluding the pair on the last abdominal segment). The body is thickest at the rear and tapers to the head. These insects form the characteristic hump or "loop" when crawling. When populations are heavy, loopers eat much of the leaf surface, causing plants to look very ragged. Populations are often held in check by beneficial insects and diseases. Note: Although many pyrethroid insecticides are labeled for soybean looper control, they are not recommended because resistance is well documented.

Green Cloverworm: This species is commonly found in Tennessee soybean fields. The green cloverworm is a slender green caterpillar with three pairs of abdominal prolegs. It becomes very active and falls to the ground when disturbed. The feeding damage produced by the green cloverworm is similar to that of loopers. Although they are present most of the growing season, they are damaging only with very high populations or in combination with other defoliators.

Japanese Beetle: Japanese beetle adults are metallic green or greenish-bronze beetles, ½ inch long, with reddish wing covers. They have white spots near the tip of the abdomen and on the sides. As they feed on soybean foliage, Japanese beetles skeletonize the leaves. This pest rarely occurs at economically damaging levels.

Bean Leaf Beetle: The bean leaf beetle feeds on leaves and sometimes on small pods. The beetles may feed through the pod and eat the beans, leaving damage that resembles bollworm feeding. The adults can cause severe damage on small plants. The larvae feed on roots and nodules and underground portions of the stems. Adults are reddish to tan, usually with four dark spots on each wing.

Mexican Bean Beetle: Mexican bean beetles damage plants by feeding on the underside of the leaf surface, resulting in a skeletonized appearance. Both adults and larvae feed in a similar manner. Adults are copper brown with 16 black spots on the back. Larvae are yellow to brown with many spines on the back and sides. Both adults and larvae are about ¼ inch long. This pest rarely occurs at economically damaging levels.

Blister Beetles: Blister beetles are elongated, soft-winged beetles that feed on leaves. One species, the striped blister beetle, has alternating dark brown and yellow stripes running the length of the body. Another species, the margined blister beetle, is black with a gray stripe along margins of the wing covers. These insects usually feed in groups in one or several areas of the field.

Soybean Aphid: Also called Chinese aphid, this is a relatively new pest for Tennessee, discovered first in Middle Tennessee. Its distribution probably includes all soybean growing areas in Tennessee, but pest numbers are generally low and scattered at this time. Aphids pierce leaf tissue during feeding in order to suck sap from soybean leaves. Soybean mosaic virus and other viral diseases are sometimes transmitted by aphids during feeding.

Pod Feeders

Fall Armyworm: The fall armyworm is a multi-colored, striped caterpillar with an inverted "Y" on the head and four pairs of abdominal prolegs. Armyworms may feed on leaves, stems, pods and beans. They may appear in large numbers and quick control is important.

Corn Earworm: The corn earworm, also called the bollworm or podworm, can seriously reduce yields since it feeds directly on beans by eating a hole in the pod and consuming the seed. Large caterpillars may be green, brown or yellow. The body is stocky and the head is usually pale brown or orange. Light and dark stripes run the length of the body. The larva has four pairs of abdominal prolegs. Young blooms and tender leaves are sometimes eaten. Beans should be checked during flowering and early pod set.

Stink Bugs: Stink bugs suck the juices from immature soybean seeds. This feeding introduces disease organisms into developing seeds, reduces germination and lowers milling quality. Damaged beans appear wrinkled and are smaller than normal. Adults are shield-shaped, either green or brown and are about ½ inch long.

Stem and Seedling Feeders

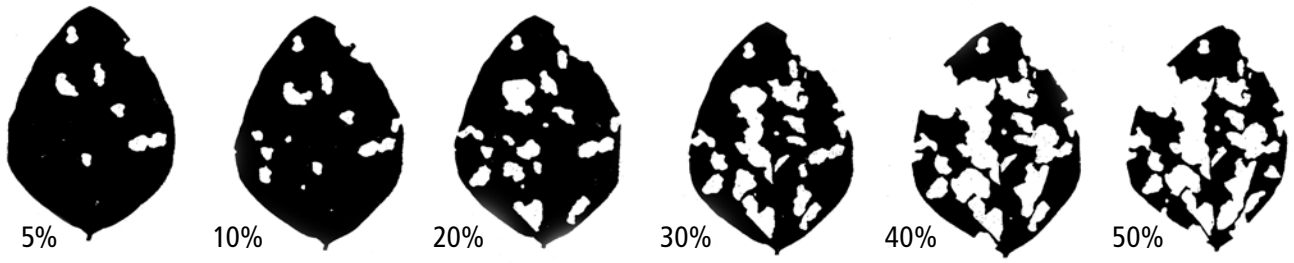
Threecornered Alfalfa Hopper: The adult threecornered alfalfa hopper is a green, wedge-shaped insect about ¼ inch long. Adults and nymphs feed by inserting their piercing-sucking mouthparts into the stem a few inches above the soil line. This feeding around the stem girdles the plant, often causing it to lodge later in the season. It is primarily a problem in reduced tillage fields. Maintaining a clean field border helps to reduce population numbers.

Scouting Procedures

A good sampling plan is to check 6 feet of row at five locations or take 25 sweeps at four locations in average-sized fields (about 50 acres). Increase sampling points proportionately with the acreage in a field. Make sure sample points are scattered over the entire field. Look for:

- **Seedling/Stem Feeding**
  Check seedlings very closely until the plants are about 12 inches tall. The stems become woody and severe damage from seedling pests becomes less likely at this time. Look for insects that may be on the plant (threecornered alfalfa hopper) or in the soil around the base of the plants (lesser corn stalk borer, cutworms). Evaluate stand loss (percentage of dead or dying plants) and try to determine if future stand loss is probable (insects easily found and actively damaging plants).
- **Foliage Feeders**
  Determine which insects are eating the foliage and estimate percent defoliation. Use a sweep net or a drop cloth (shake sheet) to sample for insect pests. At each sample point, estimate percent foliage loss so that an average can be calculated for the field. For soybean aphids, begin scouting in early July. Look for aphids on the undersides of upper leaves in vegetative and flowering soybeans. Estimate aphid density per plant at 5-10 locations throughout the field.
- **Pod-Feeders:** After full bloom (when pods are being "set") look closely for any pod-feeding caterpillars (corn earworms and fall armyworms) and stink bugs that are dislodged onto the shake cloth or into the sweep net. Count these carefully.

Figure 1 – Percent Defoliation



Expected Occurrence of Insect Pests in Soybean

Below is a timetable of when common pests are typically encountered in soybean, although conditions vary from season-to-season or farm-to-farm within a season.

Stage of Plant Development	Common Pests	Occasional Pests
Seedling	Threecornered alfalfa hopper	Thrips, grasshoppers, bean leaf beetle, cutworms, grape colaspis, white grubs
V5 - R1 (Early flowering)	---	Threecornered alfalfa hopper
R1 - R5 (Early flowering to early podfill)	Stink bugs, green cloverworm	Threecornered alfalfa hopper, blister beetles, corn earworm, fall armyworm, loopers, soybean aphid
R5 + (mid to late podfill)	Stink bugs, loopers, green cloverworm	Blister beetles, fall armyworm, loopers, soybean aphid

Insecticide Seed Treatments

Insecticide seed treatments such as Cruiser (thiamethoxam), Gaucho (imidacloprid) and NipsIt (clothianidin) are available from seed companies or local distributors. Seed treatments will help control some seed and seedling pests such as thrips, bean leaf beetle, grape colaspis, threecornered alfalfa hopper, wireworms and white grubs. Data indicates that insecticide seed treatments provide an average yield increase of 1-3 bushels per acre in Tennessee, with the higher responses typically occurring in early-planted soybeans.

Suggested Threshold Levels for Insect Pests of Soybean	
Threecornered Alfalfa Hopper	Treat if 10 percent of young plants (up to 10-12 inches) are infested with adults and/or nymphs. Use a threshold of 1 hopper per sweep for plants taller than 12 inches.
Defoliating pests (bean leaf beetles, green cloverworm, blister beetles, loopers, grasshoppers, etc.)	Treat at 30 percent defoliation until bloom (R1), 20 peercent from bloom to late pod fill (R1-R7), 30 percent from late pod fill to near maturity (R7). Alternatives to defoliation thresholds: Bean leaf beetle – 50 beetles per 25 sweeps during pod fill Green cloverworm – 38 larvae per 25 sweeps during pod fill Loopers – 19 larvae per 25 sweeps during pod fill
Soybean Aphid	Treat when an average of 250 aphids or more is found per plant from early bloom (R1) until early pod fill (R5). Treatment after R5 is less likely to increase yield.
Corn Earworm or Fall Armyworm	Once blooming has begun, treat when an average of 9 or more larvae is found per 25 sweeps (or 3 to 4 larvae are found per foot of row).
Stink Bugs	From beginning bloom (R1) to near maturity (R7), treat when an average of 9 or more stink bugs is found per 25 sweeps (or 1 stink bug is found per foot of row).*

* In soybeans planted on 36-inch or wider rows, sweep only one row. In narrow-row soybeans, allow the normal arch of a sweep net to continue through the adjacent rows.

Suggestions for Chemical Control of Soybean Insects

Insects & Chemicals (Trade Names)	Lbs Active Ingredient Per Acre	Amount Formulation Per Acre	Acres a Gallon Will Cover
CUTWORMS			
bifenthrin (Brigade 2E, Discipline 2E)	0.047 – 0.10	3 – 6.4 oz	42.7 – 20
carbaryl			
(Sevin 80S)	1.0 – 1.5	1.25 – 1.875 lb	---
(Sevin XLR Plus)	1.0 – 1.5	32 – 48 oz	4 – 2.7
chlorpyrifos (Lorsban 4E, Nufos 4E)	0.5 – 1.0	16 – 32 oz	8 – 4
chlorpyrifos (Lorsban Advanced 3.755)	0.5 - 0.94	17 - 32 oz	7.5 - 4
esfenvalerate (Asana XL 0.66E)	0.03 – 0.05	5.8 – 9.6 oz	22 – 13
permethrin (Pounce 3.2E)	0.05 – 0.10	2 – 4 oz	64 – 32
thiodicarb (Larvin 3.2)	0.5 – 0.75	20 – 30 oz	6.4 – 4.3
β-cyfluthrin (Baythroid XL 1)	0.065 – 0.0125	0.8 – 1.6 oz	160 – 80
γ-cyhalothrin (Declare 1.25, Prolex 1.25)	0.0075 – 0.0125	0.77 – 1.28 oz	166 – 126
λ-cyhalothrin (Karate 2.08, Warrior II)	0.015 – 0.025	0.96 – 1.60 oz	133 – 80
Z-cypermethrin (Mustang Max 0.8E)	0.008 – 0.025	1.28 – 4.0 oz	100 – 32

Insects & Chemicals (Trade Names)	Lbs Active Ingredient Per Acre	Amount Formulation Per Acre	Acres a Gallon Will Cover
THREECORNERED ALFALFA HOPPER			
acephate 90 (Orthene 90S)	0.75 – 0.99	0.83 – 1.10 lb	---
carbaryl			
(Sevin 80S)	1.0	1.25 lb	---
(Sevin XLR Plus)	1.0	32 oz	4
esfenvalerate (Asana XL 0.66E)	0.03 – 0.05	5.8 – 9.6 oz	22 – 13
β-cyfluthrin (Baythroid XL 1)	0.025 – 0.044	1.6 – 2.8 oz	80 – 45
γ-cyhalothrin (Declare 1.25, Prolex 1.25)	0.0075 – 0.0125	0.77 – 1.28 oz	166 – 126
λ-cyhalothrin (Karate 2.08, Warrior II)	0.015 – 0.025	0.96 – 1.6 oz	133 – 80
Z-cypermethrin (Mustang Max 0.8E)	0.0175 – 0.025	2.8 – 4.0 oz	45 – 32
BEAN LEAF BEETLE			
acephate 90 (Orthene 90S)	0.75 – 0.99	0.83 – 1.10 lb	---
bifenthrin (Brigade 2E, Discipline 2E)	0.063 – 0.10	4 – 6.4 oz	32 – 20
carbaryl			
(Sevin 80S)	0.5 – 1.0	0.67 – 1.25 lb	---
(Sevin XLR Plus)	0.5 – 1.0	16 – 32 oz	8 – 4
chlorpyriphos (Lorsban 4E, Nufos 4E)	0.5 – 1.0	16 – 32 oz	8 – 4
chlorpyrifos (Lorsban Advanced 3.755)	0.5 - 0.94	17 - 32 oz	7.5 - 4
esfenvalerate (Asana XL 0.66E)	0.03 – 0.05	5.8 – 9.6 oz	22 – 13
methomyl (Lannate LV 2.4)	0.23 – 0.45	12 – 24 oz	10.4 – 5.3
methyl parathion 4 (Methyl 4E)	1.0	32 oz	4
permethrin (Pounce 3.2E)	0.05 – 0.1	2 – 4 oz	64 – 32
β-cyfluthrin (Baythroid XL 1)	0.0125 – 0.022	1.6 – 2.8 oz	80 – 45
γ-cyhalothrin (Declare 1.25, Prolex 1.25)	0.0075 – 0.0125	0.77 – 1.28 oz	166 – 100
λ-cyhalothrin (Karate 2.08, Warrior II)	0.015 – 0.025	0.96 – 1.6 oz	133 – 80
Z-cypermethrin (Mustang Max 0.8E)	0.0175 – 0.025	2.8 – 4.0 oz	45 – 32
GRASSHOPPERS			
acephate 90 (Orthene 90S)	0.30 - 0.50	0.33 - 0.56 lb	---
bifenthrin (Brigade 2E, Discipline 2E)	0.063 - 0.10	4 - 6.4 oz	32 - 20
carbaryl			
(Sevin 80S)	0.5 – 1.5	0.67 – 1.875 lb	---
(Sevin XLR Plus)	0.5 – 1.5	16 – 48 oz	8 – 2.7
chlorpyrifos (Lorsban 4E, Nufos 4E)	0.25 – 0.50	8 – 16 oz	16 – 8
chlorpyrifos (Lorsban Advanced 3.755)	0.25 - 0.47	8.5 - 16 oz	15.1 - 8
diflubenzuron (Dimilin 2L), for immatures	0.031	2 oz	64
esfenvalerate (Asana XL 0.66E)	0.03 – 0.05	5.8 – 9.6 oz	22 – 13
methyl parathion 4 (Methyl 4E)	1.0	32 oz	4
β-cyfluthrin (Baythroid XL 1)	0.0155 – 0.022	2.1 – 2.8 oz	60 – 45

γ-cyhalothrin (Declare 1.25, Prolex 1.25)	0.0125 - .0.015	1.28 - 1.54 oz	100 - 83
λ-cyhalothrin (Karate 2.08, Warrior II)	0.025 - 0.030	1.6 - 1.9 oz	80 - 67
Z-cypermethrin (Mustang Max 0.8E)	0.020 - 0.025	3.2 - 4.0 oz	40 -32
MEXICAN BEAN BEETLE			
acephate 90 (Orthene 90S)	0.75 - 0.99	0.83 - 1.10 lb	---
bifenthrin (Brigade 2E, Discipline 2E)	0.063 - 0.10	4 - 6.4 oz	32 - 20
carbaryl			
(Sevin 80S)	0.5 - 1.0	0.67 - 1.25 lb	---
(Sevin XLR Plus)	0.5 - 1.0	16 - 32 oz	8 - 4
chlorpyrifos (Lorsban 4E, Nufos 4E)	0.5 - 0.75	16 - 24 oz	8 - 5.3
chlorpyrifos (Lorsban Advanced 3.755)	0.5 - 0.75	17 - 25.6 oz	7.5 - 5
dimethoate 4	0.5	16 oz	8
esfenvalerate (Asana XL 0.66E)	0.015 - 0.03	2.9 - 5.8 oz	44 - 22
methomyl (Lannate LV 2.4)	0.23 - 0.45	12 - 24 oz	10.4 - 5.3
methyl parathion 4 (Methyl 4E)	0.5	16 oz	8
permethrin (Pounce 3.2E)	0.05 - 0.1	2.0 - 4.0 oz	64 - 32
β-cyfluthrin (Baythroid XL 1)	0.0125 - 0.022	1.6 - 2.8 oz	80 - 45
γ-cyhalothrin (Declare 1.25, Prolex 1.25)	0.0075 - 0.0125	0.77 - 1.28	166 - 100
λ-cyhalothrin (Karate 2.08, Warrior II)	0.015 - 0.025	0.96 - 1.6 oz	133 - 80
Z-cypermethrin (Mustang Max 0.8E)	0.0175 - 0.025	2.8 - 4.0 oz	45 - 32
BLISTER BEETLE			
carbaryl			
(Sevin 80S)	0.5 - 1.0	0.67 - 1.25 lb	---
(Sevin XLR Plus)	0.5 - 1.0	16 - 32 oz	8 - 4
methyl parathion 4 (Methyl 4E)	0.5	16 oz	8
β-cyfluthrin (Baythroid XL 1)	0.0125 - 0.022	1.6 - 2.8 oz	80 - 45
γ-cyhalothrin (Declare 1.25, Prolex 1.25)	0.0125 - 0.015	1.28 - 1.54	100 - 83
λ-cyhalothrin (Karate 2.08, Warrior II)	0.025 - 0.03	1.6 - 1.9 oz	80 - 67
Z-cypermethrin (Mustang Max 0.8E)	0.0175 - 0.025	2.8 - 4.0 oz	45 - 32
JAPANESE BEETLE			
bifenthrin (Brigade 2E, Discipline 2E)	0.063 - 0.10	4 - 6.4 oz	32 - 20
carbaryl			
(Sevin 80S)	1.0	1.25 lb	---
(Sevin XLR Plus)	0.5 - 1.0	16 - 32 oz	8 - 4
esfenvalerate (Asana XL 0.66E)	0.03 - 0.05	5.8 - 9.6 oz	22 - 13.3
permethrin (Pounce 3.2E)	0.05 - 0.10	2 - 4 oz	64 - 32
β-cyfluthrin (Baythroid XL 1)	0.0125 - 0.022	1.6 - 2.8 oz	80 - 45
γ-cyhalothrin (Declare 1.25, Prolex 1.25)	0.0125 - .015	1.28 - 1.54 oz	100 - 83
λ-cyhalothrin (Karate 2.08, Warrior II)	0.025 - 0.03	1.6 - 1.9 oz	80 - 67
Z-cypermethrin (Mustang Max 0.8E)	0.0175 - 0.025	2.8 - 4.0 oz	45 - 32

GREEN CLOVERWORM			
acephate 90 (Orthene 90S)	0.75 - 0.99	0.83 - 1.10 lb	---
bifenthrin (Brigade 2E, Discipline 2E)	0.063 - 0.10	4 - 6.4 oz	32 - 20
carbaryl			
(Sevin 80S)	0.5 - 1.0	0.67 - 1.25 lb	---
(Sevin XLR Plus)	0.5 - 1.0	16 - 32 oz	8 - 4
chlorpyrifos (Lorsban 4E, Nufos 4E)	0.25 - 0.5	8 - 16 oz	16 - 8
chlorpyrifos (Lorsban Advanced 3.755)	0.25 - 0.47	8.5 - 16 oz	15.1 - 8
esfenvalerate (Asana XL 0.66E)	0.015 - 0.03	2.9 - 5.8 oz	44 - 22
indoxacarb (Steward 1.25)	0.055 - 0.11	5.6 - 11.2 oz	22.8 - 11.5
methomyl (Lannate LV 2.4)	0.23 - 0.45	12 - 24 oz	10.7 - 5.3
methoxyfenozide (Intrepid 2)	0.063 - 0.125	4 - 8 oz	32 - 16
methyl parathion 4 (Methyl 4E)	0.375 - 0.50	12 - 16 oz	10.6 - 8
permethrin (Pounce 3.2E)	0.05 - 0.1	2 - 4 oz	64 - 32
spinosad (Tracer)	0.031 - 0.062	1 - 2 oz	128 - 64
thiodicarb (Larvin 3.2)	0.25 - 0.4	10 - 16 oz	12.8 - 8
β-cyfluthrin (Baythroid XL 1)	0.025 - 0.044	1.6 - 2.8 oz	80 - 45
γ-cyhalothrin (Declare 1.25, Prolex 1.25)	0.0075 - 0.0125	0.77 - 1.28	166 - 100
λ-cyhalothrin (Karate 2.08, Warrior II)	0.015 - 0.025	0.96 - 1.6 oz	133 - 80
Z-cypermethrin (Mustang Max 0.8E)	0.0175 - 0.025	2.8 - 4.0 oz	45 - 32
SOYBEAN LOOPER			
indoxacarb (Steward 1.25)	0.055 - 0.11	5.6 - 11.3 oz	22.8 - 11.5
methoxyfenozide (Intrepid 2)	0.063 - 0.125	4 - 8 oz	32 - 16
spinosad (Tracer 4)	0.031 - 0.062	1 - 2 oz	128 - 64
thiodicarb (Larvin 3.2)	0.45 - 0.75	18 - 30 oz	7.0 - 4.3
CORN EARWORM			
bifenthrin (Brigade 2E, Discipline 2E)	0.063 - 0.10	4 - 6.4 oz	32 - 20
carbaryl			
(Sevin 80S)	0.5 - 1.5	0.67 - 1.25 lb	---
(Sevin XLR Plus)	0.5 - 1.5	16 - 48 oz	8 - 2.7
esfenvalerate (Asana XL 0.66E)	0.03 - 0.05	5.8 - 9.6 oz	22 - 13
methomyl (Lannate LV 2.4)	0.23 - 0.45	12 - 24 oz	10.7 - 5.3
permethrin (Pounce 3.2E)	0.1 - 0.2	4 - 8 oz	32 - 16
spinosad (Tracer 4)	0.047 - 0.062	1.5 - 2.0 oz	85 - 64
thiodicarb (Larvin 3.2)	0.25 - 0.4	10 - 16 oz	12.8 - 8
β-cyfluthrin (Baythroid XL 1)	0.0125 - 0.022	1.6 - 2.8 oz	80 - 46
γ-cyhalothrin (Declare 1.25, Prolex 1.25)	0.0075 - 0.0125	0.77 - 1.28	166 - 100
λ-cyhalothrin (Karate 2.08, Warrior II)	0.015 - 0.025	0.96 - 1.6 oz	133 - 80
Z-cypermethrin (Mustang Max 0.8E)	0.0175 - 0.025	2.8 - 4.0 oz	45 - 32

FALL ARMYWORM			
acephate 90 (Orthene 90S)	0.75 - 0.99	0.83 - 1.10 lb	---
bifenthrin (Brigade 2E, Discipline 2E)	0.063 - 0.10	4 - 6.4 oz	32 - 20
carbaryl			
(Sevin 80S)	1.0 - 1.5	1.25 - 1.875 lb	---
(Sevin XLR Plus)	1.0 - 1.5	32 - 48 oz	4 - 2.7
indoxacarb (Steward 1.25)	0.055 - 0.11	5.6 - 11.3 oz	22.8 - 11.5
methomyl (Lannate LV 2.4)	0.23 - 0.45	12 - 24 oz	10.7 - 5.3
methoxyfenozide (Intrepid 2)	0.063 - 125	4 - 8 oz	32 - 16
spinosad (Tracer 4)	0.047 - 0.062	1.5 - 2.0 oz	85 - 64
thiodicarb (Larvin 3.2)	0.25 - 0.4	10 - 16 oz	12.8 - 8
β-cyfluthrin (Baythroid XL 1)	0.0125 - 0.022	1.6 - 2.8 oz	80 - 45
γ-cyhalothrin (Declare 1.25, Prolex 1.25)	0.065 - 0.075	1.28 - 1.54 oz	100 - 83
λ-cyhalothrin (Karate 2.08, Warrior II)	0.025 - 0.03	1.6 - 1.92 oz	80 - 67
Z-cypermethrin (Mustang Max 0.8E)	0.020 - 0.025	3.2 - 4.0 oz	40 - 32
STINK BUGS			
acephate 90 (Orthene 90S)	0.50 - 0.99	0.56 - 1.10 lb	---
bifenthrin (Brigade 2E, Discipline 2E)	0.063 - 0.10	4 - 6.4 oz	32 - 20
methyl parathion 4 (Methyl 4E)	0.3 - 1.0	12 - 32 oz	10.6 - 4
β-cyfluthrin (Baythroid XL 1)	0.025 - 0.044	1.6 - 2.8 oz	80 - 45
γ-cyhalothrin (Declare 1.25, Prolex 1.25)	0.0125-0.015	1.28-1.54 oz	100 - 80
λ-cyhalothrin (Karate 2.08, Warrior II)	0.025 - 0.030	1.6 - 1.9 oz	80 - 67
Z-cypermethrin (Mustang Max 0.8E)	0.020 - 0.025	3.2 - 4.0 oz	40 - 32
SPIDER MITES			
bifenthrin (Brigade 2E, Discipline 2E)	0.063 - 0.10	4 - 6.4 oz	32 - 20
chlorpyrifos (Lorsban 4E, Nufos 4E)	0.25 - 0.5	8 - 16 oz	16 - 8
chlorpyrifos (Lorsban Advanced 3.755)	0.25 - 0.47	8.5 - 16 oz	15.1 - 8
dimethoate 4	0.5	16 oz	8
SOYBEAN APHID			
acephate 90 (Orthene 90S)	0.75 - 0.99	0.83 - 1.10 lb	---
bifenthrin (Brigade 2E, Discipline 2E)	0.063 - 0.10	4 - 6.4 oz	32 - 20
chlorpyrifos (Lorsban 4E, Nufos 4E)	0.50 - 1.0	16 - 32 oz	8 - 4
chlorpyrifos (Lorsban Advanced 3.755)	0.50 - 0.94	17 - 32 oz	7.5 - 4
γ-cyhalothrin (Declare 1.25, Prolex 1.25)	0.0175 - 0.025	2.8 - 4.0 oz	125 - 32
λ-cyhalothrin (Karate 2.08, Warrior II)	0.025 - 0.030	1.6 - 1.9 oz	133 - 80
Z-cypermethrin (Mustang Max 0.8E)	0.0175 - 0.025	2.8 - 4.0 oz	45 - 32

Premixed Insecticide Product

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

Trade Names (Insecticides)	Amount Product per Acre	Acres Treated per Gal of Product	Primary Target Pests (see label for other pests that may be controlled)
Cobalt (chlorpyrifos, γ-cyhalothrin)	19 - 38 oz	6.7 - 3.3	Stink bugs, corn earworm, green cloverworm, threecornered alfalfa hopper
Endigo ZC (thiamethoxam, λ-cyhalothrin)	3.5 - 4.5 oz	36.6 - 28.4	Stink bugs, corn earworm, green cloverworm, threecornered alfalfa hopper
Hero (bifenthrin, Z-cypermethrin)	4 - 10.3 oz	32 - 12.4	Stink bugs, corn earworm, green cloverworm, threecornered alfalfa hopper
Leverage (imidacloprid, cyfluthrin)	3.8 oz	33.7	Stink bugs, corn earworm, green cloverworm, threecornered alfalfa hopper
Leverage 360 (imidacloprid, β-cyfluthrin)	2.8 oz	45.7	Stink bugs, corn earworm, green cloverworm, threecornered alfalfa hopper

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 systems can add to 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: Seed corn now routinely comes treated with insecticide. These insecticides will control or suppress a number of seed and seedling insect pests (see below). Insecticide seed treatments, specifically Poncho and Cruiser, have largely replaced the use of in-furrow or banded insecticides that were often applied at planting. However, many at-planting insecticides can still be used for the control of seed and seedling pests.

Consider using at-planting insecticides when:
- You have a known soil-insect problem.
- You are planting in a field that was previously sod or small grains.

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

Trade Names	Insecticide Active Ingredients	Billbugs	White grubs	Wireworms	Seedcorn maggot	Cutworms	Sugarcane beetle	Stink bugs	Chinch bugs	Southern corn rootworm	Western corn rootworm
Poncho 250	Clothianidin, 0.25 mg ai/kernel	P, NL	F	G	E	P	F	P	G	E, NL	P, NL
Poncho 500	Clothianidin, 0.50 mg ai/kernel	F	G	G	E	P	G	P	G	E	P
Cruiser Extreme 250	Thiamethoxam, 0.25 mg ai/kernel	P, NL	F	G	E	P	P	P	F	E, NL	P, NL
Cruiser Extreme 500	Thiamethoxam, 0.50 mg ai/kernel	P, NL	G	G	E	P	F	P	F	E	P, NL
Gaucho 600, Imida E-AG 5 FST, Senator	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, 1.5 oz/42 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
KickStart*	Diazinon + Lindane, 1.5 oz/42 lb seed	P, NL	F, NL	P?	F	P, NL	P, NL	P, NL	P, NL	P?, NL	P, NL
Kernel Guard Supreme*, KickStart VP*	Permethrin, 1.5 oz/42 lb seed	P, NL	F, NL	P?	F	P, NL	P, NL	P, NL	P, NL	P?, 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.
* Rates listed are formulated product amounts that also include fungicidal and inert ingredients.
Parts of this table are courtesy of Auburn University Publication 2009IPM-428 (Insect, Disease, Nematode, and Weed Control Recommendations for 2009).

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 CR)	6 oz/1000 row ft	Seedcorn maggot, Southern corn rootworm, Wireworms, White grubs
cyfluthrin, tebupirimphos (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)**	0.15 - 0.3 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 Lorsban with ALS herbicides such as Accent, Steadfast, Lightning, 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 Prolex. Please see their labels for specific use instructions.

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 as 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 an effective scouting program. Traps can be used in each county or on individual farms to provide producers with advance warnings of insect infestations.

Bt Corn Traits: YieldGard Corn Borer and Herculex I hybrids express a protein that is highly effective in controlling European and southwestern corn borer. Bt corn is typically recommended on at least part of a grower's acreage and particularly in late planted fields. YieldGard Rootworm and Herculex RW hybrids express a protein that controls 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 increases the likelihood of western corn rootworm infestations. YieldGard VT Triple (VT3), YieldGard VT Triple Pro (VT3 Pro), Herculex XTRA and SmartStax technologies contain Bt traits for control of both corn borers and corn rootworms. **Resistance management guidelines for Bt corn require a producer to plant a refuge of non-Bt corn**. Please refer to the grower licensing agreement and

Relative Efficacy of Selected Bt Corn Products

Traits / Brands	Primary Target Pests	Corn borers	Cutworm	Corn earworm	Fall armyworm	Western corn rootworm
YieldGard Corn Borer, Agrisure CB/LL	Corn borers	Excellent	Poor	Fair	Fair-Good	None
Herculex I	Corn borers	Excellent	Good	Poor	Good	None
YieldGard VT Triple	Corn borers, Corn rootworm	Excellent	Poor	Fair	Fair-Good	Excellent
Herculex XTRA	Corn borers, Corn rootworm	Excellent	Good	Poor	Good	Excellent
Genuity VT Triple Pro	Corn borers, Corn rootworm, Other caterpillar pests	Excellent	Poor	Very Good	Excellent	Excellent
Genuity SmartStax*	Corn borers, Corn rootworm, Other caterpillar pests	Excellent	Good	Very Good	Excellent	Excellent
Agrisure Viptera*	Corn borers, Other caterpillar pests	Excellent	Good	Excellent	Excellent	None unless stacked with rootworm resistance

Parts of this table are courtesy of Auburn University Publication 2009IPM-428 (Insect, Disease, Nematode, and Weed Control Recommendations for 2009).
* When this document was printed, SmartStax and Viptera were not for sale in the U.S., and these products will not be available until all necessary regulatory approvals and authorizations have been granted.

refuge guidelines provided by the company for complete details.

When to Treat

Seedling Plants

- **Seed or Root Feeding Insects:** Only at-planting insecticide treatments or seed treatments are effective in controlling infestations of seedcorn maggots, wireworms, white grubs and southern corn rootworms. Fields with prior infestations or no-till or minimum-till plantings are more likely to benefit from an at-planting insecticide for the prevention of these insect pests. This is strongly recommended for fields that were in pasture, CRP or fallow the previous year. Bt corn with rootworm resistance will provide effective control of western corn rootworm but has no effect on other seed or root feeding insects.
- **Armyworm (True):** Treatment may be necessary when one worm is found on 25 percent of the plants checked.
- **Fall Armyworm:** Treat when 50 percent of the plants have one or more larvae per plant.
- **Flea Beetles:** Treat when 75 percent of the plants show obvious scarring by beetles on stems and leaves.
- **Cutworms:** Treat when larvae are present and 5 percent or more of plants are damaged or when two larvae per 100 plants are present
- **Sugarcane Beetles:** The sugarcane beetle is an occasional pest of seedling corn, feeding on roots and reducing plant stands. Although few insecticides are labeled for this pest in field corn, some at-planting insecticides and seed treatments can suppress damage caused by sugarcane beetles. Rescue treatments of chlorpyrifos (e.g., Lorsban) or pyrethroid insecticides may provide some control and are recommended when 10 percent of the stand is lost or badly damaged.
- **Stink Bugs:** The growing point of small plants can be damaged by stink bug feeding resulting in irregular growth. Treat corn less than 24 inches tall if 10 percent or more of plants are infested with stink bugs. Some at-planting insecticides and seed treatments may suppress stink bug feeding on seedling corn.

Whorl-Stage or Larger Plants

- **Fall Armyworm and Corn Earworm:** These are two "budworms" commonly found in Tennessee field corn. Controls should be initiated when 75 percent of whorls have larvae present. Control of larvae in ears is not economically practical in field corn.

- **European Corn Borer:** Treat 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. Bt hybrids with corn borer protection provide a high level of control for this pest.
- **Southwestern Corn Borer:** Treat when 20-30 percent or more of plants are found with live larvae. Bt hybrids with corn borer protection provide a high level of control for this pest.
- **Japanese Beetles:** No formal thresholds have been established. Control may be needed if beetles are clipping silks on most ears.
- **Stink Bugs:** Before silking, small developing ears (½ - ¾ inches long) can be damaged by stink bug feeding resulting in malformed ear development. Treat corn if 10 percent or more of plants are infested with stink bugs at or shortly before ear shoots appear (about V15). Do not treat stink bug infestations once silking has begun.

Suggestions for Chemical Control of Corn Insects			
Insect	**Insecticide (Trade Names)**	**Product Rate/Acre (Unless Specified)**	**Pre-Harvest Interval (Days) And Comments**
Cutworms	bifenthrin (Brigade 2E, Discipline 2E)	2.1 - 6.4 oz	Foliar application, 30
	carbaryl (Sevin XLR Plus 4)	64 - 128 oz	0
	chlorpyrifos (Lorsban 4E, Nufos 4E, Lorsban Advanced 3.755)*	24 - 32 oz	21
	esfenvalerate (Asana XL 0.66E)	5.8 - 9.6 oz	21
	methoxyfenozide (Intrepid 2F)	4-8 oz	21
	permethrin (Pounce 3.2E)	4 - 8 oz	30
	β-cyfluthrin (Baythroid XL 1)	0.8 - 1.6 oz	21
	γ-cyhalothrin (Declare 1.25, Prolex 1.25)	0.77 - 1.28 oz	21
	λ-cyhalothrin (Karate 2.08, Warrior II)	0.96 - 1.6 oz	21
	Z-cypermethrin (Mustang Max 0.8E)	1.28 - 2.8 oz	30 grain, 60 forage
Armyworm (True)	bifenthrin (Brigade 2E, Discipline 2E)	2.1 - 6.4 oz	30
	carbaryl (Sevin XLR Plus 4)	32 - 64 oz	0
	chlorpyrifos (Lorsban 4E, Nufos 4E, Lorsban Advanced 3.755)*	24 - 32 oz	21
	esfenvalerate (Asana XL 0.66E)	5.8 - 9.6 oz	21
	methomyl (Lannate LV 2.4)*	12 - 16 oz	3
	methoxyfenozide (Intrepid 2F)	4 - 8 oz	21
	methyl parathion 4 (Methyl 4E)	8 oz	12
	permethrin (Pounce 3.2E)	4 – 8 oz	30

	spinosad (Tracer 4SC)	1 - 3 oz	1 grain, 7 forage
	β-cyfluthrin (Baythroid XL 1)	1.6 - 2.8 oz	21
	γ-cyhalothrin (Declare 1.25, Prolex 1.25)	1.02 - 1.54 oz	21
	λ-cyhalothrin (Karate 2.08, Warrior II)	1.28 - 1.92 oz	21
	Z-cypermethrin (Mustang Max 0.8E)	3.2 - 4.0 oz	30 grain, 60 forage
Fall Armyworm	bifenthrin (Brigade 2E, Discipline 2E)	2.1 - 6.4 oz	30
	carbaryl (Sevin XLR Plus 4)	32 - 64 oz	0
	chlorpyrifos (Lorsban 4E, Nufos 4E, Lorsban Advanced 3.755)*	24 - 32 oz	21
	methomyl (Lannate LV 2.4)*	12 - 16 oz	3
	methoxyfenozide (Intrepid 2F)	4 - 8 oz	21
	methyl parathion 4 (Methyl 4E)	8 oz	12
	permethrin (Pounce 3.2E)	4 - 8 oz	30
	spinosad (Tracer 4SC)	1 - 3 oz	1 grain, 7 forage
	β-cyfluthrin (Baythroid XL 1)	2.8 oz	21
	γ-cyhalothrin (Declare 1.25, Prolex 1.25)	1.02 - 1.54 oz	21
	λ-cyhalothrin (Karate 2.08, Warrior II)	1.28 - 1.92 oz	21
	Z-cypermethrin (Mustang Max 0.8E)	3.2 - 4.0 oz	30 grain, 60 forage
Corn Earworm	bifenthrin (Brigade 2E, Discipline 2E)	2.1 - 6.4 oz	30
	carbaryl (Sevin XLR Plus 4)	32 - 64 oz	0
	esfenvalerate (Asana XL 0.66E)	5.8 - 9.6 oz	21
	flubendiamide (Belt 4)	2 - 3 oz	28
	methomyl (Lannate LV 2.4)*	12 - 16 oz	3
	permethrin (Pounce 3.2E)	4 - 8 oz	30
	spinosad (Tracer 4SC)	1 - 3 oz	1 grain, 7 forage
	β-cyfluthrin (Baythroid XL 1)	1.6 - 2.8 oz	21
	γ-cyhalothrin (Declare 1.25, Prolex 1.25)	0.77 - 1.28 oz	21
	λ-cyhalothrin (Karate 2.08, Warrior II)	0.96 - 1.6 oz	21
	Z-cypermethrin (Mustang Max 0.8E)	1.76 - 4.0 oz	30 grain, 60 forage
Southwestern and European Corn Borer	bifenthrin (Brigade 2E, Discipline 2E)	2.1 - 6.4 oz	30
	carbaryl (Sevin XLR Plus 4)	48 - 64 oz	0
	carbofuran (Furadan 4F)	24 - 32 oz	30
	esfenvalerate (Asana XL 0.66E)	7.8 - 9.6 oz	21
	flubendiamide (Belt 4)	2 - 3 oz	28
	methoxyfenozide (Intrepid 2F)	4 - 8 oz	21
	permethrin (Pounce 3.2E)	4 - 8 oz	30
	spinosad (Tracer 4SC)	2 - 3 oz	1 grain, 7 forage
	β-cyfluthrin (Baythroid XL 1)	1.6 - 2.8 oz	21

	γ-cyhalothrin (Declare 1.25, Prolex 1.25)	1.02 - 1.54 oz	21
	λ-cyhalothrin (Karate 2.08, Warrior II)	1.28 - 1.92 oz	21
	Z-cypermethrin (Mustang Max 0.8E)	2.72 - 4.0 oz	30 grain, 60 forage
Flea Beetles	bifenthrin (Brigade 2E, Discipline 2E)	2.1 - 6.4 oz	30
	carbaryl (Sevin XLR Plus 4)	32 - 64 oz	0
	chlorpyrifos (Lorsban 4E, Nufos 4E, Lorsban Advanced 3.755)*	32 oz	21
	esfenvalerate (Asana XL 0.66E)	5.8 - 9.6 oz	21
	permethrin (Pounce 3.2E)	4 - 8 oz	30
	β-cyfluthrin (Baythroid XL 1)	0.8 – 1.6 oz	21
	γ-cyhalothrin (Declare 1.25, Prolex 1.25)	1.02 - 1.54 oz	21
	λ-cyhalothrin (Karate 2.08, Warrior II)	1.28 - 1.92 oz	21
	Z-cypermethrin (Mustang Max 0.8E)	2.72 - 4.0 oz	30 grain, 60 forage
Stink Bugs	bifenthrin (Brigade 2E, Discipline 2E)	2.1 - 6.4 oz	30
	carbaryl (Sevin XLR Plus 4)	32 - 64 oz	0
	methyl parathion 4 (Methyl 4E)	8 - 16 oz	12
	β-cyfluthrin (Baythroid XL 1)	1.6 - 2.8 oz	21
	γ-cyhalothrin (Declare 1.25, Prolex 1.25)	1.02 - 1.54 oz	21
	λ-cyhalothrin (Karate 2.08, Warrior II)	1.28 - 1.92 oz	21
	Z-cypermethrin (Mustang Max 0.8E)	2.72 - 4.0 oz	30 grain, 60 forage
Japanese Beetle	bifenthrin (Brigade 2E, Discipline 2E)	2.1 - 6.4 oz	30
	carbaryl (Sevin XLR Plus 4)	32 - 64 oz	0
	β-cyfluthrin (Baythroid XL 1)	1.6 - 2.8 oz	21
	γ-cyhalothrin (Declare 1.25, Prolex 1.25)	1.02 - 1.54 oz	21
	λ-cyhalothrin (Karate 2.08, Warrior II)	1.28 - 1.92 oz	21
	Z-cypermethrin (Mustang Max 0.8E)	2.72 - 4.0 oz	30 grain, 60 forage
Grasshoppers	bifenthrin (Brigade 2E, Discipline 2E)	2.1 - 6.4 oz	30
	carbofuran (Furadan 4F)	4 - 8 oz	30
	chlorpyrifos (Lorsban 4E, Nufos 4E, Lorsban Advanced 3.755)*	8 - 16 oz	21
	esfenvalerate (Asana XL 0.66E)	5.8 - 9.6 oz	21
	β-cyfluthrin (Baythroid XL 1)	2.1 - 2.8 oz	21
	γ-cyhalothrin (Declare 1.25, Prolex 1.25)	1.02 - 1.54 oz	21
	λ-cyhalothrin (Karate 2.08, Warrior II)	1.28 - 1.92 oz	21
	Z-cypermethrin (Mustang Max 0.8E)	2.72 - 4.0 oz	30 grain, 60 forage

* Caution: When using organophosphate insecticides such as Lorsban or Lannate with ALS herbicides such as Accent, Steadfast, Lightning, Option or Resolve, the possibility for plant injury exists. See herbicide label for restrictions.

Premixed Insecticide Products

The following products are available as premixes of two 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)
Cobalt (chlorpyrifos, γ-cyhalothrin)	See label	Foliar applications; Corn earworm, stink bugs, Japanese beetle, corn borers; Pre-harvest interval - 21 days grain, 14 days forage
Hero 1.24 (bifenthrin, Z-cypermethrin)	4.0 - 10.3 oz	Corn borers, stink bugs, corn earworm; Pre-harvest interval - 30 days grain, 60 days forage

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

2010 Sorghum Insect Control Recommendations

Introduction

Grain sorghum is an important minor rotational crop in Tennessee. Sorghum is more drought-tolerant than either corn or soybeans, and provides another non-host crop for managing soybean cyst nematode populations. Grain sorghum can be used in a double-crop system following wheat or as a late-planted grain crop.

Several insect pests may reduce yields. By planting grain sorghum on the recommended dates, some insect problems can be reduced or avoided. Infestations of the sorghum midge, corn earworm, fall armyworm and sorghum webworm will cause more damage to late-planted sorghum. Fortunately, there are many insecticides that will control economically damaging populations of sorghum insect pests.

Insects Sucking Juices from Leaves

Different types of aphids may be found on grain sorghum early in the season. These insects are found on top and underneath the leaves and whorls of sorghum plants, where they cause damage by sucking juices from the plant. The most common aphids found in grain sorghum are the greenbug and the corn leaf aphid. The greenbug injects plant tissue with toxic saliva and both types of aphids can transmit viral diseases like Maize Dwarf Mosaic Virus.

Insects Feeding on Grain Heads and Seed Kernels

The sorghum midge and sorghum webworm feed on the ripening grain kernels. Sorghum webworms feed on the ripening kernels by devouring the inside and leaving the hollow kernel shell. Corn earworms and fall armyworms usually consume the entire kernel as they feed.

Insects Feeding on Leaf Tissue

Corn earworms and fall armyworms feed in the whorls of young grain sorghum plants. Severe feeding injury to the growing point or intercalary meristem may destroy the emerging grain head.

Recommended Planting Dates

Grain sorghum should be planted from May 1 to June 1 for highest yields. Planting before mid-May will avoid some insect damage from the midge, fall armyworm, sorghum webworm and corn earworm.

Scouting Procedures for Sorghum Insects and Economic Threshold Levels

Greenbug: A small, light green aphid with a dark green stripe down the back. It is approximately 1/16 inch long. Reproductive potential is very high compared to other aphids. Early-planted sorghum is more susceptible to attack from greenbug. Look on the undersides of leaves for these small green aphids. Treat when one or two greenbugs are on a majority of the plants in the seedling stage and leaves are showing damage. The greenbug has a toxic substance in its saliva that causes red spots on leaves where it has fed. In larger plants, treat when one or two leaves per plant are dying.

Yellow Sugarcane Aphid: A small aphid that is yellow to light green, although usually yellow in sorghum. They have two double rows of dusky-colored spots down the top of the abdomen, and rows of spots are also present along the lateral margins of the abdomen. The body is covered with short, stiff hairs. The cornicles (tail-pipes at the end of the abdomen) are reduced to slightly elevated pores. Like the greenbug, the yellow sugarcane aphid injects a toxin while feeding that causes red spots on leaves where it has fed. Use the same treatment threshold as for greenbug.

Corn Leaf Aphid: The cornicles, legs and antennae of this species are black. The body is bluish-green in color and about 1/16-inch long. Aphids are usually found feeding in the whorl of the sorghum plant. Check primarily in the whorls of sorghum plants for this insect. The corn leaf aphid does not inject a toxic saliva into the leaves, as do greenbugs, but can transmit viral diseases if Johnsongrass is present in the field. Sorghum plants can tolerate a large number of these insects, so treatments are usually unnecessary.

Sorghum Midge: This is a small gnat-like insect, reddish-orange and about 1/10 inch long. Female sorghum midges lay eggs in the spikelets and seed husks during the bloom stage of sorghum. The larvae feed on the developing seeds, causing them to dry up and die. Check grain heads from emergence through bloom stage twice a week. Place a clear plastic bag over the head and shake, allowing the bag to remain over the head, and observe any midges that may light on the bag walls. Treat when an average of one midge per grain head is found.

Sorghum Webworm: This is a small, hairy caterpillar with four reddish -brown stripes down its back. Full-grown larvae are about ½-inch long. They are usually associated with a sticky webbing in the area of their feeding. Check inside grain heads for larvae and on

the leaves under grain heads for white fecal droppings from these insects. Close examination is necessary. Treat when an average of 3-4 or more larvae is found per grain head.

Corn Earworm: This larva has alternating light and dark stripes down its body. The skin is set with tiny spines and the color varies from green to pink. The head capsule is a creamy-yellow. Full grown larvae are about 1½ inches long. Corn earworms feed in the whorls of young plants, and can devour entire grain kernels. Check in the whorls of young plants and inside the grain heads of older plants. Treat when an average of two or more small larvae or one large (> ½ inch) larva is found per head.

Fall Armyworm: Larvae have a dark head capsule and a more prominent inverted Y on the front of the head. The body color is greenish to brownish, with brownish to black stripes on the sides of the body. Check in the whorls of young late-planted sorghum plants and inside the grain heads of more mature plants. Treat when an average of two or more small larvae or one large (> ½ inch) larva is found per head.

Insecticide Seed Treatments

Insecticidal seed treatments (e.g., Cruiser, Gaucho, Poncho) are available from seed companies. Seed treatments will help control some seed and seedling pests such as chinch bug, greenbug, wireworms and white grubs. However, there has been very little testing of these treatments in Tennessee.

Suggestions for Chemical Control of Sorghum Insects

Insect Pest	Insecticide	Rate Product Per Acre	Pre-Harvest Days* (Grain)
Aphids including greenbug**	chlorpyrifos (Lorsban 4, Nufos 4, Lorsban Advanced 3.775)	8 - 32 oz	30-60, see label
	chlorpyrifos, γ-cyhalothrin (Cobalt)	13 oz	30
	dimethoate 4	8 - 16 oz	See label
Sorghum Midge	chlorpyrifos (Lorsban 4, Nufos 4, Lorsban Advanced 3.775)	8 oz	30
	chlorpyrifos, γ-cyhalothrin (Cobalt)	7 - 13 oz	30
	methomyl (Lannate LV 2.4)	12 - 24 oz	14
	β-cyfluthrin (Baythroid XL 1)	1.0 - 1.3 oz	14
	γ-cyhalothrin (Declare 1.25, Prolex 1.25)	0.77 - 1.02 oz	21
	λ-cyhalothrin (Karate 2.08, Warrior II)	0.92 - 1.23 oz	30
	Z-cypermethrin (Mustang Max 0.8)	1.28 - 4.0 oz	14
Corn Earworms & Sorghum Webworm	carbaryl (Sevin 80S)	1.25 - 2.5 lb	21
	carbaryl (Sevin XLR 4)	16 - 32 oz	21
	chlorpyrifos (Lorsban 4, Nufos 4, Lorsban Advanced 3.775)	16 - 32 oz ***	30-60, see label
	chlorpyrifos, γ-cyhalothrin (Cobalt)	19 - 38 oz	See label
	methomyl (Lannate LV 2.4)	24 oz	14
	spinosad (Tracer 4)	1.5 - 3.0 oz	7
	β-cyfluthrin (Baythroid XL 1)	1.3 - 2.8 oz	14
	γ-cyhalothrin (Declare 1.25, Prolex 1.25)	1.02 - 1.54 oz	21
	λ-cyhalothrin (Karate 2.08, Warrior II)	1.23 - 1.85 oz	30
	Z-cypermethrin (Mustang Max 0.8)	1.76 - 4.0 oz	14
Fall Armyworm	carbaryl (Sevin 80S)	1.25 - 2.5 lb	21
	carbaryl (Sevin XLR 4)	32 - 64 oz	21

	chlorpyrifos (Lorsban 4, Nufos 4, Lorsban Advanced 3.775)	16 - 32 oz	30-60, see label
	chlorpyrifos, γ-cyhalothrin (Cobalt)	19 - 38 oz	See label
	methomyl (Lannate LV 2.4)	12 - 24 oz	14
	spinosad (Tracer 4)	1.5 - 3.0 oz	7
	β-cyfluthrin (Baythroid XL 1)	1.3 - 2.8 oz	14
	γ-cyhalothrin (Declare 1.25, Prolex 1.25)	1.02 - 1.54 oz	21
	λ-cyhalothrin (Karate 2.08, Warrior II)	1.23 - 1.85 oz	30
	Z-cypermethrin (Mustang Max 0.8)	1.76 - 4.0 oz	14
Stink Bugs	carbaryl (Sevin 80S)	1.5 - 2.5 lb	21
	carbaryl (Sevin XLR 4)	38 - 64 oz	21
	chlorpyrifos, γ-cyhalothrin (Cobalt)	19 - 38 oz	See label
	β-cyfluthrin (Baythroid XL 1)	1.3 - 2.8 oz	14
	γ-cyhalothrin (Declare 1.25, Prolex 1.25)	1.02 - 1.54 oz	21
	λ-cyhalothrin (Karate 2.08, Warrior II)	1.23 - 1.85 oz	30
	Z-cypermethrin (Mustang Max 0.8)	1.76 - 4.0 oz	14

* Waiting period from insecticide application until grain harvest.
** Controls usually unnecessary for corn leaf aphids.
*** Use higher rate for control of corn earworm.

Many farmers in Tennessee use wheat as a double-crop with soybeans. As with any crop, wheat has several insect pests that may reduce yields if not effectively controlled in the field. Yields can be improved if more producers take time to inspect their fields during the growing season for insect pests. This publication is designed to acquaint the producer with the major insect pests of wheat, the damage they cause and measures used to control the pests.

Aphids: Several aphids feed on the leaves and grain heads of wheat. These pests are significant in that they are capable of transmitting diseases to the plant such as barley yellow dwarf virus in addition to the damage inflicted by their feeding habits. Adult aphids are only about 1/8 inch long, and adults may or may not have two pair of nearly transparent wings.

Oat-Bird Cherry Aphid is dark green in color and is responsible for transmission of the barley yellow dwarf virus. This is usually the most common aphid observed in wheat.
Corn Leaf Aphid is bluish-green and all of the legs, cornicles and antennae are black.
Greenbug is a pale green, usually having a dark green stripe down the back of the wingless forms. The tips of the legs and cornicles are black, and the antennae are mostly black.
Rice Root Aphid occurs on the roots of wheat and has been known to transmit barley yellow dwarf virus.

Armyworms: Armyworms can be serious pests of wheat when populations reach large numbers. Armyworms get their name from their migrating habit, as they sometimes start at one portion of the field and devour everything in their path.

True Armyworm: Damaging infestations of true armyworm normally occur in the spring. Mature 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. Besides feeding on foliage, larvae will sometime cut the heads of maturing wheat plants.

Fall Armyworm: As the name implies, the fall armyworm is normally a pest of early planted seedling wheat. These insects can completely defoliate a wheat field when populations are very large. This insect differs from the true armyworm by having a prominent inverted Y on the front of the head and no dark bands on the outer portion of the prolegs.

Hessian Fly: These small insects have been responsible for tremendous wheat losses in the past. Hessian fly larvae feed on stems at the base of plants, hidden behind the leaf sheaths. Larvae are reddish at first emergence and turn white or greenish white; they are shiny and without legs. Larvae are legless, resembling small grains of rice, and our approximately ¼ inch long when full grown. The pupae, or flax seed stage, are brown in color but otherwise similar to the larvae. Tennessee typically does not have significant problems with this pest. However, early planted wheat is susceptible to infestation. Planting after October 15 (i.e., the "fly free date") will greatly reduce the likelihood of serious Hessian fly infestations. Also, avoid planting wheat as a cover crop prior to the fly free date. Volunteer wheat is a good fall host for this pest, and any volunteer wheat should be destroyed before September. Plowing under wheat stubble after harvest may help reduce subsequent infestations in the fall. Although some varieties are available with resistance to Hessian flies, there are no varieties with adequate resistance to the fly biotype most common in Tennessee (Biotype L).

Cereal Leaf Beetle: The cereal leaf beetle is a pest of wheat, oats, barley and other cereal crops. It has been found in most all counties in Tennessee, and may be present from April - June The larvae are pale yellow and soft-bodied, but the larvae are normally covered with their fecal material giving them a dark gooey, shiny appearance. Adults are shiny, black beetles with red legs and thorax and are approximately 3/16 inch long. Adults and larvae skeletonize the leaf tissue between the veins.

Suggested Economic Threshold Levels

Corn Leaf, Oat-Bird Cherry and Rice Root Aphid: No thresholds have been established in Tennessee. Treatment should be made when heavy populations are causing leaves to dry up and die in several portions of the field. An insecticide seed treatment such as Gaucho or Cruiser can be used to reduce transmission of barley yellow dwarf virus. Data suggests that early planted wheat is most likely to benefit from use of a seed treatment. Foliar insecticide applications in the fall can also reduce transmission of barley yellow dwarf virus, but they must be applied before aphid populations are already established in the field.

Greenbug: This aphid injects a toxin while feeding. Treatment should be made when aphids are killing three or more leaves per plant. For wheat less than 6 inches tall, treatment should also be considered if greenbugs number 50 or more per linear foot. Treatment should also be made if greenbugs number 200 or more per foot in wheat 6-10 inches tall.

Armyworms: Treatment for fall armyworm should be considered when four or more larvae are present per square foot (16 per 4 square feet). For true armyworm, use a threshold of 6-8 larvae per square foot if wheat is still in the milk stage. Once past the milk stage, wheat can tolerate higher populations and treatment is not usually recommended unless larvae are cutting wheat heads.

Hessian Fly: Foliar applied insecticide are difficult to time and only marginally effective. Plant after the fly fee date (October 15) and use resistant varieties if they are available. Resistant varieties may help suppress Hessian fly populations, although no varieties provide adequate resistance to Biotype L. Insecticide seed treatments (e.g., Cruiser and Gaucho) will provide some suppression of fall infestations of Hessian fly.

Cereal Leaf Beetle – Check 10 plants per sample site for larvae and adults. Treatment is necessary if one larva and/or adult is present per stem.

Suggestions for Chemical Control of Wheat Insects

Insect	Insecticide (Trade Names)	Rate/Acre
Aphids	Seed Treatments	
	imidacloprid (Gaucho 600)	0.8 - 2.4 oz per 100 lb seed
	thiamethoxam (Cruiser 5)	0.75 - 1.33 oz per 100 lb seed
	Foliar Treatments	
	dimethoate 4*	8 - 12 oz
	methomyl (Lannate LV 2.4)*	12 - 24 oz
	methyl parathion 4 (Methyl 4)*	8 - 24 oz
	β-cyfluthrin (Baythroid XL 1)	1.8 - 2.4 oz
	γ-cyhalothrin (Declare 1.25, Prolex 1.25)	1.54 oz
	λ-cyhalothrin (Karate 2.08, Warrior II)	1.28 - 1.92 oz
	Z-cypermethrin (Mustang Max 0.8)	3.2 - 4.0 oz
Armyworms (True & Fall)	carbaryl (Sevin XLR Plus 4)	32 - 48 oz
	methyl parathion 4 (Methyl 4)*	24 oz
	methomyl (Lannate LV 2.4)*	12 - 24 oz
	spinosad (Tracer 4)	1.5 - 3 oz
	β-cyfluthrin (Baythroid XL 1)	1.8 - 2.4 oz
	γ-cyhalothrin (Declare 1.25, Prolex 1.25)	1.02 - 1.54 oz
	λ-cyhalothrin (Karate 2.08, Warrior II)	1.28 - 1.92 oz
	Z-cypermethrin (Mustang Max 0.8)	3.2 - 4.0 oz
Cereal Leaf Beetle	carbaryl (Sevin XLR Plus 4)	32 oz
	methomyl (Lannate LV, 2.4)*	12 - 24 oz
	spinosad (Tracer 4)	1 - 3 oz
	β-cyfluthrin (Baythroid XL 1)	1.0 - 1.8 oz
	γ-cyhalothrin (Declare 1.25, Prolex 1.25)	1.02 - 1.54 oz
	λ-cyhalothrin (Karate 2.08, Warrior II)	1.28 - 1.92 oz
	Z-cypermethrin (Mustang Max 0.8)	1.76 - 4.0 oz

*Use extra caution when handling these insecticides.

Suggested Economic Threshold Levels

Armyworms: Treatment should be considered when populations exceed 3-4 larvae per square foot. If fields are ready or near ready for cutting, harvesting is suggested rather than applying insecticide.

Grasshoppers: Treatment thresholds have not been established.

Suggestions for Chemical Control of Pasture Insects			
Insect	**Insecticide (Trade Names)**	**Rate per Acre**	**Restrictions/Comments***
Armyworms or Grasshoppers	carbaryl (Sevin XLR Plus 4)	32 - 48 oz	Must remove cattle. Do not apply within 14 days of harvest or grazing. Other Sevin formulations are also available.
Grasshoppers	diflubenzuron (Dimilin 2L)	2 oz	Allow 1 day after treatment before cutting for hay. Apply when grasshoppers are small.
Armyworms or Grasshoppers	malathion (malathion 57E)	32 oz	Must remove cattle. Allow spray to dry before harvest or grazing.
Armyworms	methomyl (Lannate 2.4LV)	12 - 24 oz	Bermudagrass only. Must remove cattle. Do not apply with 3 days of harvest or 7 days of grazing.
Armyworms	methoxyfenozide (Intrepid 2F)	4 - 8 oz	Do not apply within 7 days of harvest; 0 day application restriction for grazing.
Armyworms or Grasshoppers	methyl parathion (Methyl 4E)	24 oz	Must remove cattle. Do not apply within 15 days of harvest or grazing.
Armyworms	spinosad (Tracer 4F)	1 - 2 oz	Do not apply within 3 days of harvest; 0 day restriction for grazing.
Armyworms Grasshoppers	β-cyfluthrin (Baythroid XL 1)	1.6 - 1.9 oz 1.9 oz	Do not apply within 7 days of harvest; 0 day application restriction for grazing.
Armyworms or Grasshoppers	λ-cyhalothrin (Karate 2.08, Warrior II)	1.3 - 1.9 oz	Do not apply within 7 days of harvest; 0 day restriction for grazing.
Armyworms or Grasshoppers	Z-cypermethrin (Mustang Max 0.8)	2.8 - 4 oz	0 day application restriction for forage or hay.

* See insecticide labels for complete list of pests controlled, restrictions and comments.

Insecticide Classes, Re-entry Intervals and EPA Registration Numbers

The re-entry interval is the time period required by federal law between application of pesticides to crops and the entrance of workers into those crops without protective clothing. Re-entry intervals serve to protect workers from possible pesticide poisonings. Growers, scouts and other farm laborers must effectively communicate when and where pesticides have been applied. Reentry periods vary by product. Scouts should not enter fields until all reentry intervals have expired. Safety is of utmost importance. Be sure to establish proper communication channels with all parties involved.

Producers are required to keep records, including EPA product registration numbers, of all insecticides applied to fields. Re-entry intervals and product registration numbers for products not listed below are provided on the insecticide labels.

Insecticide (Class)*	Reentry Interval (hours)	EPA Product Registration Number**	Insecticide (Class)*	Reentry Interval (hours)	EPA Product Registration Number**
Acramite	12	400-514	Force (P)	0	100-1075
Agri-Mek (SA)	12	100-898	Furadan (C)	48	279-2876
Ammo (P)	12	279-3027-5905	Gaucho Grande (CN)	12	264-968
Asana XL (P)	12	352-515	Intrepid (IGR)	4	62719-442
Aztec (P, OP)	48	264-813	Intruder (CN)	12	8033-24-352
Belt (D)	12	264-1025	Karate (P)	24	100-1097
Bidrin (OP)	6 Days	5481-448	Lannate (C)	72	352-384
Bidrin XP (P, OP)	6 Days	5481-552	Larvin (C)	48	264-379
Brigade (P)	12	279-3313	Leverage 360 (P, CN)	12	264-1104
Brigadier (P) (CN)	12	279-3332	Lorsban (OP)	24	62719-220
Capture (P)	12	279-3114	Lorsban Advanced (OP)	24	62719-591
Carbine	12	71512-9-279	Malathion (OP)	12	See label
Centric (CN)	12	100-1147	Methyl parathion (OP)	96	See label
Cobalt (P, OP)	24	62719-575	Monitor (OP)	48	264-729
Comite II (OS)	7 Days	400-154	Mustang Max (P)	12	279 - 3249
Counter (OP)	48	5481-545	Oberon	12	264-850
Coragen (D)	4	352-729	Orthene (OP)	24	59639-33
Couraze Max (CN)	12	264-783-67760	Poncho (CN)	---	264-789
Cruiser (CN)	12	100-941	Pounce (P)	12	279-3051
Curacron (OP)	48	100-669	Portal (M)	12	71711-19
Delta Gold 1.5 (P)	12	264-1011-1381	Prolex (P)	24	see label
Declare (P)	24	67760-96	Sevin XLR Plus (C)	12	264-333
Denim (SA)	48	100 - 903	Sevin 80S (C)	12	264-316
Diamond (IGR)	12	66222-35-400	Steward (OX)	12	352-638
Dicofol 4 (OC)	12	66222-56	Temik (C)	48	264-330
Dimethoate (OP)	48	See label	Tracer (SPN)	4	62719-267
Dimilin (IGR)	12	400-461	Trimax Pro (CN)	12	264-855
Di-Syston (OP)	48	264-734	Warrior (P)	24	100-1112
Discipline (P)	12	5481-517	Zeal	12	59639-123
Endigo ZC (P, CN)	24	100-1276			

* The classes of insecticides listed above are identified by the following abbreviations: Bt, Bacillus thuringiensis (microbial); C, carbamate; CN, chloronicotinyl (= neonicotinoid); (D), Diamides; IGR, insect growth regulator; (M),METI- Acaricides, OX, oxadiazine; OC, organochlorine; OP, organophosphate; OS, organosulfur; P, pyrethroid; SA, synthetic avermectin; SPN, spinosad.
** Registration numbers change with company brands, although the product name or active ingredient may be the same. Check the label to be sure.

Additional Brand Names of Commonly Used Active Ingredients (Generic Insecticides)

Active Ingredients (Common Brand Names)	Additional Brands with Same or Similar Active Ingredient*
abamectin (Agri-Mek, Zephyr, Zoro)	Abba, Temprano
acephate (Orthene 90, Orthene 97)	Acephate 90, Acephate 97
bifenthrin (Brigade, Capture, Discipline, Fanfare)	Bifenthrin, Bifenture, Capture LFR, Sniper, Tundra
chlorpyrifos (Lorsban, Nufos)	Chlorpyrifos, Govern, Lorsban Advanced, Warhawk, Yuma
cypermethrin (Ammo)	Cypermethrin, Up-Cyde
esfenvalerate (Asana XL)	Adjourn, S-FenvalorStar
imidacloprid (Trimax Pro, Couraze Max)	Alias, Imida, Imidacloprid, Nuprid, Pasada, Provado
methyl parathion (Methyl 4E)	Methyl Parathion 4E, Penncap-M 2E
permethrin (Pounce 3.2E)	Ambush 2E, Permethrin 3.2, Perm-Up
β-cyfluthrin (Baythroid XL)	Tombstone (= cyfluthrin)
γ-cyhalothrin (Declare, Prolex)	Proaxis
λ-cyhalothrin (Karate, Warrior II)	Lambda, Lambda-Cy, LambdaStar, Silencer
Z-cypermethrin (Mustang Max)	Respect

* Read the insecticide label before making application. Although active ingredients are the same or very similar, brands often have different formulations, different labeled uses, and different use rates. This information is provided for educational purposes, and some of the additional brands listed above have not been independently evaluated by the University of Tennessee.

Insecticide Safety Considerations

Communication and safety are important considerations to avoid accidental insecticide poisoning. Scouts should be familiar with commonly used insecticides. Talk frequently with growers, co-workers and employers. Know when and what insecticide applications have been made to a field. Someone should know your approximate whereabouts and schedule in case of accident or emergency. Cell phones or two-way radios are suggested has a means of emergency communication.

Know Your Insecticides

Insecticides vary widely in their toxicity to people. Never enter a field immediately after an insecticide application. This is especially dangerous for highly toxic insecticides. Generally, the organophosphate (OP) and carbamate insecticides are the most acutely toxic classes of insecticide. Insecticide labels provide information on minimum re-entry intervals following an insecticide application, treatment information in the case of poisoning, and other information. The table below provides a relative index of acute toxicity for some common insecticides. This is primarily for dermal (skin) exposure. Many relatively safe insecticides can be very dangerous if ingested because even insecticides with low toxicity are often mixed with dangerous chemicals. Always seek immediate medical attention if any insecticide is swallowed.

Insecticide Poisoning

Symptoms may include eye tearing, blurred vision, salivation, unusual sweating, coughing, vomiting, and frequent bowel movements and urination. Breathing may become difficult, and muscles may twitch and become weak. It is rare, but death can occur. Symptoms last hours to days after exposure to carbamate insecticides but can last for weeks after exposure to organophosphate insecticides. Pyrethroid insecticides can cause sneezing, eye tearing, coughing, and occasional difficulty breathing. Serious symptoms rarely develop.

Treatment for suspected insecticide poisoning should be immediate. Insecticide labels contain treatment instructions for physicians. Remove clothing and wash any skin which was exposed to insecticide.

Relative Insecticide Toxicity of Some Commonly Used Insecticides

Insecticide (common name)	Risk level*	Insecticide (common name)	Risk level*
Ammo (cypermethrin)	L-M	Intruder (acetamiprid)	L
Asana XL (esfenvalerate)	L-M	Karate (λ-cyhalothrin)	L-M
Baythroid XL (β-cyfluthrin)	L-M	Lannate (methomyl)	H
Bidrin (dicrotophos)	H	Larvin (thiodicarb)	M
Brigade, Capture (bifenthrin)	L-M	Lorsban (chlorpyrifos)	M
Centric or Cruiser (thiamethoxam)	L	Malathion	L
Comite (propargite)	M	Methyl parathion	H
Counter (terbufos)	H	Monitor (methamidophos)	M
Curacron (profenofos)	H	Mustang Max (Z-cypermethrin)	L-M
Delta Gold (deltamethrin)	L-M	Orthene (acephate)	L-M
Denim (emamectin benzoate)	L	Trimax or Gaucho (imidacloprid)	L
Diamond (novaluron)	L	Sevin (carbaryl)	L
Dicofol	M	Steward (indoxacarb)	L
Dimethoate	M-H	Temik (aldicarb)	H
Furadan (carbofuran)	H	Tracer (spinosad)	L
Intrepid (methoxyfenozide)	L	Vydate (oxamyl)	H

* L = Low, M = Moderate, H = High

Other Safety Considerations

Besides the risk of pesticide poisonings, and more common, scouts may suffer heat stroke. Symptoms of heat stroke include weakness, dizziness, rapid pulse, reddish tinge to skin, nausea and/or vomiting, unconsciousness, and high body temperature.

Safety Tips:

- Always follow label instructions concerning re-entry intervals and protective clothing requirements following an insecticide application.
- To avoid heat stroke, drink plenty of water, wear a wide-brimmed hat, and take breaks in the shade.
- Pants, rather than shorts are recommended to reduce wear and tear on your legs. They also keep your skin from contacting any insecticide residue on plants.
- Bring a change of clothes, particularly later in the year when early morning dew will soak your clothing. Not only will you be more comfortable, dry clothes are a better barrier to any insecticide residue that may be present on plants.
- Wash your hands before eating or drinking.
- If possible, schedule your hardest work during cooler times of the day.
- You are more likely to get in an automobile or four-wheeler accident than to be poisoned by pesticides, so drive carefully!

Precautionary Statement

To protect people and the environment, pesticides should be used safely. This is everyone's responsibility, especially the user. Read and follow label directions carefully before you buy, mix, apply, store or dispose of a pesticide. According to laws regulating pesticides, they must be used only as directed by the label.

Disclaimer

This publication contains pesticide recommendations that are subject to change at any time. The recommendations in this publication are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. The label always takes precedence over the recommendations found in this publication.

Use of trade or brand names in this publication is for clarity and information; it does not imply approval of the product to the exclusion of others that may be of similar, suitable composition, nor does it guarantee or warrant the standard of the product. The author(s), the University of Tennessee Institute of Agriculture and University of Tennessee Extension assume no liability resulting from the use of these recommendations.

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