2018 Insect Control Recommendations for Field Crops
Cotton, Soybean, Field Corn, Sorghum, Wheat and Pasture

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2018 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, 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:

- **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 tobacco 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, 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 (NAWF) and Terminating Insect Control

NAWF is the number of fruiting branches (nodes) above the uppermost first-position white flower of a plant. Counting from the top, the first node will have an unfolded leaf the size of a quarter or larger. NAWF is a useful measure of plant maturity and can be used to help make insect management decisions. NAWF=5 is referred to as cutout (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- to 2-day-old larvae.
- Two treatments on a 4- to 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 1/4 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.

Bt Cotton and Resistance Management

Bt cottons — including Bollgard II, Bollgard III, TwinLink, TwinLink Plus, WideStrike and WideStrike 3 technologies — are more effective than the original Bollgard technology, including better activity on bollworm, armyworms and loopers. However, insecticide treatments may still be needed if sufficient pest pressure occurs, particularly for bollworm or fall armyworm. Bt cotton does not control tarnished plant bugs, stink bugs or other non-caterpillar pests.

A refuge is not required for Bt cotton varieties, but planting a refuge is still a potentially valuable resistance management strategy. Planting non-Bt cotton will provide a source of susceptible moths for mating with resistant moths that survive in Bt cotton.

Boll Weevil

The boll weevil has been successfully eradicated from Tennessee. Post-eradication pheromone trapping will continue in order to detect reinfestations 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 first square	Thrips	Aphids, Cutworms, 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 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 it provides 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, Fanfare 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 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
β-cyfluthrin (Baythroid XL 1)	0.0065 - 0.0125	0.8 - 1.6 oz	160 - 80
γ-cyhalothrin (Declare 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, a foliar treatment may be needed even when preventative controls were used. Foliar applications, when needed, typically provide the most benefit when applied before the third true leaf has emerged. Under conditions of slow emergence and seedling growth, consider applying a foliar insecticide at the first or second leaf stage when the emerging leaf shows signs of thrips injury and especially if immature thrips are present. Two foliar insecticide applications are rarely justified if at-planting treatments were used.

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 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
imidacloprid (Admire Pro 4.6)	0.27 - 0.33	7.4 - 9.2 oz	17.3 - 13.9
imidacloprid (Velum Total 2.17)	0.24 - 0.31	14 - 18 oz	9.1 - 7.1
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
spinetoram (Radiant SC 1), suppression **	0.012 - 0.023	1.5 - 3 oz	42.7 - 21.3
Treated Seed			
imidacloprid (Gaucho 600, Aeris, Acceleron Standard, Acceleron Elite, Avicta Elite Cotton Plus)	0.34 - 0.375 mg active ingredient per seed		
Orthene 97 ST or Acephate 80S *	Acephate can be applied to a seed at 6.4 oz/100 lb seed (Orthene 97 ST) or 8 oz/100 lb seed (Acephate 80 S)		

* Not recommended as a standalone treatment for thrips control.

** Radiant SC is suggested if western flower thrips are present in significant numbers. The use of an adjuvant is recommended when using Radiant SC for control of thrips.

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 to 7 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
PLANT BUGS - PHASE I, PRE-BLOOM WINDOW*			
acetamiprid (Intruder Max 70WP, Strafer Max 70WP)	0.074 – 0.101	1.7 - 2.3 oz	9.4 - 7.0
clothianidin (Belay 2.13)	0.05 - 0.067	3 - 4 oz	42.7 - 32
flonicamid (Carbine 50WG)	0.081 - 0.089	2.6 - 2.8 oz	6.2 - 5.7
imidacloprid 2.0	0.047 - 0.062	3 - 4 oz	42.7 - 32
imidacloprid 4.0 (Couraze Max)	0.047 - 0.062	1.5 - 2 oz	85 - 64
imidacloprid 4.6 (Admire Pro)	0.047 - 0.062	1.3 - 1.7 oz	97.7 - 74.2
thiamethoxam (Centric 40WG)	0.044 - 0.05	1.75 - 2.5 oz	9.1 – 6.4
PLANT BUGS - PHASE II, BLOOMING WINDOW			
acephate 90 (Orthene 90S)	0.45 - 0.675	0.5 - 0.75 lb	2 - 1.3
acephate 97 (Orthene 97SP)	0.49 - 0.73	0.5 - 0.75 lb	2 - 1.3
dicrotophos (Bidrin 8)	0.31 - 0.5	5 - 8 oz	25.6 - 16
dimethoate 4	0.25 – 0.5	8 - 16 oz	16 - 8
malathion 5	1.25	32 oz	4
novaluron (Diamond 0.83, Mayhem 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.
***Pyrethroid insecticides applied alone will not provide adequate control of tarnished plant bugs. However, tank mixing pyrethroid insecticides with other Phase II recommended insecticides will often improve their performance.

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, Strafer 70WSP)*	0.026 - 0.048	0.6 - 1.1 oz	26.7 - 14.5
clothianidin (Belay 2.13), suppression*	0.05 - 0.067	3 - 4 oz	42.7 - 32
dicrotophos (Bidrin 8)*	0.25 - 0.5	4 - 8 oz	32 - 16
dimethoate 4*	0.125 - 0.5	4 - 16 oz	32 - 16
flonicamid (Carbine 50 WP)	0.044 - 0.089	1.4 - 2.8 oz	11.4 - 5.7
imidacloprid 2.0*	0.031 - 0.047	2 - 3 oz	64 - 42.7
imidacloprid 4.0 (Couraze Max)*	0.031 - 0.047	1 - 1.5 oz	128 - 85
imidacloprid 4.6 (Admire Pro)*	0.047 - 0.062	0.9 - 1.3 oz	142 - 98.5
thiamethoxam (Centric 40WG)*	0.031 - 0.05	1.25 - 2 oz	12.8 - 8

* Because of resistance, these products may fail or only provide suppression, especially if the same class of insecticide was used previously.

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). Insecticide application will often be needed when 10-20 percent or more of plants are infested with eggs.

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- to 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

Recent data indicates bollworm are developing resistance to some Bt toxins. Thus, insecticide applications for bollworm in Bt cotton are more likely and especially for WideStrike, TwinLink, and Bollgard II. Treatment is less likely for WideStrike 3, TwinLink Plus, and Bollgard III varieties. **Prior to bloom**, 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. Treatment should also be made if a combination of square and boll sampling shows 6 percent or more injury (e.g., 3 percent square injury and 3 percent boll injury, 4 percent square injury and 2 percent boll injury, etc.). Scouting fields twice per week may be necessary once blooming has begun, especially if heavy egg lays are occurring. Treatments based on eggs alone is not usually recommended, but applications to some Bt technologies should be considered when high numbers of eggs are present. 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, Fanfare 2)	0.05 - 0.1	3.2 - 6.4 oz	40 - 20
cypermethrin 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 - 0.020	1.6 - 2.6 oz	80 - 49
γ-cyhalothrin (Declare 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
BOLLWORM AND TOBACCO BUDWORM			
acephate 90 (Orthene 90S)	0.9	1 lb	1
chlorantraniliprole (Prevathon 0.43 SC)	0.067 - 0.09	16 - 27 oz	6.4 - 4.7
chlorantraniliprole, λ-cyhalothrin (Besiege)	See label	8 - 12.5 oz	16 - 10.25
emamectin benzoate (Denim 0.16)	0.01 - 0.015	8 - 12 oz	16 - 10.7
indoxacarb (Steward 1.25)	0.11	11.3 oz	11.3
methomyl (Lannate LV 2.4)	0.45	24 oz	5.3
spinetoram, methoxyfenozide (Intrepid Edge)	See label	7 - 8 oz	18.3 - 16
spinetoram (Radiant SC 1)	0.033 - 0.0625	4.25 - 8 oz	30.1 - 16
spinosad (Blackhawk 36% WDG)	0.056 - 0.072	2.0 - 3.2 oz	6.4 - 5

* Pyrethroids have often been used when the population is exclusively bollworm, such as would be expected on Bt cotton varieties, but the efficacy of pyrethroid insecticides for the control of bollworm has declined. Thus, alternative chemistries or tank mixes with alternative chemistries may be needed for adequate control.

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- to 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, Fanfare 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- to 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 (Abba 0.15, Agri-Mek 0.15, Zoro 0.15)	0.0047 - 0.019	4 - 16 oz	32 - 8
(Agri-Mek SC 0.7)	0.0055 - 0.019	1 - 3.5 oz	128 - 36.6
bifenazate (Acramite 4)	0.375 - 0.75	16 - 24 oz	8 - 5.3
bifenthrin (Brigade 2, Discipline 2, Fanfare 2)*	0.06 - 0.1	3.8 - 6.4 oz	33 - 20
dimethoate 4*	0.25 - 0.5	8 - 16 oz	16 - 8
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
(Zeal SC 2.88)	0.300 - 0.045	1.33 - 2 oz	96.2 - 64
fenpyroximate (Portal 0.4)	0.05 - 0.075	16 - 24 oz	8 - 5.3
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.

Bt cotton provides some control of fall armyworm infestations. Insecticide treatment may still be necessary depending upon pest pressure. It is unlikely that WideStrike, WideStrike III, TwinLink Plus, and Bollgard III varieties will require an insecticide application to control fall armyworm. 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	1.0 lb	1
chlorantraniliprole (Prevathon 0.43 SC)	0.067 - 0.09	20 - 27 oz	6.4 - 4.7
chlorantraniliprole, λ-cyhalothrin (Besiege)	See label	8 - 12.5 oz	16 - 10.25
emamectin benzoate (Denim 0.16)	0.01 - 0.015	8 - 12 oz	16 - 10.7
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, Mayhem 0.83)	0.039 - 0.078	6 -12 oz	21.3 - 10.7
spinetoram (Radiant SC 1)	0.033 - 0.0625	4.25 - 8 oz	30.1 - 16
spinetoram, methoxyfenozide (Intrepid Edge)	See label	6 - 8 oz	21.3 - 16
spinosad (Blackhawk 36% WDG)	0.056 - 0.072	2.4 - 3.2 oz	6.7 - 5

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

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

Bt cottons 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
chlorantraniliprole (Prevathon 0.43 SC)	0.067 - 0.09	20 - 27 oz	6.4 - 4.7
chlorantraniliprole, λ-cyhalothrin (Besiege)	See label	8 - 12.5 oz	16 - 10.25
emamectin benzoate (Denim 0.16)	0.0075 - 0.01	6 - 8 oz	21.3 - 16
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
spinetoram (Radiant SC 1)	0.033 - 0.0625	4.25 - 8 oz	30.1 - 16
spinetoram, methoxyfenozide (Intrepid Edge)	See label	4 - 8 oz	32 - 16
spinosad (Blackhawk 36% WDG)	0.056 - 0.072	2.4 - 3.2 oz	6.7 - 5

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.

Bt cotton provides 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
chlorantraniliprole (Prevathon 0.43 SC)	0.067 - 0.09	20 - 29 oz	6.4 - 4.4
chlorantraniliprole, λ-cyhalothrin (Besiege)	See label	10 - 12.5 oz	12.8 - 10.25
emamectin benzoate (Denim 0.16)	0.01 - 0.015	8 - 12 oz	16 - 10.7
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
spinetoram (Radiant SC 1)	0.033 - 0.0625	4.25 - 8 oz	30.1 - 16
spinetoram, methoxyfenozide (Intrepid Edge)	See label	4 - 8 oz	32 - 16
spinosad (Blackhawk 36% WDG)	0.056 - 0.072	2.4 - 3.2 oz	6.7 - 5

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- or 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
spiromesifen (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 or more insecticides. The use of these premixes may provide suppression or control of multiple pests, and thus, are typically recommended when several pests are present at treatment level. Use of these products is suggested primarily after first bloom.

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)
Athena (bifenthrin, abamectin)	10 - 17 oz	12.8 - 7.5	Spider mites
Besiege (chlorantraniliprole, λ-cyhalothrin)	8 - 12.5 oz	16 - 10.25	Most caterpillar pests, stink bugs
Bidrin XP II (dicrotophos, bifenthrin)*	8 - 12.8 oz	16 - 10	Plant bugs, stink bugs, bollworm
Brigadier (imidacloprid, bifenthrin)	5.1 - 7.7 oz	25.1 - 16.6	Plant bugs, stink bugs, bollworm
Cobalt Advanced (chlorpyrifos, γ-cyhalothrin)	22 - 42 oz	5.8 - 3	Plant bugs, stink bugs, bollworm
Double Take (diflubenzuron, λ-cyhalothrin)	4 oz	32	Stink bugs, bollworm
Endigo ZC (thiamethoxam, λ-cyhalothrin)	4 - 5.5 oz	32 - 23.3	Plant bugs, stink bugs, bollworm
Fyfanon Plus ULV (malathion, γ-cyhalothrin)	10 - 16 oz	12.8 - 8	Plant bugs, stink bugs, bollworm
Hero (bifenthrin, Z-cypermethrin)	5.2 - 10.3 oz	24.6 - 12.4	Stink bugs, bollworm
Intrepid Edge (methoxyfenozide, spinetoram)	4 - 8 oz	32 - 16	Most caterpillar pests
Leverage 360 (imidacloprid, β-cyfluthrin)	2.8 - 3.2 oz	45 - 40	Plant bugs, stink bugs, bollworm
Stallion (chlorpyrifos, Z-cypermethrin)	9.25 - 11.75 oz	13.8 - 10.9	Plant bugs, stink bugs, bollworm
Triple Crown (Z-cypermethrin, bifenthrin, imidacloprid)	4.5 - 6.4 oz	28.4 - 20	Plant bugs, stink bugs, bollworm

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